Chapter 7
Land Use, Social Issues, and Economics

7.1 Agricultural Land and Water Use

The CALFED Bay-Delta Program would provide increased water security for the majority of agricultural users in the state but also would convert existing farmlands to other uses in some regions.

7.1 Agricultural Land and Water Use

7.1.1 SUMMARY

Agricultural resources are an important feature of the existing environment of the state, and are recognized and protected under CEQA and state policy. One of the major principles of the state's environmental and agricultural policy is to sustain the long-term productivity of the state's agriculture by conserving and protecting the soil, water, and air that are agriculture's basic resources. It is CALFED Bay-Delta Program (Program) policy that adverse environmental effects on agricultural resources resulting from CALFED programs, projects, and actions will be fully assessed and disclosed under CEQA, and avoided or mitigated as required by CEQA. Assessment, disclosure, and avoidance and other mitigation strategies will be developed at the programmatic and project-specific levels in consultation with other state, federal and local agencies with special expertise or authority over agricultural resources which may be affected by the project—such as the California Department of Food and Agriculture and Department of Conservation.

Agriculture is one of the foundations of California's prosperity. Agriculture provides employment for one in every ten Californians, and provides a variety and quantity of foodstuffs that both feed the nation and provide a significant source of international exports. California leads the nation in the production of many commodities, including wine grapes, walnuts, and artichokes. Because of California's high-quality soils, temperate climate, and access to irrigation water, the state's growers and workers are able to produce over 250 different food, fiber, and livestock commodities. Agriculture in the state is facing increasing competition for the water it uses to help restore environmental resources and to meet the needs of California's expanding urban population.

Preferred Program Alternative. The Preferred Program Alternative would increase certainty in the availability of irrigation water. As lands and waters are restored to their natural functions, the recovery of endangered species and the maintenance of species that might otherwise become threatened will result in a more reliable supply of water to the state's growers. As cleaner water with fewer contaminants becomes available through the Water Quality Program, growers will have opportunities to be more flexible in their plantings and to grow higher value crops. The Watershed Program would assist in providing adequate, high-quality water available to farmers and may provide higher grazing productivity. The Levee System Integrity Program would ensure that agriculture on Delta islands is protected from disastrous flooding and that other Delta water irrigation water users are protected from the salt-water intrusion that island flooding could cause. The Water Use Efficiency Program would allow farmers to update aging and inefficient irrigation systems, resulting in increased yields and new crop opportunities. The Water Transfer Program may result in additional water becoming available at times and locations where irrigation water may not otherwise be available. The Storage and Conveyance elements would provide improved access to water for the state's growers.

The Preferred Program Alternative would convert agricultural lands to other uses, including habitat, levee improvements, and water storage. This conversion would add to the existing statewide conversion of substantial amounts of agricultural lands to urban uses and other habitat uses, and would conflict with the adopted plans of many local governments. Increased water demand from the Ecosystem Restoration Program could reduce water supply reliability to some localized areas under specific conditions, but other Program actions would result in an overall increase in water supply reliability to agriculture. The transfer of water from one area to another may result in localized adverse impacts on agriculture in the source water areas and may result in beneficial effects on agriculture in the receiving areas. Mitigation strategies have been developed that could lessen many of the impacts of the Program; however, a significant conversion of agricultural lands could occur.

Alternatives 1, 2, and 3. All three Program alternatives would result in impacts on agriculture similar to impacts described for the Preferred Program Alternative. All three alternatives also would provide benefits essentially similar to those of the Preferred Program Alternative. Alternative 1 likely would result in fewer impacts on agriculture because fewer facilities would be constructed. Alternative 3 likely would result in the greatest impacts because construction of an isolated facility could require converting somewhat more agricultural land. The differences are not substantial, however, and an adverse impact that is potentially significant for one alternative would be potentially significant for all alternatives.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. (See Chapter 9 for a discussion of mitigation monitoring and implementation.) See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Conversion of prime, statewide important, and unique farmlands to project uses (1,2,5,6,7,8,9,10, 11,12,13,14,15,16,17,18,20,21,24, 26, 27).

Conflicts with local government plans and policies (3,4,25).

Conflicts with adjacent land uses (19,22,23).

Mitigation Strategies

1. Siting and aligning Program features to avoid or minimize impacts on agriculture.
2. Examining structural and nonstructural alternatives to achieving project goals in order to avoid impacts on agricultural land.
3. Implementing features that are consistent with local and regional land use plans.
4. Involving all affected parties, especially landowners and local communities, in developing appropriate configurations to achieve the optimal balance between resource impacts and benefits.
5. Retaining water allocations from retired drainage-impaired lands within the existing water districts.
6. Supporting the testing and application of alternative crops to idled farmland (for example, agroforestry or energy crops).
7. Providing water supply reliability benefits to agricultural water users.
8. Supporting the California Farmland Conservancy Program in acquiring easements on agricultural land in order to prevent its conversion to urbanized uses and increase farm viability. Focusing on lands in proximity to where any conversion impact takes place.
9. Restoring existing degraded habitat as a priority before converting agricultural land.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative (continued)

10. Focusing habitat restoration efforts on developing new habitat on public lands before converting agricultural land.

11. If public lands are not available for restoration efforts, focusing restoration efforts on acquiring lands that can meet ecosystem restoration goals from willing sellers where at least part of the reason to sell is an economic hardship (for example, lands that flood frequently or where levees are too expensive to maintain).

12. Using farmer-initiated and developed restoration and conservation projects as a means of reaching Program goals.

13. Where small parcels of land need to be acquired for waterside habitat, seeking out points of land on islands where the ratio of levee miles to acres farmed is high.

14. Obtaining easements on existing agricultural land for minor changes in agricultural practices (such as flooding rice fields after harvest) that would increase the value of the agricultural crop(s) to wildlife.

15. Including provisions in floodplain restoration efforts for compatible agricultural practices.

16. Purchasing water for habitat purposes so that the same locality is not affected over the long term.

17. Using a planned or phased habitat development approach in concert with adaptive management.

18. Minimizing the amount of water supply required to sustain habitat restoration acreage.

19. Developing buffers and other tangible support for remaining agricultural lands. Vegetation planted on these buffers should be compatible with farming and habitat objectives.

20. In implementing levee reconstruction measures, working with landowners to establish levee reconstruction methods that avoid or minimize the use of agricultural land.

21. Working with landowners to establish levee subsidence BMPs that avoid impacts on land use practices. Through adaptive management, further modify BMPs to reduce impacts on agricultural land.

22. Implementing erosion control measures to the extent possible during and after project construction activities. These erosion control measures can include grading the site to avoid acceleration and concentration of overland flows, using silt fences or hay bales to trap sediment, and revegetating areas with native riparian plants and wet meadow grasses.

23. Protecting exposed soils with mulches, geotextiles, and vegetative ground covers to the extent possible during and after project construction activities in order to minimize soil loss.

24. Using rotational fallowing to reduce selenium drainage.

25. Advising the Director of Conservation and the local governing body responsible for the administration of the preserve of a proposal, when it appears that land within an agricultural preserve may be acquired from a willing seller by a state CALFED agency for a public improvement as used in Government Code Section 51920.

26. Limiting the number of acres that can be fallowed (in order to produce transferrable water) in a given area (district or county) or the amount of water that can be transferred from a given area.

27. Supporting assistance programs to aid local entities in developing and implementing groundwater management programs in water transfer source areas.

Bold indicates a potentially significant unavoidable impact.

7.1.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. An area of controversy for this resource is the amount of water used by wetland habitat, and how much more water would be needed for wetlands created on presently irrigated agricultural lands. A thorough search by Program water use staff found no comprehensive studies of this issue that apply directly to California. Studies done in Utah and Florida have been reviewed and adjusted for California conditions, but their conclusions show a wide range of variance. For this section, the higher end of water use for wetland evapotranspiration versus crop evapotranspiration, as shown in the two above-cited studies, is used. It is acknowledged that experts disagree on this issue.

7.1.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

7.1.3.1 ALL REGIONS

The Program study area represents an important agricultural region for both California and the United States. California is the most diversified agricultural economy in the world, producing more than 250 crop and livestock commodities. The study area encompasses approximately 85% of total California irrigated land, covering all or portions of 39 of the 58 counties in California. In 1995, the 39 counties together contributed about 95% of California's agricultural production value and represented nine of the top ten agricultural counties in California, and seven of the top ten counties in the nation. Agriculture in the study area is also an important employer that affects the regional economy through the expenditures of farmers and the processing and transportation of crops harvested.

Agricultural Land Use. The USDA Natural Resources Conservation Service (NRCS) and the California Department of Conservation (DOC) distinguish among four basic designations of farmland, which are defined by NRCS and mapped by DOC as Important Farmlands: Prime Farmland, Additional Farmland of Statewide Importance, Unique Farmland, and Additional Farmland of Local Importance. The DOC adds a designation of Grazing Land.

Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops that also is available for these uses.

Prime farmland has the soil quality, growing season, and moisture supply needed to produce sustained high yields or crops economically when treated and managed (including water management) according to modern farming methods.

Farmland of statewide importance is land other than prime farmland with a good combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Both prime farmland and farmland of statewide importance must be cultivated and irrigated to qualify under the DOC's important farmland system.

Unique farmland is land other than prime farmland and farmland of statewide importance that is used to provide specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality or high yields of a specific crop when treated and managed according to modern farming methods. Examples of such crops are citrus, olives, avocados, fruit, and vegetables.

Additional farmland of local importance is land used for the production of food, feed, forage, fiber, and oilseed crops, even though these lands are not identified as having national or state-wide importance. These lands are identified by a local committee made up of concerned agencies and organizations that reviews the lands under this category on at least a 5-year rotational basis.

Grazing land is similar to additional farmland of local importance, but the land is grazed by cattle or sheep rather than being used for crops.

Table 7.1-1 shows totals of 1996 important farmland acreage based on information from the DOC's Important Farmland Series maps for counties in the Central Valley. The numbers are totals of important farmland acreage (including prime and unique farmland, and farmland of local and state-wide importance) in the Delta, Sacramento River, and San Joaquin River Regions—the regions where important farmland is most likely to be affected. (It is important to note that several of the counties in the study area have not been completely surveyed by the DOC for important farmland and that these summaries have been approximated based on irrigation studies. DOC prepares conversion and acreage reports biennially—the latest figures available currently are for 1996. See Plates 2 and 3 at the end of this document for a generalized representation of important farmlands in the Delta, Sacramento River, and San Joaquin River Regions. For a detailed discussion of the Farmland Mapping and Monitoring Program and acreages by county, visit the DOC's internet web site at **http://www.consrv.ca.gov/dlrp/index.htm.**)

Table 7.1-1. Important Farmland in the Central Valley

PROGRAM REGION	ACRES
Delta Region	641,229
San Joaquin River Region	3,751,089
Sacramento River Region	2,442,276
Total	**6,834,594**

Table 7.1-2 identifies approximate acres in irrigated agriculture for each of the five Program regions.

Agricultural Water Use. Agricultural lands in the five Program study regions receive irrigation water from the CVP, the SWP, local surface water rights and water projects, and groundwater. Most of this water is delivered to farmers through irrigation districts and other water agencies. The availability and reliability of a supply of high-quality water limit the productivity of important farmland.

Table 7.1-3 provides agricultural water use and water pricing in all Program regions from 1985 to 1990.

Central Valley Project. The CVP supplies about 30% of the total agricultural water use in the study area. Most CVP water is delivered to the Central Valley counties in the Sacramento River and San Joaquin River Regions. CVP water is delivered to approximately 250 water districts, individuals, and companies through water service contracts, Sacramento River water rights, and San Joaquin River exchange contracts. The terms "water service contract" and "project water" refer here to water developed by the CVP and delivered pursuant to repayment and water service contracts.

Table 7.1-2. Irrigated Acres and Production Value in All Program Regions, 1986 to 1995

	DELTA REGION		BAY REGION		SACRAMENTO RIVER REGION		SAN JOAQUIN RIVER REGION		OTHER SWP AND CVP SERVICE AREAS	
Crop Category	Irrigated Acres (1,000 acres)	Production Value (million dollars)	Irrigated Acres (1,000 acres)	Production Value (million dollars)	Irrigated Acres (1,000 acres)	Production Value (million dollars)	Irrigated Acres (1,000 acres)	Production Value (million dollars)	Irrigated Acres (1,000 acres)	Production Value (million dollars)
Pasture	37	4	15	2	189	19	290	34	185	15
Alfalfa	65	37	50	9	161	68	527	374	420	258
Sugar beets	15	13	0	0	28	25	51	54	,32	40
Field crops	151	76	16	10	335	176	786	532	154	67
Rice	11	9	0	0	469	394	18	12	0	0
Truck crops	28	77	47	280	16	31	301	982	289	1,514
Tomatoes	45	91	4	10	135	234	180	433	8	47
Orchards	61	177	26	148	265	578	668	2,074	22	343
Grains	60	16	14	3	175	43	344	103	146	47
Grapes	36	127	70	316	10	42	507	1,681	37	215
Cotton	0	0	0	0	4	2	1,269	1,153	20	19
Subtropical orchards	0	0	0	0	15	30	221	973	167	842
Total	**509**	**628**	**244**	**779**	**1,803**	**1,642**	**5,162**	**8,403**	**1,481**	**3,408**

Sources:
County agricultural commissioner reports, various years.

Table 7.1-3. Agricultural Water Use and Water Pricing in All Program Regions, 1985 to 1990

	IRRIGATION APPLIED WATER USE BY PROGRAM REGION (TAF)				
WATER SOURCE	DELTA	BAY	SACRAMENTO RIVER	SAN JOAQUIN RIVER	OTHER SWP AND CVP SERVICE AREAS
Local water	1,100	123	1,801	4,854	107
CVP water	85	54	1,467	4,268	0
SWP water	0	13	1	1,168	232
Groundwater	110	544	1,448	1,803	229
	WEIGHTED AVERAGE PRICE ($/af)				
Surface water	0-15	15-45	0-15	20-85	15-255
Groundwater	20-35	60-130	30-60	30-80	80-120

Notes:
af = Acre-feet.
TAF = Thousand acre-feet.

Source:
DWR 1994.

State Water Project. The SWP supplies about 10% of the total agricultural water use in the Program study area. Through contracts with 29 water agencies, the SWP provides water in the Central Valley to Butte, Solano, Kings, and Kern Counties; outside the Central Valley to several southern California counties; to Alameda and Santa Clara Counties in the South Bay Area; and to Napa and Solano Counties in the North Bay Area. In addition, the SWP provides water rights deliveries to water rights holders along the Feather River (Butte and Plumas Counties).

Local Surface Water. Local surface water supplies (those not delivered by either project) provide about 40% of all agricultural water supplies in the Program study area. More local surface water supplies are available on the east side of the valley because of the larger amount of precipitation in the Sierra Nevada. Locally owned water projects are especially important on the Yuba, Stanislaus, Tuolumne, Kings, and Merced Rivers; but local sources on the west side, such as the federal Solano Project, also are important.

Groundwater. Groundwater provides a significant supply of water for agriculture in normal years and often is used to reduce or eliminate shortages of surface water supplies during drought. On average, groundwater provides about 20% of the total agricultural water use in the Program study area.

Declining groundwater tables, subsidence, and loss of aquifer storage continue to be costly problems, particularly in the western and southern parts of the San Joaquin River Region and the Bay Region, where less surface water is available. Declining groundwater tables increase pumping costs. The costs of subsidence include damage to structures, failure of well casings, and the need for frequent surveying. The increased level of salinity and mineral content from groundwater, particularly in the San Joaquin Region, creates tailwater disposal issues and reduces crop flexibility. Water from the CVP and SWP had replaced some of the groundwater pumping, and withdrawals were about equal to estimated recharge by the 1970s. However, the droughts in the late 1970s and late 1980s to early 1990s, combined with the supply restrictions imposed by the CVPIA of 1992, the Bay-Delta Accord, and biological opinions have reduced surface water supplies and renewed the past trend of groundwater depletion throughout the valley.

Agricultural Habitats. Cropland, orchards, and vineyards have been developed on some of the state's most fertile soils. Soils supported a much greater diversity of native species and productive natural habitats historically than they do today. Many wildlife species have adapted to areas now converted to cropland. Wintering waterfowl and shorebirds consume waste grains left in fields after harvest, and use fields flooded for weed control, leaching, and creation of seasonal wetlands. For a more detailed discussion of the types and value of agricultural habitats and seasonal wetlands, see Section 6.2, "Vegetation and Wildlife," and the Ecosystem Restoration Program Plan.

7.1.3.2 Delta Region

Agricultural Land Use. Agriculture in the Delta Region began in the mid-1800s, consisting primarily of dryland farming or irrigated agriculture from artesian wells, groundwater pumping, and creek-side diversions. Extensive Delta development began in late 1850, when the Federal Swamp Land Act promoted converting swamp and overflow lands to agricultural production. During the early 1900s, a series of levees and human-made waterways were developed to enhance future agricultural and urban development.

Today, of the nearly 750,000 acres in the Delta, about 641,000 acres are rich farmland. Most of this area is classified as prime farmland, farmland of statewide importance, and unique farmland, or land with high statewide significance for agricultural production. The Delta's rich peat and mineral soils support several types of agriculture. One of the unique problems with organic or peat soil is that, when exposed to aerobic conditions by farm cultivation, the soil oxidizes and erodes away. This process has led to a drop in land surface elevations several feet below sea level throughout much of the Delta from historical levels at or above sea level. For a more thorough discussion of this unique problem, see Section 5.5, "Geology and Soils."

Between 1976 and 1993, the total amount of agricultural land in the Delta was reduced by about 14,500 acres. This was largely due to conversion of agricultural land to urban uses in the Brentwood and Oakley areas of Contra Costa County, the Pocket area in Sacramento County, the West Sacramento area in Yolo County, and the Stockton and Tracy areas in San Joaquin County.

Agricultural Water Use. Most agricultural water users in the Delta are private water right holders. Local water rights water accounts for over 85% of the total irrigation water use. Other irrigation water sources in the Delta Region are CVP water and groundwater, each accounting for about 5-10% of the total agricultural water uses. Between 1985 and 1990, compared to other parts of California, the cost of water was much cheaper in the Delta Region because of large amounts of local riparian and pre-1914 appropriative water rights. These are the most secure agricultural water rights, as they are connected to the land; newer water supplies are less secure and more expensive.

7.1.3.3 BAY REGION

Agricultural Land Use. As is characteristic of all the Program study regions, agriculture in the Bay Region expanded greatly during the Gold Rush of 1849. As more people arrived in California and urban development flourished along the Bay and in lower watershed areas, more land in the upper watersheds was brought into production. Although the number of farms between the end of World War II and the mid-1960s declined, the number of irrigated acres increased by 25%, with the average farm containing 51 acres. Orchards were by far the most important crop in the Bay Region, followed by vegetables and other truck crops (such as melons, potatoes, and garlic). Other crops included alfalfa, sugar beets, and field crops. Prior to the 1940s, land uses in the Bay Region were principally urban in the City of San Francisco and rural in other portions of the region. Over the last 50 years, however, land uses throughout the region have become progressively more urbanized.

Approximately 493,000 acres of farmland categorized as important were mapped in 1996 for the Bay Region, including large acreages in Contra Costa, Solano, Napa, and Sonoma Counties.

Agricultural Water Use. Over 75% of irrigation water sources in the Bay Region are from groundwater pumping. Local water and project water make up the other 25%. Groundwater extractions commonly exceed groundwater replenishment; therefore, many of the region's aquifers are experiencing overdraft conditions.

Between 1985 and 1990, the average cost of surface water in the Bay Region is estimated at $15-$45 per acre-foot, about the average in California. The cost of groundwater in the Bay Region is estimated at $60-$130 per acre-foot, much higher compared to the Delta and Sacramento River Regions.

7.1.3.4 SACRAMENTO RIVER REGION

Agricultural Land Use. Land uses in the Sacramento River Region are principally agricultural and open space, with urban development focused in the City of Sacramento. More than half the region's population lives in the greater metropolitan Sacramento area. Other fast-growing communities include Vacaville, Dixon, Redding, Chico, and various Sierra Nevada foothill towns. Urban development has occurred along major highway corridors in Placer, El Dorado, Yolo, Solano, and Sutter Counties, and has taken some irrigated agricultural land out of production. The suburban ranchette homes on relatively large parcels that surround many of the urban areas often include irrigated pastures or small orchards.

Historically, rice was the most important crop in the Sacramento River Region, accounting for 30% of the total irrigated acres. Almost 90% of California rice crops were grown in this region from 1946 to 1950.

The next important crops in the Sacramento River Region were irrigated pasture and orchards, each accounting for 20% of the total irrigated acres.

Excluding the Delta portion of the Sacramento River Region, in 1996, approximately 2.4 million acres of important farmland were mapped in the Sacramento River Region (for areas covered by the DOC important farmland map series).

Agricultural Water Use. About 40% of irrigation water sources in the Sacramento River Region are from local water rights or local water projects. CVP project water and groundwater each make up about half of the remainder of the total agricultural water use. The 30% of the region's lands that are irrigated with groundwater generally have a very reliable supply.

The majority of diverters along the Sacramento and Feather Rivers existed before major CVP and SWP reservoirs were built. Between 1985 and 1990, the average cost of surface water in the Sacramento River Region is estimated at $0-$15 per acre-foot, among the lowest costs in California. The cost of groundwater is estimated at $30-$60 per acre-foot, also among the lowest in the state.

7.1.3.5 SAN JOAQUIN RIVER REGION

Agricultural Land Use. Land uses in the San Joaquin River Region are predominantly grazing and open space in the mountain and foothill areas, and agricultural in the San Joaquin Valley area. Urban land use in 1996 totaled approximately 375,000 acres. Urban areas include the cities of Stockton, Fresno, Visalia, Modesto, Merced, and Tracy, as well as smaller communities such as Lodi, Galt, Madera, and Manteca. The western side of the region, south of Tracy, is sparsely populated. Small farming communities provide services for farms and ranches in the area, all relatively close to I-5.

Prior to the 1960s, land uses in the San Joaquin River Region were principally agriculture and open space, with urban uses limited to small farm communities. Although agriculture and food processing are still the region's major industries, expansion from the San Francisco Bay Area and local industrial growth over the past 30 years have resulted in the creation of major urban centers throughout the region.

Between 1946 and 1950, in terms of irrigated acres, cotton and grains were the most important crops in the San Joaquin River Region, accounting for 22% and 20% of the total irrigated acres, respectively. The next important crops in the San Joaquin River Region were irrigated pasture, alfalfa, and grapes, each accounting for about 15% of the total irrigated acres. Almost 100% of California cotton and 90% of California grapes were grown in this region from 1946 to 1950.

In 1996, excluding the Delta portion of San Joaquin County, about 3,751,000 acres of important farmland were mapped in the San Joaquin River Region (for areas that have been mapped by the DOC under important farmland criteria).

Agricultural Water Use. About 40% of irrigation water sources in the San Joaquin River Region are from local water rights or local water projects. CVP project water provides 35% of total irrigation water uses. The rest of the region's water is made up of approximately 10% from the SWP and 15% from groundwater pumping.

Between 1985 and 1990, the average cost of surface water in the San Joaquin River Region is estimated at $20-$85 per acre-foot, at the high end of cost in California. The cost of groundwater is estimated at $30-$80 per acre-foot, also at the high end of cost in the state.

7.1.3.6 OTHER SWP AND CVP SERVICE AREAS

Agricultural Land Use. Although the Other SWP and CVP Service Areas include California's most heavily urbanized areas, much of the region's land remains in agricultural uses. Intensive agriculture occurs in the Santa Maria and lower Santa Ynez Valleys. Moderate levels of agricultural activity also occur near the South Coast area, and much of the region is grazed. Agricultural crops include grapes, vegetables, and truck crops, as well as a thriving flower seed industry. Important farmland mapped in the area totaled approximately 2.1 million acres in 1996 (for areas that have been mapped by the DOC under important farmland criteria).

Because agricultural land acreages and production are both reported on a county basis, acreages for the San Felipe Division of the CVP are shown under the Bay Region, rather than under the Other SWP and CVP Service Areas.

Between 1946 and 1950, in terms of irrigated acres, alfalfa and subtropical orchards were the most important crops in the region, accounting for 24% and 22% of the total irrigated acres, respectively. The next important crops in the region were truck crops, field crops, and grains, each accounting for about 15-20% of the total irrigated acres. Other crops grown in the region included pasture and orchards. Over 90% of California subtropical orchards was grown in this region during the 1950-1964 period. Development in the region has steadily increased since the 1880s.

The South Coast is the most urbanized region in all of California. Prime, statewide important, and unique farmland account for about 462,000 acres of the South Coast area. The largest amount of irrigated agriculture is in Ventura County, where about 112,000 acres of cropland are cultivated, including vegetables, strawberries, citrus fruit, and avocados.

Agricultural Water Use. Outside the Central Valley, SWP water and groundwater each provides 40% of the total irrigation water in the region. Local water provides the rest of total irrigation water uses.

Between 1985 and 1990, the average cost of surface water in the Other SWP and CVP Service Areas is estimated at $15-$255 per acre-foot, among the highest costs in California. The cost of groundwater is estimated at $80-$120 per acre-foot, also among the highest costs in the state.

Summary

The Program study area contains a large amount of productive agricultural lands, with over 9.5 million acres mapped as important farmlands in 1996. Development of agriculture began in much of the study area as early as 1850. Today, rich soils, a beneficial climate, and a large array of water developments and flood protection projects provide the necessary inputs to support the state's highly productive agricultural lands. In many areas, however, the state's burgeoning population is reducing the amount of agricultural lands through conversion to urban uses. Water is supplied to the state's agriculture by the CVP (30%), the SWP (10%), local surface water projects (40%), and groundwater (10%).

7.1.4 ASSESSMENT METHODS

Agricultural land and water use impacts could occur in two main categories: direct and construction-related impacts, and indirect impacts.

Direct impacts are those changes in physical land and water uses or in land use designations that result from construction of new facilities or conversion of lands from one use to another. For this analysis, direct impacts are those that would occur if any of the alternatives are implemented.

Indirect effects occur later in time and could be farther removed in distance. Indirect land use effects include changes in broad land use policies, resources, or economies that could result from changes in land uses or in the long-term availability of water resources. Potential indirect and operations-related impacts of the Program include long-term changes in the number of acres in agricultural use.

As a Programmatic EIS/EIR, this assessment does not provide site-specific details or specific estimates of acreages potentially affected for a given alternative. Rather, potential increases or decreases in agricultural land uses by region are qualitatively estimated, or described with a range of gross acres. Given the level of detail appropriate for a programmatic assessment, project-level information is not available. This, in turn, means that this document cannot detail agricultural impacts, or benefits, in other than region-level estimates of acreages.

A programmatic-level analysis of the amount of water used by conversion of agricultural land for habitat purposes was made, using the methods and assumptions presented below.

The amount of water needed to support a particular land use is considered to be the amount of water that is supplied naturally by rainfall (soil moisture) and the water that must be applied for irrigation or to flood a wetland and supply evapotranspiration requirements. Evapotranspiration requirements of crops or other types of vegetation are variable. A monthly water budget can be used to estimate the evapotranspiration and corresponding applied water requirements of specific crops, given assumed soil moisture parameters and a monthly rainfall sequence. For this programmatic impact assessment, however, only the approximate differences in annual water requirements between those typical of existing conditions and those estimated for habitat restoration use were evaluated.

Open-water evaporation in the Delta Region of the Central Valley is approximately 5 acre-feet per year. [Note: Unless noted otherwise, "acre-feet" figures in this section refer to "acre-feet per acre per year."] Annual evapotranspiration from crops is generally less than open-water evaporation, although the annual evapotranspiration of perennial crops such as alfalfa may approach open-water evaporation. Average crop evapotranspiration for Delta lowlands and uplands is estimated to average about 3 acre-feet, with about 2 acre-feet of applied water needed for evapotranspiration (the remaining evapotranspiration is supplied from rainfall).

Wetlands evapotranspiration generally is considered about equal to open-water evaporation. The evapotranspiration rate for riparian vegetation with access to shallow groundwater could be similar to that of open-water evaporation. Very little of the evapotranspiration requirements of aquatic habitat is supplied from rainfall because rainfall occurs when the water supply conditions are not limited. Therefore, as much as 3 acre-feet per year per acre of habitat of increased water supply may be needed if agricultural land is converted to aquatic or riparian habitats (5 acre-feet of evaporation required by aquatic habitats minus 2 acre-feet of applied water evapotranspiration required for crops). Where land is planted to crops that use more than 2 acre-feet of applied water for evapotranspiration (such as alfalfa or pasture), the water supply impacts of conversion to aquatic or riparian habitat would be less than 3 acre-feet. However, where the existing land use is unirrigated natural vegetation, the water supply impacts would be higher (5 acre-feet) because existing applied water use would be zero.

Table 4.2 (in Chapter 4) provides estimated acres of habitat restoration in each of four geographic regions being proposed as part of the Ecosystem Restoration Program. This table was used to estimate impacts on water supply. Actual water supply impacts due to additional evapotranspiration water use by restored habitat lands would depend on monthly water supply conditions. If excess water is flowing from the Delta to the Bay, no impacts on water supply diversions or exports would occur. Water supply impacts in wet years would be low, because excess water supply conditions usually exist in many months during wet years. However, potential water supply impacts likely would occur in dry years. These potential water supply impacts can be minimized by carefully selecting the areas for habitat restoration in order to control the amount of additional water supply needed to maintain the aquatic or riparian habitat, or by reducing the water applied to flooded seasonal wetlands in dry years.

7.1.5 SIGNIFICANCE CRITERIA

For this analysis, an impact on agricultural land or water use is considered significant if implementing a Program action would result in:

- Permanent or long-term reduction in agricultural acreage in a region or the conversion of any lands categorized as prime, statewide important, or unique farmland.
- Adverse effects on agricultural operations from adjacent land uses (for example, creation of no-spray zones adjacent to new habitat, siltation from levee construction, or other incompatible uses).
- An increase in groundwater pumping that would cause or exacerbate overdraft of a basin, which in turn leads to a conversion of farmlands to non-agricultural uses.
- Inconsistency with agricultural objectives of local, regional, and state plans.
- Conflicts with applicable environmental plans or policies adopted by agencies with jurisdiction over the project.
- Conflicts with general plan designations or zoning.
- Conversion of lands under the Williamson Act or other agricultural easement to an incompatible use.

7.1.6 NO ACTION ALTERNATIVE

7.1.6.1 DELTA REGION

Agricultural land conversion will significantly affect the Delta Region under the No Action Alternative. Between 1994 and 1996, the DOC's Farmland Mapping and Monitoring Program mapped a loss of 12,288 acres of prime, statewide important, and unique agricultural lands in the five Delta counties. During this same 2-year period, 14,689 acres of agricultural lands in those five counties were committed by local governments to future urbanization and non-agricultural uses. This trend will continue under the No Action Alternative. A number of projects being carried out or proposed independent of the Program would convert agricultural land in the Delta, including the Stone Lakes NWR, the North Delta NWR, and the Yolo Basin Wildlife Area. Together, the three wildlife area proposals could convert up to 51,000 acres of agricultural land to wildlife uses. DWR estimates that levee failures in the Delta Region will result in continued, and even accelerated, flooding of tracts that are currently in agricultural use. Besides inundating farmlands, levee failures would cause salt water intrusion potentially far into the Delta. If the intrusion occurred during the irrigation season, the resulting decrease in water quality could seriously affect irrigation of lands elsewhere in the Delta and also in the export areas. Specific agricultural land use impacts would depend on the actual location of the modifications and improvements to be implemented under the No Action Alternative.

7.1.6.2 BAY REGION

Agriculture in the Bay Region will continue to experience the impacts of urban conversion under the No Action Alternative. Between 1994 and 1996, local governments committed 10,761 acres to future urbanization and non-agricultural use.

7.1.6.3 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Conversion of agricultural lands to urban uses will continue, and possibly accelerate, as the Sacramento, Stockton, Fresno, and Bakersfield metropolitan areas continue to expand, as well as dozens of smaller cities. It has been estimated that up to 1 million acres of agricultural land in the Central Valley could be converted within the next 40 years. Other activities will substantially affect agricultural resources under the No Action Alternative. Water currently being used for irrigation purposes could be diverted to provide protection for currently endangered species or for newly listed species. Although the exact amount of this water loss cannot be quantified due to varying habitat demands and the recovery or decline of the species involved, the amount could be substantial. The significance of this water loss to agriculture would be magnified by the lack of any additional water efficiency, surface storage, conveyance improvements, or conjunctive use programs. Water rights purchase and water transfer programs will occur with greater frequency as urban areas view irrigation water as a cheap alternative for accommodating growing populations. These transfers and purchases may be unregulated, or only lightly regulated, and may substantially affect exporting regions. County ordinances to strengthen area-of-origin water rights may reduce this effect to some extent. In addition, it is estimated that 45,000 acres of drainage problem lands in the San Joaquin River Region will be retired by 2020.

Table 7.1-4 illustrates how agricultural water use could change in portions of the Central Valley as a result of implementation of the CVPIA. The estimates in this table are taken from the CVPIA PEIS and indicate the predicted change in water use under CVPIA Alternative 1 relative to the CVPIA No Action Alternative. These estimates, based on hydrologic and economic modeling conducted for the CVPIA PEIS, illustrate how changes in surface water delivery are expected to affect groundwater pumping. The estimates indicate that part of any change in surface water delivery is likely to be offset by a change in groundwater use. The degree of replacement depends on the relative cost of groundwater and surface water, and on the relative cost and benefit of other potential adjustments (for example, changing the amount of acreage irrigated or the irrigation methods).

Table 7.1-4. Substitutions of Groundwater for Surface Water in Portions of the Central Valley Due to a Decrease in Surface Water Delivery

SOURCE	AGRICULTURAL WATER USE— 2020 CONDITION WITHOUT CVPIA (TAF/year)	CHANGE DUE TO CVPIA DEDICATED WATER FOR RESTORATION (TAF/year)
Sacramento Region		
Surface water	4,524	-39
Groundwater	2,603	25
Total applied	7,127	-14
San Joaquin River Region		
Surface water	4,453	-302
Groundwater	3,427	134
Total applied	7,880	-168

Notes:
TAF = Thousand acre-feet.

These estimates are included as an illustration and are taken from the CVPIA PEIS.

7.1.6.4 OTHER SWP AND CVP SERVICE AREAS

As with the balance of the state, agriculture in the Other SWP and CVP Service Areas would be heavily affected by urban conversion. As with regions in the Central Valley, water costs likely would increase, and supplies would become more tenuous.

Summary. Under the No Action Alternative, agricultural land conversions, both to urban uses and to habitat uses, would be substantial. Throughout the Program study area, it is estimated that urbanization may convert over 1 million acres of agricultural lands within the next 40 years. A total of 45,000 acres of drainage-impaired lands may be retired, and over 50,000 acres of agricultural land may be converted to habitat use in existing and planned wildlife areas. Other areas of agricultural land likely would be lost due to levee failures in the Delta. Irrigation water reliability likely would be reduced due to diversion to support endangered species and from water transfers.

7.1.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For agricultural land and water use, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as described in Section 7.1.8.

7.1.7.1 ALL REGIONS

Conversion of prime, statewide important, or unique farmland to other uses likely would conflict with many local or regional agricultural land use plans or policies, which would result in a potentially significant unavoidable impact. For example, agricultural policies in the five Delta county general plans contain the following statements:

- Yolo County: "It is the policy of Yolo County to vigorously conserve and preserve the agricultural lands in Yolo County. Yolo County shall protect and conserve agricultural land use especially in areas presently farmed or having prime agricultural soils and outside of existing planned urban communities and outside of city limits. Nonagricultural land use activities are prohibited from agriculturally designated areas in Yolo County."

- Solano County: "Preserve and maintain essential agricultural lands including intensive agricultural areas comprised of high quality soils and irrigated lands and extensive agricultural areas with unique or significant dryland farming or grazing activities."

- Sacramento County: "The County shall balance the protection of prime farmland and farmland with intensive agricultural investments with the preservation of natural habitat realized by the establishment of environmental mitigation banks and sites, wildlife refuges and other natural resource preserves so as to protect farmland and to conserve associated habitat values."

- San Joaquin County: "Agricultural areas shall be principally used for crop production, ranching and grazing."

- Contra Costa County: "County Agricultural Resources Goal 8-H: To conserve prime agricultural land outside the Urban Limit Line exclusively for agriculture."

The specific locations of projects have not been identified for this programmatic-level analysis. However, it is likely that lands designated for agriculture in county and city general plans would be used for storage, conveyance, habitat, and levee purposes. Thus, inconsistency with these plans would result in a potentially significant adverse impact on agricultural land use.

It is also likely that a substantial amount of the agricultural land that the various programs could convert would be enrolled in the California Land Conservation Act, known as the Williamson Act. Under the Williamson Act, landowners contract with their city or county to keep lands in farming or open space for a minimum of 10 years. In return, the landowner receives a reduction in property taxes. The State makes subvention payments to local governments with Williamson Act contracts to defray a portion of the foregone property taxes. State or local agencies acquiring Williamson Act-contracted lands are required to notify the DOC beforehand and, in the case of prime farmland, to make findings that no other non-contracted land is feasible for the proposed use. However, these findings are not required for fish and wildlife enhancement projects or flood control projects, which are defined in the Act as compatible with agricultural preserves. Also exempted from this requirement are projects designated as State Water Facilities. Although the conversion of agricultural lands enrolled in the Williamson Act is often used as an indicator of significance, projects from both the Ecosystem Restoration Program and the Levee System

Integrity Program likely would be compatible with the Act. Williamson Act-contracted lands may also be acquired for other Program purposes, such as storage and conveyance. The loss of Williamson Act-contracted land for storage and conveyance, or other Program purposes that are incompatible with Williamson Act uses is considered a potentially significant impact.

The MSCS and the Ecosystem Restoration Program identify a target of from 324,000 to 389,000 acres of agricultural lands to be seasonally flooded or cooperatively managed in various regions to provide additional wildlife benefits. The Ecosystem Restoration Program intends to accomplish this goal by purchasing conservation easements from farmers or providing incentives to farmers who use farming methods and crops favorable to wildlife. Because no conversions of agricultural lands to other program uses are contemplated under this action, it would not result in a significant environmental impact. However, because crop yields could be reduced or production could be more difficult, this issue is discussed in Section 7.2, "Agricultural Economic Issues," and Section 7.3, "Agricultural Social Issues."

7.1.7.2 Delta Region

Ecosystem Restoration Program

The Ecosystem Restoration Program involves conversion of land in the Delta Region to habitat and ecosystem restoration, levee setbacks, and floodways. In general, agriculture is the dominant land use on the nonconveyance side of levee structures in the Delta. The Ecosystem Restoration Program could convert up to 112,000 acres of important farmland. Although some of these agricultural uses may be shifted to the Central Valley or elsewhere, this conversion is a potentially significant unavoidable adverse impact on agricultural land use.

Restoration of habitat adjacent to agricultural operations could cause compatibility issues. If adjacent habitats contained sensitive species, aerial spraying of farmlands could be constrained. Weeds or pest species could move from restored habitat lands to agricultural fields, while removal or eradication could be constrained. Although mitigation is available to reduce the severity of this impact, it remains a potentially significant unavoidable impact.

Habitat restoration in the Delta Region could affect water supply because some aquatic habitats use more water for evapotranspiration than some of the current agricultural land uses. Shoal and mid-channel island habitat restoration would not require additional water nor would perennial grasslands, which were assumed to be sustained by natural rainfall. Seasonal wetlands on lands that will continue agricultural practices generally use water in fall and winter when evaporation is relatively low. Therefore, the water requirements for flooding these areas may be less (1 or 2 acre-feet per acre per year) than for other aquatic habitats. The 28,000 acres of seasonal wetland restoration targeted for the Delta Region therefore could require from 28,000 to 56,000 acre-feet per year of additional water (see Table 4-2 in Chapter 4).

The remaining aquatic and riparian habitat restoration targets from Table 4-2 for the Delta Region total between 58,300 and 74,000 acres. If it is assumed that all this habitat is developed on existing agricultural land, as much as 3 acre-feet per acre (5 acre-feet for wetlands minus 2 acre-feet for agricultural land) would be needed. Therefore, a maximum of between 174,900 and 222,000 acre-feet per year of additional water supply could be needed in the Delta Region for tidal and nontidal habitat restoration. The maximum potential additional water use for Delta Region habitat restoration therefore could range from 202,900 and 278,000 acre-feet per year. As noted in Section 7.1.4, not all of these water supply needs would result in reduced availability of water for agricultural purposes. During times when excess water is flowing from the Delta to the Bay, no impacts on water supply diversions or exports would occur. In addition, some of the tidal habitat restoration identified in Table 4-2 (in Chapter 4) would involve dredging or filling existing open-water habitat to create shallow-water or slough habitat, which would not affect water supply because the restored habitat already is open water.

Effects on other water users cannot be determined until the location and other specific details of the habitat restoration are known.

Water Quality Program

Since the CVP and SWP are required to maintain water quality standards in the Delta, it is likely that impacts on Delta water users would be minimal. The long-term benefits of the Water Quality Program include improved water quality conditions, which would benefit agricultural users. Because it is anticipated that up to 45,000 acres of land in the Grasslands Subarea of the San Joaquin River Region with drainage problems would be retired under the No Action Alternative, this land retirement under the Program is not considered a potentially significant impact compared to the No Action Alternative.

Levee System Integrity Program

Levee system integrity measures could convert up to 35,000 acres of land in the Delta to Program uses, most of which would likely be important agricultural land. The specific locations of lands that would be affected by the Preferred Program Alternative are not known at this time. The Levee System Integrity Program has the potential to create incompatibilities with adjacent agricultural land uses, due to construction-related and post-construction sedimentation and erosion. Although these incompatible uses are considered a potentially significant impact, mitigation is available to reduce impacts to a less-than-significant level. Protection of flood-threatened agricultural lands due to levee improvements through the Levee System Integrity Program would provide considerable benefits to agricultural land use.

No impacts on agricultural land and water use from the Levee System Integrity Program are anticipated in any Program region other than the Delta. The Levee System Integrity Program is not discussed below for the other Program regions.

Water Use Efficiency Program

The Water Use Efficiency Program is not anticipated to directly affect land use. However, the program may indirectly affect agricultural land use. The flexibility to grow different crops in order to respond to market demand may be reduced due to higher costs for water and water infrastructure. Improved efficiency may allow the continued viability of agriculture in some areas. Efficiency improvements that result in greater water supply reliability but also higher annual cost may cause a shift in the types of crops grown, such as to higher value crops that justify the increased water cost. A shift to high-value crops may lead to a sustained, less-flexible water demand. Improvement in the long-term viability of some agricultural lands is a benefit.

Water Transfer Program

The Delta Region would be a potential beneficiary of the Water Transfer Program, as water transfers can result in a more efficient distribution of water resources among users during low-flow periods, increasing the reliability of supplies in the Delta during water supply shortages.

Watershed Program

The Delta Region could receive better quality irrigation water as a result of Watershed Program activities. As upstream watersheds are managed to create less erosion and sedimentation, and to improve water quality, these waters eventually will reach the Delta with fewer sediments and pollutants.

Storage

Potentially significant and unavoidable adverse impacts on existing land uses could result from land conversions associated with new or expanded surface water storage. Specific land use impacts would depend on the location of any new storage facilities. For this programmatic analysis, it was assumed that the most likely new or enlarged reservoir sites would be in the foothills rather than in flat, valley-bottom areas where agricultural land uses would occur. Therefore, storage elements likely would affect less intensively used agricultural lands, such as grazing lands, and not the better farmland generally found on the valley floor. All Program alternatives however, include the possibility of in-Delta storage, which could result in potentially significant impacts on agricultural lands in the region. Up to 15,000 acres of Delta agricultural lands could be affected by this Program element. Although the effect is not well documented, there is also a potential for seepage to affect islands adjacent to new in-Delta storage. If this potential seepage affected agricultural lands to the point where lands were permanently removed from production, it would result in a significant impact. Mitigation is available to reduce this potentially significant impact to a less-than-significant level; see Section 5.4.

Agricultural water users in the Delta Region could receive some of the additional water supply developed by the Preferred Program Alternative. However, the cost and availability of water from new storage and conveyance facilities will depend on the alternative selected, the location of facilities proposed, and amount of new water from each of these facilities. Therefore, the allocation of new water by region is uncertain.

7.1.7.3 BAY REGION

Ecosystem Restoration Program

Habitat restoration in the Bay Region has a low potential to affect water supply because water from the San Francisco Bay, which would be used to maintain the restored habitat, is not otherwise used for water supply. The additional evapotranspiration resulting from conversion of land to tidal or nontidal wetlands would not cause any decrease in fresh-water supplies. Potential impacts on important agricultural land in the Bay Region are not expected to be significant because project features are planned to be located mostly on tidal or other nonagricultural lands.

Watershed, Water Transfer, Water Quality, and Water Use Efficiency Programs

No impacts on agricultural land and water use in the Bay Region are anticipated from implementation of any of these programs.

Storage

Agricultural water users in the Bay Region could receive some of the additional water supply developed by the Preferred Program Alternative. However, the cost and availability of water from new storage and conveyance facilities will depend on the alternative selected, the location of facilities proposed, and the amount of new water from each of these facilities. Therefore, the allocation of new water by region is uncertain.

7.1.7.4 SACRAMENTO RIVER REGION

Ecosystem Restoration Program

The Ecosystem Restoration Program could convert up to 34,000 acres of important farmland, primarily on the east side of the valley and the valley trough in the Sacramento Valley. This conversion is a potentially significant unavoidable adverse impact on agricultural land use.

Incompatibility impacts in this region are similar to those discussed for the Delta Region.

Habitat restoration in the Sacramento River Region may not require as much additional water per acre of habitat as the Delta Region because much of the floodplain and meander corridor vegetation would be sustained by soil moisture and shallow groundwater storage resulting from rainfall, snowmelt, and storm flows. Because current agricultural water use is likely to be similar to the additional riparian water supply needed to sustain riparian corridor habitat restoration efforts, relatively small water supply impacts likely would result from these restoration activities. However, if riparian habitat is restored from natural areas not fully supporting riparian habitat, a water supply impact of up to 2 acre-feet per acre per year of riparian habitat could result. If all of the potential 34,000 acres of riparian restoration were created from these types of natural vegetation lands, which is unlikely, a maximum of 68,000 acre-feet per year of additional water would be required in the Sacramento River Region.

Water Quality Program

The Water Quality Program may provide better quality irrigation water in the Sacramento River Region as mercury and heavy-metal drainage problems are addressed.

Water Transfer Program

The Water Transfer Program could affect agricultural land use primarily through changes in agricultural, open space, habitat, and developed land use. In addition to the source of water for a transfer, the timing, magnitude, and pathway of each transfer can substantially affect the potential for significant impacts. The water source varies according to the water transfer category: crop fallowing (surface water or groundwater), shifting to a crop with a lower water demand (surface water or groundwater), groundwater substitution for surface water (surface water), direct groundwater transfers (groundwater), conserved water (surface water or groundwater), and stored water in reservoirs (surface water).

Beneficial impacts associated with the transferred water's destination include increasing agricultural acreage in areas with limited water supplies.

Potentially significant adverse impacts associated with the transferred water include: (1) agricultural land conversion due to crop fallowing, (2) agricultural land conversion due to increased costs or groundwater overdrafts resulting from direct groundwater or groundwater replacement transfers, and (3) land use changes that could be inconsistent with local agricultural objectives. Mitigation is available to reduce these impacts to a less-than-significant level.

Water transfers are not expected to directly affect land use; however, they could indirectly affect agricultural opportunities by changing the availability of water in selling and receiving areas. Transfers could result in adverse economic effects due to temporary or longer term reduction in cropped lands or shift in crop types.

Water Use Efficiency Program

Potential impacts related to agriculture in the Sacramento River Region from Water Use Efficiency Program actions would be similar to those discussed for the Delta Region.

Watershed

Potential watershed activities in the Sacramento River Region would be compatible with applicable agricultural land use plans and policies in their affected jurisdictions. Watershed activities could improve grazing land conditions and grazing use, potentially resulting in a beneficial impact.

Storage

Storage facilities could result in conversion of agricultural land in the foothill or mountain areas in the Sacramento River Region, a potentially significant and unavoidable adverse impact. Development of storage facilities also could conflict with local and regional plans regarding agricultural lands. Some agricultural land, which could be classified as locally important or grazing lands, could be affected by the Storage Program elements, a potentially significant and unavoidable adverse impact. Because storage facility locations have not been selected, the amount of important farmland affected is not known and will be determined in future project-specific environmental documentation.

Because potential new or enlarged reservoir sites would be located primarily in the foothills and would affect dryland crops and grasslands that rely on rainfall, changes in applied water have not been estimated.

Agricultural water users in the Sacramento River Region could receive some of the additional water supply developed by the Preferred Program Alternative. However, the cost and availability of water from new storage and conveyance facilities will depend on the alternative selected, the location of facilities proposed, and the amount of new water from each of these facilities. Therefore, the allocation of new water by region is uncertain.

Groundwater storage projects in the Sacramento River Region could affect adjacent agricultural operations. Particularly in dry years, groundwater level declines could occur as a result of overpumping in storage facilities. In extreme cases, the use of wells on adjacent or nearby properties could be lost due to adverse groundwater quality or lower groundwater levels. Temporary loss of groundwater availability, or increased pumping costs, could result in adverse economic effects on neighboring agricultural lands. These effects are discussed in Section 7.2, "Agricultural Economics." Groundwater storage facilities could provide a benefit to neighboring agricultural operations by ensuring that adequate supplies of groundwater are available and by reducing pumping costs in most years as groundwater levels remain higher.

7.1.7.5 San Joaquin River Region

Ecosystem Restoration Program

The Ecosystem Restoration Program could convert up to 5,800 acres of important farmland, primarily east of the San Joaquin River in the San Joaquin River Region. This conversion would result in a potentially significant unavoidable adverse impact on agricultural land use.

Incompatibility impacts in this region are similar to those discussed for the Delta Region.

Habitat restoration in the San Joaquin River Region may not require as much additional water per acre of habitat as the Delta Region because much of the floodplain and meander corridor vegetation would be sustained by soil moisture and shallow groundwater storage resulting from rainfall, snowmelt, and storm flows. Because current agricultural water use is likely to be similar to the riparian water supply needed to sustain riparian corridor habitat restoration efforts, relatively small water supply impacts likely would result from these restoration activities. However, if riparian habitat is restored from natural areas not fully supporting riparian habitat, a water supply impact of up to 2 acre-feet per acre of riparian habitat could result. If all of the potential 5,800 acres of riparian restoration were created from these types of natural vegetation lands, which is unlikely, a maximum of 11,600 acre-feet per year of additional water would be required in the San Joaquin River Region.

Water Quality Program

As proposed in the Water Quality Program, up to 37,000 acres of agricultural land with water quality problems (for example, the presence of selenium) may be idled in the Grasslands Subarea of the San Joaquin River Region as a measure to improve water quality in the region and in the Delta. The exact location of these lands and, consequently, the types of crops that would be idled are not known. Therefore, the Water Quality Program could affect up to 37,000 acres of agricultural land, possibly including prime, statewide important, and unique farmland. This loss is considered potentially significant and unavoidable. It should be noted that 45,000 acres of land would be retired under the No Action Alternative, compared to 37,000 acres of land that would be retired under the Preferred Program Alternative.

Again, the location and mix of crops that would be retired as part of the Water Quality Program is not definable at the programmatic level. But assuming an average of 3 acre-feet of applied water per crop acre and a maximum of 37,000 acres of drainage problem lands idled, approximately 111,000 acre-feet of water would not be applied. As discussed for the Delta Region, this reduction in applied water does not necessarily equate to new water available for other uses. ("New water" is water not previously available that is created by reducing irrecoverable losses or outflow to the ocean or inland salt sinks.) Some of this water would likely be recoverable in the San Joaquin River Region by downstream or in-basin users.

Water Use Efficiency Program

Impacts on agriculture in San Joaquin River Region from the Water Use Efficiency Program would generally be the same as those discussed for the Sacramento River Region. Soil salinity in the San Joaquin River Region can be reduced if lower-salinity water is applied. However, if water higher in salinity is applied, or if water conservation actions reduce water applications to levels that do not allow adequate soil leaching, soil salinity could increase. This condition is not likely because of the widespread and successful use in the region of integrated on-farm management techniques to deal with salinity in soil and irrigation water.

Water Transfer Program

Impacts associated with Water Transfer Program actions would be similar to those discussed for the Sacramento River Region.

Watershed Program

Potential watershed activities in the San Joaquin River Region would be compatible with applicable agricultural land use plans and policies in their affected jurisdictions. Watershed activities could improve grazing land conditions and grazing use, potentially resulting in a beneficial impact.

Storage

Storage facilities could result in conversion of agricultural land in the foothill or mountain areas in the San Joaquin River Region, a potentially significant and unavoidable adverse impact. Development of storage facilities also could conflict with local and regional plans regarding agricultural lands. Some agricultural land, which could be classified as locally important or grazing lands, could be affected by the Storage element. Because storage facility locations have not been selected, the amount of important farmland affected is not known and would be determined in project-specific environmental documentation.

Because potential reservoir sites would be sited primarily in the foothills and would affect dryland crops and grasslands that rely on rainfall, changes in applied water have not been estimated.

Agricultural water users in the San Joaquin River Region could receive some of the additional water supply developed by the Preferred Program Alternative. However, the cost and availability of water from new storage and conveyance facilities will depend on the alternative selected, the location of facilities proposed, and the amount of new water from each of these facilities. Therefore, the allocation of new water by region is uncertain.

Groundwater storage projects in the San Joaquin River Region could affect adjacent agricultural operations. Particularly in dry years, groundwater level declines could occur as a result of overpumping in storage facilities. In extreme cases, the use of wells on adjacent or nearby properties could be lost due to adverse groundwater quality or lower groundwater levels. Temporary loss of groundwater availability, or increased pumping costs, could result in adverse economic effects on neighboring agricultural lands. Groundwater storage facilities could provide a beneficial effect on neighboring agricultural operations, by ensuring that adequate supplies of groundwater are available and by reducing pumping costs in most years as groundwater levels remain higher.

7.1.7.6 OTHER SWP AND CVP SERVICE AREAS

Ecosystem Restoration, Water Quality, and Watershed Programs

No impacts on agricultural land and water use in the Other SWP and CVP Service Areas are associated with Ecosystem Restoration, Water Quality, or Watershed Program actions.

Water Use Efficiency Program

Indirect changes in land use in the Other SWP and CVP Service Areas may result from the Water Use Efficiency Program. Improved efficiency may allow the continued viability of agriculture in some areas, which will tend to maintain the existing uses of agricultural lands in some regions and reduce the amount that may go out of production or become urbanized. Efficiency improvements that result in greater water supply reliability but also in higher annual cost may cause a shift in the types of crops grown. Improvement in the long-term viability of some agricultural lands would be a potential beneficial impact.

Water Transfer Program

The Other SWP and CVP Service Areas would primarily be recipients of water transferred from the Sacramento River and San Joaquin River Regions. However, transfers of water within this region are possible. If such transfers occur, impacts would be similar to those described for the Sacramento River Region and would depend on whether a particular area is buying or selling water.

Storage

Potential direct impacts on agricultural land in the Other SWP and CVP Service Areas are not expected to be significant and have not been quantified because few agricultural areas would be directly affected by Storage element features. Agricultural water users in the region could receive some of the additional water supply developed by the Preferred Program Alternative. However, the cost and availability of water from new storage and conveyance facilities will depend on the alternative selected, the location of facilities proposed, and the amount of new water from each of these facilities. Therefore, the allocation of new water by region is uncertain.

7.1.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For agricultural land and water resources, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.1.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Delta Region

In the Delta Region, channel widening could require conversion of up to 4,500 acres of agricultural land. Adverse land use impacts of the modifications are considered potentially significant. To the extent that dredging reduces the amount of land that setback levees require, dredging could result in a lesser impact than setback levees but impacts would remain potentially significant. If dredged spoils are permanently disposed of on agricultural lands, a potentially significant adverse impact could result by converting farmland. Dredged materials will be analyzed, dredged, and handled in accordance with permit requirements. Permits will incorporate mitigation strategies identified in Section 5.3.11 to prevent release of contaminants of concern. Potentially significant impacts will be reduced to a less-than-significant level through these mitigation strategies.

Building the diversion facility from the Sacramento River to the Mokelumne River would result in a potentially significant and unavoidable adverse land use impact from permanent conversion of important farmlands.

Changes in project operations are not anticipated to adversely affect agricultural land and water use. Water supply is not expected to be affected in the Delta Region; therefore, impacts on agricultural land and water use resources associated with water supply are not anticipated in the region.

Bay Region

No impacts on agricultural land and water use are anticipated in the Bay Region from the Conveyance element.

Sacramento River Region

In the Sacramento River Region, some agricultural lands could be converted as a result of connector canals from new storage facilities to existing conveyance facilities. The amount of this conversion is not currently quantifiable but likely would result in a less-than-significant impact. Changes in project operations are not anticipated to adversely affect agricultural land and water use in the Sacramento River

Region. Water supply is not expected to be affected in the Sacramento River Region; therefore, impacts on agricultural land and water use resources associated with water supply are not likely.

San Joaquin River Region

Some agricultural lands in the San Joaquin River Region could be converted as the result of connector canals from new storage facilities to existing conveyance facilities. The amount of this conversion is not currently quantifiable but likely would result in a less-than-significant impact. Changes in project operations may affect agricultural land and water use in the San Joaquin River Region. Any increases in water supply caused by changes in the amount of water exported to the region could result in a beneficial effect, depending on the magnitude of the increase and its timing.

Other SWP and CVP Service Areas

Changes in project operations may affect agricultural land and water use. Any reductions in water supply caused by changes in the amount of water exported to the Other SWP and CVP Service Areas could result in a potentially significant adverse impact, depending on the magnitude of the reduction. Any increases in water supply reliability caused by changes in the amount of water exported to this region could result in a beneficial impact, depending on the magnitude of the increase.

7.1.8.2 ALTERNATIVE 1

Because Alternative 1 does not include a diversion facility on the Sacramento River or levee setbacks on the Mokelumne River, the amount of agricultural lands converted would be somewhat less than for the Preferred Program Alternative. Nevertheless, the impact on agricultural land use is considered potentially significant.

7.1.8.3 ALTERNATIVE 2

Impacts on agricultural land use under Alternative 2 would be similar to those described for the Preferred Program Alternative.

7.1.8.4 ALTERNATIVE 3

Impacts on agricultural land use under Alternative 3 would be slightly greater than those for the Preferred Program Alternative because of the additional impacts associated with construction of an isolated facility.

7.1.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

7.1.9.1 PREFERRED PROGRAM ALTERNATIVE

This section presents the comparison of the Preferred Program Alternative, and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were generally the same impacts as those identified in Sections 7.1.7 and 7.1.8, which compare the Program alternatives to the No Action Alternative. The only exception to this statement is that retirement of drainage-impaired lands, some of which are important farmlands, is contemplated in both the No Action Alternative and all the Program Alternatives. However, the Preferred Program Alternative could retire 37,000 acres, rather than the 45,000 acres that are of drainage-impaired lands contemplated under the No Action Alternative. Therefore, when compared to existing conditions, the Preferred Program Alternative would result in retirement of 37,000 more acres of agricultural land, resulting in a somewhat lesser impact associated with retirement of drainage-impaired lands than under the No Action Alternative.

The benefits to agricultural land and water resources would be greater water supply reliability, increased irrigation water quality, and increased protection of Delta agriculture from levee failure flooding under each of the alternatives (Preferred Program Alternative and Alternatives 1, 2, and 3) than under existing conditions. The overall benefits under each of these four alternatives is likely to be somewhat greater than the benefits to agricultural land and water resources under the No Action Alternative.

At the programmatic level, the comparison of Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative—again, except for the difference in the amount of drainage-impaired land retired.

The following potentially significant unavoidable impacts, as indicated by the **bold font**, are associated with the Preferred Program Alternative:

- **Conversion of prime, statewide important, and unique farmlands to project uses**
- **Conflicts with local government plans and policies**
- **Conflicts with adjacent land uses**

7.1.9.2 ALTERNATIVE 1

Impacts on agricultural land and water use under Alternative 1 compared to existing conditions would be similar to those described for the Preferred Program Alternative, without impacts associated with converting lands for the diversion facility on the Sacramento River.

7.1.9.3 ALTERNATIVE 2

Impacts on agricultural land and water use under Alternative 2 would be similar to those described for the Preferred Program Alternative.

7.1.9.4 ALTERNATIVE 3

Impacts on agricultural land and water use under Alternative 3, when compared to existing conditions, would be similar to those described for the Preferred Program Alternative, but somewhat greater than those for the Preferred Program Alternative because construction of an isolated facility would require converting larger amounts of agricultural land. The isolated conveyance facility also would tend to increase salinity over current conditions in the central Delta areas. This decrease in water quality could negatively affect agricultural water users in this area of the Delta, potentially reducing crop yields and crop flexibility.

7.1.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. If identified in the analysis, this section also presents any potentially significant adverse cumulative impacts that remain unavoidable regardless of efforts to avoid, reduce or mitigate them. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For agricultural land and water use, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.1.7 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate them. At the programmatic level of analysis, the impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level are noted on the list in **bold type**.

A long-term trend in the Program study area has been conversion of agricultural lands to other, primarily urban, uses. As an example, between 1994 and 1996, the five Delta counties lost 12,288 acres of prime, statewide important, and unique agricultural lands. Most of this loss occurred as a result of urbanization of farmland in and near cities in the five-county area. During this same 2-year period, 14,689 acres of agricultural lands in those five counties were committed, largely through the planning process, to future urbanization and nonagricultural uses. Statewide, between 1994 and 1996, over 55,000 acres of agricultural lands in these categories (for areas covered by the DOC's important farmland map series) have been converted, mostly to urban uses. Between 1993 and 1995, some 71,000 acres of Williamson Act-contracted lands were converted to public improve-ments statewide, of which about half were for habitat and other public open space uses. Mitigating these losses to some extent is the creation of new agricultural lands, in particular the creation of new unique farmland through the planting of grape vines in foothill and valley terrace areas. Urbanization of farmland in the Central Valley and foothill areas is expected to continue into the foreseeable future. Population projections for 2020 show California's population at 47.5 million, a substantial increase over the 1995 level of 32.1 million.

One study found that population in the Central Valley is expected to triple by 2040, putting tremendous pressure on agricultural lands. The study concluded that low-density urban development could consume more than 1 million acres of farmland by 2040. Even if more compact urban development occurred, over 474,000 acres of farmland still would be converted to urban uses. Another study that projected land use patterns based on population growth found that an additional 331,530 acres of urbanized land would be required (a 37% increase by 2005) if full development in the 12-county Bay-Delta region occurred, including affecting 39,511 acres of mostly farmed wetlands in the Delta.

Other water-related initiatives that are not part of the Program, such as the CVPIA, have reduced water availability to agriculture, potentially idling cropland or forcing a change to lower value crops (see Section 5.1 for a discussion of water supply reliability). Wildlife habitat projects outside or only partially within the Program, including the Yolo Basin Wildlife Area, the Stone Lakes NWR, and the proposed North Delta NWR, potentially could convert up to 51,000 additional acres of prime, statewide important, or unique farmland from agricultural production to habitat.

While many would argue that conversion of agricultural lands to habitat or other non-urban uses is preferable to agricultural loss from urbanization, cumulative impacts on agriculture in the project area—from the Program and other causes—are considered potentially significant. The maximum foreseeable loss over the 20- to 30-year span of the Program would total 243,000 acres of important farmland converted to Program uses. All the Program alternatives would contribute to the trend of agricultural land conversion, by creating wildlife habitat, larger levees, and water storage and conveyance facilities on lands in agricultural production.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The long-term productivity of agricultural lands used for levee, conveyance, or habitat purposes by the Program would be lost to agricultural production. In addition, some agricultural lands may be adversely affected by construction impacts in the short term. Many of the Program features, however, will enhance the long-term productivity of other agricultural lands in the state. Increases in irrigation water quality, water supply reliability, and efficient use, in addition to protection from levee failure, would tend to increase the productivity of farmland in the Program area.

Irreversible and Irretrievable Commitments. All Program alternatives would directly and indirectly convert prime, statewide important, and unique agricultural lands to conveyance, storage, levee, and habitat uses. This is an irreversible and irretrievable commitment of these resources.

7.1.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing. Avoidance, compensation, or minimization strategies could include:

- Siting and aligning Program features to avoid or minimize impacts on agriculture.
- Examining structural and nonstructural alternatives to achieving project goals to avoid impacts on agricultural land.
- Implementing features that are consistent with local and regional land use plans.
- Involving all affected parties, especially landowners and local communities, in developing appropriate configurations to achieve the optimal balance between resource impacts and benefits.
- Retaining water allocations from retired drainage-impaired lands within the existing water districts.
- Supporting the testing and application of alternative crops to idled farmland (for example, agroforestry or energy crops).
- Providing water supply reliability benefits to agricultural water users on an equitable basis.
- Supporting the California Farmland Conservancy Program in acquiring easements on agricultural land in order to prevent its conversion to urbanized uses and increase farm viability. Focusing on lands in proximity to where any conversion impact takes place.
- Restoring existing degraded habitat as a priority before converting agricultural land.
- Focusing habitat restoration efforts on developing new habitat on public lands before converting agricultural land.
- If public lands are not available for restoration efforts, focusing restoration efforts on acquiring lands that can meet ecosystem restoration goals from willing sellers where at least part of the reason to sell is an economic hardship (for example, lands that flood frequently or where levees are too expensive to maintain).
- Using farmer-initiated and developed restoration and conservation projects as a means of reaching Program goals.
- Where small parcels of land need to be acquired for waterside habitat, seeking out points of land on islands where the ratio of levee miles to acres farmed is high.
- Obtaining easements on existing agricultural land for minor changes in agricultural practices (such as flooding rice fields after harvest) which would increase the value of the agricultural crop(s) to wildlife.
- Including provisions in floodplain restoration efforts for compatible agricultural practices.
- Purchasing water for habitat purposes so that the same land or locality is not affected over the long term.
- Using a planned or phased habitat development approach in concert with adaptive management.

- Minimizing the amount of water supply required to sustain habitat restoration acreage.
- Developing buffers and other tangible support for remaining agricultural lands. Vegetation planted on these buffers should be compatible with farming and habitat objectives.
- In implementing levee reconstruction measures, working with landowners to establish levee reconstruction methods that avoid or minimize the use of agricultural land.
- Working with landowners to establish levee subsidence BMPs that avoid impacts on land use practices. Through adaptive management, further modify BMPs to reduce impacts on agricultural land.
- Implementing erosion control measures to the extent possible during and after project construction activities. These erosion control measures can include grading the site to avoid acceleration and concentration of overland flows, using silt fences or hay bales to trap sediment, and revegetating areas with native riparian plants and wet meadow grasses.
- Protecting exposed soils with mulches, geotextiles, and vegetative ground covers to the extent possible during and after project construction activities in order to minimize soil loss.
- Using rotational fallowing to reduce selenium drainage.
- Advising the Director of Conservation and the local governing body responsible for the administration of the preserve of a proposal, when it appears that land within an agricultural preserve may be acquired from a willing seller by a state CALFED agency for a public improvement as used in Government Code Section 51920.
- Limiting the number of acres that can be fallowed (in order to produce transferrable water) in a given area (district or county) or the amount of water that can be transferred from a given area.
- Supporting assistance programs to aid local entities in developing and implementing groundwater management programs in water transfer source areas.

7.1.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

Actions associated with the Ecosystem Restoration, Levee System Integrity, and Water Quality Programs, and the Storage and Conveyance elements could convert up to a maximum of 243,000 acres of existing prime, statewide important, and unique farmland to Program uses. The loss of agricultural lands in these categories cannot be fully mitigated and is considered potentially significant. Because no other category of land in the Program area is available and usable for Program projects, the loss of these agricultural lands is considered unavoidable. Also, conflicts with local government land use plans and policies would constitute a potentially significant impact that is considered unavoidable. Conflicts with adjacent land uses also would constitute a potentially significant unavoidable impact resulting from Program actions.

7.2 Agricultural Economics

The CALFED Bay-Delta Program may enhance or maintain agricultural revenues through increased water supply reliability, greater irrigation efficiency, and levee protection but may reduce agricultural income in local areas through farmland conversion and increased water prices.

7.2 Agricultural Economics

7.2.1 SUMMARY

Agriculture in the CALFED Bay-Delta Program (Program) area is an important portion of the economy. A total of 85% of the state's irrigated acres are in the Program area. The 39 counties in the Program area contribute 95% of California's agricultural production value, represent 9 of the top 10 agricultural production counties in the state, and include 7 of the top 10 agricultural production counties in the nation. Many towns, cities, counties, and special districts are supported by the revenues brought in by agriculture and its support industries, particularly in the Central Valley. Even while the state's agricultural sector is squeezed by ever-increasing population growth and water supply uncertainty, the agricultural economy has continued to grow.

Preferred Program Alternative. Several elements of the Preferred Program Alternative would provide protection and certainty to the agricultural economy. Increasing water supply reliability is one expected result of a successful Ecosystem Restoration Program. The Levee System Integrity Program would prevent levee breaches from flooding Delta islands, keeping lands in that region in production. The Water Use Efficiency Program can provide long-term savings and increased revenues to the agricultural economy. The Storage and Conveyance elements may provide additional water to agriculture in some areas. The magnitude and distribution of economic effects to agriculture will depend on the cost of this water. The Water Transfer Program can increase the opportunity for urban and agricultural users needing water to purchase it from willing sellers. Sellers are most likely to be existing agricultural users, resulting in water formerly used for agriculture to be exported for urban or agricultural use elsewhere, while increasing the economic well-being of the sellers.

Agricultural lands converted by Levee System Integrity and Ecosystem Restoration Program actions could result in adverse agricultural economic effects. Short-term adverse effects resulting from implementation of the Water Quality Program also could occur. The retirement of drainage-impaired lands under the Water Quality Program may cause adverse economic effects. Actions in the Storage and Conveyance elements could require the conversion of farmland, resulting in adverse effects on the agricultural economy.

Associated with any direct effects on the agricultural economy are the indirect effects, associated with the agricultural sector's purchase of goods and services in localized areas.

Alternatives 1, 2, and 3. Effects under any of the three alternatives would closely resemble those of the Preferred Program Alternative. Differences in effects among the alternatives would be minimal.

7.2.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Below is a brief description of areas of controversy for agricultural economics. Given the programmatic nature of this document, many of these areas of controversy cannot be addressed; however, subsequent project-specific environmental analysis will evaluate these topics in more detail.

Significance of Adverse Effects. It should be noted that CEQA does not treat social and economic effects as environmental impacts. CEQA requires a discussion of economic and social effects if they will lead to physical changes in the environment. NEPA requires a full discussion of social and economic consequences where they are related to a project that could cause significant environmental impacts.

Magnitude of Crop Effects. It has been suggested that estimates of direct effects on agricultural revenues were either too low (the analysis should have used average crop value or even high-revenue crops rather than lower revenue field crops) or too high (the analysis should have accounted for yield increases that come from improved irrigation management). These suggestions were included as comments from farm groups and environmental groups in the March 1998 CALFED Draft Programmatic EIS/EIR. Both possibilities have been recognized in the discussion of effects below, but quantitative estimates are presented for what are considered the most likely range of effects.

Projected Crop Mix. No Action Alternative assumptions regarding future agricultural crop mix and water use will remain in dispute. This analysis relies primarily on the assumptions in DWR's Bulletin 160-98.

Agricultural Multipliers. Various individuals have recommended the use of higher or different multipliers for agriculture ("multipliers" estimate how direct changes in agricultural production affect other sections of the economy, such as trucking, processing, and distribution). These recommendations were included as comments from a county agricultural commissioner and farm groups in the March 1998 CALFED Draft Programmatic EIS/EIR. Given the programmatic nature of this document and the uncertainty of where Program features will be located, it is not possible to use crop-specific multipliers, some of which may be higher than those used in the analysis. This document uses IMPLAN, the most widely used economic model, for agricultural multipliers. Results are described in Section 7.10, "Regional Economics."

The Program recognizes the importance of agricultural economics to regions potentially affected by Program actions. As a multi-billion dollar industry, agriculture and related industries are the bases of livelihood for many communities throughout the Central Valley and Bay-Delta. Although different user groups may disagree about the magnitude of regional economic effects related to agricultural activities, no one disputes its importance in the California economy. Subsequent project-specific environmental analyses will evaluate these effects in more detail.

7.2.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

California agriculture produces an abundance of products, including over 50% of the U.S. production of fruits, nuts, and vegetables on 3% of the nation's farmland. The economic value of agriculture to the communities of the Sacramento Valley, Delta, and San Joaquin Valley is greater than the gross value of the farm products (farm gate value) or the number of direct farm-related jobs. The agricultural industry can affect the local and regional economies in two ways. First, to produce and harvest a crop requires a variety of inputs, such as seed, fertilizer and chemicals, water, equipment and fuel, and labor. Then, after harvest, farm produce is transported, stored, processed, packaged, and marketed. These tasks result in direct economic activity. The second effect is the distribution of the income resulting from the initial direct economic activity. This income supports local and regional economies as this farm and farm-related income is spent for food, housing, and other consumer items. The economic multiplier depends on the commodity produced, its use of local labor and inputs, and the extent of value-added processing the commodity receives in the region. Section 7.10, "Regional Economics," presents estimates of regional effects from changes in farm production. As discussed above, these estimates are derived from IMPLAN.

Farm Profiles. Numbers and sizes of farms, together with ownership patterns, describe the general structure of agriculture in a region. A large number of farms can mean greater economic influences in the region in terms of employment, spending, and taxes. Ownership patterns can indicate the numbers of farm owners and managers who live within a region. Labor expenses are important to workers and the communities in which they live.

Table 7.2-1 shows a summary of farm profiles by region.

Cropping Patterns and Production Value. A cropping pattern is the share of acres in a region planted to individual crops or categories of crops, including fallowed land. Agricultural land use can be partially described by its cropping pattern, and cropping patterns are important to agricultural and regional economics.

Agricultural Production Costs and Revenues. Agricultural net returns are revenues less costs. Higher costs reduce farm profits, but some part of costs also represent farm expenditures in the regional economy. Revenues are unit price multiplied by the level of production. Table 7.2-2 includes regional summaries of production costs and revenues for example years 1987 and 1992.

(Note: As used in this discussion, the terms "agricultural sales," "gross revenue," "agricultural product value," and "production value" are synonymous. "Production costs" and "production expenses" also are synonymous.)

Table 7.2-1. Number of Farms, Farm Sizes, and Farm Ownership in All Regions, 1987 and 1992

		NUMBER AND SIZE			OWNERSHIP STATUS		
REGION	YEAR	NUMBER OF FARMS	LAND IN FARMS (1,000 acres)	AVERAGE FARM SIZE (acres)	FULL OWNERS	PART OWNERS	TENANTS
Delta	1987	4,033	962	238	2,817	691	529
	1992	3,639	900	247	2,525	628	487
Bay	1987	8,377	2,315	276	5,950	1,194	1,233
	1992	7,453	2,261	303	5,306	1,035	1,112
Sacramento River	1987	11,916	4,527	380	8,183	2,160	1,568
	1992	11,507	4,334	377	7,786	2,093	1,629
San Joaquin River	1987	28,742	10,095	351	20,942	4,610	3,730
	1992	26,731	9,656	361	9,144	4,420	3,168
Other SWP and CVP Service Areas	1987	21,281	6,279	295	16,744	1,837	2,700
	1992	19,899	5,488	276	16,063	1,639	2,197

Sources:
U.S. Census 1989 and 1994.

Table 7.2-2. Farm Income and Production Expense in All Regions, 1987 and 1992

		TOTAL FARM INCOME (million dollars)			TOTAL PRODUCTION EXPENSES (million dollars)					NET CASH RETURN (million dollars)
Region	Year	Agricultural Product Value	Other Revenue	Total	Livestock Related	Fertilizers and Chemicals	Hired and Contract Labor	Other	Total	
Delta	1987	496	12	508	81	38	97	169	385	123
	1992	590	10	600	89	48	128	209	474	126
Bay	1987	845	2	847	102	36	255	281	674	173
	1992	1,065	6	1,071	105	53	338	335	831	240
Sacramento River	1987	1,515	145	1,660	126	140	252	525	1,043	617
	1992	1,394	183	1,577	147	180	316	630	1,273	304
San Joaquin River	1987	6,565	222	6,787	1,276	531	1,337	2,197	5,341	1,446
	1992	8,089	308	8397	1,780	670	1,691	2,736	6,877	1,520
Other SWP and CVP Service Areas	1987	3,743	30	3,773	872	185	842	1,044	2,943	830
	1992	4,295	29	4,324	904	222	1,072	1,312	3,510	814

Sources:
U.S. Census 1989 and 1994.

7.2.3.1 DELTA REGION

Farm Profiles. Between 1944 and 1964, the number of farms in the Delta Region increased from 3,457 in 1944 to 4,502 in 1949, and then declined to 3,374 in 1964. The decline was due mainly to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the Delta Region increased from 58 acres in 1944 to 132 acres in 1964.

The number of farms in the Delta Region decreased from 4,033 in 1987 to 3,639 in 1992, partly due to loss of farmland (62,000 acres) to industrial and urban uses, and partly due to the accumulation of farmland into fewer and larger farms. The average farm size increased from 238 to 247 acres during this period. About 70% of farms in the Delta are operated by full owners.

Cropping Patterns and Production Value. Truck crops dominate Delta crop production, accounting for 30% of the region's total harvested acres. The next important group of crops in the region includes alfalfa, grains, and orchards, each accounting for 10-15% of the total crop acreage. Orchards and grapes together accounted for less than 20% of the total harvested acreage in the Delta between 1986 and 1995 but produced about 50% of the total production value, reflecting high crop values per acre. Alfalfa and field crops produced about 15% of total production value with more than 40% of the total harvested acres, indicating lower crop values per acre.

Agricultural Production Costs and Revenues. Agricultural net returns are revenues less costs. Higher costs reduce farm profits, but some part of costs also represent farm expenditures in the regional economy. Revenues are unit price multiplied by the level of production.

Farms in the Delta Region achieved $496 million in agricultural sales in 1987 and $590 million in 1992, as shown in Table 7.2-2. Production expenses were about $474 million in 1992, leaving a net cash return of $126 million. Hired and contract labor was the largest expense reported, accounting for 25% of total expenses.

7.2.3.2 BAY REGION

Farm Profiles. Between 1944 and 1964, the number of farms in the Bay Region increased from 5,581 in 1944 to 6,146 in 1954, then declined to 4,103 in 1964. This was partly due to the accumulation of irrigated land into fewer and larger farms, and also due to urban encroachment.

The number of farms in the Bay Region decreased from 8,377 in 1987 to 7,453 in 1992, partly due to loss of farmland (54,000 acres) to industrial and urban uses, and partly due to the accumulation of farmland into fewer and larger farms. The average farm size increased from 276 acres to 303 acres during this period. About 70% of farms in the Bay Region are operated by full owners.

Cropping Patterns and Production Value. Grapes are the dominant crop in the Bay Region, accounting for 30% of the region's total harvested acres. The next important group of crops in the region is sugar beets and truck crops, each accounting for about 20% of the total crop acreage. Between 1986 and 1995, grapes and orchards together accounted for less than 50% of the total harvested acreage but produced about 80% of the total production value, reflecting high crop values per acre. Alfalfa, grains, and field crops produced about 2% of total production value with more than 35% of total harvested acres, indicating lower crop values per acre.

Agricultural Production Costs and Revenues. Farms in the Bay Region achieved $845 million in agricultural sales in 1987 and $1,065 million in 1992, as shown in Table 7.2-2. Production expenses were about $831 million in 1992, leaving a net cash return of $240 million. Hired and contract labor was the largest expense reported, accounting for about 40% of total expenses; and this expense has been increasing over time.

Because both agricultural acreage and production are reported on a county basis, the San Felipe Division is included under the Bay Region in this section rather than under the Other SWP and CVP Service Areas.

7.2.3.3 SACRAMENTO RIVER REGION

Farm Profiles. Between 1944 and 1964, the number of farms in the Sacramento River Region increased from 9,948 in 1944 to 11,538 in 1954, then declined to 9,255 in 1964. This was mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 64 acres in 1944 to 138 acres in 1964.

The number of farms in the Sacramento River Region decreased from 11,916 in 1987 to 11,507 in 1992, primarily due to loss of farmland (193,000 acres) to industrial and urban uses. The average farm size remained about the same during this period. About 70% of farms are operated by full owners.

Cropping Patterns and Production Value. Rice is the number one crop in the Sacramento River Region, accounting for 26% of the region's total harvested acres. The next important group of crops in the region includes field crops (19%), orchards (15%), pasture (11%), and grains (10%). Between 1986 and 1995, orchards and tomatoes together accounted for less than 25% of the total harvested acreage in this region but produced about 50% of the total production value, reflecting high crop values per acre. Pasture, alfalfa, grains, and field crops produced less than 20% of total production value with more than 50% of total harvested acres, indicating lower crop values per acre.

Due to extensive re-use of water in the Sacramento Valley, substantial savings occur only from fallowing or through crop shifts. Decreased reliability constrains the conversion to high-value crops because of increased risk, particularly when groundwater is unavailable or of low quality. Instead, more lower value but drought-tolerant crops are planted.

Agricultural Production Costs and Revenues. Farms in the Sacramento River Region achieved $1,515 million in agricultural sales in 1987 and $1,349 million in 1992, as shown in Table 7.2-2. Production expenses were about $630 million in 1992, leaving a net cash return of $304 million. Hired and contract labor was the largest expense reported, accounting for about 25% of total expenses.

The region supports about 2,145,000 acres of irrigated agriculture. About 1,847,000 acres are irrigated on the valley floor; the surrounding mountain valleys in the region add about 298,000 irrigated acres (primarily pasture and alfalfa) to the region's total.

7.2.3.4 San Joaquin River Region

Farm Profiles. Between 1944 and 1964, the number of farms in the San Joaquin River Region increased from 30,212 in 1944 to 33,832 in 1949, then declined to 25,153 in 1964. This was mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 78 acres in 1944 to 155 acres in 1964.

The number of farms in the San Joaquin River Region decreased from 28,742 in 1987 to 26,731 in 1992, partly due to the loss of farmland (439,000 acres) to industrial and urban uses, and partly due to the accumulation of farmland into fewer and larger farms. The average farm size increased from 351 to 361 acres during this period. About 73% of farms are operated by full owners.

Cropping Patterns and Production Value. In terms of harvested acres, cotton is the number one crop in the San Joaquin River Region, accounting for 25% of the region's total harvested acres. The next important crops in the region are field crops (15%), orchards (13%), grapes (10%), and alfalfa (10%). Between 1986 and 1995, grapes and orchards together accounted for less than 25% of the total harvested acreage in this region but produced about 50% of the total production value, reflecting higher crop values per acre. Pasture, alfalfa, grains, and field crops produced less than 20% of total production value with more than 50% of total harvested acres, indicating lower crop values per acre.

Agricultural Production Costs and Revenues. Farms in the San Joaquin River Region achieved $6,565 million in agricultural sales in 1987 and $8,089 million in 1992, as shown in Table 7.2-2. Production expenses were about $2,736 million in 1992, leaving a net cash return of $1,520 million. Hired and contract labor was the largest expense reported, accounting for about 25% of total expenses.

7.2.3.5 Other SWP and CVP Service Areas

Farm Profiles. Between 1944 and 1964, the number of farms in the Other SWP and CVP Service Areas decreased from 33,715 in 1944 to 13,603 in 1964, mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 30 acres in 1944 to 82 acres in 1964.

The number of farms in the region decreased from 21,281 in 1987 to 19,899 in 1992, primarily due to the loss of farmland (791,000 acres) to industrial and urban uses. The average farm size decreased from 295 to 276 acres during this period.

Cropping Patterns and Production Value. In terms of harvested acres, alfalfa is the number one crop in the Other SWP and CVP Service Areas, accounting for 28% of the region's total harvested acres. The next important crops in the region are pasture (12%), subtropical orchards (11%), field crops (10%), and grains (10%). Between 1986 and 1995, truck crops and orchards together accounted for less than 30% of the total harvested acreage in the region but produced about 70% of the total production value, reflecting higher crop values per acre. Pasture, alfalfa, grains, and field crops produced less than 15% of total production value with more than 50% of the total harvested acres, indicating lower crop values per acre.

Agricultural Production Costs and Revenues. Farms in the Other SWP and CVP Service Areas achieved $3,743 million in agricultural sales in 1987 and $4,295 million in 1992, as shown in Table 7.2-2. Production expenses were about $3,510 million in 1992, leaving a net cash return of $814 million. Hired and contract labor was the largest expense reported, accounting for about 30% of total expenses.

Moderate levels of irrigated agriculture are located in the Mojave River, Antelope, and Indian Wells Valleys. Most of the acreage produces alfalfa, pasture, or deciduous fruit. About one-half (30,000 acres) of the entire region's irrigated crop land is estimated to lie in the SWP service area.

Prominent agricultural crops in the southern portion of San Bernardino County, the middle portion of Riverside County, and the Salton Sea in Imperial County include alfalfa, winter vegetables, melons, grapes, dates, and wheat.

7.2.4 ASSESSMENT METHODS

Assessment variables for agricultural economic effects include irrigated acres, agricultural water and land use, water quality, costs and revenues from agricultural production, and risk and uncertainty. Potential effects are quantified based on existing estimates of land and water value, crop revenue per acre, and costs. Land and water use impacts are described in Section 7.1, "Agricultural Land and Water Use." All of the potential effects described in this section are based on review of and experience with other studies.

Water supply changes, land conversion, and costs were estimated using existing policy-level models, such as the Central Valley Production Model, and by interpolating or extrapolating estimates for other studies.

Counties in the Delta Region would bear many of the economic effects of conversion of agricultural land to other uses. These counties also would benefit from levee improvements and other construction activity. Due to the programmatic nature of this EIS/EIR, county-level detail and quantification are not possible or appropriate. Effects are summarized below in Section 7.2.7 for several regions, one of which is the Delta Region.

Table 7.2-3 shows the threshold and rate of decline due to salinity for major categories of crops grown in the Delta. For this analysis, an effective leaching fraction of 15% was used to convert between changes in applied water salinity and the resulting change in soil water salinity.

7.2.5 CRITERIA FOR DETERMINING ADVERSE EFFECTS

Criteria used to evaluate the adverse effects of the Program are listed below. The following results of Program actions are considered adverse effects:

- Permanent or long-term reduction in acres of irrigated land in a region.
- A change in water quality that would reduce crop yields.
- Changes in costs or revenues that change the economics of farming to an extent that land use, water use, or employment could be affected.

Table 7.2-3. Major Crops in the Delta Region and Corresponding Threshold Salinity Level

CROP CATEGORY	IRRIGATED ACRES (1,000 acres)	THRESHOLD SALINITY LEVEL (ECe)*	PERCENT YIELD DECREASE FROM THE THRESHOLD (%)
Pasture	37	5.0	10.0
Rice	11	3.0	12.0
Truck crops	28	1.5	14.0
Tomatoes	45	2.5	9.9
Alfalfa	65	2.0	7.3
Sugar beets	15	7.0	5.9
Field crops	151	1.7	15.0
Orchards	61	1.5	12.0
Grains	60	6.0	7.1
Grapes	36	1.5	19.0

*The salinity of the soil saturation extract is expressed as ECe, which is the electrical conductivity (in μmhos/cm).

Sources:

- Irrigated acreage is from Affected Environment and Environmental Impacts: Agricultural Production and Economics, CALFED Bay-Delta Program, September 1997.
- Maas-Hoffman coefficients are described in United Nations, Food and Agriculture Organization Irrigation and Drainage Paper 29, "Water Quality For Agriculture," 1976.

7.2.6 NO ACTION ALTERNATIVE

The predominant issues that would affect future agricultural economic conditions under the No Action Alternative include changes in the markets for agricultural products, the supply and reliability of irrigation water, changes in water quality, development of water transfer markets, the cost of water, and conversion of farmland.

- *Changes in the agricultural market* - Demand for fruits and vegetables will increase, resulting in a shift away from field crops and grain production (see the California Water Plan Update [DWR 1994]).

- *Irrigation water supply* - Several important changes have occurred to water supply conditions for agriculture. The CVPIA allocates up to 800 TAF of CVP water per year for environmental restoration. Likewise, the 1994 Bay-Delta Accord reduces the amount of water pumped from the Delta and delivered for agricultural and municipal uses. Estimates by Reclamation in 1997 of the average annual effect of the CVPIA on agricultural production value range from $76 to $151 million lost.

- *Water quality* - Reasonably foreseeable changes in water management are expected to affect water quality and thereby will affect agricultural yields. DWR has predicted retirement of up to 45,000 acres of drainage-impaired lands in the San Joaquin Valley, which would result in an adverse economic effect. However, the elimination of runoff from these acres would result in improved downstream water quality in the San Joaquin River and Delta Regions, potentially improving crop selection options and yields.

- *Water transfers* - The use of water transfers likely will increase in the future; however, water transfers have not been assessed quantitatively in this report due to the uncertainty and speculation involved. These transfers have the potential to cause adverse economic effects in agricultural areas transferring water and beneficial economic effects in agricultural areas receiving transferred water.

- *Cost of water* - Implementing cost-of-service and tiered water pricing, plus the restoration charges and surcharges imposed by the CVPIA, will increase the cost of irrigation water.

- *Conversion of farmland* - The continued trend of agricultural land conversion, particularly to urban purposes but also to habitat, will result in decreased agricultural production.

- *Levee failures* - The likelihood of levee failures in the Delta may result in a short- or long-term loss of agricultural production on affected Delta islands. In addition, water quality impacts associated with levee failures may negatively affect crop production within the export areas.

7.2.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For agricultural economics, the consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer and Watershed Programs, and Storage element are similar under all Program alternatives, as described below. The consequences of the Conveyance element vary among Program alternatives, as described in Section 7.2.8.

7.2.7.1 DELTA REGION

Ecosystem Restoration Program

The Ecosystem Restoration Program primarily would affect agricultural economics in the Delta Region by taking agricultural land out of production. Section 4.3 in Chapter 4 contains a description of the potential acreages of agricultural lands that would be affected by the Program. The crops removed could range from a mix of field and forage crops (corn, grain, and pasture) to high-value orchards. The agricultural land would be purchased at a negotiated fair market value, which would reduce the economic hardship on local farmers. It is expected that gross revenue losses would range from $500 to $1,500 per acre on average for the region, depending on the ultimate locations of agricultural land conversions. These effects are estimated to result in a gross revenue loss of $56-$167 million per year. This loss would result in the subsequent loss of agriculturally related economic activity in other sectors of the economy, such as farm equipment suppliers, trucking, processing, and packing. The indirect economic losses to agricultural support sectors also could affect neighboring regions. The adverse effects could be substantial.

The Ecosystem Restoration Program also includes a program to provide incentives for more wildlife-friendly agricultural practices. The program could affect up to 75,000 acres of cropland in the Delta, and would encourage off-season flooding of lands for waterfowl habitat, modifying tillage practices, and leaving a portion of grain and cover crops unharvested. Direct costs to growers would be compensated. Economic effects to farm workers and related industries could result from reduced harvested yields, but these effects are expected to be small.

Possible methods to alleviate adverse economic effects could include:

- Providing technical assistance to growers on ways to increase the production yielded from a unit of water (through measures such as improvement in distribution uniformity), which will tend to keep production up even as acreage goes down.

- Developing rules for restoration and land conversion that recognize and protect the agricultural productivity of surrounding lands. Issues addressed could include control of rodents and other pests, seepage and salinity control, and public access restrictions.

- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction.

- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.

- Compensating property owners for the value of their land and associated improvements.

- Supporting growers interested in implementing value-added programs on their land (for example, hunting and birdwatching).

Losses could be much greater if substantial amounts of orchard, vineyard, and vegetable land are converted. Gross revenue losses would exceed $2,000 per acre on such lands. Some of this acreage and revenue likely would shift to other regions of the state, placing more demand on existing surface water and groundwater resources in those regions. The loss of farmland may adversely affect the financial viability of local agencies, especially water and reclamation districts.

Additional flows entering the Delta as part of the Ecosystem Restoration Program could improve the quality of water diverted for agricultural use. Benefits could include improved yields of salt-sensitive crops, reduced water application and management costs, and greater flexibility in crop selection.

As described above, the Ecosystem Restoration Program also calls for use of cooperatively managed lands in the Delta (lands that are managed to provide wildlife benefits as well as crop benefits). Because these programs provide compensation to landowners, often require labor needs beyond normal agricultural practices, and may increase income to landowners through hunter-related and other fees, cooperative management may result in local economic benefits.

Water Quality Program

Control of upstream drain water quality and quantity from Water Quality Program actions could reduce the salinity of water diverted in the Delta for irrigation. Benefits could include reduced costs, higher yields, and more flexible crop selection. Water quality BMPs, if applied to Delta agriculture, could raise production costs.

Levee System Integrity Program

The Levee System Integrity Program would benefit Delta agriculture by providing greater protection from inundation and salinity intrusion. Setback levees could require purchasing and converting up to 35,000 acres of important farmland. The value of crops taken out of production could range from $18 to $53 million per year. This loss may be offset by lower flood risks to remaining agricultural lands.

Possible methods to alleviate this adverse effect could include:

- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction. Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.

- Compensating property owners for the value of their land and associated improvements.

Additionally, the loss of farmland may adversely affect the financial viability of local agencies, especially water and reclamation districts.

Water Use Efficiency Program

Water Use Efficiency actions may increase farm capital, operations, or maintenance costs. Many of these practices, however, also would increase net farm income due to increased crop yield or quality, or by reducing the need for other production inputs. The Water Use Efficiency incentive program would provide funding for practices that provide Program benefits but are not profitable for growers. (For example, efficiency measures that may result in statewide benefits but are locally not cost effective.) Economic benefits could accrue from increased water use efficiency in terms of reduced water costs, increasing the economic output of some farming operations.

Water Transfer Program

No effects on agricultural economics in the Delta Region are anticipated from Water Transfer Program actions.

Watershed Program

No effects on agricultural economics in the Delta Region are anticipated from Watershed Program actions.

Storage

Some Delta agricultural lands, including up to 15,000 acres of important farmland, could be converted to provide in-Delta storage. The value of crops taken out of production could range from $8 to $23 million per year. Some additional water supply may become available to Delta users as a result of new storage, but the amount is expected to be small. Water quality improvements made possible by releases from storage could benefit Delta agriculture. Potential charges imposed on agricultural water use to recover costs of Storage components could lead to changes in agricultural activities (such as crop selection and water use).

Possible methods to alleviate this adverse effect could include:

- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction.
- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.
- Compensating property owners for the value of their land and associated improvements.

7.2.7.2 BAY REGION

Ecosystem Restoration Program

Effects from Ecosystem Restoration Program actions on agricultural economics in the Bay Region are expected to be minor.

Water Quality and Water Use Efficiency Programs

To the extent that they apply to areas nontributary to the Delta, BMPs under the Water Quality Program could increase production costs. Incentives provided under the Water Use Efficiency Program could induce expenditures to improve or upgrade irrigation systems. The increased net cost to growers would be offset by cost sharing or other incentive program.

Levee System Integrity and Watershed Programs

No effects on agricultural economics are anticipated in the Bay Region from Levee System Integrity and Watershed Program actions.

Water Transfer Program

Because of the water supply deficiencies in some agricultural areas, water transfers may be an important future source of water in the Bay Region. The region is more likely to be a recipient than a source of water transfers. Agricultural areas in Santa Clara and San Benito Counties, for example, are subject to reductions in CVP supply, yet have relatively high willingness to pay for transferred water (Draft CVPIA PEIS 1997).

Storage

Some additional water supply could become available in the Bay Region. Potential charges imposed on agricultural water use to recover costs of program components could lead to changes in agricultural activities (such as crop selection and water use).

7.2.7.3 SACRAMENTO RIVER REGION

Ecosystem Restoration Program

The Ecosystem Restoration Program would convert productive farmland in the Sacramento River Region for habitat restoration. The crop revenue loss associated with removing these lands from production generally ranges from $500 to $1,500 per acre, resulting in a regional loss in crop revenue of between $17 and $51 million per year in the Sacramento River Region. This loss would result in a substantial adverse economic effect on farm revenues, income generation, and employment levels. Loss of production also may adversely affect the financial viability of local agencies, especially water and reclamation districts. Losses per acre could exceed $2,000 if particular orchard lands are converted for restoration purposes.

Up to 25,000 acres of the 34,000 acres of existing agricultural land that could be converted by the Ecosystem Restoration Program fall within the floodplain formed by stream meanders and setback levees. Field crops, such as rice, grains, corn, and oil seeds, could be grown on these lands. Orchards, in particular, cannot survive the periodic inundation in these areas; therefore the program would need to compensate for the conversion of existing orchard lands. Average revenue generated by orchards in the region ranges up to $1,500 per acre. Compensation would need to cover losses in net revenue and investment. Reductions in employment associated with production, packing, and processing of orchard crops are potentially substantial. However, Section 7.1.7.4 includes these 25,000 acres as converted from agricultural uses completely, not as lands converted to a lower agricultural use. Thus, the economic effect of losing those lands is included in the numbers above. Planting some of that acreage back to field crops would be a mitigation strategy that could reduce the adverse effects noted in Section 7.2.7.3.

The Ecosystem Restoration Program also includes a program to provide incentives for more wildlife-friendly agricultural practices. The program could affect up to 300,000 acres of cropland in the Sacramento Valley, and would encourage off-season flooding of lands for waterfowl habitat, modifying tillage practices, and leaving a portion of grain and cover crops unharvested. Rice, other small grains, corn, and pasture are the crops most likely to be affected. An additional 5,000 acres of non-irrigated grazing land also would be enhanced for wildlife habitat. Direct costs to growers and ranchers would be compensated. Economic effects on farm workers and related industries could result from reduced harvest yields. Effects on individual farms would be minor but, in aggregate, the effects may be substantial. Reduced yields on participating rice land also could induce growers to plant additional lower-value-crop acreage to rice in order to make up the lost yield.

Possible methods to alleviate these adverse effects could include:

- Developing rules for restoration and land conversion that recognize and protect the agricultural productivity of surrounding lands. Issues addressed could include control of rodents and other pests, seepage and salinity control, and public access restrictions.
- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction.
- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.
- Compensating property owners for the value of their land and associated improvements.
- Supporting growers interested in implementing value-added programs on their land (for example, hunting and birdwatching).
- Planting lands to field crops within stream meander areas.

Changes in the quantity or pattern of in-stream flow could affect downstream agricultural users and could result in adverse economic effects.

Possible methods to alleviate these adverse effects could include:

- Developing water transfer rules that protect groundwater users, downstream diverters, and other potentially affected agricultural producers.

Water Quality Program

BMPs for the Water Quality Program could lead to beneficial and adverse effects in land and water use patterns. Adverse effects more likely would result from increased production costs. Beneficial effects include reduced salinity of irrigation water, which could increase yields, reduce production costs, and provide more flexible crop selection.

Possible methods to alleviate these adverse effects could include:

- Providing incentives and technical expertise to landowners interested in establishing higher-value crops.
- Providing cost-sharing and other financial assistance to reduce the effects potentially resulting from the implementation of the Water Use Efficiency and Water Quality Programs.
- Providing technical assistance to growers on ways to increase the production yielded from a unit of water (through measures such as improvement in distribution uniformity), which will tend to keep production up even as acreage goes down.

Levee System Integrity Program

No effects on agricultural economics are anticipated in the Sacramento River Region from the Levee System Integrity Program.

Water Use Efficiency Program

Effects on agricultural economics in the Sacramento River Region from the water use efficiency program would be similar to those noted above for the Delta Region.

Water Transfer Program

Water transfers would result in beneficial or adverse effects in the Sacramento River Region, depending on the timing, magnitude, and pathway of each transfer. Reduced pumping costs for areas receiving a water transfer could occur. Water transfers based on direct groundwater pumping or groundwater substitution could cause a temporary or permanent increase in groundwater pumping. Increased costs associated with groundwater overdraft include pumping from lowered groundwater levels, deepening wells, lowering pumps, and redrilling wells. These increased operating costs could reduce irrigated acreage at nearby farms that are not transferring water. Direct groundwater and groundwater substitution transfers also could reduce surface water flows due to induced seepage; reduce crop yields due to lower water quality; reduce demand for crop storage and processing; reduce demand for farm inputs; lower ground elevations, increasing the risk of flooding in affected areas; and reduce habitat supported by surface seepage of groundwater. Adverse effects on agricultural economics can be minimized using reduction strategies. Beneficial effects from water transfers include revenues to fund irrigation equipment and technology or to offset the costs of increased groundwater pumping.

Any reductions in water supply caused by changes in the amount of water exported from the Sacramento River Region could reduce agricultural production and result in an adverse effect, depending on the magnitude of the reduction. Reductions in agricultural production also could adversely affect related agricultural industries and cause third-party effects on local rural economics. Strategies may be available to reduce the adverse economic effects.

Surface water transfers can affect the quantity, timing, and quality of water available to downstream users. For example, irrigation water diverted from the Colusa Basin Drain in the Sacramento Valley is primarily return flow from other irrigated lands. Water transferred from the upstream lands, unless restricted to only crop consumptive use, would reduce water available for others. Strategies may be available to reduce this adverse effect.

Possible methods to alleviate these adverse effects could include:

- Developing water transfer rules that protect groundwater users, downstream diverters, and other potentially affected agricultural producers.
- Providing technical assistance to growers on ways to increase the production yielded from a unit of water (through measures such as improvement in distribution uniformity), which will tend to keep production up even as acreage goes down.
- Supporting a mitigation or compensation fund for those who incur higher groundwater costs as a result of transfer or restrictions on direct groundwater or groundwater substitution transfers (accompanied by a limit on groundwater drawdowns and a local groundwater monitoring program).

In addition, the criteria and objectives in the Water Transfer Program, in conjunction with existing legal constraints on water transfers, will protect against adverse socioeconomic effects due to water transfers (see Chapter 4 in the Water Transfer Program Plan).

Watershed Program

Implementation of upper watershed enhancements in the Sacramento River Region would restore riparian habitat, stabilize stream channels, restore natural stream hydrology, and create a nonpoint source pollution buffer. These actions also could result in short- or long-term conversion of upper watershed grazing lands that are adjacent to waterways. Conversion of land could reduce agricultural revenues and employment, and could adversely affect local government revenues and services. Any such economic effects of the Watershed Program in the Sacramento River Region would be minor.

Possible methods to alleviate the adverse effect could include:

- Compensating property owners for the value of their land and associated improvements.

Storage

Agricultural lands in the Sacramento River Region could be affected by the location of storage facilities. Potential reservoir sites are in foothill or mountain areas, where land use is largely non-irrigated grazing. Some irrigated lands may exist in the valleys potentially to be inundated, with pasture, hay, and grains the predominant crops. Effects include permanent conversion and inundation, and temporary disruption of agricultural activity during construction. Permanent conversion of farmland for facilities would result in an adverse economic effect. Potential charges imposed on agricultural water use to recover costs of Storage components could lead to changes in agricultural activities (such as crop selection and water use).

Economic effects in the Sacramento River Region from improvements in water supply reliability would be minor.

Potential beneficiaries of additional supply in the Sacramento River Region primarily would be CVP contractors, who would use the water to replace groundwater or supply lost from the CVPIA. According to an analysis completed for the CVPIA, the direct value of this water to agriculture ranges from $30 to $40 per acre-foot per year. Potential charges imposed on agricultural water use to recover costs of the Storage component could lead to changes in agricultural activities (such as crop selection and water use).

7.2.7.4 SAN JOAQUIN RIVER REGION

Ecosystem Restoration Program

The Ecosystem Restoration Program would convert productive farmland in the San Joaquin River Region for habitat restoration. The crop revenue loss associated with removing these lands from production generally ranges from $500 to $1,500 per acre, resulting in a regional loss in crop revenue of between $3 and $9 million per year in the San Joaquin River Region. This loss would result in an adverse economic effect on farm revenues, income generation, and employment levels. Loss of production also may adversely affect the financial viability of local agencies, especially water and reclamation districts. Losses per acre could exceed $2,000 if particular orchard, vineyard, or vegetable lands are converted for restoration purposes.

The Ecosystem Restoration Program also includes a program to provide incentives for more wildlife-friendly agricultural practices. The program could affect up to 15,300 acres of cropland in the San Joaquin River basin, and would encourage off-season flooding of lands for waterfowl habitat, modifying tillage practices, and leaving a portion of grain and cover crops unharvested. Direct costs to growers would be compensated. Economic effects to farm workers and related industries could result from reduced harvested yields, but these effects are expected to be small.

Possible methods to alleviate adverse effects could include:

- Developing rules for restoration and land conversion that recognize and protect the agricultural productivity of surrounding lands. Issues addressed could include control of rodents and other pests, seepage and salinity control, and public access restrictions.

- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction.

- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.

- Compensating property owners for the value of their land and associated improvements.

- Supporting growers interested in implementing value-added programs on their land (for example, hunting and birdwatching).

Changes in the quantity or pattern of in-stream flow could affect downstream agricultural users and could result in adverse effects.

Possible methods to alleviate these adverse effects could include:

- Developing water transfer rules that protect groundwater users, downstream diverters, and other potentially affected agricultural producers.

- Providing technical assistance to growers on ways to increase the production yielded from a unit of water (through measures such as improvement in distribution uniformity), which will tend to keep production up even as acreage goes down.

Water Quality Program

BMPs for the Water Quality Program could lead to beneficial and adverse effects on land and water use patterns. Adverse effects most likely would result from increased production costs. Beneficial effects include reduced salinity of irrigation water, which could increase yields, reduce production costs, and provide more flexible crop selection. Table 7.2-3 summarizes the sensitivity of different crops to irrigation water salinity. Improvements in the salinity of water delivered to agricultural users can reduce the amount of water needed for leaching. As a result, less drain water is produced, and less salt is added to the soil and groundwater.

More carefully monitored application of water can result in increased yields and reduced chemical costs, irrespective of salinity. Lower applied water amounts could adversely affect drain water users (forcing them to search for another source of supply), raise groundwater pumping lifts, and impair groundwater storage for conjunctive use.

Possible methods to alleviate these adverse effects could include:

- Providing incentives and technical expertise to landowners interested in establishing higher-value crops.

- Providing cost-sharing and other financial assistance to reduce the effects potentially resulting from the implementation of the Water Use Efficiency and Water Quality Programs.

- Strengthening incentives for long-term agricultural zoning.

Retirement of lands with water quality problems in the San Joaquin River Region would result in adverse effects on agricultural jobs. This action could result in crop value losses of between $18.5 and $56 million per year in the region, using crop values of $500-$1,500 per acre. Economic sectors dependent on agricultural production also would be affected by losses.

Possible methods to alleviate these adverse effects could include:

- Providing technical assistance to growers on ways to increase the production yielded from a unit of water (through measures such as improvement in distribution uniformity), which will tend to keep production up even as acreage goes down.

- Providing assistance to reduce potential effects from implementation of the Water Use Efficiency and Water Quality Programs.

- Avoiding fallowing or shifting crops that require high input and output expenditures.

Improvements in water quality delivered to the San Joaquin Valley potentially could enhance crop selection, water management, and yields; improvements also could result in beneficial effects on agricultural economics in the San Joaquin River Region.

Levee System Integrity Program

Protection from salt-water contamination of delivered irrigation water supplies from implementation of the Levee System Integrity Program could benefit the San Joaquin River Region. DWR has forecast continuing Delta island levee failures unless these levees are repaired and strengthened. When levees around Delta islands fail, salt water from the Bay tends to flow toward the break and into the Delta. Since much of the irrigation water for the San Joaquin River Region is pumped from the Delta, the increased salt content due to a levee break would increase the salinity of irrigation water. The Levee System Integrity Program would strengthen and improve Delta island levees, making breaks and failures less likely.

Water Use Efficiency and Watershed Programs

Effects on agricultural economics in the San Joaquin River Region for the Water Use Efficiency and Watershed Programs would be similar to those described for the Delta Region.

Water Transfer Program

The Water Transfer Program could result in beneficial effects in the San Joaquin River Region. These benefits likely would occur from the transfer of water into the region that would replace or supplement other supplies. For instance, if contractual supplies are not available due to a drought, water transfers would act as a replacement source. The cost to transfer water into the region may increase operating costs but probably would be implemented only if the transfer is cost effective for the buyer.

In some instances, the San Joaquin River Region would be a source for water transfers. These transfers most likely would be based on surface or subsurface (groundwater) storage programs but may include land fallowing, conservation, and crop modification. As a source area, effects on agricultural economics from water transfers would be similar to those described for the Sacramento River Region.

Storage

Agricultural lands in the San Joaquin River Region could be affected by the location of storage facilities. Large storage facilities probably would be located in foothill or mountain areas, where land use is largely non-irrigated grazing. Some irrigated lands may exist in the valleys potentially to be inundated, with pasture, hay, and grains the predominant crops. Effects include permanent conversion and inundation, and temporary disruption of agricultural activity during construction. Permanent conversion of farmland for facilities could cause adverse economic effects.

Possible methods to alleviate these adverse effects could include:

- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.

- Compensating property owners for the value of their land and associated improvements.

Much of the additional water from new storage in the San Joaquin River Region would be used to reduce groundwater overdraft, to increase in-stream flows, and to support production of lands fallowed by supply restrictions of the CVPIA and Bay-Delta Accord. The value of this water for agricultural production is $60-$100 per acre-foot. Some of this water could support acreage shifted out of the Delta Region because of land conversion. Potential charges imposed on agricultural water use to recover costs of Storage components could lead to changes in agricultural activities (such as crop selection and water use).

The effects of new water supply from the Storage Program depends on the scale of the storage and conveyance facilities, the allocation of available water among users, and the cost of the water. Because quantities and effects depend on conveyance configurations, effects are further discussed below in Section 7.2.8. Potential charges imposed on agricultural water use to recover costs of the Storage component could lead to changes in agricultural activities (such as crop selection and water use).

7.2.7.5 Other SWP and CVP Service Areas

Ecosystem Restoration Program

Substantial conversion of agricultural land in the Delta Region could shift some production to desert areas in southern California, such as the Imperial Valley.

Water Quality Program

Potential cost effects from the Water Quality Program may occur if BMPs are applied to areas outside the Central Valley.

Levee System Integrity Program

Benefits of the Levee System Integrity Program in avoiding salinity intrusion would accrue to the Other SWP and CVP Service Areas. DWR has forecast continuing Delta island levee failures unless these levees are repaired and strengthened. When levees around Delta islands fail, salt water from the Bay tends to flow toward the break and into the Delta. Since much of the irrigation water for the Other SWP and CVP Service Areas is pumped from the Delta, the increased salt content due to a levee break would increase the salinity of irrigation water. The Levee System Integrity Program would strengthen and improve Delta island levees, making breaks and failures less likely.

Water Use Efficiency Program

Economic benefits could accrue from increased water use efficiency in terms of reduced water costs, increasing the economic output of some farming operations. Efficiency improvements that result in greater water supply reliability but also higher annual costs may facilitate a shift to higher value crops that justify the increased irrigation costs.

Water Transfer Program

Potential benefits from the Water Transfer Program could include increased agricultural production, income, and employment opportunities associated with any transfer that uses the water for agricultural production outside the Central Valley.

Watershed Program

No effects on agricultural economics in the Other SWP and CVP Service Areas are anticipated from Watershed Program actions.

Storage

Additional water may be available to SWP contractors in the South Coast and Central Coast areas, depending on changes in storage, conveyance, and operations. It is unlikely, however, that substantial amounts of this water would be delivered for irrigation use.

Relatively little SWP water pumped into southern California is used for irrigation, and a portion of the water is mixed with other local water sources. The aggregate effect on agriculture in these areas is potentially beneficial. Potential charges imposed on agricultural water use to recover costs of Storage components could lead to changes in agricultural activities (such as crop selection and water use).

7.2.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For agricultural economics, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.2.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Conveyance facilities could require conversion of agricultural land that produces crop revenues of between $5 and $15 million per year. Setback levees would require purchasing and converting agricultural land and losing the value of crops taken out of production. To the extent that dredging reduces the amount of land that setback levees require, dredging could result in a lesser effect by causing less crop damage. Loss of this revenue is considered an adverse economic effect. In addition to conveyance facilities, the Preferred Program Alternative may include in-Delta storage. These conveyance and storage facilities would require conversion of agricultural land producing crop revenue of between $8 and $23 million per year. Effects on farm employment, agricultural suppliers, and other economic sectors are described in Section 7.3, "Agricultural Social Issues." Effects of water supply increases in the Delta Region would be small.

Agricultural lands in the Sacramento River and San Joaquin River Regions could be adversely affected by the location of new connector canals that would connect new storage facilities to existing conveyance facilities.

Changes in project operations are not anticipated to substantially affect agricultural land and water use in the Delta Region, Sacramento River Region, Bay Region, or Other SWP and CVP Areas. Changes in project operations may affect agricultural economics in the San Joaquin River Region. The effect could be positive or negative, depending on whether these changes would increase or reduce water diverted for agricultural use.

Potential charges imposed on agricultural water use to recover costs of Program components could lead to changes in agricultural activities (such as crop selection and water use).

Possible methods to alleviate these adverse effects could include:

- Strengthening tax and other incentives for long-term agricultural zoning.
- Scheduling construction activities in such a manner that current crops may be harvested prior to initiating construction.
- Paying fair market value for any crops destroyed or taken out of production on private or leased lands during project construction.
- Compensating property owners for the value of their land and associated improvements.

Agricultural water supply effects would vary by alternative, based on differences in the configuration and operation of conveyance. Most additional agricultural supply would be available for irrigation in the San Joaquin River Region, with smaller amounts delivered to the Sacramento River, Bay Region, and Other SWP and CVP Service Areas.

If new supply was offered at prices comparable to existing SWP and CVP contract rates, demand for irrigation would range between 0.5 and 1.5 MAF over the long-term average, and up to 2.2 MAF in dry and critical years. Under the No Action Alternative, substantial groundwater overdraft occurs, and economic analysis indicates that most of any new supply would directly or indirectly replace groundwater pumping (that is, reduce the overdraft). Some of this water also could support the shift of crops out of the Delta Region.

If the new supply was offered to users at prices substantially more than the cost of pumping groundwater or more than its value in crop production, little of the new supply is likely to be used for irrigation. Potential new irrigation supply under the Preferred Program Alternative with storage would range up to about 710 TAF over the long-term average and about 920 TAF in dry and critical years.

7.2.8.2 Alternative 1

Agricultural economic effects under Alternative 1 associated with the Conveyance element would be similar to those described for the Preferred Program Alternative, without the diversion facility on the Sacramento River. Consequently, the amount of agricultural land and crop value lost in the Delta Region would be less than for the Preferred Program Alternative. Nevertheless, the loss of land and crops under Alternative 1 would cause adverse economic effects similar to those described for the Preferred Program Alternative. Possible methods to alleviate the effects also would be similar.

Potential new irrigation supply under Alternative 1 with storage would range up to about 700 TAF over the long-term average and up to about 930 TAF in dry and critical years.

7.2.8.3 Alternative 2

Agricultural economic effects under Alternative 2 would be similar to those described for the Preferred Program Alternative.

Potential new irrigation supply under Alternative 2 with storage would range up to about 650 TAF over the long-term average and about 890 TAF in dry and critical years.

7.2.8.4 Alternative 3

Agricultural economic effects under Alternative 3 associated with the Conveyance element would be somewhat greater than those described for the Preferred Program Alternative because more agricultural land would be required for construction of an isolated facility.

Potential new irrigation supply under Alternative 3 with storage would range up to about 830 TAF over the long-term average and up to about 1.0 MAF in dry and critical years.

7.2.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

7.2.9.1 PREFERRED PROGRAM ALTERNATIVE

The analysis found that the beneficial and adverse economic effects from implementing any of the Program alternatives when compared to existing conditions were the same effects as those identified in Sections 7.2.7 and 7.2.8, which compare the Program alternatives to the No Action Alternative. The comparison of Program alternatives to existing conditions did not identify any additional economic effects that were not identified in the comparison of Program alternatives to the No Action Alternative.

The analysis indicates that proposed Program actions for levee protection, storage and conveyance, and ecosystem restoration could result in agricultural land conversions, particularly in the Delta. Adverse agricultural economic effects could result from implementation of the Preferred Program Alternative combined with the expected future conversion of agricultural lands, when compared to existing conditions.

The benefits to agricultural economics are associated with water supply reliability actions from the Water Use Efficiency, Water Quality, Storage, and Conveyance elements—which could improve the availability and quality of water for agricultural purposes above the existing conditions baseline.

The following potential adverse economic effects are associated with the Preferred Program Alternative:

- Reductions in agricultural production and income
- Reduction in goods and services purchased by the agricultural sector

7.2.9.2 ALTERNATIVE 1

Agricultural economic effects under Alternative 1 compared to existing conditions would be similar to those described for the Preferred Program Alternative, without the effects resulting from the conversion of agricultural lands for a diversion facility.

7.2.9.3 ALTERNATIVE 2

Agricultural economic effects under Alternative 2 compared to existing conditions would be similar to those described for the Preferred Program Alternative.

7.2.9.4 ALTERNATIVE 3

Agricultural economic effects under Alternative 3 compared to existing conditions would be similar to those described for the Preferred Program Alternative but somewhat greater because construction of an isolated facility would require converting larger amounts of agricultural land. The isolated conveyance facility also would tend to increase salinity in south and central Delta areas. This decrease in water quality could negatively affect agricultural water users in these areas of the Delta, potentially reducing crop yields and crop flexibility, which would cause adverse economic effects.

7.2.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. For agricultural economics, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative effects are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term effects. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.2.1 summarizes the potentially significant adverse long-term effects on agricultural economics. Section 7.2.7 and 7.2.8 elaborate on long-term effects. Adverse agricultural economic effects primarily are related to land conversion.

The conversion of agricultural lands to other uses is expected to continue, and land conversion resulting from Program implementation would increase this amount. Reasons for continued conversion include:

- Pressure from population growth, especially in the Central Valley
- Reduced quantity and reliability of water supply for irrigation
- Increased cost of CVP water supply
- Drainage and salinity impacts
- Water transfers for urban use
- Water acquisition and habitat restoration under other programs such as the CVPIA

The cumulative effect on the agricultural economy of these trends and programs, especially when combined with Program implementation, is potentially quite large. The cumulative impacts of land conversion are described in more detail in Section 7.1, "Agricultural Land and Water Use."

Growth-Inducing Effects. No effects are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The long-term productivity of agricultural land converted for conveyance, storage, and levee improvements would be lost.

Water transfers involving groundwater or groundwater substitution can cause long-term degradation in the resource, including groundwater quality problems, subsidence, and increased pumping costs. All of these impacts can affect agricultural productivity and costs.

Levee system improvements sacrifice some agricultural land in the short term to protect remaining lands from inundation and salinity intrusion over the long term.

Irreversible and Irretrievable Commitments. All Program alternatives would directly and indirectly convert prime, statewide-important and unique farmland for conveyance, storage, habitat and levee improvements. These are, in most cases, irreversible and irretrievable commitments of land resources. Storage and conveyance features also could result in irretrievable commitment of resources, such as construction materials, labor, and energy resources.

7.2.11 ADVERSE EFFECTS

Adverse effects on agricultural economics include the loss of prime, statewide-important, and unique farmland to other uses, such as habitat or levee setbacks. Direct effects result from these losses, such as loss of farm revenue and production opportunities; indirect effects include less labor demand, reduced farm spending for goods and services, and associated regional economic and fiscal effects. These effects would be most concentrated and most substantial in the Delta Region.

Water supply changes in localized areas could result in the loss of agricultural income and jobs, which are considered adverse economic effects of the Program.

7.3 Agricultural Social Issues

By improving water supply reliability and quality, the CALFED Bay-Delta Program would benefit the agricultural community but may result in localized adverse social effects.

7.3 Agricultural Social Issues

7.3.1 SUMMARY

Farms and ranches in the CALFED Bay-Delta Program (Program) study area provide hundreds of thousands of jobs. Besides the men and women who work directly in agricultural jobs, many others work in jobs that support agriculture—moving crops to market, processing them for consumption, and providing the equipment and materials needed to support the nation's most diverse agricultural economy. In turn, the wages earned by these workers and the taxes paid on agricultural property provide revenues that support local governments throughout the Program area. When farmers and farm workers are displaced, it is these local governments that must supply an array of services to support them until other employment can be found. For many of the state's growers and farm workers, the water supply reliability provided by the Program would ensure that the lands they work can continue to be irrigated. In some areas, Program actions would displace agriculture, in turn displacing the jobs of agricultural workers.

Preferred Program Alternative. Increased water supply reliability would reduce the potential for future irrigation water disruptions and resulting social dislocations throughout most of the Program area, a major benefit of the Preferred Program Alternative. In some areas, agricultural employment would increase as a result of higher quality, more reliable water supplies and better irrigation efficiency, allowing the planting of higher value or more labor-intensive crops. These benefits would result from actions under the Water Quality, Storage, Water Use Efficiency, and Conveyance Elements. In the Delta Region, Levee System Integrity Program actions would protect agricultural jobs and income from catastrophic loss due to levee failure.

In some localized areas, Program elements would cause a reduction in agricultural employment and an associated increase in social issue effects. Areas that export water through the Water Transfer Program may experience increased land fallowing, with a reduction in agricultural employment and a shift of water from agricultural to urban uses. Conversion of agricultural lands to Program purposes, including actions under the Ecosystem Restoration and Levee System Integrity Programs, and the Storage element, would adversely affect agricultural employment, as would retirement of lands with drainage problems under the Water Quality Program.

Where employment is reduced, local government would be called on to provide many safety-net services while simultaneously experiencing a reduction in tax revenues. Special districts, such as levee or flood control districts, also could face declining revenues in some areas.

Alternatives 1, 2, and 3. All three Program alternatives would result in adverse social effects similar to those described for the Preferred Program Alternative. Differences in adverse social effects between the alternatives would be minimal.

7.3.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to agricultural social issues. While many issues associated with the Program are controversial, the effects concerning agricultural social issues are well understood and have not caused a dispute among experts. However, the following issue is best discussed under this section.

Significance of Adverse Effects. It should be noted that CEQA does not treat social and economic changes from a project as significant impacts on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. Economic and social effects of a project also may be used to assess the significance of a physical effect. Under NEPA, economic and social effects must be addressed if they are inter-related to the natural or physical environmental effects of a project.

7.3.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

7.3.3.1 ALL REGIONS

Farming and farm-related industries in the Central Valley are estimated to directly and indirectly create about 3 in every 10 jobs and about 30% of personal income. Statewide, agriculture and related activities account for about 1 in every 10 jobs.

Social Well Being Related to Agriculture. To describe the affected environment for social well being, this document relies on the grouping of counties for each region shown in Table 7.3-1. This grouping is necessary to aggregate racial, income, and population data from the U.S. Census.

The affected environment for social well being involves both community stability issues and environmental justice issues. Although community stability and environmental justice issues overlap in many respects (for example, income and poverty levels), they are discussed separately for organizational purposes. Additionally, community stability is described for the entire study area rather than on a regional basis.

Community Stability. The affected environment for community stability includes the following:

- Social groups in the Program study area
- Economic indicators of social well being
- Employment opportunities
- Community social structure

Several important social groups are related to agriculture in the study area: farmers, farm workers, and agribusiness.

Table 7.3-1. Program Regions and Groupings of Counties

PROGRAM REGIONS	COUNTIES
Delta Region	98% of Contra Costa, 45% of Sacramento, 46% of San Joaquin, 30% of Solano, and 20% of Yolo
Bay Region	Alameda, 2% of Contra Costa, Marin, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Sonoma
Sacramento River Region	Butte, Colusa, Glenn, Placer, 55% of Sacramento, Shasta, 70% of Solano, Sutter, Tehama, 80% of Yolo, and Yuba
San Joaquin River Region	Fresno, Kern, King, Madera, Merced, 54% of San Joaquin, Stanislaus, and Tulare
Other SWP and CVP Service Areas	Imperial, Los Angeles, Plumas, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura

Economic indicators of social well being include population demographics, median family income, per capita income, poverty rates, and unemployment rates. These indicators are summarized by region in Table 7.3-2.

This section summarizes the regional economic indicators of social well being in the study area as they apply to all social groups and communities. The following general conclusions were derived from review of the economic data presented in Table 7.3-2:

- In the study area, people living in predominantly rural areas have lower incomes, higher poverty rates, and higher unemployment rates than those living in the urban regions. However, San Francisco and Los Angeles Counties experience high income levels and some of the highest poverty rates in the state.

- In all regions, pockets of prosperity have an "averaging effect" of statistically raising average personal income levels and lowering average poverty and unemployment rates.

Personal income is measured as family or per capita income, as shown in Table 7.3-2. Median family income is a measure of the annual income received by families living together in the same household. "Median" is a statistical term for the midpoint of a data set. The median family income in the study area covers a wide range. Per capita income in the study area ranges from $10,000 in the Tulare Lake area in the San Joaquin River Region and Yuba County in the Sacramento River Region, to $28,000 in Marin County in the Bay Region.

As shown in Table 7.3-2, existing unemployment rates are lowest in the Bay and Delta Regions, where more employment opportunities are available. Unemployment rates are presented as a range in areas with diverse economies, such as the urban and agricultural areas in the Sacramento Valley and San Joaquin Valley.

Poverty rates also range widely in the study area. The highest poverty rates in the study area occur in predominantly rural areas, and poverty rates are higher among minority ethnic groups. A 1986 study by the California Employment Development Department (EDD) estimated the poverty rates among races in California during 1980, as summarized in Table 7.3-3. Unemployment rates in the study area are higher among minority ethnic groups. The EDD estimated state-wide unemployment rates among races in California during 1980, as summarized in Table 7.3-4.

Table 7.3-2. Existing Conditions: Regional Demographics and Economic Indicators of Social Well Being

	DELTA	BAY	SAN JOAQUIN RIVER	SACRAMENTO RIVER	OTHER CVP AND SWP SERVICE AREAS
1996 Population[a]	2,362,514	5,498,964	3,004,222	1,666,650	19,159,450
Economic Indicators					
Median family income (1989)[b]	40,690	46,373	30,862	31,794	38,825
Per capita income[c] (1994)	21,991	28,079	16,475	18,313	20, 358
Poverty rate	11%	9%	18%	13%	13%
1995 Unemployment rate[d]					
Average	7.8%	6.6%	13.3%	11.2%	10%
Range	5.8 to 12.3%	4.3 to 13.5%	8.2 to 16.9%	6.1 to 19.7%	5.1 to 28.8%

Notes:
[a] Source: California Department of Finance; county population data was aggregated into CALFED Regions according to Table 7.3-1.
[b] Source: California Department of Finance; median family income for each county was averaged to show average median family income for each CALFED region.
[c] Source: California Department of Finance; per-capita income for each county was averaged to show average per-capita income for each CALFED region.
[d] Source: California Department of Finance; average of counties in each Program region.

Table 7.3-3. Poverty Rate in California by Ethnicity (1980)

ETHNICITY	POVERTY RATE (Percentage)
White	6
Black	21
Hispanic	18
Asian and other	11

Source:
California Employment Development Department. 1986.

Table 7.3-4. Unemployment Rate in California by Ethnicity (1980)

ETHNICITY	UNEMPLOYMENT RATE (Percentage)
White	4
Black	7
Hispanic	7
Asian and other	4

Source
California Employment Development Department. 1986.

Average annual agricultural employment was about 400,000-435,000 jobs from 1987 to 1992. Approximately 420,000 people were employed in the agriculture industry in 1992. The relationship between the agricultural sector and the larger economy of the Central Valley is important in the assessment of social factors. Agricultural employment is becoming a less significant factor in measuring the viability of the local economy in all areas of the Central Valley. The economy of the Central Valley has grown and diversified, and nonagricultural employment opportunities are increasing. This general trend does not hold true for many smaller communities, where agriculture remains the dominant industry and economic force.

Factors affecting social well being include not only employment opportunities but also job guarantees. Job guarantees are affected by seasonal employment trends and economic trends and, in some cases, natural occurrences. Seasonal employment affects agricultural workers. Economic trends also may affect agriculture. Natural occurrences such as weather conditions can shorten or lengthen seasonal employment opportunities. For example, water shortages can reduce the number of acres farmed. Natural occurrences such as drought and flood conditions, and economic conditions are not under the control of the Program and, although they are not addressed further in this chapter, are important to consider in the assessment of existing conditions.

For the Program study area, the largest sectors of workers who may be affected by Program actions are seasonal farm workers and agricultural workers. Seasonal unemployment among farm workers and agricultural workers usually occurs during winter months following harvest. Changes in seasonal employment can affect the demand for social services. The demand for social services increases during periods of unemployment, such as requests for unemployment payments, health services, and other family support programs. The need to utilize family, health, and income support services can decrease social well being among persons who are employed during much of the year but are seasonally unemployed.

Local communities provide a social base for people to access assistance and support during times of need. The social structure of a community may provide job training, educational opportunities, family support services, religious and cultural outlets for support and counseling, recreational opportunities, and monetary assistance. These services may be available through community or county agencies, or from cultural and religious institutions in the community.

The local community also provides an identifying factor for all residents and a sense of belonging. When economic changes occur in an area, such as the loss or gain of a major employer, or drought or flood conditions, the local community can be affected significantly. This is especially true if the local economy is centered around one industry type, such as agriculture. The community is a crucial level of social organization. It is at this level that most social services are delivered, social networks formed, and values and beliefs confirmed.

Environmental Justice. The analysis of potential environmental justice issues focuses on the farm worker population. Within the population potentially affected by the Program, this population is the most racially diverse. Table 7.3-5 indicates ethnicity by Program region, and Table 7.3-6 presents the racial distribution of farm workers by Program region.

Table 7.3-5. Ethnicity by Program Region

	ETHNICITY (Percentage)			
PROGRAM REGION	WHITE	BLACK	ASIAN	HISPANIC
Delta Region	68	8	9	14
Bay Region	61	8	15	16
Sacramento River Region	82	4	5	10
San Joaquin River Region	62	4	6	30
Other SWP and CVP Service Areas	52	9	9	30

The vast majority of U.S. farm workers have been Mexican immigrants and their children since the Bracero Program, which operated from 1942 to 1964, brought in more than 4 million laborers from Mexico. Earlier decades saw substantial numbers of Chinese, Japanese, Filipinos, Native Americans, and African Americans working on farms. By 1983, an estimated 90% of the seasonal farm laborers in California were Mexicans or Chicanos, while nationwide the figure was 60%. Most migrant farm workers are either American citizens or are working in the country legally. The Department of Labor estimates that about 25% of migrant farm workers are illegal immigrants.

Additionally, the Department of Labor estimates that, at any given time, 12% (or at least 190,000) domestic farm workers are out of work nationwide. The majority of farm workers earn annual wages of less than $7,500. Although wage rates for farm workers have increased over the last decade, when the rates are adjusted for inflation, real wages of farm workers have decreased 15-25% in that time.

Section 7.14, "Environmental Justice," analyzes environmental justice in greater detail.

Table 7.3-6. Racial Distribution of Farm Workers by Program Region

PROGRAM REGION	HISPANIC	WHITE	BLACK	AMERICAN INDIAN/ESKIMO ALEUTIAN	ASIAN/ PACIFIC ISLANDER	OTHER	TOTAL NUMBER OF FARM WORKERS
Delta Region	77%	15.1%	0.8%	0.3%	6.5%	0.3	5,470
Bay Region	82.2%	14.4%	1%	0%	2.2%	0.2	12,230
Sacramento River	58.9%	30.9%	0.4%	1%	8.2%	0.6	11,560
San Joaquin River	84%	11.9%	0.3%	0.2%	3.4%	0.2	74,220
Other SWP and CVP Service Areas	86.9%	10.1%	.9%	.2%	1.7%	0.2	44,960
Totals	**122,490**	**19,500**	**840**	**400**	**4,860**	**350**	**148,440**

Source:
U.S. Census of Population and Housing 1990.

7.3.3.2 DELTA REGION

Between 1944 and 1964, the number of farms in the Delta Region increased from 3,457 in 1944 to 4,502 in 1949, and then declined to 3,374 in 1964. The decline was due mainly to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the Delta Region increased from 58 acres in 1944 to 132 acres in 1964.

As shown in Table 7.3-2, the 1996 total population for the Delta Region was 2,362,514. The median family income was $40,690 (1989), per capita income was $21,991 (1994), the poverty rate was 11% (1990), and the unemployment rate ranged from 5.8 to 12.3% (1995).

7.3.3.3 BAY REGION

Between 1944 and 1964, the number of farms in the Bay Region increased from 5,581 in 1944 to 6,146 in 1954 and then declined to 4,103 in 1964. The decrease was partly due to the accumulation of irrigated land into fewer and larger farms, and partly due to urban encroachment.

As shown in Table 7.3-2, the 1996 total population for the Bay Region was 5,498,964. The median family income was $46,373 (1989), per capita income was $28,079 (1994), the poverty rate was 9% (1990), and the unemployment rate ranged from 4.3 to 13.5% (1995).

7.3.3.4 SACRAMENTO RIVER REGION

Between 1944 and 1964, the number of farms in the Sacramento River Region increased from 9,948 in 1944 to 11,538 in 1954, then declined to 9,255 in 1964. The decline was mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 64 acres in 1944 to 138 acres in 1964.

As shown in Table 7.3-2, the 1996 total population for the Sacramento River Region was 1,666,650. The median family income was $31,794 (1989), per capita income was $18,313 (1994), the poverty rate was 13%, and the unemployment rate ranged from 6.1 to 19.7% (1995).

7.3.3.5 San Joaquin River Region

Between 1944 and 1964, the number of farms in the San Joaquin River Region increased from 30,212 in 1944 to 33,832 in 1949, then declined to 25,153 in 1964. The decline was mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 78 acres in 1944 to 155 acres in 1964.

As shown in Table 7.3-2, the 1996 total population for the San Joaquin River Region was 3,004,222. The median family income was $30,862 (1989), per capita income was $16,475 (1994), the poverty rate was 18% (1990), and the unemployment rate ranged from 8.1 to 16.9% (1995).

7.3.3.6 Other SWP and CVP Service Areas

Between 1944 and 1964, the number of farms in the Other SWP and CVP Service Areas decreased from 33,715 in 1944 to 13,603 in 1964, mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 30 acres in 1944 to 82 acres in 1964.

As shown in Table 7.3-2, the 1996 total population for the Other CVP and SWP Service Areas was 19,159,450. The median family income was $38,825 (1989), per capita income was $20,358 (1994), the poverty rate was 13%, and the unemployment rate ranged from 5.1 to 28.8% (1995).

7.3.4 ASSESSMENT METHODS

Social well being, for purposes of this analysis, is measured in terms of community stability. Community stability is a measure of a community's ability to absorb social and economic changes that may result from a proposed action. Assessment of community stability is based on changes in economic and social indicators that may occur as a result of a Program action. These indicators include median family income, per capita income, poverty rates, and unemployment rates, as summarized by Program region in Table 7.3-2.

Predicting the human behavior that could result from Program actions is a difficult task. Past studies of impacts on community stability and social conditions related to water supply projects have focused on social, economic, and land use changes resulting from short-term drought conditions. The actual effects of implementation of long-term water supply programs cannot be predicted with complete assurance but must be projected based on assumptions of human behavior, primarily the assumed actions of farm managers and land owners implementing long-term changes to farm operations. This analysis is based on the regional economics analysis and projected changes to regional employment. These findings have been applied to the analysis for farmers, farm workers, and agribusiness.

7.3.5 CRITERIA FOR DETERMINING ADVERSE EFFECTS

For this analysis, socioeconomic effects are measured in terms of adverse changes in community stability. Community stability is measured by several economic indicators, including median and per capita income, poverty rates, and unemployment. An adverse effect on community stability would occur if a Program action resulted in a change to any of these indicators that substantially exceeded historical fluctuations.

7.3.6 NO ACTION ALTERNATIVE

7.3.6.1 ALL REGIONS

Future agricultural social conditions under the No Action Alternative are expected to decline somewhat compared to existing conditions.

The key factors that would affect farmers under the No Action Alternative include changes in the markets for agricultural products, the supply and reliability of irrigation water, the development of water transfer markets, and the cost of water. Increasing demand for fruits and vegetables is expected to result in a shift toward production of these commodities and away from field crops and grains. Decreases in water availability due to the CVPIA and the Bay-Delta Accord likely would be made up with groundwater supplies. However, depending on the size of the deficit, groundwater may not be able to completely compensate. Further, pumping groundwater could increase costs and decrease profits.

The number of agricultural jobs may increase in areas due to projected changes in crop production to higher value and more labor-intensive crops. However, agricultural employ-ment would remain seasonal. Improved mechanization for picking and sorting crops, and other improvements could eliminate tasks that currently are labor intensive. Changes in irrigation technology also may occur that could change farm labor needs. Changes to the population, crop production, and technology resulting in a decrease in employment opportunities or the duration of employment may create an increased need for social services to provide food, health care, and housing for those facing economic hardship. These needs may be seasonal or year round, depending on the extent of the change and the education, training, and technical skills of the population in the area affected.

Statewide urbanization will continue to result in conversion of large amounts of agricultural land. As the need for agricultural labor in these urbanizing areas decreases, substantial social effects will occur. Conversion of agricultural lands would be the largest cause of adverse agricultural social effects.

7.3.6.2 DELTA REGION

The conversion of farmlands to other uses, particularly urban uses, under the No Action Alternative would continue to reduce farm production and farm worker jobs.

Proposed and potential habitat projects, including the Stone Lakes NWR, may convert existing agricultural land to other uses under the No Action Alternative. In addition, DWR has forecast that flooding due to levee failure will negatively affect agriculture in the Delta Region. Both these impacts would adversely affect agricultural employment in the region.

7.3.6.3 Bay Region, Sacramento River Region, and Other SWP and CVP Service Areas

No effects related to agricultural social issues beyond those noted under "All Regions" are anticipated for these regions.

7.3.6.4 San Joaquin River Region

Under the No Action Alternative, DWR has forecast that up to 45,000 acres of drainage-impaired lands in the San Joaquin River Region will be retired from production by 2040. This land retirement would result in the loss of jobs associated with these lands. In other areas of the region, a change to higher value agricultural production, such as the conversion of grazing land to vineyards in Central Valley terrace areas, would tend to increase the number of agricultural jobs.

7.3.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

Because of the programmatic level of the analysis and the uncertainty of where Program projects will be sited, social effects cannot be predicted for specific cities or counties. Consequently, regions, rather than specific jurisdictions, were used to describe effects. The authors acknowledge that adverse social effects likely would occur in certain jurisdictions within a region, and that reliance on regional numbers for employment and other job-related statistics does not reflect the potential adverse social effects that may be experienced by a particular city or county. While socioeconomic effects in a region may be relatively minor, these same effects concentrated in a particular jurisdiction may be substantial. Additional assessment of social effects from individual project components on specific localities will be carried out during the environmental review process for the individual projects.

For agricultural social issues, the adverse effects of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, Watershed, and Storage elements are similar under all Program alternatives, as described below. The adverse effects of the Conveyance element vary among Program alternatives, as described in Section 7.3.8.

7.3.7.1 All Regions

Water Use Efficiency Program

During the drought of the early 1990s, many communities faced reduced employment resulting from significant reduction in irrigated acreage, which left farm laborers without jobs. To the extent that efficiency improvements would help increase water supply reliability, employment opportunities would be maintained. Water supply reliability would contribute to the stability of many local agricultural communities.

Job opportunities could be created by water use efficiency improvements. As irrigation management improves, so must the knowledge of those irrigating or scheduling irrigations. This development would result in the need for more skilled labor but at higher costs. In addition, the design and installation of new or improved on-farm or district water delivery systems would create more jobs for skilled laborers. It is conceivable that efficiency improvements, especially those that involve physical construction, would add to local employment.

However, water use efficiency improvements could adversely affect farm labor. A benefit of improved irrigation efficiency that may be experienced by farmers is a reduced need for labor, due either to less cultivation or a change in irrigation methods. The addition of pressurized irrigation systems would result in the most substantial effect on farm labor. With pressurized irrigation, the activities of several workers could be replaced by only one worker.

Possible methods of alleviating this adverse effect could include:

- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce.

Improved water use efficiencies often translate to higher crop yields and better quality of farm products. Such advances can increase on-farm direct income, benefitting the farmer's net income and often translating to additional economic activity. Increased income can help the overall economy in total sales and purchases, and in increased tax revenues that strengthen vital functions, such as schools, roads, and social and health services.

Water use efficiency improvements also could result in improved crop yields. Improvements in the yield per acre-foot of applied water, even with possible reductions in water supply, would result in greater production of food and fiber on the same land. As populations continue to increase—in the state, the nation, and globally—highly efficient food production would be an asset.

The preceding discussion applies to all Program regions, and the Water Use Efficiency Program is not included in region-specific discussions below.

Watershed Program

No adverse effects related to agricultural social issues are associated with Watershed Program actions in any Program region. The program is not included below in region-specific discussions.

Ecosystem Restoration Program

The Ecosystem Restoration Program also has a target of from 353,933 to 388,933 acres of agricultural land within the Program regions to be seasonally flooded or cooperatively managed for wildlife values with the largest acreage in the Sacramento River Region. Examples of these actions include paying farmers to flood rice fields during winter, purchasing conservation easements for agricultural lands near habitat areas, and providing payments to growers who allow a portion of a grain crop to remain unharvested in order to provide wildlife feed and cover. None of these programs will result in conversions of agricultural lands; therefore, no environmental impact is included in Section 7.1. However, a reduction in harvested acreage in each affected region could occur, with resulting effects to workers who normally would be involved in harvesting and processing. Since other agricultural activities, such as planting and weed control, would not be changed, the effects to farm workers of leaving some crops standing would not be as noticeable as leaving the acreage fallow. Similarly, the community would experience some economic effects from a reduction in harvested acres, or if late plantings due to wildlife needs resulted in reduced yields or an inability to harvest. These effects would not be as substantial as converting the lands to other uses or leaving the land fallow.

Community economic effects can be expected to be reduced somewhat by other uses that can be generated from seasonally flooded fields or standing crops, such as hunting or birdwatching, and the economic contributions made by participants in those activities.

7.3.7.2 Delta Region

Ecosystem Restoration Program

Implementation of the Ecosystem Restoration Program in the Delta could result in the conversion of up to 112000 acres of important farmland to restored habitat. These conversions would result in reductions in the number of jobs for farmers, farm workers, and agribusiness. Actions associated with the Ecosystem Restoration Program could result in a regional loss of agricultural revenues of up to $167 million per year. Approximately 8,350 jobs also could be lost, which is considered an adverse social effect. The severity of the effect depends on the magnitude of the job loss, the extent of strategies employed to reduce job loss, and the actual location of the projects.

The adverse effects would be most noticeable in the loss of jobs for farm workers with limited skills. Stress may be put on existing social services, such as welfare and job training, to help provide transitions for displaced farm workers. Because the Delta Region already is experiencing high levels of unemployment and the labor force is primarily farm workers, the social and economic structure of these communities could be adversely affected. Examples may include higher demand for social services; increased crime; and loss of local small businesses, requiring customers to travel further to purchase supplies. Less technically skilled workers and those lacking basic education levels and English language skills may have more difficulty finding new employment.

Per capita income for displaced farmers and families may decline. Farm managers may be required to travel farther to their place of employment or move to other areas to gain employment. The need to move or to be away from home and family for longer periods could add additional burden to family members.

It is anticipated that displaced farm managers and technicians eventually could find work in other regions or find other jobs related to agriculture. The need for social services to provide training or economic assistance for a portion of these displaced workers may temporarily increase.

Possible methods of alleviating these adverse effects could include:

- Supporting local governments and workers faced with increased demand for social services resulting from labor displacement.

- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce. Retraining efforts could be focused on restoration practices and technology to directly reduce job losses attributable to the Ecosystem Restoration Program.

- Including clauses in restoration and construction contracts that require use of the local workforce to the extent possible.

The Ecosystem Restoration Program may increase the need for unskilled and skilled labor in the Delta Region. Depending on project features and location, ecosystem restoration can be labor intensive, requiring substantial amounts of semi-skilled labor. The Ecosystem Restoration Program would tend to provide greater water supply reliability to farmlands, increasing the security of some agricultural jobs. Increased numbers of recreation jobs also may reduce the level of effects to some extent.

Water Quality Program

No effects related to agricultural social issues are associated with Water Quality Program actions in the Delta Region.

Levee System Integrity Program

The Levee System Integrity Program would convert up to 35,000 acres of important farmland in the Delta through larger and improved levees or setback levees. Up to 2,625 jobs could be lost from conversion of these farmlands, resulting in adverse social effects. The program also would preserve existing farm worker jobs that otherwise would be lost to flooding of Delta islands.

Adverse social effects from the Levee System Integrity Program are not anticipated in any region other than the Delta, and the Levee System Integrity Program is not included in discussions below for the remaining Program regions.

Water Transfer Program

Adverse social effects are not anticipated to result in the Delta Region from Water Transfer Program actions.

Storage

The extent of Storage element effects would vary due to the variation in water yield and the opportunity to shift agriculture to various parts of the Delta. All Program alternatives could result in adverse effects on farmers, farm workers, and agribusiness as a result of the agricultural land conversion due to in-Delta storage options. Up to 15,000 acres of important farmland could be converted for storage in the Delta. This conversion could result in a reduction of up to 1,125 jobs for farmers, farm workers, and agribusiness. The intensity of this adverse effect would depend on the location and size of storage projects.

Possible methods of alleviating this adverse effect could include:

- Supporting local governments and workers faced with increased demand for social services resulting from labor displacement.
- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce.
- Providing opportunities for alternative industries to develop, such as recreation.

7.3.7.3 BAY REGION

Ecosystem Restoration, Water Quality and Water Transfer Programs, and Storage

No adverse social effects are anticipated on farmers, farm workers, or agribusiness in the Bay Region from any of these Program elements.

7.3.7.4 SACRAMENTO RIVER REGION

Ecosystem Restoration Program

The adverse social effects of the Ecosystem Restoration Program in the Sacramento River Region would be similar to those described for the Delta Region. Ecosystem restoration could result in conversion or idling of productive agricultural land in the Sacramento River Region. Conversion or idling of agricultural lands would result in a loss of jobs for farmers, farm workers, and agribusiness. It is estimated that up to $51 million in agricultural revenues could be lost annually as the result of this program, resulting in a loss of up to 2,550 jobs. The actual severity of the social effects would depend on the magnitude of farm worker job loss and the extent of strategies employed to reduce job loss. Additional jobs would be created through restoration activities.

Possible methods of alleviating these adverse effect could include:

- Supporting local governments and workers faced with increased demand for social services resulting from labor displacement.
- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce. Retraining efforts could be focused on restoration practices and technology to directly reduce job losses attributable to the program.
- Including clauses in restoration and construction contracts that require use of the local workforce to the extent possible.

Water Quality Program

No adverse effects in the Sacramento River Region related to agricultural social issues are anticipated from Water Quality Program actions.

Water Transfer Program

The transfer of water previously used for farming from one region to another could result in adverse social effects. If fields are fallowed because water is transferred for use elsewhere, the farm workers who provided labor for the transferring farming operation could lose their jobs, depending on groundwater availability and crop flexibility. If adjacent or nearby farms are affected by groundwater overdrafts as a result of groundwater pumping increases to make up for transferred water, those farmers and their labor force also could be adversely affected. Long-term transfers that reallocate water from local agricultural uses would result in greater adverse social effects than would short-term transfers.

Possible methods of alleviating these adverse effects could include:

- Supporting limitations on the amount of acreage that can be fallowed in a given area.
- Supporting a fee levied on transfers, administered by local governments, to compensate the local area for increased service costs incurred by local governments, to provide mitigation funds for compensating losses, or to pay for retraining farm workers.

In addition, the criteria and objectives in the Water Transfer Program, in conjunction with existing requirements placed on water transfers, will protect against adverse socioeconomic effects due to water transfers (see Chapter 4 in the Water Transfer Program Plan).

Storage

The beneficial effects of additional water supply in the Sacramento River Region could include the development of additional acreage for agriculture, increased water supply reliability resulting in greater farm investments, and shifts to higher water use and higher value crops. Other beneficial effects include development of additional acreage shifted from the Delta due to land conversion, changes to higher water use and higher value crops, and the availability of additional farm worker jobs if additional acreage is developed. The extent of this beneficial effect would vary and would depend on the ultimate cost of the water.

Development of the storage facilities could require the conversion of agricultural lands in the Sacramento River Region, resulting in a potential adverse social effect on farmers, ranchers, and farm workers. This effect could be offset by shifting crops and grazing to other parts of the Sacramento River Region. Adverse effects on farm workers would depend on new acreage or new cropping patterns developed by farmers. All alternatives, depending on storage elements implemented, could result in a minimal to substantial number of new jobs.

7.3.7.5 SAN JOAQUIN RIVER REGION

The Ecosystem Restoration Program could result in conversion of agricultural land in the San Joaquin River Region. Adverse social effects of the Ecosystem Restoration Program, and strategies to alleviate those effects, would be similar to those described for the Delta Region. Agricultural revenue losses are estimated at $9 million in the region as a result of this program.

Water Quality Program

Retirement of lands with water quality problems in the San Joaquin River Region could adversely affect agricultural jobs in the region. These lands are forecast to be retired under the No Action Alternative. It is likely however, that the lands would be retired sooner under the Program than under the No Action Alternative. The loss of these irrigated lands would lead to an adverse social effect as the jobs they support are lost

Possible methods of alleviating this adverse effect could include:

- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce.

Increased irrigation water quality in other areas could lead to better yields or selection of higher-value crops, both of which could increase farm income and farm worker jobs.

Water Transfer Program

The adverse effects and possible alleviation related to agricultural social issues in the San Joaquin River Region from Water Transfer Program actions would be similar to those described for the Delta and Sacramento River Regions. However, this region may also be the recipient of water transfers and would experience beneficial agricultural social effects. These benefits would result from increased agricultural production, incomes, and employment opportunities.

Storage

The beneficial effects of additional water supply could include the development of additional acreage and increased water supply reliability, which may result in greater farm investments and shifts to higher water use and higher value crops. A substantial number of jobs could become available if additional acreage or higher labor demand crops were developed.

Development of the storage facilities, depending on the location, could require the conversion of agricultural lands, resulting in adverse social effects. This negative effect could be offset by shifting development of acreage to other parts of the San Joaquin River Region. Effects on farm workers would depend on new agricultural acreage developed by farmers. Depending on the storage elements implemented, all alternatives could result in from several to a significant number of new jobs. A beneficial effect could be experienced by farm workers and associated agricultural business.

7.3.7.6 Other SWP and CVP Service Areas

Ecosystem Restoration Program

Effects on agriculture in the Other SWP and CVP Service Areas resulting from Ecosystem Restoration Program actions are expected to be small. Substantial conversion of agricultural land in the Delta Region could shift some production to desert areas in southern California, such as the Imperial Valley.

Water Quality Program and Storage

No effects related to agricultural social issues are anticipated in the Other SWP and CVP Service Areas as a result of the Water Quality Program or Storage element.

Water Transfer Program

Water transfers would increase agricultural production, incomes, and employment opportunities associated with any transfer that uses the water for agricultural production outside the Central Valley. The net change in jobs in the Other SWP and CVP Service Areas is expected to be minimal, with only minor effects on community stability.

7.3.8 Consequences: Program Elements that Differ among Alternatives

For agricultural social issues, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.3.8.1 Preferred Program Alternative

Delta Region

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not be associated with the Preferred Program Alternative.

Channel widening under the Conveyance element likely would convert up to 4,900 acres of important farmland, depending on project location. The reduction of agricultural jobs from such conversion would result in adverse social effects.

Possible methods of alleviating these adverse effects could include:

- Supporting local governments and workers faced with increased demand for social services resulting from labor displacement.

- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce.

- Including clauses in restoration and construction contracts that require use of the local workforce to the extent possible.

Changes in project operations are not anticipated to adversely affect agricultural social issues. Water supply to individual farms is not expected to be affected in this region; therefore, agricultural social issues would not be substantially affected.

Construction of a diversion facility on the Sacramento River would require converting additional agricultural lands, thereby reducing the number of agricultural jobs. However, the number of construction-related jobs would increase.

Bay Region

No effects related to agricultural social issues in the Bay Region are associated with Conveyance element actions.

Sacramento River Region

Changes in project operations are not anticipated to adversely affect agricultural social issues in the Sacramento River Region. Water supply is not expected to be affected in the region; therefore, social effects would not be substantial.

San Joaquin River Region

Changes in project operations may affect agricultural social issues in the San Joaquin River Region. Any reductions in water supply caused by changes in the amount of water exported to the region could reduce agricultural jobs and associated businesses, and result in an adverse effect, depending on the magnitude of the reduction. Possible methods of alleviating this adverse effect could include:

- Supporting local governments and workers faced with increased demand for social services resulting from labor displacement.

- Supporting training and educational opportunities, job referral and placement services, and job retraining for unemployed individuals to reenter the workforce.

Any increases in water supply caused by changes in the amount of water exported to the region could increase agricultural jobs and associated businesses, and result in a beneficial effect, depending on the magnitude of the increase.

Other SWP and CVP Service Areas

Changes in project operations may affect agricultural social issues in the Other SWP and CVP Service Areas, but the effect is anticipated to be small. Any reductions in water supply caused by changes in the amount of water exported to the region could reduce agricultural jobs and associated businesses, and result in an adverse effect. Any increases in water supply caused by changes in the amount and timing of water exported to this region could increase agricultural jobs and associated businesses, and result in a beneficial effect.

7.3.8.2 ALTERNATIVE 1

Because Alternative 1 does not include constructing a diversion facility on the Sacramento River, somewhat fewer acres of agricultural lands in the Delta Region would be converted for conveyance, resulting in an adverse social effect on agriculture and agricultural workers of less magnitude but nevertheless substantial. Effects associated with other conveyance features and possible methods of alleviating them would be similar to those described for the Preferred Program Alternative.

7.3.8.3 ALTERNATIVE 2

Social effects under Alternative 2 would be similar to those described for the Preferred Program Alternative.

7.3.8.4 ALTERNATIVE 3

Social effects under Alternative 3 and possible methods of alleviating them would be similar to those described for the Preferred Program Alternative. Adverse effects would be somewhat larger due to the potential for a greater amount of agricultural land to be converted for construction of an isolated facility.

7.3.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

The analysis found that the beneficial and adverse social effects from implementing any of the Program alternatives when compared to existing conditions were the same effects as those identified in Section 7.3.7 and Section 7.3.8, which compare the Program alternatives to the No Action Alternative. Additionally, the comparison of the Program alternatives to existing conditions did not identify any additional agricultural social effects that were not identified in the comparison of Program alternatives to the No Action Alternative.

The analysis indicates that the Program proposed actions for levee protection, storage and conveyance, and ecosystem restoration could result in additional large-scale land conversions that would affect agricultural lands, particularly in the Delta. Adverse agricultural social effects could result from the Preferred Program Alternative when compared to existing conditions.

7.3.9.1 PREFERRED PROGRAM ALTERNATIVE

The benefits to agricultural social conditions would be associated with water supply reliability actions from the Water Use Efficiency, Water Quality, Storage, and Conveyance elements, which could improve the availability and quality of water for agricultural purposes above the existing conditions baseline. The Program is expecting an overall improvement in water supply reliability for agriculture relative to the No Action Alternative.

The following potential adverse social effects are associated with the Preferred Program Alternative:

- Farm worker and other agricultural-related job losses
- Loss of revenues to local governments and districts

7.3.9.2 ALTERNATIVE 1

Agricultural social effects under Alternative 1 would be similar to those described for the Preferred Program Alternative, without the effects resulting from the conversion of agricultural lands for a diversion facility on the Sacramento River.

7.3.9.3 ALTERNATIVE 2

Agricultural social effects under Alternative 2 would be similar to those described for the Preferred Program Alternative.

7.3.9.4 ALTERNATIVE 3

Agricultural social effects under Alternative 3 would be similar to those described for the Preferred Program Alternative but somewhat greater because construction of an isolated facility would require converting larger amounts of agricultural land. The isolated conveyance facility also would tend to increase salinity in south and central Delta areas. This decrease in water quality could negatively affect agricultural water users in these areas of the Delta, potentially reducing crop yields and crop flexibility. Both of these adverse effects associated with Alternative 3 could result in greater adverse agricultural social effects than the other Program alternatives.

7.3.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. For agricultural social issues, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative effects are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term effects. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Sections 7.3.1 summarizes the adverse long-term effects related to agricultural social issues. Sections 7.3.7 and 7.3.8 elaborate on the long-term effects.

As discussed in Section 7.1, "Agricultural Land and Water Use," the conversion of agricultural lands for Program purposes contributes to a state-wide trend of agricultural land conversion. Between 1994 and 1996, approximately 55,000 acres of important farmlands were converted to other uses in the state (in areas for which the DOC prepares important farmland series maps). Predictions run as high as 1 million acres of agricultural land to be converted to urban uses in the Central Valley by 2040. In addition, up to 51,000 acres of agricultural lands could be converted from Delta wildlife and habitat initiatives. The production and agricultural worker job losses associated with these conversions are substantial. Adding to these losses is the increasing use of technology to replace agricultural workers. The effects of production and job losses associated with the Program's conversion of up to 243,000 acres of important farmlands, when viewed along with the other effects noted above, is substantial.

Growth-Inducing Effects. No effects are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The long-term productivity of up to 243,000 acres of agricultural lands could be eliminated by the Program. Long-term productivity of an undetermined number of acres of agricultural lands would be enhanced through better quality water, additional availability of irrigation water, increased irrigation efficiency, and protection from flooding. Jobs dependent on agriculture and the social well being of some localities in the affected regions would tend to be reduced by farmland conversion and tend to be increased by the other Program features noted above.

Irreversible and Irretrievable Commitments. All Program alternatives would directly and indirectly convert prime, statewide-important, and unique farmland for conveyance, storage, habitat, and levee improvements. These are, in most cases, irreversible and irretrievable commitments of land resources. Storage and conveyance features also could result in irretrievable commitments of resources, such as construction materials, labor, and energy resources.

7.3.11 ADVERSE EFFECTS

Farm worker and other agricultural-related job losses resulting from Program actions may result in adverse agricultural social effects. In some cases, jobs may be shifted to other areas, and new recreation or restoration jobs could mitigate for some of the agricultural jobs lost; however, jobs also may be eliminated with no replacement. Job loss is considered a substantial adverse agricultural social effect of the Program. The loss of revenues and increased services burdens on some local governments and districts also could present an adverse social effect.

7.4 Urban Land Use

All potentially significant adverse impacts on urban land use that are associated with the CALFED Bay-Delta Program can be mitigated to a less-than-significant level. Urban land uses would benefit from increased flood protection.

7.4 Urban Land Use

7.4.1 SUMMARY

Population growth in California creates demand for land resources for residential, commercial, and infrastructure uses, which are collectively referred to as urban uses in this section. As population grows, urbanization has the potential to convert substantial amounts of land from agriculture, wetland, open space, and other land use categories to urban uses. CALFED Bay-Delta Program (Program) actions could cause direct and indirect beneficial and adverse impacts on urban land use.

Preferred Program Alternative. Under the Preferred Program Alternative, Urban land uses would benefit from increased flood protection associated with the Ecosystem Restoration, Levee System Integrity, and Storage Programs. Overall, the Program would provide greater flood protection for urban centers than under the No Action Alternative.

Displacement of individuals and utility infrastructure or disruption of established communities could result from Ecosystem Restoration, Levee System Integrity, Storage, and Conveyance Element actions. Water transfers to urban areas, improvements in water quality, and increased reliability of supplies could induce growth in urban areas that currently lack the water supplies to support such growth. Specific locations for habitat development and storage and conveyance structures could be inconsistent with localized general plan land use designations or zoning. Mitigation strategies have been developed which, when implemented, are expected to reduce all potentially significant adverse impacts on urban land uses to a less-than-significant level.

Alternatives 1, 2, and 3. Generally, beneficial and adverse impacts associated with the Program alternatives would be the same as those described for the Preferred Program Alternative. Impacts would differ depending on the magnitude and type of conveyance facilities that are constructed. Under Alternative 3, construction of an isolated conveyance facility primarily would affect agricultural land uses. Constructing the isolated facility could significantly affect urban land uses by displacing residents or conflicting with general plans and zoning; however, these potentially significant impacts can be mitigated to a less-than-significant level.

The following table presents a summary of potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. See the text in this chapter for more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Displacement of some existing commercial uses and residents from Program actions located in urban land use areas (1,2,5,6).

Physical disruption or division of established communities (1-10).

Potential conflicts of habitat development and storage and conveyance facilities with general plan land use designations or zoning if located in urban use areas (3,4).

Mitigation Strategies

1. Selecting and designing program actions that minimize the displacement of existing residents.
2. Selecting and designing Program actions that do not physically disrupt or divide established communities.
3. Selecting Program actions, to the extent practicable, that are consistent with local and regional land use plans.
4. Notifying all affected persons (for example, residents, property owners, school officials, and business owners) in the project area of the construction plans and schedules.
5. Providing relocation assistance to displaced persons or businesses.
6. Minimizing the amount of permanent easement required for construction of facilities and consulting with property owners to select easement locations that would lessen property disruption and fragmentation, if applicable.
7. Relocating roads and utilities prior to project construction to ensure continued access and utility service through the project area.
8. Preparing a detailed engineering and construction plan as part of the project design plans and specifications, and including procedures for rerouting and excavating, supporting, and filling areas around utility cables and pipes in this plan.
9. Verifying utility locations through consultation with appropriate entities and field surveys (such as probing and pot-holing).
10. Reconnecting disconnected cables and lines promptly.

No potentially significant unavoidable impacts related to urban land use are associated with the Preferred Program Alternative.

7.4.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Below is a brief description of the areas of controversy that relate to urban land use. Given the programmatic nature of this document, many of these areas of controversy cannot be addressed; however, subsequent project-specific environmental analysis will evaluate these topics in more detail.

For urban land use, the primary area of controversy concerns differing opinions of the potential beneficial or significant adverse effects from the Water Quality and Water Use Efficiency Programs. Specifically, the concerns are whether or not these programs could cause sufficient urban land use changes to induce growth. A closely related concern expressed by both public and CALFED agencies involves the assumptions used or the unavailability of information to determine the cost/benefit economic analysis regarding potential urban land use changes. The economic analysis concerns are outlined in the "Urban Water Supply Economics" impact analysis in Section 7.5.

Other issues regarding the potential effects of Program actions do not meet the CEQA definition of areas of controversy but are the focus of disagreement and concern among interested parties—for example, the financial and environmental burden small urban communities might face if they need to relocate discharge facilities. The significance of this impact cannot be determined at this programmatic level of analysis. This issue is more appropriately addressed in second-tier, project-specific documentation.

7.4.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

7.4.3.1 DELTA REGION

Before 1920, few records were kept of urban land development (urban acreage calculations) in California. Generally, urban development in the Delta Region began in the early 1900s, following construction of the railroads and as the San Francisco Bay and southern California geographic regions were developing into urban centers. Urban development includes residential, industrial, commercial, and other urban uses.

Land use in the Delta shifted dramatically in the 1850s, after the federal Swamp and Overflowed Lands Act was passed. This legislation allowed the Delta wetlands to be reclaimed, which they were, primarily for agricultural use. Between 1920 and 1950, another land use shift began—from agricultural to urban. As in other parts of California, private water development projects by cities and utilities assisted in the urban expansion.

Urban expansion in the Delta Region continues. For example, between 1976 and 1993, urban land in the Delta increased by approximately 23,000 acres. In 1993, about 44,000 acres of land in the Delta were classified as urban land, and 83,000 acres were classified as native land. DWR defines native land as land that has all native vegetation, is barren, or is riparian. Since 1976, approximately 12,000 acres of native land were developed for urban uses.

Approximately 71,000 acres (about 8%) in the Delta Region are urbanized, with most of the development on the periphery of the region in Sacramento, San Joaquin, and Contra Costa Counties. Much of the urbanization in the region is centered in incorporated cities, such as Antioch, Brentwood, Isleton, Pittsburg, Rio Vista, Sacramento, and West Sacramento. Fourteen unincorporated communities also are in the Delta Region: Discovery Bay, Oakley, Bethel, Courtland, Freeport, Hood, Ryde, Walnut Grove, Byron, Terminous, Thornton, Hastings Tract, and Clarksburg.

7.4.3.2 BAY REGION

Prior to the 1940s, the most significant urban area in the Bay Region was the City of San Francisco; most of the other portions of the region were rural. During the last 50 years, however, land uses throughout the region have shifted, becoming progressively more urbanized. Post-World War II urbanization in the metropolitan San Francisco area was the principal catalyst for this development, along with growth in the cities of Oakland and San Jose, which are the other major urban areas in the region. Since the 1970s, the South Bay Region has become a hub for companies that provide high-technology products and services. Suburban sprawl, characterized by low-density residential and light manufacturing land uses, occupies much of the Bay Region outside the San Francisco area.

Land uses in the Bay Region are diverse and include the Napa Valley and Sonoma County wine industry; international business and tourism in San Francisco; technological development and production in the Silicon Valley; and urban, suburban, and rural residential uses. Urban land accounts for about 23% (655,600 acres) of the land area.

7.4.3.3 SACRAMENTO RIVER REGION

Agriculture and open space historically have comprised most of the land use in the Sacramento River Region. Since the 1970s, however, urban land uses in the greater metropolitan Sacramento area have begun to supplant some agricultural uses. Except for Sacramento County, the region generally contains large quantities of parkland, forests, and other open space and has preserved its traditionally rural nature. Urban development accounts for approximately 863,000 acres (about 4%) of total land use in the region.

Land uses in the Sacramento River Region are still principally agricultural and open space, with urban development focused in and around the City of Sacramento. More than half the region's population lives in the greater metropolitan Sacramento area. Other fast-growing communities include Vacaville, Dixon, Redding, Chico, and several Sierra Nevada foothill towns. Urban development along major highway corridors in Placer, El Dorado, Yolo, Solano, and Sutter Counties has taken some irrigated agricultural land out of production. Suburban ranchette homes on relatively large parcels surround many of the urban areas and often include irrigated pastures or small orchards.

7.4.3.4 SAN JOAQUIN RIVER REGION

The Spanish settled the San Joaquin Valley area for cattle ranching in the 1700s. By the mid-1800s, gold mining to the north and east created a demand for agricultural products, and led to the first large irrigation developments in the region. Large areas of wetlands, such as Tulare Lake, were reclaimed for agriculture; and the advent of the railroad expanded agricultural markets to the rest of the nation. Many early irrigation developments were private; but in the 1930s and 1940s, the federal government played a larger role by developing multi-purpose projects on the east side rivers and valley floor.

Although agriculture and food processing are still the region's major industries, expansion from the San Francisco Bay Area and Sacramento over the past 30 years has created major urban centers throughout the San Joaquin River Region. Open space uses—including national forest and parkland, state parks and recreational areas, and U.S. Bureau of Land Management and military properties—historically comprised about one-third of the region.

Land uses in the San Joaquin River Region are predominantly open space in the mountain and foothill areas and agricultural in the San Joaquin Valley area. Urban land usage in 1990 totaled 295,300 acres, or about 2% of the region's area. Urban areas included the cities of Stockton, Modesto, Merced, and Tracy, as well as smaller communities such as Lodi, Galt, Madera, and Manteca. In contrast to the large valley urban centers, separated by flat agricultural fields and linked by freeways, the foothills are sprinkled with small communities that are connected by two-lane roads. The western side of the region, south of Tracy, is sparsely populated. Many small agricultural communities dot the eastern side of the southern San Joaquin Valley, with urban development and anticipated population growth focused in the cities of Fresno, Bakersfield, Visalia, and Tulare.

7.4.3.5 OTHER SWP AND CVP SERVICE AREAS

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

Urban development of the Other SWP and CVP Service Areas has increased steadily since the 1880s. Urban land uses grew quickly during and after World War II, as the combination of major industries (defense, tourism, and entertainment), international trade, and an expanding interstate highway system brought thousands of new residents to the greater Los Angeles and San Diego metropolitan areas. Since the 1970s, suburban sprawl has grown to comprise the majority of coastal and inland valley land uses. Open space uses, including national forest and parkland, and state parks and recreational areas, historically comprised about one-third of the region.

The Spanish settled the Central and South Coast areas for trade and cattle production. After 1850, the areas grew quickly as agriculture, business, and industry took advantage of the warm Mediterranean-like climate. The rapidly expanding South Coast population soon required water imports from outside the area, and the Los Angeles Aqueduct, Colorado River Aqueduct, San Diego Aqueduct, and SWP were developed to meet this need. The Los Angeles metropolitan area is now the second largest in the nation.

The South Coast is the most urbanized area in California. Of the approximately 7 million acres in the area, about 1.7 million acres (about 12%) are urbanized. Most of the area's coastal plains and valleys are densely populated. The largest cities are Los Angeles, San Diego, Long Beach, Santa Ana, and Anaheim. Areas undergoing increased urbanization include the coastal plains of Orange and Ventura Counties, the Santa Clarita Valley in northwestern Los Angeles County, the Pomona/San Bernardino/Moreno Valleys, and the valleys north and east of the city of San Diego. To the north of the area are the cities of Santa Barbara, Lompoc, Santa Maria, Morro Bay, and San Luis Obispo. Military installations include Vandenberg Air Force Base (AFB) and Camp Roberts.

The eastern portion of Kern County, northeast portion of Los Angeles County, and western San Bernardino County hold many desert valleys and small mountain ranges. Although not densely populated, these areas contain growing urban areas, including the city of Lancaster. Principal urban areas within the SWP and CVP service areas here include the Coachella Valley and Palm Springs, Indio, Cathedral City, and Palm Desert. Vacation and resort facilities in these areas include hotels, country clubs, golf courses, and other residential communities.

The South Coast area encompasses about 12.6 million acres; an estimated one-fifth (2.5 million) of this acreage lies within the SWP and CVP service areas. About 10% (roughly 250,000 acres) of land in the SWP and CVP service areas in the South Coast is urbanized.

7.4.4 ASSESSMENT METHODS

Impacts related to urban land use could be direct or indirect. Direct impacts are those changes in physical land uses, or in land use designations, that result from constructing new facilities or converting lands from one use to another. Indirect effects would occur later in time and can be further removed in distance. Indirect land use effects could include changes in broad land use policies, resources, or economies that result from changes in land uses or in the long-term availability of water resources that are caused by Program actions. Potential indirect impacts of the Program include changes in the number of acres in developed use.

7.4.5 SIGNIFICANCE CRITERIA

Impacts on urban land use are considered potentially significant if implementation of a Program action would:

- Displace residents.
- Displace current urban land uses.
- Conflict with applicable environmental plans or policies of federal, state, or regional agencies with jurisdiction over land use.
- Conflict with city or county general plan designations or zoning.
- Disrupt or divide the physical arrangement of an established community.

7.4.6 NO ACTION ALTERNATIVE

Under the No Action Alternative, urban development trends in California would continue, as population levels are projected to increase. Acres would continue to move from other categories to the urban land use category. Projects listed in Attachment A for the No Action Alternative generally would not generate new urban lands, as the projects primarily would be implemented on agricultural lands, wetlands, or land use categories other than urban. Projects planned under the No Action Alternative are expected to result in an improvement in water supply reliability for urban communities.

7.4.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For urban land use, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as described in Section 7.4.8.

7.4.7.1 DELTA AND BAY REGIONS

Ecosystem Restoration Program

The Ecosystem Restoration Program includes converting lands in the Delta Region for habitat and ecosystem restoration, levee setbacks, and floodways. Potentially significant impacts on urban land use would depend on the actual location of the modifications and improvements; however, these actions most likely would affect agricultural land uses rather than urban land uses. Increased flood protection would benefit urban land uses in the Delta and Bay Regions. Displacement of residents from Ecosystem Restoration Program actions is considered a potentially significant adverse impact; however, mitigation is available to lessen the severity of the impact.

Water Quality Program

The Water Quality Program focuses on source control of water quality and reducing the release of pollutants into the Bay-Delta system and its tributaries. The program is not anticipated to result in any significant direct or indirect impacts on urban land uses.

Levee System Integrity Program

The Levee System Integrity Program would acquire new rights-of-way and construct setback levees to increase flood protection in the Delta Region. Most Levee System Integrity Program actions likely would occur on agricultural land. The Levee System Integrity Program would provide indirect beneficial impacts on urban land uses in the Delta Region from increased flood protection. The only Levee System Integrity Program actions in the Bay Region involve upgrading levees in the Suisun Marsh. These actions are not expected to result in any direct or indirect impacts on land use in the Bay Region.

Water Use Efficiency Program

The Water Use Efficiency Program is not anticipated to directly affect urban land use. The program relies on incentives, technical assistance, and policies carried out by local agencies to achieve its goals. Indirect changes in urban land use could result from the Water Use Efficiency Program, such as changes in landscape materials. These impacts are considered less than significant.

Water Transfer and Watershed Programs

It is unlikely that the Water Transfer and Watershed Programs would affect urban land use in the Delta and Bay Regions.

Storage

Developing new surface water storage or enlarging existing storage reservoirs could result in beneficial and potentially significant adverse impacts on urban land use in the Delta and Bay Regions. Beneficial impacts would include increased flood protection for urban land uses. All potentially significant construction-related impacts can be mitigated to a less-than-significant level. Improvements in water supply reliability resulting from the Storage program could affect urban land uses by inducing growth (see "Growth-Inducing Impacts" under Section 7.4.10, "Additional Impact Analysis"). Because specific locations of facilities have not been identified, the compatibility and consistency of potential actions with county and city general and local plans are not evaluated in this analysis. However, inconsistency between program elements and these plans could result in a potentially significant adverse impact on urban land use. Mitigation is available to lessen the impact to a less-than-significant level.

7.4.7.2 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs

These programs are not anticipated to affect urban land use in the Sacramento River or San Joaquin River Region.

Storage

The only potentially significant adverse urban land use impacts in the Sacramento River and San Joaquin River Regions are related to water storage. The impacts associated with the Storage Program in these regions would be similar to those described for the Delta and Bay Regions. Because specific locations of facilities have not been identified, the compatibility and consistency of potential actions with county and city general and local plans are not evaluated in this analysis. However, inconsistency between Program elements and these plans could result in a potentially significant adverse impact on urban land use. Mitigation is available to lessen the impact to a less-than-significant level.

7.4.7.3 OTHER SWP AND CVP SERVICE AREAS

All Programs

The Program alternatives are unlikely to result in potentially significant adverse direct or indirect impacts on urban land uses in the Other SWP and CVP Service Areas. Please see Section 7.4.10 regarding potential growth-inducing impacts.

7.4.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For urban land use, the Conveyance element results in environmental consequences that differ in magnitude and location among the alternatives, as described below.

7.4.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. No impacts on urban land use are expected as a result of the diversion facility.

Conveyance components such as channel widening and dredging could require relocating some commercial uses and a few scattered residences. Scattered residences are often on island perimeters adjacent to the levees. Impacts on urban land use resulting from these modifications could be potentially significant but can be mitigated to a less-than-significant level. (Please see Section 5.7, "Transportation," and Section 7.6, "Utilities and Public Services," for associated impacts.)

7.4.8.2 ALTERNATIVES 1, 2, AND 3

Generally, beneficial and adverse impacts associated with the Conveyance element would be the same as those described for the Preferred Program Alternative, but impacts would differ according to the magnitude and location of conveyance facilities.

Under Alternative 3, an isolated conveyance facility primarily would affect agricultural land uses; therefore, impacts on urban land uses most likely would be negligible. Constructing the isolated facility could displace residents or conflict with general plans and zoning ordinances. These potentially significant impacts can be mitigated to a less-than-significant level. Conflicts with general plans and zoning ordinances cannot be determined at this programmatic level of analysis.

7.4.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were the same impacts as those identified in Sections 7.4.7 and 7.4.8, which compare the Program alternatives to the No Action Alternative.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative.

The analysis indicates that improved flood control resulting from the Levee System Integrity Program would benefit urban land uses, when compared to existing conditions.

The potentially significant adverse impacts related to urban land use that are associated with the Preferred Program Alternative include:

- Displacement of existing commercial uses and residents from Program actions located in urban land use areas.
- Physical disruption or division of established communities.
- Potential conflicts of habitat development and storage and conveyance facilities with general plan land use designations or zoning if located in urban use areas.

No potentially significant unavoidable impacts related to urban land use are associated with the Preferred Program Alternative.

7.4.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For urban land use, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.4.1 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate these impacts to a less-than-significant level. At the programmatic level, the analysis did not identify any impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level. Sections 7.4.7 and 7.4.8 elaborate on long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on urban land use in the Delta, Bay, Sacramento River, and San Joaquin River Regions: American River Water Resource Investigation, American River Watershed Project, other CVPIA actions not yet fully implemented, Delta Wetlands Project, CCWD Multi-Purpose Pipeline Project, Delta Wetlands Project, ISDP, Montezuma Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento River Flood Control System Evaluation, Sacramento Water Forum process, EBMUD Supplemental Water Supply Project, West Delta Water Management Program, and Sacramento River Conservation Area Program. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.4.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level.

Growth-Inducing Impacts. The proposed improvements in water supply reliability and availability could lead to additional growth in urban areas. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The short-term construction-related impacts of the Preferred Program Alternative on urban land uses that are associated with construction staging areas would be minor and would cease after construction was complete. Long-term indirect effects from improved water quality and availability could include the displacement of current land uses to new urban land as the result of continued population growth. Expansion of population could affect urban land use, but the significance of the impact would depend on where the population growth occurred and how it was managed. Where possible, avoidance and mitigation measures could be implemented as a standard course of action to lessen impacts on urban land use resources.

Irreversible and Irretrievable Commitments. Irreversible commitments of urban land use resources could result from implementing the Ecosystem Restoration Program and the Storage and Conveyance elements. Projects under these programs could convert lands currently in urban land uses to other uses, such as storage or conveyance facilities; however, the amount of acreage involved would result in a less-than-significant impact. The building of such facilities could result in an irreversible or irretrievable commitment of such resources as construction material, labor, and energy resources. If improved water quality and supply result in continued urban growth, an irreversible commitment of other land use categories to urban land uses would result.

7.4.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during specific project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

The following strategies could be implemented to mitigate potentially significant adverse impacts on urban land use.

- Selecting and designing Program actions that minimize the displacement of existing residents.
- Selecting and designing Program actions that do not physically disrupt or divide established communities.
- Selecting Program actions, to the extent practicable, that are consistent with local and regional land use plans. This could include consulting and working with local jurisdictions affected by Program actions early in the Phase III planning and environmental review process.
- Notifying all affected persons (for example, residents, property owners, school officials, and business owners) in the project area of the construction plans and schedules. This could include arranging schedules for road detours with residents and businesses to maintain access to homes, schools, and businesses; as well as providing protection, relocation, or temporary disconnection of utility services.

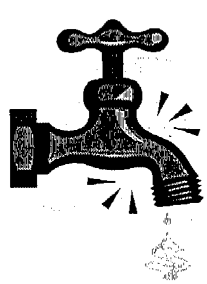
- Providing relocation assistance to displaced persons or businesses.
- Minimizing the amount of permanent easement required for construction of facilities and consulting with property owners to select easement locations that would lessen property disruption and fragmentation, if applicable.
- Relocating roads and utilities prior to project construction to ensure continued access and utility service through the project area.
- Preparing a detailed engineering and construction plan as part of the project design plans and specifications, and including procedures for rerouting and excavating, supporting, and filling areas around utility cables and pipes in this plan.
- Verifying utility locations through consultation with appropriate entities and field surveys (such as probing and pot-holing).
- Reconnecting disconnected cables and lines promptly.

7.4.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable impacts on urban land use are associated with the Preferred Program Alternative.

7.5 Urban Water Supply Economics

The CALFED Bay-Delta Program would both benefit and adversely affect urban water supply economies. Many of these economic effects cannot be determined until more project-specific information is available.



7.5 Urban Water Supply Economics

Urban water supply economics relates to the factors and relationships that determine the costs of water for urban uses. Many factors are involved, including the demand for and supply of water resources, the costs of building facilities to supply water, the costs of treating water, and the costs and availability of alternative water supplies. At this programmatic level of analysis, much of the information needed to specifically analyze the costs and benefits of CALFED Bay-Delta Program (Program) actions to urban water supply economics is not available and will not be available until specific sizes, locations, and other specifications of projects are known. In practice, integrated water management would be used to develop efficient urban water supply and quality measures, using a least-cost planning perspective. This section presents a general discussion of the effects of Program actions on urban water supply economics and notes where information is not adequate to discuss effects.

7.5.1 SUMMARY

Preferred Program Alternative. The Ecosystem Restoration Program could benefit urban water suppliers and users by lower regulatory costs. Some undesirable water quality constituents such as organic carbon could be increased by land conversion to wetlands in the Delta, and additional treatment costs may be required. No cost estimates or cost-sharing guidelines are currently available, but the share of costs paid by urban providers could be an adverse effect.

The Water Quality Program could benefit urban water suppliers and users by improved source water quality, lower treatment and regulatory costs, and relocation of water supply intakes. No cost estimates or cost-sharing guidelines are currently available.

The Water Use Efficiency Program will require expenditures to obtain conservation and water reuse goals. The magnitude of these costs in relation to No Action Alternative conservation costs is uncertain. Water revenue reductions and program costs may require water price increases, but costs of new supplies would be avoided.

The Long-Term Levee Protection Plan could benefit urban water providers by reducing the risk of export interruptions caused by levee failure. Currently, it is not clear who would pay the costs of about $1.5 billion. Therefore, economic effects on urban water providers cannot be estimated.

The Water Transfer Program could affect urban water providers in many ways, including water supply, supply costs, and water quality. The availability of water transfers might affect selection of local supplies and other imported supplies. Water transfers may facilitate urban land use and development where water supply constraints otherwise would limit growth.

The Watershed Program would provide technical assistance and funding for watershed activities and protection relevant to achieving Program goals and objectives. The program would be phased to allow for adaptive management. No cost information is currently available.

Storage and conveyance features and improvements are expected to benefit water supply economics for CVP and SWP urban water providers. Benefits involve water quality as well as quantity. The significance of these benefits will depend on population growth, baseline conditions unique to each provider and the amount of storage included in the staged implementation of the Preferred Program Alternative.

Total water supply increases under 2020 conditions with new storage range from 700 TAF to 1.3 MAF in dry and critical periods, and from 700 TAF to 1 MAF over the long-term period. The share of this water to be provided to agriculture is currently unknown. However, a range of assumptions on water management and allocation suggests that urban users would receive 190-480 TAF of new supplies in dry and critical years, and 100-300 TAF annually over the long-term period.

Most urban water supply benefits would occur in the South Coast Region. DWR's least-cost analysis suggests that costs of conservation, recycling, and drought shortage avoided by new surface storage supplies amount to $450-$1,500 per acre-foot of new average water delivery. Total South Coast Region annual average benefits would range from $5 to $85 million without new storage, and from $80 to $250 million with new storage, depending on management criteria and allocation priority. Benefits in the Bay Region are less because the share of new water supply is less and the per-unit benefit is less. The Bay Region has limited need for new water supplies in average hydrologic conditions. Total Bay Region annual average benefits would range from $0.5 to $4.5 million without new storage, and from $2.5 to $13.0 million with new storage, depending on management criteria and allocation priority.

Benefits of new supply options are contingent on water management criteria, allocation priority, and the costs and amounts of water saved by Water Use Efficiency Program actions. All Program alternatives include the Water Use Efficiency Program. If recycling and conservation are implemented at levels suggested by the Water Use Efficiency Program, much of the value of new water supplies would not occur simply because the high amounts of recycling and conservation eliminate the need for the new supplies. If, on the other hand, the new supplies are allowed to replace some of the new recycling and conservation, the benefit of the new supplies is equal to the costs of Water Use Efficiency Program measures avoided. This benefit could be very large because costs of some Water Use Efficiency Program measures also could be large.

Conveyance improvements are expected to affect economics associated with salinity and disinfection by-product (DBP) precursors. Reduced salinity costs could approach $100 million annually. These values may be substantially affected by many factors that currently are uncertain. Some stakeholders feel that benefits are overstated. For example, increased use of reverse osmosis (RO) for water treatment in any case and subsequent reduction of baseline salinity levels could substantially reduce these benefits.

Economic benefits associated with DBP precursors have not been estimated, but bromide concentrations could be reduced by improved Delta conveyance. The cost for RO to remove DBP precursors could amount from $200 to $500 per acre-foot of Delta water for potable use, and some of this cost might be avoided by improved Delta conveyance. Future economic analysis would be complicated by changing technology and drinking water quality requirements. In particular, ultra-violet (UV) treatment technology may eliminate the need for RO and would substantially reduce the economic benefits of improved conveyance associated with DBPs.

Total costs of the storage and conveyance components are estimated at $4-$12 billion. The allocation of these costs among water users and other interests is unknown. Storage and conveyance cost repayment is expected to adversely affect water supply economics. The significance of these adverse effects will depend on cost allocation and repayment requirements that will be developed in the staged implementation of the Preferred Program Alternative.

Alternatives 1, 2, and 3. The pattern of potential beneficial and adverse effects on urban water supply economies associated with Alternatives 1, 2, and 3 is largely the same as described for the Preferred Program Alternative. These alternatives differ from the Preferred Program Alternative primarily in the effects on conveyance costs and water quality costs. Due to the programmatic nature of this document, the costs cannot be determined at this level of analysis.

7.5.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Given the programmatic nature of this document, these areas of controversy cannot be addressed; however, subsequent project-specific planning and environmental analysis will evaluate these topics in more detail. Differing opinions involve the following issues:

- The amount of RO or other treatment technologies in place in 2020 (regardless of conveyance facilities) is currently unknown but could substantially influence water quality benefits from the Conveyance element.
- How the economic benefits of changes in concentrations of DBP precursors can be evaluated.
- How costs can be allocated and recovered for Program actions and facilities.
- How water will be allocated to urban water users because of the uncertainty of the irrigation users' willingness to pay.

The Program recognizes the importance of urban water supply economics to regions potentially affected by Program actions. The costs, benefits, and patterns of urban water supply cost allocation for Program actions have yet to be developed. Economic effects cannot be identified until the location of specific projects and allocation of water are identified.

It should be noted that social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic or social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic or social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project. Methods to avoid or reduce adverse social and economic effects are also presented in this chapter.

7.5.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

In an economic analysis, the specific groups of affected persons must be described. The term "provider," as used in this section, includes all persons with a direct economic stake in water supply and costs. End-users of water, shareholders in private water utilities, and any public or private interests who pay any part of the costs or receive the benefits of water services qualify as a provider.

Parts of the San Felipe Division of the CVP are included under both the Bay Region and the Other SWP and CVP Service Areas in the "Affected Environment/Existing Conditions" descriptions. For the remainder of the urban water supply economic analysis, however, the San Felipe Division of the CVP is included only under the Bay Region.

7.5.3.1 DELTA REGION

The Delta urban providers include the cities of Pittsburg, Antioch, Tracy, Brentwood, Isleton; parts of Stockton and Sacramento; and a variety of small communities and residential users around the Delta.

Total urban water use in the Delta has increased over time with the increase in population. Figure 7.5-1 shows population trends for some Delta urban providers.

Table 7.5-1 shows population, water use, and cost data for some major Delta providers. Industrial use occurs within the service areas of these providers, and a few large industrial users divert a significant share of total urban use within the Delta. Daily total and per capita usage (gpcd) varies considerably by season.

Figure 7.5-2 shows 1980-1990 use by the Delta providers as a percentage of 1990 use. Costs of existing and additional water supplies for Delta providers differ substantially, depending on existing and potential sources of water. Water costs in CCWD, in the City of Tracy and, to a lesser degree, in Sacramento and Stockton are affected by CVP policies. In many locations, raw water costs will be affected by groundwater development and extraction costs.

In 1992, the City of Tracy filed a water rights application with the SWRCB to divert water from the Delta near the Westside Irrigation District pump station on Wicklund Road. The City also may propose to convert existing agricultural rights to urban uses as the land is developed, and may propose to wheel both of these supplies through the Delta-Mendota Canal to the City's water treatment plant. The 1998 CVP contract rate for the City of Tracy was $37.02 per acre-foot, plus a Central Valley Project Improvement Act (CVPIA) restoration fund charge of $13.76.

The City of Sacramento serves water to a section of the city within the Delta. Much of this area is commonly known as "the Pocket." The Delta also includes part of south Sacramento. The City provides water from the Sacramento and American Rivers and from groundwater. The City does not divert surface water from within the Delta Region.

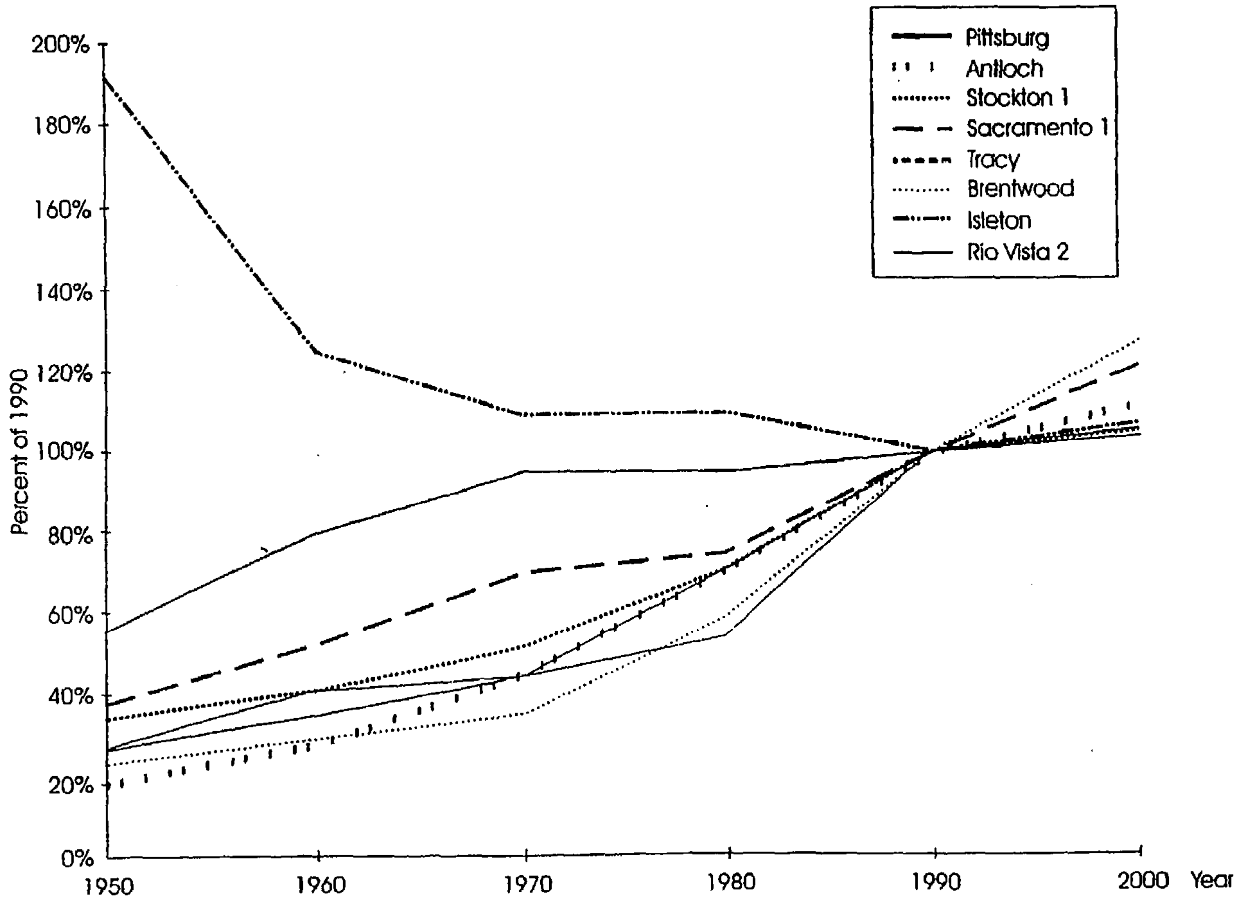


Figure 7.5-1. Population Trend for Some Delta Region Municipal and Industrial Providers as a Percentage of 1990 Population

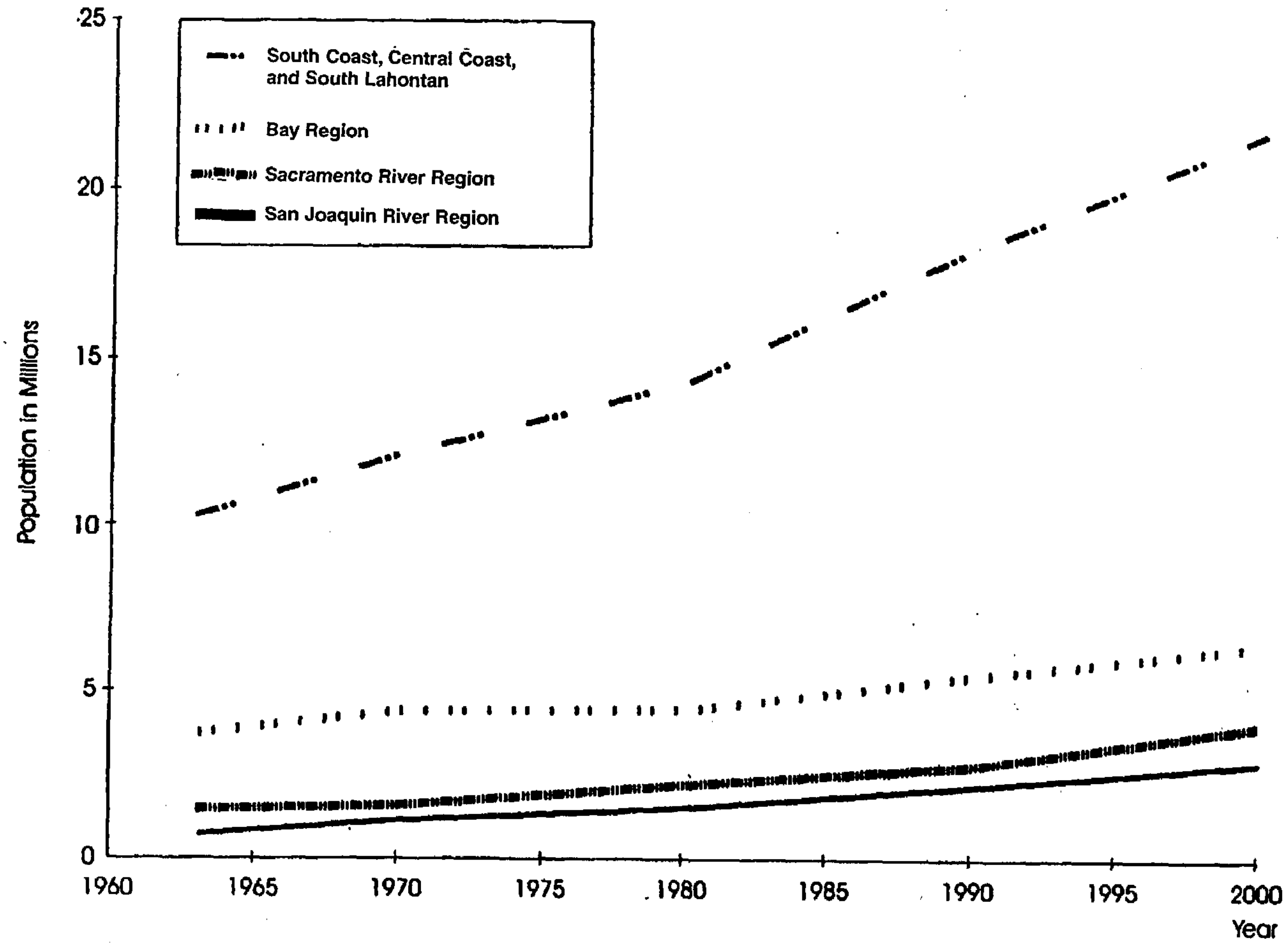


Figure 7.5-2. Bay Region Population Trends by Program Region, 1963 to 1990, and Predicted Population, 2000

Table 7.5-1. Characteristics of Some Delta Region M&I Providers

PROVIDER	POPULATION (1995)	POPULATION (1990)	WATER INTO SYSTEM (1990 mg)	WATER INTO SYSTEM (1990 af)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	AVERAGE COST ($/af)
Pittsburg	50,400	47,564	3,066	9,411	12,313	176	100	99	100	$952
Antioch	69,500	62,195	3,823	11,734	18,801	168	64	100	100	$702
Stockton[a]	226,300	210,943	17,130	52,578	64,179	183	52	100	52	$311
Sacramento[a]	391,100	369,365	37,157	114,048	111,785	272	0	3	95	$165
Tracy	40,500	33,000	3,345	10,267	9,964	270	42	100	42	$485
Brentwood	9,675	7,563	532	1,633	2,278	193	0	100	0	N/A
Isleton	870	833	83	255	353	273	0	100	0	N/A
Rio Vista[b]		3,316	370	1,136	1,403	306	0	14	0	N/A

Notes:
af = Acre-feet.
mg = Million gallons.
N/A = Not applicable.

[a] Only part of the provider is located in the Delta.
[b] Borders the Delta.

Source:
DWR 1994.

West Sacramento serves urban uses west of the Sacramento River and within the Delta. Surface water and groundwater are used. Approximately 9.7 TAF were diverted into the system in 1995, of which approximately 9 TAF were surface water. Surface water is taken from the Sacramento River under water rights and a CVP contract at a point within the Delta just north of I-80. The 1998 CVP contract rate was $15.47 per acre-foot, plus the restoration charge.

The City of Stockton is served by three purveyors: the California Water Service Company, the City of Stockton, and San Joaquin County. Each of these agencies serves parts of the Delta. The only direct diversion of water from the Delta is for several golf courses and small landscape uses. Most urban water originates from groundwater, from the Calaveras River through Stockton East Water District, and from the Stanislaus River through the CVP. The share of supplies provided by surface water and groundwater varies according to hydrologic conditions. The City supplies a small parcel in the Delta with reclaimed water.

CCWD serves lands within and outside the Delta in Contra Costa County. CCWD currently provides municipal water in the Delta for the cities of Antioch and Pittsburg and to Diablo Water District. Most of CCWD's water is obtained through a 195-TAF contract for CVP water, which is pumped from the Delta into the Contra Costa Canal from Rock Slough. CCWD also can pump up to 26.7 TAF annually from Mallard Slough and has agreed to use up to 21 TAF per year of East Contra Costa Irrigation District (ECCID) water to serve urban demands within ECCID. Existing raw water costs for CCWD are influenced by CVP rate-setting policies and the CVPIA. The 1998 CVP contract rate was $42.79 per acre-foot, plus the restoration charge. Water costs to wholesale buyers and also at the retail level are being affected by the Los Vaqueros Project. This project provides emergency water supply and stores high-quality water during the wet season for blending with Delta supplies during the dry season.

The City of Antioch obtains its supply from CCWD and from a separate Delta diversion under a 7,670 acre-foot right. The diversion and treatment facility can handle up to 8.2 million gallons per day (9.3 TAF per year), but water quality limits that amount. The salinity of the water at the diversion determines when water will be diverted, as well as the share of the City's water provided by the diversion as opposed to that supplied by CCWD. Typically, diversion ceases when salinity reaches about 200 parts per million (ppm), but diversion may continue at higher salinity if water quality (as a function of the tidal cycle) is expected to improve. As suggested by Table 7.5-1, Antioch is able to supply about 35% of its water needs with this diversion.

The City of Brentwood currently relies on groundwater for its water supplies, but the City has an agreement with CCWD to acquire up to 7 TAF annually in the future. Some of this need will be met with the 21 TAF CCWD has agreed to distribute for ECCID.

Additional towns and communities in the Delta Region not included in Table 7.5-1 or in the discussion above include Bethany, Bethel Island, Byron, Collinsville, Courtland, Discovery Bay, Four Corners, Freeport, Hood, Oakley, Ryde, San Joaquin City, Terminous, and Walnut Grove. Most of these towns are served by a larger provider, a small district, or individual groundwater wells. Oakley is served by Diablo Water District, which obtains raw water from CCWD. The City of Antioch is the purveyor for the Discovery Bay area. Bethel Island residential users are served by several small water districts.

Other industrial users in the Delta divert water under individual water rights. CCWD lists the following industrial water users and their annual diversion right: Gaylord Container Corporation (28 TAF), El Dupont De Nemours & Co. (Dupont) (1,405 acre-feet), Tosco Corporation Lion Oil Division (16,650 acre-feet), and USS Posco (12.9 TAF). Dupont obtains most of its water needs through Diablo Water District. All of these users, except for Dupont, also obtain water through CCWD. Shell Oil also is an important industrial customer for CCWD, diverting about 10 TAF annually from the Contra Costa Canal. Total industrial water sales by CCWD ranged from 27 to 48 TAF between 1984 and 1993, accounting for about one-third of CCWD's raw water demand.

7.5.3.2 Bay Region

Early in the state's history, population growth along the coast outstripped the ability of the coast's small and seasonally dry watersheds to provide adequate water supplies. Urban providers built projects, such as the Hetch-Hetchy, to bring water from more reliable supplies. Continued growth led to projects such as the SWP and CVP. The Bay Region includes areas served by any of four facilities that export water from the Delta for urban use: Contra Costa Canal and the San Felipe Division of the CVP, and a portion of the NBA and the SBA service areas of the SWP. In addition, some other areas are affected because of water exchanges that occur involving the Hetch-Hetchy and South Bay Aqueducts.

Figure 7.5-2 shows population in the Bay Region from 1963 to 1990 and projected population to 2000. The region's population increased from about 4.537 million in 1970 to 5.484 million in 1990, for an annual growth rate of 2.25%. The growth rate slowed between 1990 and 1995 but picked up again in the late 1990s.

Table 7.5-2. Per Capita per Day Water Use, Bay Region, 1968 to 1990 (gallons)

YEAR	ALL USES
1990	193
1980	180
1968	179

Sources:
DWR 1994, 1983, and 1970.

Increased real incomes and new water-using technologies increased per capita use. As urbanization spread eastward in the region, the warmer climate and increased average lot size increased average per capita use. More recently, urban water conservation measures have slowed these trends. Table 7.5-2 shows per capita water use in the Bay Region in

1968, 1980, and 1990. Since 1968, per capita use has increased slightly, probably due to new residential development in the warmer, more inland portions of the region.

The Bay Region currently relies on the SWP and CVP for about 30% of its urban water demands. Without the East Bay Municipal Utilities District (EBMUD), the share rises to about 40%. Table 7.5-3 shows recent imports into the region through the SWP and CVP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. Most imported water is delivered through the Contra Costa Canal and the SBA, with smaller shares delivered through the CVP's San Felipe Division and the NBA. Table 7.5-4 shows characteristics of some Bay Region urban providers. Daily total and per capita usage (gpcd) varies considerably by season.

Costs of existing and future water supplies are affected by the mix of supplies and their costs. DWR estimated that groundwater for urban use in the region costs from $85 to $330 per acre-foot. Costs of CVP supplies currently range from $42 to $95 per acre-foot, plus the restoration fund charge of about $14. DWR estimated SWP unit water charges for North and South Bay contractors of $212 and $109 per acre-foot, respectively. Because local water supplies generally are fully utilized, future supply increases are likely to come from additional water imports or reclamation. The region generally has adequate water supplies during average conditions, but supply deficits are a problem in dry conditions. Water transfers and conservation were used during the recent drought to attain a balance between supplies and demand, and this pattern is expected to continue in the future.

Three subregions within the Bay Region are internally independent in terms of water supply: the North Bay, the South Bay, and CCWD. The North Bay consists of SWP entitlement holders served by the NBA of the SWP and others who have used or could use this facility in exchanges. Two water districts are served by the NBA: Napa County Flood Control and Water Conservation District (NCFCWCD), and Solano County Flood Control and Water Conservation District (SCFCWCD). NCFCWCD serves SWP water in southern Napa County. SCFCWCD serves the cities of Vallejo, Vacaville, Fairfield, Benicia, and Suisun City. The two districts have transferred water and obtained surplus water through the facility. In addition to SWP entitlement water, Vallejo receives water-rights water through the NBA.

Table 7.5-3. M&I Water Delivered to the Bay Region by the SWP and CVP, 1990 to 1994 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Contra Costa Canal	186,679	153,363	109,576	93,267	134,903
San Felipe Division	65,390	53,352	69,530	56,066	81,842
State Water Project					
North Bay Aqueduct	26,071	8,352	16,171	24,234	--
South Bay Aqueduct	156,737	50,259	76,661	124,180	--
Total	**434,877**	**265,326**	**271,938**	**297,747**	**216,745**

Notes:
Does not include water rights deliveries or water transfers.
-- = Not available.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-4. Characteristics of Some Bay Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mg)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Vallejo	109,199	7,087	35,000	178	79	100	100	--
Fairfield	77,211	5,405	19,088	192	100	100	100	--
Vacaville	71,479	4,720	20,412	181	53	100	53	--
San Francisco	723,959	31,685	164,892	120	0	100	100	$484
Palo Alto	56,000	4,465	18,912	218	100	100	100	--
San Jose	873,714	41,154	201,150	129	47	100	55	$664
Santa Clara	93,800	7,988	23,031	233	38	100	38	--
Sunnyvale	117,229	7,606	27,434	178	80	100	80	--
Pleasanton	50,570	4,818	16,195	261	68	98	68	--
Concord	190,000	12,107	54,538	175	100	100	100	--

Note:
af = Acre-feet.
mg = Million gallons.
-- = Not available.

Source:
DWR 1994.

The South Bay is served by the SBA, an SWP facility, and through CVP contract supplies supplied through the San Felipe Division. Three SWP entitlement holders—Alameda County Water District, Alameda County Zone 7, and the Santa Clara Valley Water District (SCVWD)—are located in the South Bay. SCVWD also is served by the San Felipe Division of the CVP and wholesales water in a large part of the south San Francisco Bay.

For this analysis, the CCWD subregion includes that portion of the district not within the Delta. This area includes the cities of Concord, Walnut Creek, Pleasant Hill, and Martinez, and other areas south and west of the Delta.

Per capita use is generally greatest in the southern and eastern parts of the Bay Region. Many providers rely entirely on water wholesalers for their supplies. Water users in the region are almost entirely metered, and groundwater is an important part of supply for some providers.

7.5.3.3 SACRAMENTO RIVER REGION

The Sacramento River Region includes the CVP service areas of urban providers in the Sacramento Valley and a small SWP service area in the Feather River Basin.

The first use of the Sacramento River Region by Europeans was for grazing and trapping, but the first significant immigration into the region involved the Gold Rush period of 1849 through the late nineteenth century. Most of the population lived in mining communities in the foothills, and Sacramento grew first as a port for delivery of goods and people from San Francisco, and later as the terminus of the first transcontinental railroad. Agriculture developed to serve the mining communities, and the designation of Sacramento as the state capitol led to additional growth. Economic patterns in the twentieth century have mirrored national trends as services, trade, and government have become larger shares of the economy, while mining and agriculture have declined in relative terms.

The historical population trend in the Sacramento River Region from 1963 to 1990 and the projected population to 2000 is shown in comparison to other regions in Figure 7.5-2. Population increased from about 1.227 million in 1970 to 2.209 million in 1990, for an annual growth rate of 8.26%. The growth rate slowed in the early 1990s but increased in the late 1990s.

Table 7.5-5 shows per capita water use in the Sacramento River Region in 1968, 1980, and 1990. Since 1968, average per capita use has declined, possibly due to smaller lot sizes, conservation measures in new residential developments, and more multi-family housing.

Table 7.5-5. Per Capita per Day Water Use in the Sacramento River Region, 1968 to 1990 (gallons)

YEAR	ALL USES
1990	301
1980	305
1968	351

Sources:
DWR 1994, 1983, and 1970.

The Sacramento River Region generally has adequate supplies, even during drought. Some providers have excess supplies in the form of unused contracts, water rights, and excess groundwater capacity. There are some exceptions, for example, in areas of El Dorado County and in the east side of the Sacramento metropolitan area. Some providers depend entirely on CVP water service contract supplies for their water, and these supplies can be reduced in dry conditions. DWR estimated that urban groundwater in the region costs from $50 to $80 per acre-foot. CVP contract supplies currently cost anywhere from $9 to $59 per acre-foot, plus CVPIA restoration costs. Some CVP water users have no other supplies. For these providers, drought conservation and water transfers may be used in the future to obtain a balance between supply and demand.

The Sacramento Valley has relatively abundant water supplies of good quality in comparison to the other regions. The region also differs from the other regions in that it does not use urban water exported directly from the Delta. Rather, surface water diversions reduce the amount of surface water flowing into the Delta.

Most urban water use in the region occurs in the Sacramento metropolitan area. Most surface water use in the region is diverted from the American River under CVP contracts. Direct diversions from the Sacramento River may provide a larger share of supplies in the future. Another large user is the City of Redding, and the CVP provides municipal water service to about 10 small urban providers in the Redding area.

Table 7.5-6 shows recent diversions for urban use for the Sacramento River Region delivered through CVP and SWP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. Most providers in the region have water service contracts that exceed their immediate needs; therefore, reductions in deliveries during the drought were not as noticeable as in some other regions.

Table 7.5-7 shows some characteristics of Sacramento area urban providers. Per capita use rates are among the highest in the state, reflecting climate, landscaping, and pricing factors. Daily total and per capita usage (gpcd) varies considerably by season. Some providers rely entirely on the CVP for their supplies. A large share of water users in the region are not metered. Groundwater is the sole source of supply for some providers; however, some rely entirely on surface water deliveries, especially CVP water-service water. Water costs per acre-foot delivered are generally low in comparison to other regions.

Table 7.5-6. M&I Water Delivered to the Sacramento River Region by the SWP and CVP (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Clear Creek Unit	1,451	659	2,460	2,076	2,329
Cow Creek Unit	3,342	1,817	3,206	5,342	6,674
Folsom Dam and Reservoir	27,454	40,743	23,360	20,895	30,693
Folsom South (SMUD)	5,829	3,600	3,564	1,673	1,727
Sacramento River	8,900	7,753	7,945	8,314	9,321
Shasta Dam and Reservoir	1,852	1,417	1,017	2,694	1,338
Spring Creek conduit	638	337	777	885	688
Toyon pipeline	2,471	2,071	2,537	2,164	2,479
State Water Project					
Feather River area	1,448	866	2,128	3,476	--
Total	**53,385**	**59,263**	**46,994**	**47,519**	**55,249**

Notes:
SMUD = Sacramento Municipal Utility District.
-- = Not available.
Does not include water rights deliveries or water transfers.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-7. Characteristics of Some Sacramento River Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mg)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Redding	66,462	6,890	21,112	284	70	100	70	$254
Sacramento, Citizens Utility	166,000	16,055	46,064	265	0	100	0	--
Fair Oaks	38,005	4,949	12,641	357	95	6	95	--
Roseville	44,685	4,642	17,249	285	100	10	100	--
Sacramento, City of	369,365	37,157	111,785	276	0	2	95	$165
Orangevale/ Roseville	20,000	4,309	6,402	590	100	6	100	--
Carmichael	38,550	4,191	10,830	298	60	5	60	--

Notes:
Metered percentage based only on available data for all service connections.
af = Acre-feet.
GPCD = Gallons per capita per day.
mg = Million gallons.
-- = Not available.

Source:
DWR 1994.

7.5.3.4 San Joaquin River Region

The San Joaquin River Region includes only those urban providers in the San Joaquin Valley with some current or planned use of CVP or SWP supplies exported from the Delta. CVP water service contracts in the region that may be affected are served by the Delta-Mendota or San Luis Canal. SWP entitlements are served via the California Aqueduct.

The historical population trend in the San Joaquin River Region from 1963 to 1990 and the projected population to 2000 are shown in comparison to other regions in Figure 7.5-2. Population increased from about 1.676 million in 1970 to 2.974 million in 1990, for an annual growth rate of 7.72%. The growth rate slowed between 1990 and 1995 but picked up in the late 1990s. Table 7.5-8 shows per capita water use in the San Joaquin River Region in 1968, 1980, and 1990. Since 1968, per capita use has declined, probably in response to smaller lot size, more use of modern conservation in new housing, and perhaps changing patterns of water use in industry and commerce.

Table 7.5-8. Per Capita per Day Water Use, San Joaquin River Region 1968 to 1990 (gallons)

YEAR	ALL USES
1990	309
1980	355
1968	436

Source:
DWR 1994.

Table 7.5-9 shows recent imports into the San Joaquin River Region through SWP and CVP facilities. These data show the influence of the recent drought and reduced allocations, especially in 1991 and 1992. Most Delta water delivered into the San Joaquin River Region is provided to Kern County Water Agency (KCWA). The City of Bakersfield obtains SWP urban supplies through KCWA. This water is delivered for several uses within Kern County in exchange for groundwater pumped by the City of Bakersfield.

Table 7.5-10 shows characteristics of some San Joaquin Valley urban providers. Per capita use rates are generally higher than in the coastal regions, reflecting climate and landscaping factors.

Local water supplies are often unable to meet local demands, and supplemental water is exported from the Delta. SWP and CVP water is pumped from CCFB in the Delta and is transported into the region via the California Aqueduct and the Delta-Mendota Canal.

The largest CVP urban water users in the San Joaquin River Region are Avenal, Coalinga, Huron, and Westlands Water District; but small amounts of urban water are taken by a number of other districts. Stockton East is included in this group, with a CVP contract of 38 TAF. Urban water use in the Friant Division of the CVP is not included in this analysis.

7.5.3.5 Other SWP and CVP Service Areas

The Other SWP and CVP Service Areas include the service areas of all SWP entitlement holders in the central coast and south of Kern County. The single largest provider is The Metropolitan Water District of Southern California (MWD) in DWR's South Coast Region. The South Coast Region urban water demand exceeds the demands of all other urban regions combined. The South Coast Region includes Ventura, Los Angeles, and Orange Counties and the western portions of San Diego, Riverside, and San Bernardino Counties. The Other SWP and CVP Service Areas also include service areas receiving SWP water in DWR's Central Coast Region, the Antelope Valley and Mojave River Planning Subareas of the

South Lahontan Region, and the Coachella Planning Subarea of the Colorado River Region. Central Coast SWP contractors are Santa Barbara County Flood Control and Water Conservation District and San Luis Obispo Flood Control and Water Conservation District. The Central Coast SWP contractors are served by deliveries through the Coastal Aqueduct of the SWP.

Table 7.5-9. M&I Water Delivered to the San Joaquin River Region by the SWP and CVP, 1990 to 1994 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Cross Valley Canal	459	407	297	0	0
Delta-Mendota Canal	5,531	5,586	7,221	8,005	7,843
San Luis Canal	12,996	10,528	15,098	11,787	14,374
State Water Project					
Kern County Water Agency	127,837	33,122	56,305	94,220	--
Total	**146,823**	**49,643**	**78,921**	**114,012**	**22,217**

Notes:
Does not include water rights deliveries or water transfers.
-- = Not available.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-10. Characteristics of Some San Joaquin River Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mg)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Stockton	210,943	17,130	64,179	222	52	100	52	$311
Huron	4,766	284	621	163	100	--	100	–
Coalinga	8,450	1,032	2,665	327	100	16	100	–
Bakersfield, CA Water	172,800	20,222	51,641	321	15	24	15	$263

Note:
af = Acre-feet.
mg = Million gallons.
-- = Not available.

Source:
DWR 1994.

The historical population trend in portions of the Other SWP and CVP Service Areas from 1963 to 1990 and the projected population to year 2000 are shown in comparison to other regions in Figure 7.5-2. This figure shows population in DWR's Central Coast, South Coast, and South Lahontan Regions. This population increased from about 12.1 million in 1970 to 18.2 million in 1990, for an annual growth rate of 4.4%. The population growth rate slowed between 1990 and 1995.

Table 7.5-11 shows per capita water use in DWR's Central Coast, South Coast, and South Lahontan Regions in 1968, 1980, and 1990. Since 1970, per capita use in the South Coast Region has increased slightly, probably due to new residential development in the more inland, hotter portions of the region. Per capita use in the Central Coast Region has declined, probably due to high water prices and more intensive water conservation.

Table 7.5-11. Per Capita per Day Water Use, Other SWP and CVP Service Areas, 1968 to 1990 (gallons)

YEAR	ALL USES
South Coast Region	
1990	211
1980	191
1968	179
Central Coast Region	
1990	189
1980	210
1968	194
South Lahontan Region	
1990	278
1980	280
1968	305

Note:
DWR's hydrological regions defined in Bulletin 160-98.

DWR estimated that groundwater for urban use in the South Coast Region costs from $45 to $190 per acre-foot. There is little potential for new yield without intentional recharge or expensive treatment. DWR estimated an SWP unit water charge in the southern California area of $206 per acre-foot.

MWD recently developed an Integrated Resources Plan as a policy guideline for future resource and capital development. Development, treatment, and distribution costs of new Colorado River Aqueduct supplies are expected to cost about $250 per acre-foot; but the yield of these options is limited by the conveyance capacity of the Colorado River Aqueduct. Additional storage, low-cost transfers, and additional SWP supplies would cost around $300 per acre-foot; low-cost reclamation and high-cost transfers, about $400 per acre-foot; high-cost reclamation, about $600 per acre-foot; groundwater recovery about $700; and desalination would cost more than $1,400 per acre-foot.

Table 7.5-12 shows recent imports into the region through SWP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. SWP deliveries to MWD declined 72% from 1990 to 1991 and did not recover until 1993. Similar delivery patterns were experienced by the other SWP urban entitlement holders in the region.

DWR's Bulletin 160-98 estimated that the South Coast Region will experience a year 2020 supply deficit of 0.9 and 1.3 MAF in average and dry years, respectively, or enough to meet the demands of about 4.5 million persons in the average year. Most of this shortage could be eliminated with new supplies, especially reclaimed water and new yield from Colorado River, local and SWP improvements, and conservation. Nevertheless, a substantial supply deficit would remain.

Table 7.5-12. M&I Water Delivered to the Central Coast and South of Kern County by the SWP, 1990 to 1993 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993
State Water Project				
The Metropolitan Water District of Southern California	1,396,423	391,447	707,311	1,408,050
Other southern California	189,483	51,249	105,090	193,092
Total	**1,585,906**	**442,696**	**812,401**	**1,601,142**

Note:
Does not include water rights deliveries or water transfers.

Sources:
Reclamation 1996, DWR 1996.

Table 7.5-13 shows some characteristics of urban providers in the region. In the South Coast Region, only those providers delivering more than 10,000 million gallons (30.7 TAF) annually are included. Per capita use rates generally increase with distance from the coast. Most providers supply a mix of purchased and developed water, and almost all providers use a mix of surface water and groundwater supplies.

Table 7.5-13. Characteristics of Some Providers in the Other SWP and CVP Service Areas

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mg)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Central Coast Region								
San Luis Obispo	41,958	1,560	12,350	102	0	100	59	$890
Goleta	70,480	1,934	13,750	75	76	100	75	$1,381
Santa Barbara	85,571	3,079	24,146	99	61	100	68	$1,364
South Coast Region*								
Carson et al.	101,000	12,667	31,611	344	73	100	73	–
Long Beach	429,433	24,448	87,923	156	65	100	65	$498
Los Angeles	3,485,398	218,809	635,698	172	73	100	89	$462
Glendale	180,038	10,144	32,778	154	93	100	93	$312
Pasadena	131,590	12,629	36,998	263	66	N/A	67	$331
Anaheim	266,406	24,064	55,500	247	49	100	49	–
Fullerton	114,144	10,584	27,890	254	54	100	54	–
Huntington Beach	181,519	12,530	48,571	189	53	100	53	–
Santa Ana	293,742	16,665	43,491	155	25	N/A	25	–
Riverside	226,505	22,217	66,348	269	8	100	8	$268
Ontario	133,179	12,101	28,019	249	46	100	46	–
Rancho Cucamonga	101,409	13,810	32,567	373	46	100	59	–
Fontana	75,000	10,411	28,000	380	100	100	30	–
Mission Viejo	109,250	10,700	37,445	268	100	100	100	–
El Cajon et al.	227,293	13,514	53,347	163	98	100	99	–
San Diego	1,100,549	73,927	235,810	184	100	100	100	$576
Chula Vista & vicinity	135,163	15,986	60,673	324	87	100	96	–
South Lahontan Region								
Palmdale	68,842	6,073	19,626	242	43	100	44	$488

Notes:
DWR's hydrological regions defined in Bulletin 160-98.
af = Acre-feet.
mg = Million gallon.
– = Not available.

* Includes only those providers with 10,000 million gallons per year or more.

Source:
DWR 1994.

MWD's Integrated Resource Plan provides a Preferred Resource Mix for 2020, which includes 512 TAF annually of new conservation; 290 TAF of new water recycling; 40 TAF of groundwater recovery; dry-year yields of 220 and 400 TAF from existing reservoirs and the Diamond Valley Reservoir, respectively;

200 TAF of dry-year yield from conjunctive use; about 700 TAF of additional dry-year SWP supplies; and 300 TAF of water transfers from willing sellers.

7.5.4 ASSESSMENT METHODS

Social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic or social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic or social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project.

In the interest of full disclosure, the Program presents an overview of the concerns and possibilities that could affect urban water supply economics as Program elements are carried out. However, due to the programmatic nature of the document, only general information can be presented at this time; more specific information will be developed under second-tier, project-specific documentation.

Urban water supply economics assessment variables include:

- Water supply benefits and costs
- Water quality benefits
- Water conservation benefits and costs

Water Supply. The urban water supply economics assessment uses preliminary results from DWRSIM and two models of urban water supply economics to estimate the gross benefits of new Program water supplies under 2020 conditions. Water supply benefits are any cost savings on water supplies needed to meet future demands and cost savings on avoided shortage costs.

DWR has provided a preliminary least-cost planning analysis for the South Coast (Note: the terms "South Coast Region" and "Other SWP and CVP Service Areas" are used interchangeably in this analysis) and Bay Regions using a Least-Cost Planning Simulation (LCPSIM) model. The analysis uses a system simulation framework to evaluate the value of imported water. The analysis calculates the percentage of local fixed yield that is no longer cost effective under Program water delivery scenarios. The analysis considers the marginal trade-off between the increment of supply made available by Program alternatives and the regional fixed-yield options that would be built under the No Action Alternative. The analysis also incorporates opportunities for conjunctive use and for shortage contingency water transfers. This analysis assumed that local planners would incorporate least-cost planning principles as part of their decision criteria. Water demands are based on DWR's Bulletin 160-98 2020 levels. The simulation model is described in detail in Section 7.5.15.

Simple models of municipal water costs tailored to each of eight regions also are used. The eight regions are the Redding area, Sacramento area, CCWD, North Bay, South Bay, San Joaquin Valley CVP contractors, San Joaquin Valley SWP contractors, and the South Coast and South Lahontan Regions.

These regions are combined into five regions for this presentation: CCWD, the rest of the Bay Region, the Sacramento Valley, the San Joaquin Valley, and the South Coast/South Lahontan Region. The models provide some information for potentially affected urban water supplies outside the Bay and South Coast Regions. They are used to display No Action Alternative and existing conditions for these regions and provide a basis for comparison with DWRs LCPSIM.

The M&I models methodology is explained in the CVPIA Municipal Water Costs Methodology/ Modeling Technical Appendix. Water demands are based on DWR's Bulletin 160-98 2020 levels. The analysis uses demand and supply functions to estimate water shortage and supply costs. Long-run and short-run residential demand elasticity is equal to -0.20 and -0.10, respectively.

The M&I models are different from the LCPSIM model in the manner in which Water Use Efficiency Program actions are handled. The LCPSIM model uses Bulletin 160-98 baseline information on local supplies. Given the amount of surface water available in each alternative, the LCPSIM model then determines how much conservation and recycling are needed to meet demand. The amounts of conservation and recycling can then be compared to Program to Water Use Efficiency Program water savings to see if program goals were met. The M&I models, on the other hand, use the Water Use Efficiency Program savings in the baseline supplies for each alternative and then determine how much of the new surface water supplies should be used to meet demand.

Because of the programmatic nature of this document, the level of detail used for the analysis is necessarily preliminary in nature. Although the methods and principles described above result in dollar values, substantial uncertainty is associated with these values.

Several important assumptions were made for this urban water supply analysis, including the following:

- No water transfers from the Central Valley were included as alternative supplies, except in the South Coast LCPSIM analysis, where 400 TAF are allowed. This constraint may increase the value of new water relative to existing and actual future conditions because water transfers have recently been, and should continue to be, a low-cost source of supplies.

The DWRSIM preliminary runs used in the analysis, the corresponding alternatives, and the increase in average deliveries are shown in Table 7.5-14. Each alternative was simulated with and without new storage and, to consider uncertainty, each of these simulations were further modeled under two water management criteria. Criterion A assumes project operations to meet current level delivery targets. Differences between these targets and 2020 level demands would be met by alternative supply or demand management options. Also, CVP and SWP facilities are operated to meet additional prescriptive Delta actions above existing conditions. Criterion B assumes a future increase of about 10% in delivery targets, and only existing prescriptive Delta actions are required.

Incremental changes in water exports have been allocated among water users, according to two alternative water allocation assumptions. In the "low priority" allocation, urban users have priority to 20% of new supplies before agricultural users obtain any. In the "high priority" allocation, urban users have a priority to 80% of new supplies.

Limited information on the costs of Program alternatives is used in the analysis. A comparison of all benefits and costs would require estimates of benefits increasing over time with population and economic growth. Since only 2020 conditions are considered, no judgment can or should be made about the potential benefit-cost relations of the Program alternatives.

Water Quality. Water quality constituents that are important to urban water users include salinity (including bromide), organic carbon, and resultant DBPs formed during treatment; turbidity; a large number of man-made chemicals; and microbes. Water quality of urban supplies is affected by the quality of source waters, but changes in quantities of supplies are also important when a provider uses multiple supplies that vary in their quality. Some providers intentionally mix supplies of various qualities to attain their water quality goals.

Water quality and related water treatment costs could be affected by the Water Quality, Ecosystem Restoration, Watershed, Storage, and Conveyance elements. Quantitative analysis of water quality changes is available only for the Conveyance element, and quantitative economic analysis is possible only for salinity. Therefore, a comprehensive analysis of costs and benefits is not possible.

A preliminary economic analysis of salinity damages in Delta export water users' service areas was conducted for some Program conveyance alternatives. The economic analysis of salinity considered quality and quantity. DWR provided estimates of end-of-month salinity at CCFB and Rock Slough for the water years 1976-91 for the Preferred Program Alternative and Alternatives 1, 2, and 3. The salinity data accounted only for differences in salinity caused by the different geometry of conveyance and intake configurations. The data did not account for any differences caused by different export amounts, storage configurations, or the timing of exports or storage releases.

Table 7.5-14. Increase in Average Water Deliveries to Urban Water Users by Water Management Criteria, Storage, and Allocation Scenario for Program Alternatives and Two Urban Regions, Compared to the No Action Alternative (TAF)

	CRITERION A				CRITERION B			
	NO STORAGE		WITH STORAGE		NO STORAGE		WITH STORAGE	
	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Preferred Program Alternative with diversion facility on the Sacramento River								
Bay Region average incremental supply (TAF)	5	9	25	36	6	13	20	38
South Coast average incremental supply (TAF)	10	24	79	118	32	88	117	267
Alternative 1 (Preferred Program Alternative without diversion facility on the Sacramento River)								
Bay Region average incremental supply (TAF)	5	9	26	36	5	13	18	38
South Coast average incremental supply (TAF)	10	22	80	118	31	85	111	266
Alternative 2								
Bay Region average incremental supply (TAF)	5	10	25	35	5	14	11	38
South Coast average incremental supply (TAF)	10	24	78	114	43	122	161	288
Alternative 3								
Bay Region average incremental supply (TAF)	3	5	22	31	4	13	20	38
South Coast average incremental supply (TAF)	6	13	73	102	21	82	130	259

Notes:
TAF = Thousand acre-feet.

Water quality costs of these changes in salinity were estimated using an economic model of salinity costs. The model was based on an earlier model of salinity damages for the entire lower Colorado River basin. The revised model, obtained from MWD, included all of the data required to run the model for the South Coast Region and none of the data needed for the other regions included in the analysis. The model obtained from MWD with data for the South Coast Region was altered to consider the Program alternatives in terms of the quantity and salinity of SWP supplies for that region.

The model was configured to accept data for five other potentially affected regions: the South Lahontan, CCWD, the South Bay, the San Joaquin Valley, and the Central Coast. Bulletin 160-93 data were used to develop certain data on demands and quantity of other (non-Delta) supplies. A survey of potentially affected providers was conducted; and their responses provided useful information on demands, supplies, and salinity.

Results showed that economic benefits of Program alternatives depend significantly on baseline water quality levels within service areas. These levels may be substantially affected by actions between now and 2020, such as development of recycling capacity, implementation of RO, and adoption of water softeners. Economic results are especially sensitive to the amount of RO capacity in place in 2020.

New salinity and bromide data have been developed. A summary of the new salinity data is provided in Table 7.5-15. Bromide concentrations are highly correlated to the salinity data.

Water Conservation. The Water Use Efficiency Program Plan provides general and specific statewide assumptions, estimates of urban water use, and preliminary estimates of existing and future urban water conservation savings with and without the Water Use Efficiency Program. In practice, each urban water provider would implement conservation measures that are most economically feasible as part of their water supply and demand solutions.

Water conservation benefits are primarily raw water cost savings, including the avoided costs of storage projects. Economic savings also may include treatment and delivery costs, end-user energy costs, and wastewater treatment cost savings. Water conservation costs include program costs, lost water revenues, and end-user costs. Utilities pay the program costs of conservation programs, and they loose net revenues from water sales. End-users pay some additional costs for compliance with mandatory and voluntary provisions (for example, the costs of water-saving devices, time, and inconvenience). If end-users are forced to conserve, they may loose what they were willing to pay for the water above its price.

Total urban water conservation potential is estimated under the 2020 No Action Alternative at 620-750 TAF of depletion reduction in seven regions of the state (Table 7.5-16). This level of conservation is slightly more than the amount assumed to be implemented in Bulletin 160-98. With the Water Use Efficiency Program, an additional 780-910 TAF are expected to be conserved.

The Water Use Efficiency Program also includes urban water reuse. The Program would encourage cost-effective reuse actions with financial and technical assistance. Benefits are primarily water supply cost savings, but reduced regulatory costs, especially in the Bay Region, are possible. Total recycling potential under the No Action Alternative is estimated at 480 TAF of new supply, including existing reuse. This level of reuse is more than the amount included in Bulletin 160-98. With the Program, an additional 430-1,050 TAF of recycled water can be produced, with about 25% less made available as new supply (25% is applied in uses that would not otherwise exist).

The assessment of urban water use efficiency economics is largely qualitative because reliable quantitative information on the costs of water conservation is not available. This is especially true because the impact of the Program is above and beyond conservation under the No Action Alternative anticipated to 2020. Because the No Action Alternative levels are being planned for now, some baseline cost information is available. Costs of baseline savings are estimated to range between $400 and $1,600 per acre-foot per year.

The Program increment involves conservation and reuse beyond current practical experience. Costs of recycling for the Program increment have been estimated to range between $1,000 and $2,000 per acre-foot per year.

Table 7.5-15. Change and Percent Change in Conductivity of Water for Four Alternatives in Comparison to the No Action Alternative for All Water-Year Types and Dry and Critical Years, at Select Locations

	DIFFERENCE IN CONDUCTIVITY UNITS				PERCENT CHANGE				
	CRITERION A NO STORAGE		CRITERION B WITH STORAGE		CRITERION A NO STORAGE		CRITERION B WITH STORAGE		
	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	ANNUAL	MAX MONTHLY	CONCLUSION
Difference Between No Action Alternative and Preferred Program Alternative									
All water-year types									
NBA intake at Barker Slough	0	0	0	0	0.0%	0.0%	0.0%	0.0%	
CCC intake at Rock Slough	-20	-250	-140	-470	-3.0%	-21.0%	-22.0%	-40.0%	Beneficial
Old River at SR 4	-30	-250	-130	-440	-5.0%	-23.0%	-23.0%	-42.0%	Beneficial
Clifton Court Forebay	-10	-200	-110	-370	-2.0%	-20.0%	-21.0%	-39.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	0	0	-10	-10	0.0%	0.0%	-5.0%	-4.0%	
CCC intake at Rock Slough	-30	-300	-180	-590	-4.0%	-21.0%	-25.0%	-43.0%	Beneficial
Old River at SR 4	-40	-310	-460	-560	-6.0%	-24.0%	-49.0%	-45.0%	Beneficial
Clifton Court Forebay	-20	-230	-140	-450	-3.0%	-20.0%	-23.0%	-41.0%	Beneficial
Difference Between No Action Alternative and Alternative 1									
All water-year types									
NBA intake at Barker Slough	0	0	0	-10	0.0%	0.0%	0.0%	-3.0%	
CCC intake at Rock Slough	20	40	70	130	3.0%	3.0%	11.0%	11.0%	Potential [1]
Old River at SR 4	10	30	60	100	2.0%	3.0%	11.0%	9.0%	Potential [1]
Clifton Court Forebay	30	70	70	140	5.0%	7.0%	13.0%	15.0%	Potential [1]
Dry and critical years									
NBA intake at Barker Slough	0	0	-10	-10	0.0%	0.0%	5.0%	4.0%	
CCC intake at Rock Slough	30	70	100	180	4.0%	5.0%	14.0%	13.0%	Significant
Old River at SR 4	20	50	-210	140	3.0%	4.0%	-22.0%	11.0%	Significant
Clifton Court Forebay	40	90	100	270	6.0%	8.0%	16.0%	25.0%	Significant
Difference Between No Action Alternative and Alternative 2									
All water-year types									
NBA intake at Barker Slough	0	10	0	-50	0.0%	3.0%	0.0%	-15.0%	Beneficial
CCC intake at Rock Slough	-180	-590	-270	-760	-28.0%	-49.0%	-43.0%	-65.0%	Beneficial
Old River at SR 4	-160	-550	-230	-700	-27.0%	-51.0%	-41.0%	-66.0%	Beneficial
Clifton Court Forebay	-140	-470	-180	-560	-25.0%	-48.0%	-34.0%	-59.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	0	10	10	-40	0.0%	4.0%	5.0%	-16.0%	Beneficial
CCC intake at Rock Slough	-220	-720	-330	-920	-29.0%	-51.0%	-46.0%	-68.0%	Beneficial
Old River at SR 4	-200	-670	-590	-840	-29.0%	-52.0%	-62.0%	-68.0%	Beneficial
Clifton Court Forebay	-170	-560	-220	-660	-25.0%	-48.0%	-35.0%	-60.0%	Beneficial
Difference Between No Action Alternative and Alternative 3									
All water-year types									
NBA intake at Barker Slough	10	-40	0	-40	4.0%	-12.0%	0.0%	-12.0%	Beneficial
CCC intake at Rock Slough	-90	-590	-50	-320	-14.0%	-49.0%	-8.0%	-27.0%	Beneficial
Old River at SR 4	0	-420	-30	-280	0.0%	-39.0%	-5.0%	-26.0%	Beneficial
Clifton Court Forebay	-420	-830	-380	-800	-74.0%	-85.0%	-71.0%	-84.0%	Beneficial
Dry and critical years									
NBA intake at Barker Slough	10	-40	-10	-10	5.0%	-16.0%	-5.0%	-4.0%	Beneficial
CCC intake at Rock Slough	-120	-780	-60	-420	-16.0%	-55.0%	-8.0%	-31.0%	Beneficial
Old River at SR 4	0	-570	-40	-360	0.0%	-44.0%	-6.0%	-29.0%	Beneficial
Clifton Court Forebay	-530	-980	-470	-940	-78.0%	-87.0%	-76.0%	-86.0%	Beneficial

Notes:
[1] Potentially significant adverse effect.
CCD = Contra Costa Canal.
NBA = North Bay Aqueduct.
SR = State Route.

Table 7.5-16. Reuse and Urban Conservation in Bulletin 160-98, the No Action Alternative, and the Water Use Efficiency Program (TAF)

	BULLETIN 160-98 INCLUDES:		NO ACTION ALTERNATIVE LEVELS OF:		WATER USE EFFICIENCY PROGRAM, ADDITIONAL:	
REGION[a]	**REUSE**	**URBAN CONSERVATION[b]**	**REUSE**	**URBAN CONSERVATION[b]**	**REUSE**	**URBAN CONSERVATION[b]**
Bay Region	37	172	53	100-120	50-170	155-180
Central Coast Region	34	30	35	20-40	30-70	40-60
South Coast Region	273	500	392	450-495	350-810	510-555
Sacramento Valley Region	0	0	0	5-10	0	5-10
San Joaquin Valley Region	0	30	0	3-8	0	7-12
Tulare Region	0	50	0	20-35	0	35-50
Colorado River Region	15	52	15	20-40	0	25-45
Total	**386**	**855**	**480**	**620-750**	**430-1,050**	**780-910**

[a] These hydrologic regions are used in DWR's Bulletin 160-98.
[b] Urban conservation is irrecoverable loss savings.

7.5.5 CRITERIA FOR DETERMINING ADVERSE EFFECTS

Economic effects are categorized as either adverse or beneficial. A net economic effect is considered adverse if its costs are expected to be larger than its benefits, and a net effect is considered beneficial if its benefits exceed its costs. No complete estimates of benefits or costs are available for the Program alternatives. Therefore, net effects cannot be judged. For this analysis, a substantial increase in water supply is considered beneficial. This does not imply that the net benefit is positive, that benefits exceed costs, or that the costs are less than alternative sources of supply.

For water quality impacts, a reduction in TDS of Delta export water is considered beneficial if it is more than 10% of the concentration under the No Action Alternative and adverse if the increase in TDS is more than 10% of the concentration under the No Action Alternative. Impacts on DBP precursors are considered potentially significant if the change is approximately 10% or more of levels under the No Action Alternative.

7.5.6 NO ACTION ALTERNATIVE

The No Action Alternative displays the state of water supply economics for a 2020 level of development as opposed to the existing (1995) conditions. The 2020 level of development is expected to result in a substantial increase in demand for urban water because of the increase in population and urban water use over time. Average water supply under the No Action Alternative condition exceeds that of existing conditions simply because the demand put on supply is more.

This increase in supply may not come from the Delta, however, and the increased demand may be minimized by conservation and local reuse. To consider uncertainty in future water demand and supply, the Program water supply modeling has included two sets of alternative water management criteria.

Table 7.15-17 shows characteristics of urban provider groups for existing conditions and the No Action Alternative. Water prices, costs, and estimates of 2020 demands were obtained from DWR's Bulletin 160-98, Program data, and information furnished by urban water providers. Local water supplies are based on information from Bulletin 160-98 and Program data. For the analysis, water demands are reduced for additional conservation under the No Action Alternative, and water supplies have been increased to account for water recycling levels under the No Action Alternative.

Table 7.5-17. Characteristics of M&I Providers by Program Region under Existing Conditions and the No Action Alternative

CONDITION VARIABLE	DELTA REGION (CCWD)[a]	BAY REGION[b]	SACRAMENTO RIVER REGION	SAN JOAQUIN RIVER REGION	OTHER SWP AND CVP SERVICE AREAS
Existing Conditions					
TAF average demand	160	707	566	337	3,784
TAF dry-year demand	160	767	613	344	3,916
Typical retail cost, $/AF[c]	$900	$500-700	$100-300	$250-350	$450-1,350
Typical retail price, $/AF	$600	$500-700	$0-300	$100-350	$350-1,250
Percent industrial and commercial	31%	31%	41%	48%	26%
No Action Alternative (Criterion B)					
TAF average demand	205	808	823	736	6,597
TAF average shortage	28	0	0	51	789
TAF dry-year demand	205	897	896	744	6,704
Typical retail cost, $/AF[c]	$900	$575-800	$125-325	$275-400	$500-1,450
Typical retail price, $/AF	$600	$500-700	$0-350	$125-175	$420-1,350
Percent industrial and commercial	31%	31%	41%	48%	26%
Average cost of supplies[d]	$600-700	N/A	N/A	$150-250	$500-600
TAF shortage during drought[e]	19	193	9	55	405
Mandatory conservation during drought	11	45	9	33	405
TAF supplies developed during drought	8	148	0	22	0
Average cost of drought shortage, $/AF	$900-1,000	$600-700	$100-350	$150-350	$900-2,000

Notes:
AF = Acre-feet.
CCWD = Contra Costa Water District.
N/A = Not applicable.
TAF = Thousand acre-feet.

[a] Includes major industrial direct diversions of 10 TAF per year.
[b] Not Contra Costa Water District, East Bay Municipal Utility District, or Marin County.
[c] Average cost for residential customers, including service charges. Costs and prices for providers with only CVP water are typically higher.
[d] Average cost of new supplies per acre-foot needed to achieve supply/demand balance under No Action Alternative average condition.
[e] After adjusting for long-run average supplies and demand.

Sources:
DWR 1998, CALFED 1999.

7.5.6.1 DELTA REGION

For this analysis of water supply changes, economic effects on CCWD are used to represent economic impacts of the Program alternatives in the Delta Region. The primary reason for this assumption is that urban water supplies for most other providers in the Delta would not be affected by the Program alternatives in ways that can be measured at this time. In the following discussion, the term "Delta providers" is reserved for any and all providers actually located within the Delta.

Table 7.5-17 shows some characteristics of CCWD for existing conditions and the No Action Alternative. Current demand is about 160 TAF, which includes 10 TAF of direct diversions by industrial customers. Retail cost to residential customers is currently about $900 per acre-foot. Price, which does not include service charges, is about $600 per acre-foot. About one-third of demand is commercial and industrial. Demand is expected to rise to 205 TAF by 2020, with slightly higher demands in dry years due to less natural precipitation and subsequent recharge of urban landscapes.

The No Action Alternative retail cost and price are higher than those for existing conditions because of conservation and costs of new supplies. There is a small average condition supply deficit that costs from $600 to $700 per acre-foot of new supply to eliminate. Additional shortage during drought is expected to cost from $900 to $1,000 per acre-foot to eliminate. (This estimate assumes that new water transfers are not available for CCWD.)

No Action Alternative projects that are expected to improve water supply reliability or reduce future costs include the Los Vaqueros Project. This project (completed since issuance of the June 1999 Draft Programmatic EIS/EIR) improves water quality and provides emergency water supply reliability for CCWD.

Other Delta providers (not CCWD) generally are provided by larger water wholesalers, small districts, or individual wells. No specific actions have been identified that will affect these providers. However, these small providers typically have plans and programs in place that will affect their future water supplies.

7.5.6.2 BAY REGION

Table 7.5-17 shows some characteristics of the Bay Region for existing conditions and the No Action Alternative. Current demand is about 707 TAF. Retail cost to residential customers is currently about $500-$700 per acre-foot; and price, which does not include service charges, is about the same. About one-third of demand is commercial and industrial.

Demand is expected to rise to 808 TAF by 2020, with slightly higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation, CVPIA restoration charge costs, and costs of new supplies. The region has a slight supply surplus in the average condition. The Bay Region has relatively unreliable supplies, resulting in a substantial supply deficit in the dry condition. This deficit is expected to cost from $600 to $700 per acre-foot to eliminate.

The Bay Region is affected by any actions that affect the SWP or the CVP. No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include the CVPIA dedicated water. Dedicated water may increase SWP supplies depending on the amount of dedicated water that can be exported from the Delta.

7.5.6.3 SACRAMENTO RIVER REGION

Table 7.5-17 shows some characteristics of the Sacramento River Region for existing conditions and the No Action Alternative. The 1990 level of demand was about 566 TAF. Retail cost to residential customers is about $100-$300 per acre-foot. Variable price, which does not include service charges, is $0-$300 per acre-foot. This price is zero in some areas because some use is not metered or priced volumetrically. About 40% of demand is commercial and industrial.

Demand is expected to rise to 823 TAF by 2020, with higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA restoration charge costs.

No Action Alternative projects that may reduce urban supplies or increase costs relative to existing conditions include the interim reoperation of Folsom Reservoir, which could reduce urban water supplies in the Sacramento area by dedicating more storage space to flood control.

7.5.6.4 SAN JOAQUIN RIVER REGION

Table 7.5-17 shows some characteristics of the San Joaquin River Region for existing conditions and the No Action Alternative. Current demand is about 337 TAF. Retail cost to residential customers is currently about $250-$350 per acre-foot. Price, which does not include service charges, is $100-$350 per acre-foot. About one-half of demand is commercial and industrial.

Demand is expected to double to 736 TAF by 2020, with higher demands in dry years due to less recharge of urban landscapes. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and CVPIA costs.

No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include:

- *Monterey Agreement* - This project revises the formula used to allocate SWP water, retires 45 TAF of agricultural entitlement, allows transfers of 130 TAF of entitlement from agriculture to urban use, and allows sale of the Kern Fan element of the Kern Water Bank to agricultural contractors.

- *New Melones Conveyance Project* - This project conveys water to Stockton East Water District and Central San Joaquin Water Conservation District for use near and within Stockton.

7.5.6.5 Other SWP and CVP Service Areas

Table 7.5-17 shows some characteristics of the Other SWP and CVP Service Areas for existing conditions and the No Action Alternative. For urban economics, this region does not include any areas served by the CVP. The San Felipe Division of the CVP is included in the Bay Region.[1]

Demand is about 3,784 TAF in average years. Retail cost to residential customers is about $450-$1,350 per acre-foot. The higher price is representative only of the Central Coast area. Price, which does not include service charges, is about $350-$1,250 per acre-foot. About one-quarter of demand is commercial and industrial.

The 2020 demand would rise to 6,597 TAF in average years. Demands are higher in dry years due to less recharge of urban landscapes. Without new supplies, the region is expected to experience a substantial water supply deficit by 2020, even during average years. The No Action Alternative cost and price are higher than those for existing conditions because of conservation and costs of new supplies.

No Action Alternative projects that are expected to increase supplies or reduce future costs, once completed, include:

- *Coastal Aqueduct* - This project will provide SWP water for urban use in San Luis Obispo and Santa Barbara Counties.

- *Monterey Agreement* - The Monterey Agreement will change SWP water allocations for urban use, for the reasons described above and because allowable operations at Castaic Lake and Lake Perris will change.

- *Diamond Valley Lake* - MWD's Diamond Valley Lake will provide emergency storage following an earthquake, supplies during drought, and supplies to meet peak summer demands.

- *Semitropic Water Storage District Groundwater Banking Project* - This project will allow certain SWP entitlement holders to recharge and extract SWP water in the Semitropic Water Storage District, and will reduce overdraft and increase operational flexibility. As of 1999, SCVWD and MWD are participating.

7.5.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For urban water supply economics resources, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Program elements are similar under all Program alternatives, as described below. The environmental consequences of the Storage and Conveyance elements vary among Program alternatives, as described in Section 7.5.8.

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[1] Economic analyses were developed on a county-wide basis not by Program region; therefore, in the economic analyses, the San Felipe Division is included in the Bay Region rather than in the Other SWP and CVP Service Areas.

7.5.7.1 DELTA REGION

Ecosystem Restoration Program

Ecosystem restoration actions are expected to result in small effects on urban water supplies and costs, unless environmental flows reduce urban supplies or urban providers pay a substantial share of the costs of restoration. Water flows for fish and wildlife could increase urban water supply if: (1) the water can be reused as urban water exports, or (2) the flows contribute to Delta water quality standards. Prices of water transfers may be increased by dedication of water for environmental purposes.

Some restoration actions may beneficially affect water quality in the Delta. Water quality improvements may occur through dilution caused by increased Delta inflow for restoration purposes and through reduced pollution loads caused by development and restoration of marsh and riparian habitats—leading to increased immobilization of pollutants in these habitat types. The opposite effect could occur during construction but would be short term. Other water quality impacts may be negative; for example, habitat restoration could increase organic carbon loads in Delta water, which would increase DBP levels in treated waters. These potentially significant impacts may or may not be able to be mitigated to a less-than-significant level. (Refer to Section 5.3 for more information about water quality impacts and mitigation strategies.)

Restoration may reduce the uncertainty of urban water supplies by enhancing the recovery of special-status species. Water supply costs could be reduced because urban providers acquire water supplies to protect against uncertainty and this uncertainty could be reduced by ecosystem improvements.

Water Quality Program

The Water Quality Program could benefit urban water suppliers and users by improved water quality and lower treatment costs.

The Water Quality Program Plan details Water Quality Program actions, but no dollar cost estimates have been provided. Cost allocation issues for this program also have not been resolved. The cost of the Water Quality Program is considered an adverse economic effect.

The cost of relocating Tracy's wastewater treatment plant discharge is considered an adverse effect. However, the magnitude of this cost is not currently known.

Levee System Integrity Program

Benefits of the Levee System Integrity Program include less risk of export interruptions caused by levee failure. The Levee System Integrity Program Plan could be implemented over a 30-year period and would cost about $1.5 billion dollars. Costs include efforts to reach and maintain PL 84-99 standards ($1 billion) and implement Special Improvement Projects ($360 million). Currently, cost allocations are not known. Levee System Integrity Program actions would result in less-than-significant impacts on Delta hydraulics and water quality. Very small economic effects on water supply and quality, and associated costs are expected in normal conditions.

Water Use Efficiency Program

Table 7.5-16 shows amounts of new water conservation and new re-use associated with the Water Use Efficiency Program. The cost of these actions could range from $400 to $1,000 per acre-foot annually.

Water Transfer Program

The Water Transfer Program does not advocate any particular transfers, and no estimate of cost is possible at this time. Water supply, supply costs, and water quality could be affected by water transfers. The availability of water transfers might affect selection of local supplies and other imported supplies. Water transfers may facilitate urban land use and development where water supply constraints otherwise would limit growth.

Watershed Program

Because no cost or cost-sharing information is currently available, effects associated with urban water supply economics cannot be determined.

7.5.7.2 BAY REGION

Ecosystem Restoration Program

Effects associated with the Ecosystem Restoration Program that are related to urban water supply economics in the Bay Region would be similar to those described for the Delta Region.

Water Quality Program

Economic effects associated with the Water Quality Program in the Bay Region would be similar to those described for the Delta Region. The program could include relocation of the NBA intake to the Colusa-Tehama Canal or to Miner Slough. No monetary benefits or costs have been estimated.

Levee System Integrity Program

Economic effects associated with the Levee System Integrity Program in the Bay Region, including the Suisun Marsh, would be limited to those related to cost sharing and Delta export supplies.

Water Use Efficiency Program

The nature and pattern of impacts related to urban water supply in the Bay Region that are associated with Water Use Efficiency actions would be the same as those described for the Delta Region. Because the Bay Region generally has a high level of conservation, additional costs of conservation per unit of water saved may be higher than average. Amounts of new water conservation and new reuse are shown in Table 7.5-16. The costs of these actions could range from $500 to $1,000 per acre-foot per year.

Water Transfer Program

Economic effects of water transfers in the Bay Region would be similar to those described for the Delta Region. The Bay Area would be affected by transfers primarily as a buyer of water. Effects cannot be determined with available information.

Watershed Program

Impacts in the Bay Region associated with watershed activities would be similar to those described for the Delta Region. Impacts cannot be determined with available information.

7.5.7.3 SACRAMENTO RIVER REGION

Ecosystem Restoration and Water Quality Programs

The Ecosystem Restoration and Water Quality Programs would not affect urban water economics in the Sacramento River Region, except as water supply amounts, costs of water, and land use may be affected. Effects are expected to be minimal.

Levee System Integrity Program

Impacts associated with the Levee System Integrity Program in the Sacramento River Region would be limited to those related to cost sharing and costs of water.

Water Use Efficiency Program

The nature and pattern of impacts in the Sacramento River Region that are associated with Water Use Efficiency actions would be similar to those described for the Delta Region. Because the Sacramento River Region generally has a low level of conservation under existing conditions, additional costs of conservation per unit of water saved may be lower than average. Real water savings from conservation or reuse may be minimal because of this region's location upstream of the Delta. However, conservation can reduce costs of new infrastructure and treatment, and reduced water diversions could provide ecosystem flow and water quality benefits.

Water Transfer Program

The nature and pattern of impacts in the Sacramento River Region associated with water transfers would be similar to those described for the Delta Region. The Sacramento River Region would be affected primarily as a seller of water.

Watershed Program

Impacts in the Sacramento River Region associated with watershed actions would be similar to those described for the Delta Region. Land use effects could have minimal influence on the cost of urban water supplies.

7.5.7.4 SAN JOAQUIN RIVER REGION

Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, and Watershed Programs

The nature and pattern of urban water supply economic impacts in the San Joaquin River Region would be the same as those described for the Delta Region.

Water Transfer Program

The nature and pattern of impacts in the San Joaquin River Region associated with water transfers would be the same as those described for the Delta Region, except that water transfers could affect the amount of water exported from the Delta for urban use.

7.5.7.5 OTHER SWP AND CVP SERVICE AREAS

All Programs

The nature and pattern of economic effects associated with Program elements in the Other SWP and CVP Service Areas would be similar to those described for the Bay Region. The Water Transfer and Water Quality Programs could result in a relatively large beneficial effect in this region. Cost effects should be greater in magnitude but about the same relative to population size.

7.5.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For urban water supply economics, the Storage and Conveyance elements differ among the alternatives because the conveyance component differs. Although the range of storage is the same for all Program alternatives, storage differs in this analysis not in the physical impacts but in the amount of water that can be transported through the Delta, depending on conveyance features.

7.5.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Delta Region

Storage and Conveyance features and improvements are expected to result in a beneficial effect on water supply economics for CVP water providers located in the Delta, primarily parts of CCWD. Benefits involve water quality as well as quantity. Most quality improvements are related to conveyance, and most quantity improvements are tied to storage. The significance of these impacts will depend on the amount of storage. The relative size of impacts on individual providers depends on the share of the new water supplies as part of their entire water supply mix.

On the other hand, Storage and Conveyance costs are expected to result in an adverse effect on water supply economics. The amount of adverse effects from the Preferred Program Alternative will depend on how costs are allocated. No information currently is available to determine allocation of costs between uses. No information has been developed that would allow water supply benefits to be compared to costs. Cost allocation and repayment requirements will be developed in the staged implementation phase of the Preferred Program Alternative.

Water supply effects on urban providers in the Delta other than CCWD would be minimal because most Delta providers do not receive CVP or SWP supplies. Conveyance effects on Delta urban providers could involve construction and displacement effects, and water quality effects could be important for some Delta providers.

Storage

Preliminary DWRSIM modeling studies were used to estimate effects on urban water supply. Table 7.5-14 shows the total increase in water supply for the entire Bay Region, including CCWD, under Program alternatives.

Table 7.5-17 shows some characteristics for the Delta Region (CCWD) in 2020. Analysis using the M&I models was conducted. With increased supplies and reduced demand under the Water Use Efficiency Program, CCWD would experience limited need for new supplies in the average hydrologic condition. New stored supplies would be valuable only if they were allowed to replace relatively expensive conservation or recycling. In the dry condition, CCWD would experience a shortage of about 5 TAF, or about 2.5% of demand in the 2020 dry condition. Economic losses of about $500-$600 per acre-foot of shortage could be eliminated with new supplies.

Conveyance

DWR provided a preliminary analysis of salinity. The salinity analysis did not consider differences in the amount of storage or in the amount and timing of exports between alternatives. Rather, only differences in conveyance and intake configurations were modeled. Results are provided in Table 7.5-15 and in

Section 5.3. The reduction in salinity at the Contra Costa Canal intake at Rock Slough and at Old River at SR 4 is considered beneficial.

Limited estimates of bromide concentrations also are available. For estimates at the Contra Costa Canal intake and at Old River at SR 4, the Preferred Program Alternative could result in a lower average concentration of bromide than the No Action Alternative. Information is limited, and changes in salinity and concentrations of bromides could be potentially significant. The economic consequences of this effect cannot be estimated at this time.

Changes in project operations may affect urban water supply economics. Any reductions in water supply caused by changes in the amount of water exported to the Delta Region could result in an adverse effect, depending on the magnitude of the reduction. Any increases in water supply caused by changes in the amount of water exported to this region could result in a beneficial effect.

Bay Region

Modeling results are similar to those described for the Delta Region, except that the demand for new supplies is different and the Bay Region would be affected through different water export facilities.

Storage

Water supply effects occur through deliveries of the NBA and the SBA, through the San Felipe Division of the CVP, and through the Contra Costa Canal. Table 7.5-14 shows the total increase in water supply under Program alternatives. Without new storage, supplies for the entire Bay Region, which includes CCWD, are increased by 5-13 TAF in comparison to the No Action Alternative, depending on management criteria and priority. The addition of storage to the Preferred Program Alternative increases supply by 7-25 TAF in comparison to the same criteria and priority without storage. Water supply effects with or without the diversion facility on the Sacramento River are similar, except under Criterion A with storage—where the diversion facility results in about twice as much water supply for the Bay Region.

Table 7.5-17 shows some characteristics for the region in 2020. In the average condition, and with Water Use Efficiency Program recycling and conservation, the Bay Region would have little if any need for new water in 2020. The shortages for the No Action Alternative identified in Table 7.5-17 would be eliminated by the Water Use Efficiency Program conservation savings and recycled water identified in Table 7.5-16.

DWR's LCPSIM, which bases regional economic efficiency on the least-cost planning criterion, allows a new Delta water supply to change the use of regional long-term water supply and water use efficiency options compared to what would otherwise have been economically efficient without that supply. The economically efficient level of expected shortage-related costs and losses (including the costs of shortage contingency water transfers) can be similarly changed.

Economic benefits from a new Delta supply can be obtained either from a reduction in both regional long-term option use costs and expected shortage-related costs and losses or from a net reduction in their sum. A new Delta supply, for example, may produce benefits from a regional least-cost plan that includes an increase in expected shortage-related costs and losses but achieves an even larger reduction in option use costs (or vice-versa).

The results of LCPSIM studies for the Bay Region are shown in Table 7.5-18. The results were produced by determining the regional least-cost plan for each Program alternative scenario. Shown for each scenario are the incremental Delta supply benefits (in terms of avoided annual costs), as well as the changes from the No Action Alternative for expected shortage-related costs and losses, including changes in water transfer costs and quantities for the 73-year study period. Changes in regional long-term option use and annual option use costs also are shown.

Without new storage, the new supplies are worth from $0.5 to $4.5 million annually in terms of shortage and other supply costs avoided. With new storage, the new supplies are worth from $2.5 to $13.0 million annually. The average value of new supplies ranges from $70 to $562 per acre-foot.

Conveyance

Limited information on salinity and bromide concentrations is available. For estimates at CCFB, the average salinity and concentration of bromides decreased under the Preferred Program Alternative. This decrease would be a benefit to the Bay Region through the SBA and the San Felipe Division. The economic consequences of this effect cannot be determined at this time.

Sacramento River Region

Modeling results are similar to those reported for the Delta Region except that this region has no potential to be affected by water quality changes related to cross-Delta conveyance. Increased water supply would be obtained by diversion from the Sacramento River or a tributary, or by exchange. With Program actions, the region does not experience any notable water shortage in the average 2020 condition. In dry conditions, about 10 TAF of new supply could be used under 2020 conditions. Water supplies to eliminate this shortage would be worth about $200-$400 per acre-foot.

San Joaquin River Region

Modeling results are similar to those reported for the Delta Region. Because most urban water use in the region does not require water exports from the Delta, water quality would not be greatly affected by Delta conveyance. For providers using water that might be affected by Program actions, about 13 TAF of new supply are needed to meet 2020 demand in the average condition. New supplies would be worth about $200-$400 per acre-foot in terms of avoided costs. In the dry period, an additional 44 TAF could be used, and this supply would be worth about $250-$350 per acre-foot.

Water quality improvements from improved Delta conveyance would affect a number of small urban providers throughout the region. Estimates of salinity effects are provided in Table 7.5-15.

Other SWP and CVP Service Areas

Table 7.5-14 shows the total increase in water supply for the Other SWP and CVP Service Areas. Without new storage, the Preferred Program Alternative would create from 10 to 90 TAF of new water supply for the South Coast. With new storage, the Preferred Program Alternative would create from 80 to 270 TAF of new supply, on average.

Table 7.5-17 shows some characteristics of the Other SWP and CVP Service Areas in 2020 under the No Action alternative. In the average condition, and with Water Use Efficiency Program recycling and conservation, the Other SWP and CVP Service Areas would have little if any need for new water in 2020. The shortages for the No Action Alternative identified in Table 7.5-17 would be eliminated by the Water Use Efficiency Program conservation savings and recycled water identified in Table 7.5-16.

DWR's LCPSIM, which bases regional economic efficiency on the least-cost planning criterion, allows a new Delta water supply to change the use of regional long-term water supply and water use efficiency options compared to what would otherwise have been economically efficient without that supply. The economically efficient level of expected shortage-related costs and losses (including the costs of shortage contingency water transfers) can be similarly changed.

Economic benefits from a new Delta supply can be obtained either from a reduction in both regional long-term option use costs and expected shortage-related costs and losses or from a net reduction in their sum. A new Delta supply, for example, may produce benefits from a regional least-cost plan that includes an increase in expected shortage-related costs and losses but achieves an even larger reduction in option use costs (or vice-versa).

The results of LCPSIM studies for the Other SWP and CVP Service Areas are shown in Table 7.5-19. The results were produced by determining the regional least-cost plan for each Program alternative scenario. Shown for each scenario are the incremental Delta supply benefits (in terms of avoided annual costs), as well as the changes from the No Action Alternative for expected shortage-related costs and losses, including changes in water transfer costs and quantities for the 73-year study period. Changes in regional long-term option use and annual option use costs also are shown.

Without new storage, the new supplies are worth from $5 to $85 million annually in terms of shortage and other supply costs avoided. With new storage, the new supplies are worth from $80 to $250 million annually. The average value of new supplies ranges from $430 to $1,500 per acre-foot.

Water quality improvements from improved Delta conveyance would produce a relatively large effect on this region. Estimates of salinity effects are provided in Table 7.5-15. Salinity effects are relatively important to the region because of its higher baseline salt load. This higher salt load is caused primarily by Colorado River salinity. Other important sources of salinity include water softeners and groundwater. Reduced concentrations of bromide and reduced salinity should be economically beneficial to the region.

7.5.8.2 ALTERNATIVE 1

Alternative 1 is similar to the Preferred Program Alternative without the diversion facility on the Sacramento River. Storage under Alternative 1 ranges between 0 and 6.0 MAF; for conveyance, this alternative relies primarily on the current configuration of Delta channels. Under Alternative 1, some selected channel improvements may take place in the south Delta, together with stream flow and stage barriers (or their equivalent) at selected locations.

Table 7.5-14 shows the total increase in water supply for the Bay Region and the Other SWP and CVP Service Areas. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No

Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 1; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

DWR's LCPSIM allows new water supplies to replace conservation and recycled water. Results are shown in Table 7.5-18 for the Bay Region and in Table 7.5-19 for the Other SWP and CVP Service Areas. Results are very similar to those for the Preferred Program Alternative except that, without the diversion facility, water supplies and benefits under Criterion A with storage increase less in comparison to the No Action Alternative.

Limited estimates of bromide concentrations and salinity are available. Modeling runs (DWRDSM) indicate that Alternative 1 could result in a higher average concentration of bromides in municipal water diversions than the No Action Alternative. The economic consequences of this effect cannot be estimated at this time.

7.5.8.3 ALTERNATIVE 2

Storage under Alternative 2 ranges between 0 and 6.0 MAF. This alternative also adds improvements to north Delta channels to accompany the south Delta improvements contemplated under Alternative 1. Alternative 2 also includes a diversion facility near Hood on the Sacramento River.

Table 7.5-14 shows the total increase in water supply for the Bay Region and the Other SWP and CVP Service Areas. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 2; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

DWR's LCPSIM, which bases regional economic efficiency on the least-cost planning criterion, allows a new Delta water supply to change the use of regional long-term water supply and water use efficiency options compared to what would otherwise have been economically efficient without that supply. The economically efficient level of expected shortage-related costs and losses (including the costs of shortage contingency water transfers) can be similarly changed.

Economic benefits from a new Delta supply can be obtained either from a reduction in both regional long-term option use costs and expected shortage-related costs and losses or from a net reduction in their sum. A new Delta supply, for example, may produce benefits from a regional least-cost plan that includes an increase in expected shortage-related costs and losses but achieves an even larger reduction in option use costs (or vice-versa).

The results of LCPSIM studies for the Bay Region and the Other SWP and CVP Service Areas are shown in Table 7.5-18 and Table 7.5-19, respectively. The results were produced by determining the regional least-cost plan for each Program alternative scenario. Shown for each scenario are the incremental Delta supply benefits (in terms of avoided annual costs), as well as the changes from the No Action Alternative for expected shortage-related costs and losses, including changes in water transfer costs and quantities for the 73-year study period. Changes in regional long-term option use and annual option use costs also are shown.

Table 7.5-18(a). Results of Least-Cost Analysis of Program Alternatives for the Bay Region - Criterion A

	NO ACTION	PREFERRED PROGRAM ALTERNATIVE WITH HOOD				PREFERRED PROGRAM ALTERNATIVE WITHOUT HOOD (ALTERNATIVE 1)				ALTERNATIVE 2				ALTERNATIVE 3			
		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
		LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Regional Economic Benefits																	
		Annual Value of Incremental Supply															
Average incremental supply (TAF)	N/A	5	9	25	36	5	9	26	36	5	10	25	35	3	5	22	31
Avoided costs/losses ($1,000)	N/A	$633	$619	$12,793	$12,052	$615	$910	$12,793	$12,092	$571	$795	$12,793	$11,810	$600	$1,064	$12,793	$11,613
Average value of incremental supply ($/AF)	N/A	$131	$70	$507	$336	$114	$104	$499	$333	$114	$84	$515	$336	$184	$214	$562	$372
Regional Water Management -- Least-Cost Planning Criterion																	
		Change from No Action Alternative (Costs/Losses Are Annual Values)															
Expected Shortage-Related Costs/Losses ($1,000)	$11,273	-$253	-$239	-$11,273	-$10,627	-$140	-$340	-$11,273	-$10,762	-$191	-$225	-$11,273	-$10,480	-$315	-$779	-$11,273	-$10,283
Shortage Contingency Water Transfers																	
		Change from No Action Alternative (Costs and Quantities Are for the 73-Year Study Period)															
Number of transfer events	1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
Total quantity transferred (TAF)	59	8	8	-59	-59	11	14	-59	-59	8	12	-59	-59	6	6	-59	-59
Total cost ($1,000)	$10,325	$1,400	$1,400	-$10,325	-$10,325	$1,925	$2,450	-$10,325	-$10,325	$1,400	$2,100	-$10,325	-$10,325	$1,050	$1,050	-$10,325	-$10,325
Average quantity per transfer event (TAF)	59	-26	-26	-59	-59	-24	-23	-59	-59	-26	-24	-59	-59	-27	-27	-59	-59
Water Supply/Water Use Efficiency Option Use																	
		Change from No Action Alternative (Costs and Quantities Are Annual Values)															
Conservation (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conservation cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Groundwater recovery (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groundwater recovery cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Recycling (TAF)	16	-4	-4	-16	-15	-5	-6	-16	-14	-4	-6	-16	-14	-3	-3	-15	-14
Recycling cost ($1,000)	$1,520	-$380	-$380	-$1,520	-$1,425	-$475	-$570	-$1,520	-$1,330	-$380	-$570	-$1,520	-$1,330	-$285	-$285	-$1,425	-$1,330
Seawater desalting (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seawater desalting cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total option use (TAF)	16	-4	-4	-16	-15	-5	-6	-16	-14	-4	-6	-16	-14	-3	-3	-15	-14
Total option cost ($1,000)	$1,520	-$380	-$380	-$1,520	-$1,425	-$475	-$570	-$1,520	-$1,330	-$380	-$570	-$1,520	-$1,330	-$285	-$285	-$1,425	-$1,330

Notes:

TAF = Thousand acre-feet.
See Section 5.1 and Attachment A for a description of water supply modeling assumptions and Section 7.5.12 for details on LCPSIM.

Table 7.5-18(b). Results of Least-Cost Analysis of Program Alternatives for the Bay Region - Criterion B

	NO ACTION	PREFERRED PROGRAM ALTERNATIVE WITH HOOD				PREFERRED PROGRAM ALTERNATIVE WITHOUT HOOD (ALTERNATIVE 1)				ALTERNATIVE 2				ALTERNATIVE 3			
		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
		LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Regional Economic Benefits																	
		Annual Value of Incremental Supply															
Average incremental supply (TAF)	N/A	6	13	20	38	5	13	18	38	5	14	11	38	4	13	20	38
Avoided costs/losses ($1,000)	N/A	$725	$2,552	$3,765	$7,085	$745	$2,830	$3,648	$8,033	$738	$2,748	$3,867	$7,739	$1,345	$4,346	$4,753	$7,328
Average value of incremental supply ($/AF)	N/A	$151	$200	$188	$189	$144	$217	$194	$210	$142	$204	$205	$201	$182	$239	$196	$178
Regional Water Management -- Least-Cost Planning Criterion																	
		Change from No Action Alternative (Costs/Losses Are Annual Values)															
Expected Shortage-Related Costs/Losses ($1,000)	$11,012	-$440	-$1,697	-$2,435	-$6,325	-$460	-$1,975	-$2,223	-$7,273	-$453	-$1,798	-$2,442	-$6,884	-$870	-$3,016	-$3,328	-$6,758
Shortage Contingency Water Transfers																	
		Change from No Action Alternative (Costs and Quantities Are for the 73-Year Study Period)															
Number of transfer events	1	0	1	0	0	0	1	0	0	0	1	0	0	1	1	0	-1
Total quantity transferred (TAF)	59	0	7	-1	-47	1	8	3	-34	0	9	4	-35	5	17	-6	-59
Total cost ($1,000)	*$10,325*	*$0*	*$1,225*	*-$175*	*-$8,225*	*$175*	*$1,400*	*$525*	*-$5,950*	*$0*	*$1,575*	*$700*	*-$6,125*	*$875*	*$2,975*	*-$1,050*	*-$10,325*
Average quantity per transfer event (TAF)	59	0	-26	-1	-47	1	-26	3	-34	0	-25	4	-35	-27	-21	-6	-59
Water Supply/Water Use Efficiency Option Use																	
		Change from No Action Alternative (Costs and Quantities Are Annual Values)															
Conservation (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conservation cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Groundwater recovery (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groundwater recovery cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Recycling (TAF)	15	-3	-9	-14	-8	-3	-9	-15	-8	-3	-10	-15	-9	-5	-14	-15	-6
Recycling cost ($1,000)	$1,425	-$285	-$855	-$1,330	-$760	-$285	-$855	-$1,425	-$760	-$285	-$950	-$1,425	-$855	-$475	-$1,330	-$1,425	-$570
Seawater desalting (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seawater desalting cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total option use (TAF)	15	-3	-9	-14	-8	-3	-9	-15	-8	-3	-10	-15	-9	-5	-14	-15	-6
Total option cost ($1,000)	$1,425	-$285	-$855	-$1,330	-$760	-$285	-$855	-$1,425	-$760	-$285	-$950	-$1,425	-$855	-$475	-$1,330	-$1,425	-$570

Notes:

TAF = Thousand acre-feet.

See Section 5.1 and Attachment A for a description of water supply modeling assumptions and Section 7.5.12 for details on LCPSIM.

Table 7.5-19(a). Results of Least-Cost Analysis of the Program Alternatives for the South Coast Region - Criterion A

	NO ACTION	PREFERRED PROGRAM ALTERNATIVE WITH HOOD				PREFERRED PROGRAM ALTERNATIVE WITHOUT HOOD (ALTERNATIVE 1)				ALTERNATIVE 2				ALTERNATIVE 3			
		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
		LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Regional Economic Benefits																	
		Annual Value of Incremental Supply															
Average incremental supply (TAF)	N/A	10	24	79	118	10	22	80	118	10	24	78	114	6	13	73	102
Avoided costs/losses ($1,000)	N/A	$12,624	$36,281	$111,641	$163,147	$10,956	$32,608	$110,768	$162,488	$11,749	$35,287	$107,910	$157,139	$4,630	$13,798	$101,028	$140,248
Average value of incremental supply ($/AF)	N/A	$1,247	$1,491	$1,409	$1,388	$1,133	$1,483	$1,381	$1,377	$1,157	$1,425	$1,386	$1,376	$769	$1,061	$1,389	$1,376
Regional Water Management – Least-Cost Planning Criterion																	
		Change from No Action Alternative (Costs/Losses Are Annual Values)															
Expected Shortage-Related Costs/Losses ($1,000)	$215,691	-$5,414	-$19,802	-$53,961	-$83,896	-$4,776	-$18,188	-$52,058	-$82,299	-$4,539	-$18,807	-$51,260	-$79,772	-$510	-$5,558	-$47,468	-$70,511
Shortage Contingency Water Transfers																	
		Change from No Action Alternative (Costs and Quantities Are for the 73-Year Study Period)															
Number of transfer events	6	0	0	-2	-3	0	0	-2	-3	0	0	-2	-3	0	0	-1	-1
Total quantity transferred (TAF)	1,158	-28	-179	-336	-570	-6	-97	-300	-576	-35	-188	-300	-593	12	48	-201	-385
Total cost ($1,000)	$202,650	-$4,900	-$31,325	-$58,800	-$99,750	-$1,050	-$16,975	-$52,500	-$100,800	-$6,125	-$32,900	-$52,500	-$103,775	$2,100	$8,400	-$35,175	-$67,375
Average quantity per transfer event (TAF)	193	-5	-30	13	3	-1	-16	22	1	-6	-31	22	-5	2	8	-2	-38
Water Supply/Water Use Efficiency Option Use																	
		Change from No Action Alternative (Costs and Quantities Are Annual Values)															
Conservation (TAF)	401	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conservation cost ($1,000)	$222,450	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Groundwater recovery (TAF)	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groundwater recovery cost ($1,000)	$52,353	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Recycling (TAF)	466	0	0	0	-15	0	0	0	-16	0	0	0	-13	0	0	0	-5
Recycling cost ($1,000)	$235,055	$0	$0	$0	-$14,361	$0	$0	$0	-$15,299	$0	$0	$0	-$12,477	$0	$0	$0	-$4,847
Seawater desalting (TAF)	68	-7	-16	-56	-63	-6	-14	-57	-63	-7	-16	-55	-63	-4	-8	-52	-63
Seawater desalting cost ($1,000)	$69,490	-$7,210	-$16,480	-$57,680	-$64,890	-$6,180	-$14,420	-$58,710	-$64,890	-$7,210	-$16,480	-$56,650	-$64,890	-$4,120	-$8,240	-$53,560	-$64,890
Total option use (TAF)	1,030	-7	-16	-56	-78	-6	-14	-57	-79	-7	-16	-55	-76	-4	-8	-52	-68
Total option cost ($1,000)	$579,348	-$7,210	-$16,480	-$57,680	-$79,251	-$6,180	-$14,420	-$58,710	-$80,189	-$7,210	-$16,480	-$56,650	-$77,367	-$4,120	-$8,240	-$53,560	-$69,737

Notes:

TAF = Thousand acre-feet.

See Section 5.1 and Attachment A for a description of water supply modeling assumptions and Section 7.5.12 for details on LCPSIM.

Table 7.5-19(b). Results of Least-Cost Analysis of Program Alternatives for the South Coast Region - Criterion B

	NO ACTION	PREFERRED PROGRAM ALTERNATIVE WITH HOOD				PREFERRED PROGRAM ALTERNATIVE WITHOUT HOOD (ALTERNATIVE 1)				ALTERNATIVE 2				ALTERNATIVE 3			
		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
		LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY	LOW PRIORITY	HIGH PRIORITY
Regional Economic Benefits																	
		Annual Value of Incremental Supply															
Average incremental supply (TAF)	N/A	32	88	117	267	31	85	111	266	43	122	161	208	21	82	130	259
Avoided costs/losses ($1,000)	N/A	$12,462	$40,984	$82,568	$221,111	$13,591	$40,923	$83,603	$230,591	$13,819	$42,606	$83,764	$236,827	$25,707	$81,563	$110,620	$251,398
Average value of incremental supply ($/AF)	N/A	$432	$501	$638	$852	$438	$482	$705	$866	$438	$484	$704	$886	$595	$671	$684	$872
Regional Water Management -- Least-Cost Planning Criterion																	
		Change from No Action Alternative (Costs/Losses Are Annual Values)															
Expected Shortage-Related Costs/Losses ($1,000)	$202,025	$2,030	-$3,745	-$25,367	-$91,455	$1,593	-$1,752	-$28,820	-$96,918	$2,055	-$2,155	-$28,375	-$100,540	-$1,657	-$17,238	-$39,369	-$104,243
Shortage Contingency Water Transfers																	
		Change from No Action Alternative (Costs and Quantities Are for the 73-Year Study Period)															
Number of transfer events	7	1	-1	-4	-5	1	-1	-3	-5	1	-1	-3	-5	1	0	-2	-5
Total quantity transferred (TAF)	1,032	20	207	-232	-439	45	269	-221	-367	37	241	-218	-478	29	16	-222	-690
Total cost ($1,000)	$180,600	$3,500	$36,225	-$40,600	-$76,825	$7,875	$47,075	-$38,675	-$64,225	$6,475	$42,175	-$38,150	-$83,650	$5,075	$2,800	-$38,850	-$120,750
Average quantity per transfer event (TAF)	147	-16	59	119	149	-13	69	55	185	-14	65	56	130	-15	2	15	24
Water Supply/Water Use Efficiency Option Use																	
		Change from No Action Alternative (Costs and Quantities Are Annual Values)															
Conservation (TAF)	232	-8	-8	-8	-38	-8	-8	-8	-38	-8	-8	-8	-38	-8	-8	-8	-38
Conservation cost ($1,000)	$90,513	-$6,313	-$6,313	-$6,313	-$21,313	-$6,313	-$6,313	-$6,313	-$21,313	-$6,313	-$6,313	-$6,313	-$21,313	-$6,313	-$6,313	-$6,313	-$21,313
Groundwater recovery (TAF)	93	0	-15	-28	-75	-1	-16	-27	-79	-1	-17	-27	-82	-6	-34	-39	-93
Groundwater recovery cost ($1,000)	$50,573	-$49	-$9,799	-$18,354	-$42,977	-$346	-$10,626	-$17,317	-$44,698	-$642	-$11,175	-$17,577	-$46,035	-$4,146	-$21,407	-$24,375	-$50,573
Recycling (TAF)	360	-12	-31	-49	-112	-12	-33	-47	-117	-13	-34	-48	-120	-20	-56	-63	-136
Recycling cost ($1,000)	$144,845	-$8,130	-$21,128	-$32,535	-$65,367	-$8,525	-$22,232	-$31,153	-$67,661	-$8,919	-$22,964	-$31,500	-$68,940	-$13,592	-$36,606	-$40,563	-$75,269
Seawater desalting (TAF)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seawater desalting cost ($1,000)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total option use (TAF)	685	-20	-54	-86	-225	-21	-57	-82	-234	-22	-59	-83	-240	-34	-98	-110	-267
Total option cost ($1,000)	$285,931	-$14,492	-$37,239	-$57,201	-$129,657	-$15,183	-$39,171	-$54,783	-$133,672	-$15,874	-$40,451	-$55,389	-$136,287	-$24,050	-$64,325	-$71,251	-$147,155

Notes:

TAF = Thousand acre-feet.
See Section 5.1 and Attachment A for a description of water supply modeling assumptions and Section 7.5.12 for details on LCPSIM.

Salinity and bromide concentrations in municipal water diversions are expected to be reduced under Alternative 2 when compared to the No Action Alternative. However, the economic consequences of this effect cannot be estimated at this time.

7.5.8.4 ALTERNATIVE 3

Storage under Alternative 3 ranges from 0 and 6.0 MAF. Alternative 3 adds a new canal connecting the Sacramento river in the north Delta to the SWP and CVP export facilities in the south Delta. The new canal would accompany other Delta facilities contemplated under Alternatives 1 and 2.

Table 7.5-14 shows the total increase in water supply for the Bay Region and the Other SWP and CVP Service Areas. Table 7.5-17 shows some characteristics for the urban water regions in 2020 under the No Action Alternative. The shortages for the No Action Alternative identified in Table 7.5-17 would be largely eliminated by the Water Use Efficiency Program conservation savings and recycled supplies identified in Table 7.5-16. The Water Use Efficiency Program would be in place under Alternative 3; therefore, the discussion provided for the Preferred Program Alternative applies to all regions.

DWR's LCPSIM, which bases regional economic efficiency on the least-cost planning criterion, allows a new Delta water supply to change the use of regional long-term water supply and water use efficiency options compared to what would otherwise have been economically efficient without that supply. The economically efficient level of expected shortage-related costs and losses (including the costs of shortage contingency water transfers) can be similarly changed.

Economic benefits from a new Delta supply can be obtained either from a reduction in both regional long-term option use costs and expected shortage-related costs and losses or from a net reduction in their sum. A new Delta supply, for example, may produce benefits from a regional least-cost plan that includes an increase in expected shortage-related costs and losses but achieves an even larger reduction in option use costs (or vice-versa).

The results of LCPSIM studies for the Bay Region and the Other SWP and CVP Service Areas are shown in Table 7.5-18 and Table 7.5-19, respectively. The results were produced by determining the regional least-cost plan for each Program alternative scenario. Shown for each scenario are the incremental Delta supply benefits (in terms of avoided annual costs), as well as the changes from the No Action Alternative for expected shortage-related costs and losses, including changes in water transfer costs and quantities for the 73-year study period. Changes in regional long-term option use and annual option use costs also are shown.

Modeling runs indicate that salinity and bromide concentrations in municipal water diversions would be reduced under Alternative 3 when compared to the No Action Alternative. Economic effects of these effects are as yet undetermined.

7.5.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. This programmatic analysis found that the potentially beneficial and adverse effects from implementing any of the Program alternatives when compared to existing conditions are similar to effects identified in Sections 7.5.7 and 7.5.8, which compare the Program alternatives to the No Action Alternative.

A comparison of the Preferred Program Alternative to existing conditions indicates that the adverse socioeconomic effects identified when compared to the No Action Alternative are still adverse when compared to existing conditions.

The Program is proposing actions that could cause some economic disruption of urban communities. Under the No Action Alternative, urban development would continue and some adverse socioeconomic effects on existing communities could occur as a result of that development. If the Preferred Program Alternative would affect growth, these effects would be added to other urban development effects that would occur under the No Action Alternative. The combination of these effects with other development effects represents the total changes with respect to existing conditions. The Preferred Program Alternative is not expected to affect growth because the costs and amount of new supplies would be about the same as the costs and amounts obtained by other means.
The water supply reliability actions from the Water Use Efficiency, Water Quality, Storage, and Conveyance elements could improve the availability and quality of water for urban uses, which could result in some socioeconomic benefits above the existing condition baseline. The benefits provided by the Preferred Program Alternative when compared to existing conditions are less than when compared to the No Action Alternative because of the smaller population and less demand for water under existing conditions.

7.5.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. For urban water supply economics, the analysis and conclusions regarding the Preferred Program Alternative's contribution to cumulative effects are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term effects. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.5.1 summarizes the potential long-term urban water supply economic effects. Sections 7.5.7 and 7.5.8 elaborate on long-term effects.

Adverse cumulative effects on urban water supply economics could occur if the Program and the projects and activities listed in Attachment A affect the factors that influence the cost of urban water and urban water costs increase. As discussed in this section, the costs of water for urban uses are determined by a multitude of factors and relationships, including the demand for and supply of water resources, the costs of building facilities to supply water, the costs of treating water, and the costs and availability of alternative water supplies. These economic factors are, in turn, conditioned by non-economic factors such as population levels, technology, water quality, and local water supply preferences. Economic systems allow these factors to inter-relate and determine costs and benefits. At this program level of analysis, much of the information needed to specifically analyze the costs and benefits of CALFED Program actions to urban water supply economics is not available and will not be available until specific sizes, locations, and other specifications of projects are known.

The Program and water development projects listed in Attachment A are proposing actions that would increase water supply and/or water supply reliability in some regions. To the extent that urban water supplies are increased, cumulative economic benefits would be expected if the costs of the water developed by the projects do not exceed the costs of water developed through alternate water supply projects. Some Attachment A projects would reduce or reallocate water supplies. Decreases in water supply availability would increase costs of urban supplies unless alternate water resources at equivalent cost are available. Urbanization and increased population levels will increase the demand for urban water supplies. Increased demand will tend to increase urban water costs. The combination of these effects with other development effects may result in higher average water costs and, probably, lower per capita water use.

Growth-Inducing Effects. No effects are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. No relationships between short-term uses of the environment and the maintenance and enhancement of long-term productivity have been identified for this resource.

Irreversible and Irretrievable Commitments. Costs and resources committed to a fixed water supply structure cannot be easily reversed. For urban water supply economics, costs must be paid in advance and cannot be recovered even if water supply or water quality benefits do not occur. Program water supply increases are not expected to induce growth, but urbanization would be costly to reverse or relocate if water supplies become unavailable.

7.5.11 ADVERSE EFFECTS

This preliminary analysis has identified no unavoidable adverse effects related to urban water supply economics. Additional analysis is required to fully determine economic effects, when cost and cost allocation information are available.

7.5.12 LCPSIM URBAN WATER SUPPLY ECONOMICS ASSESSMENT

The LCPSIM model has been developed to assess the economic benefits and costs of increasing water service reliability to urban areas by evaluating the economic consequences of the yearly changes in demands and availability of water supplies. The LCPSIM model measures water service reliability benefits by estimating the ability of shortage management (contingency) measures to mitigate regional costs and losses associated with a shortage. Assumptions about the effectiveness of regional long-term and shortage contingency options that can be employed to enhance reliability are incorporated into the LCPSIM model along with estimates of their costs. One of the primary objectives of the LCPSIM model is to develop an economically efficient regional water management plan.

In LCPSIM, a priority-based objective, mass balance-constrained linear programming solution is used to simulate regional water management operations on a yearly time-step, including the operation of surface and groundwater carryover storage capacity assumed to be available to the region. Economic losses due to shortage events are based on a residential water user loss function. The cost of adding regional long-term water management measures is determined using a quadratic-programming algorithm. Quadratic programming also is used to simulate water market purchases during shortage events, solving for the least-cost combination of shortage-related economic losses and the cost of transferred water. Demand hardening—the increase in the size of the economic losses associated with specific shortage events—is related to the level of use of regional long-term conservation measures. The least-cost combination of economic risk, regional long-term water management facilities and programs, and contingency water transfers is identified within the model for each alternative water management plan being evaluated. Figure 7.5-3 shows the major model logic flows. Figure 7.5-4 provides the details of the inputs.

The LCPSIM model takes a comprehensive view of water supply reliability, incorporating key information on the frequency, size, and effects of shortages. Regional water managers and users must respond primarily to actual year-to-year fluctuations in demand level and water supply availability rather than to average levels of demand and supply. As shortages increase in magnitude and regularity, shortage management becomes increasingly important. The LCPSIM model evaluates the economic justification of the level of reliability enhancement provided by any combination of long-term water management options in the context of regionally available contingency options. Regional water management options are divided into three categories: (1) shortage contingency demand management and supply augmentation, (2) long-term demand management and supply enhancement, and (3) economic risk management. The latter accepts a known degree of economic risk from shortages to avoid the use of other water management options that are perceived to be even more costly. Demands were based on the 2020-level values developed for DWR's Bulletin 160-98 and include the forecasted levels of adoption of BMPs for urban conservation.

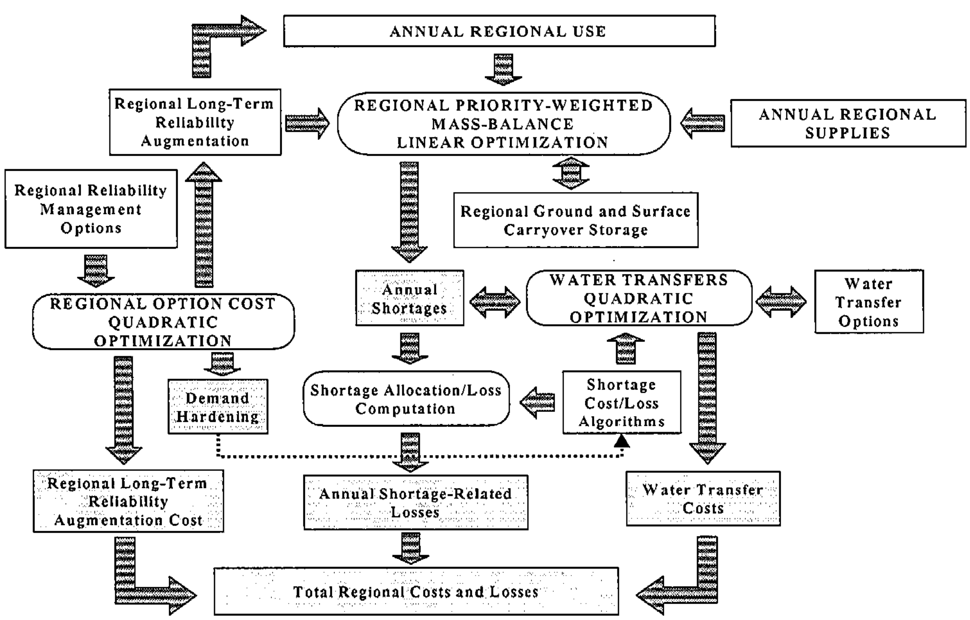


Figure 7.5-3. LCPSIM Logic Flows

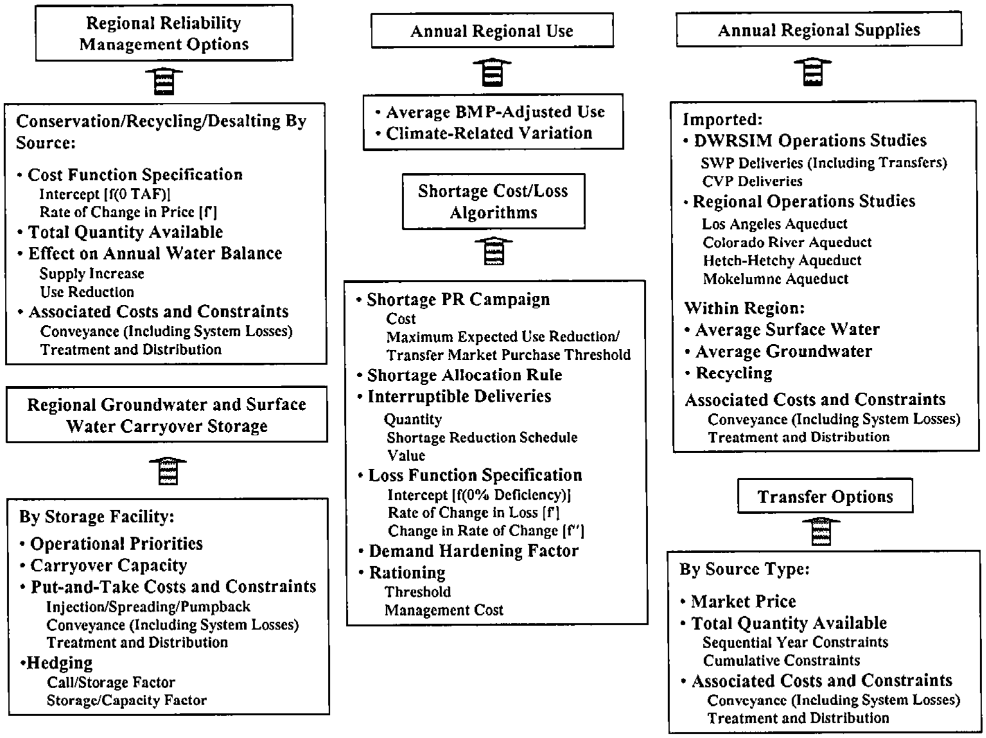


Figure 7.5-4. LCPSIM Input Data and Parameters

The LCPSIM model was run for both the Bay and South Coast Regions. Demands were based on the 2020-level values developed for DWR's Bulletin 160-98 and include the forecasted levels of adoption of BMPs for urban conservation. The residential user loss function was assumed to be the same for both regions. Shown in Figure 7.5-5 is the willingness to pay to avoid one-time shortages of specific sizes by residential customers with specified annual water use rates (use per year per household). Users in the commercial and industrial water use sectors–where, above a threshold shortage size, marginal losses were assumed to be higher–were allocated proportionately less of the overall shortage during shortage events by LCPSIM logic in order to allow the application of this loss function to the entire shortage.

Deficiency	Willingness to Pay per Shortage Event by Use per Year per Household		
	0.75 AF	0.65 AF	0.55 AF
0%	$0	$0	$0
5%	$49	$43	$36
10%	$145	$126	$106
15%	$278	$241	$204
20%	$439	$380	$322
25%	$618	$535	$453
30%	$804	$697	$590
35%	$990	$858	$726

Figure 7.5-5. LCPSIM Loss Function

Carryover storage capacity allows a current year supply which is in excess of current year use to be held over to meet use during years with supply deficiencies. Carryover storage capacity can exist in surface reservoirs or in groundwater basins. The operation of groundwater capacity is generally less effective for shortage management because annual refill (put) and extraction (take) rates can be relatively limited compared to reservoir storage capacity. Shown in Figure 7.5-6 are the carryover storage assumptions used for the South Coast Region.

Operation	Capacity (TAF)	Initial Fill	Recharge Efficiency	Put Limit (TAF)	Put Cost	Take Limit (TAF)	Take Cost	Description
1	225	100%	100%	225	$0	225	$0	Terminal Reservoirs
2	660	50%	100%	200	$0	660	$0	Local Reservoir Augmentation
3	600	50%	100%	30	$0	200	$16	Local Groundwater In-Lieu Recharge
4	600	50%	95%	170	$15	200	$16	Local Groundwater Spreading Recharge
5	660	50%	100%	660	$0	660	$0	Local Reservoir Augmentation
6	210	50%	95%	55	$90	70	$85	Local Banking
7	550	50%	95%	200	$90	120	$85	External Banking

Figure 7.5-6. South Coast Region Carryover Storage Capacities

The capacities listed are not additive for the South Coast Region because Operations 2 and 5 share the same surface reservoir storage capacity. Similarly, Operations 3 and 4 share the same groundwater storage capacity. The operations are separately identified in the model to allow for differences in refill and use operations in terms of priority, cost, or rate. Operation 1, terminal reservoir storage, is also identified separately because of differences in priority of refill and use compared to other surface reservoir storage.

Shown in Figure 7.5-7 are the carryover storage capacity assumptions for the Bay Region. This capacity includes recent agreements for banking water in the Tulare Lake basin, patterned after the agreement made for the South Coast Region (Operation 7, above).

Operation	Capacity (TAF)	Initial Fill	Recharge Efficiency	Put Limit (TAF)	Put Cost	Take Limit (TAF)	Take Cost	Description
1	100	50%	100%	100	$0	100	$0	Local Reservoir Storage
2	100	50%	95%	100	$15	20	$16	Local Groundwater Spreading
3	443	50%	95%	70	$90	70	$85	External Banking

Figure 7.5-7. Bay Region Carryover Storage Capacities

Shortage contingency water transfers were assumed to be available for both regions. The maximum annual level of contingency transfers assumed to be available from the Central Valley was 400 TAF for the South Coast Region and 100 TAF for the Bay Region, the amounts assumed to be available through the State Drought Water Bank and other transfer options. Transfer option were assumed to cost about $175 per acre-foot, excluding conveyance (specified conveyance costs are added within LCPSIM). Each transfer was constrained not to occur over 25% of the time unless the quantity transferred was less than the maximum annual amount available (that is, 250% of the maximum annual amount in any 10-year period). If less than the maximum available was transferred, the frequency could be proportionately higher. The quantity transferred during any two consecutive years also could exceed the maximum annual amount available. These constraints apply independently to each transfer source identified. In addition, transfers could only be used when the available regional supplies were below 93% of current consumptive demand. Up to a

7% shortage was assumed to be relatively easily managed with a contingency conservation program that the model assumes would be triggered by a shortage of this size.

Long-term demand management options that are adopted by water users can have a demand "hardening" effect. Although they can increase reliability by reducing the size, frequency and duration of shortage events, they can make these events relatively more costly when they do occur. This occurs because these options tend to reduce the "slack" in the system (that is, reduce or eliminate the least valuable water uses and/or the least efficient water use methods). This means that things are already "closer to the bone" for users and they are more vulnerable when shortages happen. For LCPSIM runs, the hardening factor was assumed to be 50% (that is, if conservation decreases demand by 10%, the economic effect of a shortage of a specified size was computed as if the shortage was actually 5% greater).

Figure 7.5-8 is the option input table used for the South Coast Region. Information from DWR Bulletin 160-98 was used to develop the data in the table. The conservation options shown in this figure (and in Figure 7.5-9) represent actions beyond those assumed to have been implemented to achieve the level of conservation already incorporated in the study demands due to the adoption of BMPs.

One difference in the assumptions on available options for the South Coast Region was that the Bulletin assumed that diversions from the Colorado River Aqueduct were held at 550 TAF in the base case. Transfer, conservation, and land fallowing options for the Colorado River Region to augment this supply were developed for the bulletin. For the purposes of the current LCPSIM study, the amount of water assumed to be imported through the Colorado River Aqueduct was assumed to be held at a constant 1.1 MAF to account for plans by the MWD and the San Diego County Water Authority plans for imports in the future. Consequently, no options were included which involved additional water being wheeled through the aqueduct since it is essentially at capacity under this assumption.

Source	Amount Available (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	67	$750	$0.00	2	Conservation I (New Development - Outdoor)
2	110	$400	$0.00	2	Conservation II (Indoor - 60 GPCD)
3	110	$800	$0.00	2	Conservation II (Indoor - 55 GPCD)
4	30	$500	$0.00	2	Conservation III (3% Nonresidential Use)
5	18	$1,167	$0.00	2	Conservation III (5% Nonresidential Use)
6	84	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	93	$395	$3.20	1	Groundwater Recovery I
8	2	$890	$0.00	1	Groundwater Recovery II
9	4	$179	$0.00	1	Water Recycling I
10	236	$236	$0.70	1	Water Recycling II
11	226	$433	$2.40	1	Water Recycling III
12	13	$1,180	$0.00	1	Water Recycling IV
13	5	$2,147	$165.00	1	Water Recycling V
14	5	$920	$0.00	1	Ocean Water Desalting I
15	100	$1,030	$0.00	1	Ocean Water Desalting II
16	900	$1,700	$0.00	1	Ocean Water Desalting III

Figure 7.5-8. South Coast Region Options

Figure 7.5-9 is the option input table used for the Bay Region, which also was developed from information used in Bulletin 160-98.

Source	Amount Available (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	2	$750	$0.00	2	Conservation I (New Development - Outdoor)
2	38	$400	$0.00	2	Conservation II (Indoor - 60 GPCD)
3	38	$800	$0.00	2	Conservation II (Indoor - 55 GPCD)
4	11	$500	$0.00	2	Conservation III (3% Nonresidential Use)
5	7	$1,167	$0.00	2	Conservation III (5% Nonresidential Use)
6	13	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	9	$510	$0.00	1	Groundwater Recovery I
8	20	$95	$0.00	1	Water Recycling I
9	4	$243	$0.00	1	Water Recycling II
10	24	$563	$28.50	1	Water Recycling III
11	1	$2,381	$0.00	1	Water Recycling IV

Figure 7.5-9. Bay Region Options

Price elasticity of water demand was considered in two ways. The economic optimization logic used in LCPSIM depends on comparing the marginal cost of additional regional conservation to the marginal cost of additional regional supply and the marginal expected cost of shortages. Demand is therefore a function of the overall regional economic efficiency of water management in light of the Program alternative being evaluated.

The Program alternatives were evaluated with LCPSIM by running the model with the CVP and SWP deliveries expected under the No Action Alternative to obtain the least-cost combination of shortage-related costs and losses (including shortage management costs) and the investment and operations costs of long-term water management options (that is, the least-cost solution). The model then was run with the change in deliveries expected with each Program alternative. The least-cost solution for each Program alternative then was compared to the original results.

Because the increased CVP and SWP deliveries, particularly during dry and critical years, LCPSIM achieved a least-cost solution with lower total costs (that is, a superior least-cost solution) with each of the Program alternatives. This was achieved either by a reduction in expected shortage-related costs and losses or by avoiding the costs associated with long-term water management options no longer needed to achieve the least-cost solution, or both. It should be noted that some superior least-cost solutions can result in higher shortage-related costs and losses or higher costs associated with long-term water management options but the net effect is a lower total cost.

7.6 Utilities and Public Services

Potential impacts on utilities and public services associated with CALFED Bay-Delta Program actions primarily involve relocating or modifying infrastructure components. Relocating or modifying a major infrastructure component would result in a potentially significant impact. Benefits from Program actions include decreased risk of structural failure of infrastructure because of increased levee stability.

7.6 Utilities and Public Services

7.6.1 SUMMARY

A vast network of utility generation/transmission systems and service providers cross all regions of the CALFED Bay-Delta Program (Program) study area, supplying urban and rural areas with power, water, and emergency services. Impacts on utilities and public services associated with Program actions primarily involve relocating or modifying infrastructure components and increasing power demands. Program actions are not expected to directly require construction or development of additional utility capacity, or to require public services in excess of current regional capacity. However, indirect effects may be associated with power and energy issues, as presented in Section 7.9.

Preferred Program Alternative. Beneficial impacts on utilities and other infrastructure are associated with improvement of existing levees. Electrical transmission lines, utility facilities, and emergency service centers would benefit from the reduced cumulative risk of levee failure in the area.

The Ecosystem Restoration and Levee System Integrity Programs, and the Storage and Conveyance elements could require relocating or modifying some utility and public service infrastructure components. The Storage element could result in hydropower output modifications, construction impacts, and potential stimulation of municipal and industrial (M&I) development. The significance of these impacts would depend on the size, location, and quantity of storage facilities developed. The Water Quality Program and Storage element have the potential to increase the use of recreation facilities, thereby increasing demand for utilities and public services. Additionally, the Water Quality Program could increase energy demand to supply new treatment facilities. The Storage and Conveyance elements would create additional power demand to increase pumping operations. These increases in power consumption could require additional generating capacity, as discussed in Section 7.9. The Water Use Efficiency Program and Storage element could create a need for new distribution systems to provide power or recycled water to potential customers. Proper siting of such systems could mitigate impacts associated with new distribution corridors.

Alternatives 1, 2, and 3. Impacts on utilities and public services would be similar to those described for the Preferred Program Alternative but would differ in magnitude, depending on the conveyance facilities being constructed and operated. Because Alternative 1 includes the fewest facilities, construction-related and operations-related impacts would be less. Although similar facilities are involved in Alternative 2, energy requirements most likely would be greater than those for the Preferred Program Alternative because of the higher rate of pumping. The isolated facility associated with Alternative 3 would involve the highest energy requirements and greatest potential for displacement of major infrastructure components.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses. See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Possible need for relocation or modification of major infrastructure components (1,2,4,5).

Increased risk of gas line rupture during construction phase (3).

Mitigation Strategies

1. Siting project facilities and transmission infrastructure to avoid existing infrastructure.
2. Constructing overpasses, small bridges, or other structures to accommodate existing infrastructure.
3. Coordinating construction activities with utility providers.
4. Designing and operating facilities to minimize the amount of energy required and to maximize the amount of energy created.
5. Designing project facilities to avoid or minimize their effect on existing infrastructure.

No potentially significant unavoidable impacts on utilities and public services are associated with the Preferred Program Alternative.

7.6.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to utilities and public services. In addition, no areas of concern are associated with utilities and public services.

7.6.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

7.6.3.1 DELTA REGION

Water-Related Infrastructure. Most water conveyance facilities in the Delta have been developed under the authority of the federal government's CVP and California's SWP.

As part of CVP development, exportation of water from the Delta began in 1940 with the completion of the Contra Costa Canal. Other major federal units were completed during the early 1950s, including the Delta-Mendota Canal and the Delta Cross Channel (DCC). The DCC transfers water across the Delta from the Sacramento River to the Tracy Pumping Plant, which serves the Delta-Mendota Canal.

Numerous SWP facilities have been developed in the Delta, including the Harvey O. Banks Delta Pumping Plant, the California Aqueduct, and the North Bay Aqueduct (NBA).

Water conveyance infrastructure consists of a multitude of agricultural, industrial, and municipal diversions for supplying water to the Delta itself and for export by the SWP and CVP. Diversions and conveyance require canals, waterways, levees, siphons, pumps, radial gates, and other miscellaneous infrastructure. Municipal and industrial (M&I) demands in the Delta are met by conveying water through the Contra Costa Canal to the cities of Martinez, Antioch, and Pittsburgh and to numerous industrial complexes in the vicinity.

Electric Utility and Communication Infrastructure. Power transmission facilities have developed parallel to the population growth of various communities surrounding the Delta. Pacific Gas and Electric (PG&E) and the Western Area Power Administration have developed power transmission lines across the Delta islands and waterways. Many of the corridors are within the periphery of the Delta upland areas, including several natural gas-fired plants. Power-generating facilities are absent from the central Delta. Communication infrastructure in the region includes underground cable and fiber optic lines, and communication/transmission towers. Please refer to Section 7.9 for more information on hydropower energy production and the impacts of the CALFED Program on hydropower energy production.

Natural Gas Infrastructure. Natural gas was discovered in the Delta Region in 1935 and has since been developed into a significant source supply and depot for underground storage. Gas fields, pipelines, underground storage areas, and related infrastructure are located in the Delta. Infrastructure consists mainly of pipelines and storage facilities owned by oil and gas companies, public utilities, and various independent leaseholders.

Public Services. Police protection is provided by various departments within the cities and counties of the Delta Region. For example, the San Joaquin Sheriff's Department marine patrol division provides water patrol services to approximately 600 square miles of waterways in the Delta area. The Contra Costa County Sheriff's Department provides law enforcement services in the area as well. Fire protection service is provided by various departments in the Delta area, including the San Joaquin County Delta Fire Protection District and the Contra Costa Fire Protection District. Volunteer firefighters are also available to respond to fire emergencies as needed. Fire suppression in areas not under the jurisdiction of a fire protection district is the responsibility of the landowners. Emergency services are provided by cities and counties in the region.

7.6.3.2 BAY REGION

Water-Related Infrastructure. Three subregions in the Bay Region are internally independent in terms of water supply: the North Bay, the South Bay, and Contra Costa Water District. The North Bay consists of SWP entitlement holders served by the SWP's NBA and others who use this facility in exchanges. Two water districts are served by the NBA: Napa County Flood Control and Water Conservation District (NCFCWCD) and Solano County Flood Control and Water Conservation District (SCFCWCD). In Solano County, Reclamation's Solano Project provides a substantial source of water supply. Local reservoirs in Napa County provide additional supply. NCFCWCD serves SWP water in southern Napa County. SCFCWCD serves the cities of Vallejo, Vacaville, Fairfield, Benicia, and Suisun. The two districts have transferred water and obtained surplus water through the NBA. In addition to SWP entitlement water, Vallejo receives water allocated from water rights through the NBA.

The South Bay is served by the SWP's South Bay Aqueduct (SBA) and through the San Felipe Division with CVP contract supplies. Three SWP entitlement holders—Alameda County Water District, Alameda County Zone 7, and the Santa Clara Valley Water District (SCVWD)—are located in the South Bay. In addition, SCVWD is served by the San Felipe Division of the CVP and wholesales water in a large part of the region south of San Francisco Bay.

The Suisun Marsh is located in the Bay Region. The Program actions that would directly affect utilities and public services in the marsh are levee improvements under the Levee System Integrity and Ecosystem Restoration Programs. Levee System Integrity Program actions would take place primarily in the Delta Region and, for most resources, the program is discussed only for the Delta Region. Utilities and public services associated with Suisun Marsh are described under "Delta Region" for the Levee System Integrity Program. Ecosystem Restoration Program actions are described under "All Regions" and include Suisun Marsh.

Electric Utility and Communication Infrastructure. Bay Region electric infrastructure consists of a large and complex grid of power plants, transmission lines, and substations. Generating facilities in the region primarily are fired with natural gas and oil. Major power generation facilities and oil refineries are located along the straits, and their operations can combine to significantly affect the chemical and thermal quality of the water in the Bay-Delta. Entrainment at some of the intakes to these facilities contributes to the cumulative impacts of those at the Delta pumps. Communication infrastructure in the region includes underground cable and fiber optic lines, and communication/ transmission towers.

Public Services. Various departments within the cities and counties of the Bay Region provide fire protection, police protection, and emergency services to members of their respective communities.

7.6.3.3 SACRAMENTO RIVER REGION

Water-Related Infrastructure. The Sacramento Valley has relatively abundant water supplies of good quality in comparison to the other regions. The Sacramento River Region provides its own M&I water and does not use M&I water exported directly from the Delta.

The major M&I water use in the region occurs in the Sacramento metropolitan area. Most surface water use in the region is diverted from the American River. Direct diversions from the Sacramento River may provide a larger share of supplies in the future. Another large user is the City of Redding. The CVP provides municipal water service to a large number of small M&I providers in the area.

Water resources in the Sacramento Basin have been developed for local agricultural, municipal, and industrial needs. Water resources are exported to the Bay-Delta and are used to generate power at hydroelectric facilities. Most of the developed surface water storage in the region is contained in four major reservoirs: Lake Shasta on the Sacramento River (about 4.5 MAF), Oroville Reservoir on the Feather River (about 3.5 MAF), Folsom Lake on the American River (about 1.0 MAF), and Lake Berryessa on Putah Creek (about 1.6 MAF). An additional 2.2 MAF of flood control storage is provided by a system of basins, levees, channels, and bypasses that include the Butte, Colusa, Sutter, American, and Yolo Basins. Levees and bypasses extend more than 150 miles, from Red Bluff to Suisun Bay. Flood control measures include bypass overflows that act as auxiliary channels to the Sacramento River during high-water periods.

Electric Utility and Communication Infrastructure. Infrastructure consists primarily of hydroelectric and natural gas-fired generating facilities, transmission lines, substations, distribution lines, fiber optic and cable lines, and communication towers.

Hydropower generation levels fluctuate significantly with reservoir releases, which are in turn affected by droughts (and other climatic conditions), minimum streamflow requirements, flow fluctuation restrictions, and water quality requirements. Changes in power generation affect coordinated operations of both PG&E and CVP facilities.

Natural Gas Infrastructure. Pipelines, storage areas, and compressor stations are located in the Sacramento Valley and other parts of northern California.

Public Services. Various departments within the cities and counties of the Sacramento River Region provide fire protection, police protection, and emergency services to members of their respective communities.

7.6.3.4 San Joaquin River Region

Water-Related Infrastructure. Table 7.6-1 shows recent imports into the region through SWP and CVP facilities. The data show the influence of the recent drought and reduced allocations, especially in 1991 and 1992. Most Delta water delivered into the region is provided to Kern County Water Agency (KCWA) in exchange for groundwater pumped by the City of Bakersfield.

Table 7.6-1. M&I Water Delivered to the San Joaquin River Region from the Delta, 1990 to 1994

WATER SOURCE	1990	1991	1992	1993	1994
Central Valley Project					
Cross Valley Canal	459	407	297	0	0
Delta-Mendota Canal	5,531	5,586	7,221	8,005	7,843
San Luis Canal	12,996	10,528	15,098	11,787	14,374
State Water Project					
Kern County Water Agency	127,837	33,122	56,305	94,220	--
Total	**146,823**	**49,643**	**78,921**	**114,012**	**22,217**

Notes:
Does not include water rights deliveries or water transfers.
- - = Not available.

Sources:
Reclamation 1996, DWR 1996.

Table 7.6-2 shows characteristics of some San Joaquin Valley M&I providers. Per capita use rates are generally higher than in the coastal regions, reflecting climate and landscape factors. Local water supplies are unable to meet local demands, and supplemental water is imported from the Delta Region. Infrastructure in the region consists mainly of channels, aqueducts, reservoirs, and irrigation structures.

Table 7.6-2. Characteristics of Some San Joaquin River Region Providers

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgd)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Stockton	210,943	17,130	64,179	222	52	100	52	$311
Huron	4,766	284	621	163	100	N/A	100	
Coalinga	8,450	1,032	2,665	327	100	16	100	
Bakersfield, CA Water	172,800	20,222	51,641	321	15	24	15	$263

Notes:
GPCD = Gallons per capita per day.
mgd = Million gallons per day.

Electric Utility and Communication Infrastructure. Infrastructure consists primarily of natural gas-fired and hydroelectric generating facilities, transmission lines, substations, distribution lines, fiber optic and cable television lines, and communication towers.

Natural Gas Infrastructure. Although gas fields and storage areas are not known to exist in the region, several major pipelines traverse the entire length of the San Joaquin Valley.

Public Services. Various departments within the cities and counties of the San Joaquin River Region provide fire protection, police protection, and emergency services to members of their respective communities.

7.6.3.5 Other SWP and CVP Service Areas

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of the Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

Water-Related Infrastructure. Table 7.6-3 shows recent imports into the Other SWP and CVP Service Areas through SWP facilities. These data show the influence of drought and reduced water allocations, especially in 1991 and 1992. SWP deliveries to metropolitan areas declined 72% from 1990 to 1991 and did not recover until 1993. Similar delivery patterns were experienced by the other SWP M&I entitlement holders in the region. SWP and CVP water is pumped from CCFB in the Delta and is transported into the region via the California Aqueduct and the Delta-Mendota Canal. Key SWP and CVP infrastructure includes reservoirs, aqueducts, power plants, and pumping plants.

Table 7.6-4 shows some characteristics of M&I providers in the southern portion of the region.[1] Only those providers delivering more than 10,000 million gallons annually are included. In the South Coast Subregion, per capita use rates generally reflect distance from the coast (Table 7.6-5). Most providers

[1] The regions listed in Tables 7.6-4 and 7.6-5 are hydrologic regions used by DWR in its "California Water Plan" update.

supply a mix of purchased and developed water, and almost all providers use a mix of surface water and groundwater supplies.

Table 7.6-3. M&I Water Delivered to the Central Coast and South of Kern County from the Delta, 1990 to 1993 (in acre-feet)

WATER SOURCE	1990	1991	1992	1993
State Water Project				
The Metropolitan Water District of Southern California	1,396,423	391,447	707,311	1,408,050
Other southern California	189,483	51,249	105,090	193,092
Total	**1,585,906**	**442,696**	**812,401**	**1,601,142**

Note:
Does not include water rights deliveries or water transfers.

Sources:
Reclamation 1996, DWR 1996.

Table 7.6-4. Characteristics of Some Providers in the Other SWP and CVP Service Areas

PROVIDER	POPULATION (1990)	WATER INTO SYSTEM (1990 mgy)	SERVICE CONNECTIONS (1990)	GPCD (1990)	PERCENT PURCHASED	PERCENT METERED	PERCENT SURFACE WATER	$/af AVERAGE COST
Central Coast Region								
San Luis Obispo	41,958	1,560	12,350	102	0	100	59	$890
Goleta	70,480	1,934	13,750	75	76	100	75	$1,381
Santa Barbara	85,571	3,079	24,146	99	61	100	68	$1,364
South Coast Region*								
Carson et al.	101,000	12,667	31,611	344	73	100	73	
Long Beach	429,433	24,448	87,923	156	65	100	65	$498
Los Angeles	3,485,398	218,809	635,698	172	73	100	89	$462
Glendale	180,038	10,144	32,778	154	93	100	93	$312
Pasadena	131,590	12,629	36,998	263	66	N/A	67	$331
Anaheim	266,406	24,064	55,500	247	49	100	49	
Fullerton	114,144	10,584	27,890	254	54	100	54	
Huntington Beach	181,519	12,530	48,571	189	53	100	53	
Santa Ana	293,742	16,665	43,491	155	25	N/A	25	
Riverside	226,505	22,217	66,348	269	8	100	8	$268
Ontario	133,179	12,101	28,019	249	46	100	46	
Rancho Cucamonga	101,409	13,810	32,567	373	46	100	59	
Fontana	75,000	10,411	28,000	380	100	100	30	
Mission Viejo	109,250	10,700	37,445	268	100	100	100	
El Cajon et al.	227,293	13,514	53,347	163	98	100	99	
San Diego	1,100,549	73,927	235,810	184	100	100	100	$576
Chula Vista & Vicinity	135,163	15,986	60,673	324	87	100	96	
South Lahontan Region								
Palmdale	68,842	6,073	19,626	242	43	100	44	$488

* Only those providers with 10,000 million gallons per year or more.

Notes:
GPCD = Gallons per capita per day.
mgy = Million gallons per year.
af = Acre-feet.

Electric Utility and Communication Infrastructure. A complex system of generating facilities, sub-stations, and transmission infrastructure exists in the South Coast and Central Coast Regions. Natural gas, nuclear, oil, hydroelectric, and other technologies are used for power production. Communication infrastructure in the region includes underground cable and fiber optic lines and communication/transmission towers.

Natural Gas Infrastructure. Gas storage areas, pipelines, and compressor stations are present in southern California. Pipelines and compressor stations also are present in northern California.

Public Services. Various departments within the cities and counties of the region provide fire protection, police protection, and emergency services to members of their respective communities.

Table 7.6-5. Per Capita per Day Water Use for the Other SWP and CVP Service Areas, 1968 to 1990 (gallons)

YEAR	ALL USES
South Coast Region	
1990	211
1980	191
1968	179
Central Coast Region	
1990	189
1980	210
1968	194
South Lahontan Region	
1990	278
1980	280
1968	305

7.6.4 ASSESSMENT METHODS

Impacts on utilities and public services were evaluated by comparing existing infrastructure to areas of potential construction or land use changes that would result in displacement or modification of the following components:

- Electrical facilities and supply
- Water conveyance facilities
- Natural gas fields and storage reservoirs
- Underground pipelines
- Communication facilities

Whether displacement or modification of the components listed above would affect existing police, fire, and emergency services also was considered in the evaluation.

Due to the programmatic level of detail for the Program alternatives, the impacts presented in this section are general. Additional information would be needed for more specific conclusions.

7.6.5 SIGNIFICANCE CRITERIA

Significance criteria for identifying impacts on utilities and public services are based on the displacement or modification of facilities and services due to either water-related facility development or economic stimulation. The facilities and services that may be affected include those listed above.

Impacts on utilities and public services were considered potentially significant if Program actions would:

- Create a demand for utilities that exceeds the capacity and outputs of existing infrastructure and requires new infrastructure or facilities.
- Create a demand for public services that substantially exceeds the capacity of public service agencies.
- Intersect with major infrastructure components, such as bridges or overpasses, requiring relocation of the components.
- Increase the anticipated risk of gas line rupture during the construction phase, especially to gas lines crossing exterior levees.

Due to the programmatic level of detail for the Program alternatives, the impacts presented are general. Locations of storage and conveyance facilities have not been determined, and site-specific impacts cannot be determined at the programmatic level. For this impact analysis, it was assumed that mitigation strategies could successfully relocate facilities to avoid displacement of major infrastructure components.

7.6.6 NO ACTION ALTERNATIVE

7.6.6.1 DELTA REGION

The 2020 level of development will result in an increase in population throughout the state, including the Delta Region. Population increases could require construction of additional power-generating facilities and additions or reconfiguration of the existing power distribution grid (such as transmission lines or substations). The need for additional police, fire, and emergency services would correspond to increased population in the region.

Development of water supply projects could indirectly affect the Delta Region. No Action Alternative water supply developments outside the Delta Region could necessitate development of in-Delta infrastructure, which could require development of greater utility capacity and more power distribution grids to accommodate greater pumping demands.

7.6.6.2 BAY AND SACRAMENTO RIVER REGIONS

The effects of population growth discussed above for the Delta Region are applicable to the Bay and Sacramento River Regions.

7.6.6.3 SAN JOAQUIN RIVER REGION

The potential effects of population growth and water supply development discussed for the Delta Region are relevant to the San Joaquin River Region. Conversion to recreational use could result in a greater demand for public services, potentially exceeding existing capacity.

7.6.6.4 OTHER SWP AND CVP SERVICE AREAS

The effects of population growth and water supply development discussed above for the Delta Region are likely to be applicable to the Other SWP and CVP Service Areas.

7.6.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For utilities and public services, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as described in Section 7.6.8.

7.6.7.1 ALL REGIONS

Ecosystem Restoration Program

Implementation of the Ecosystem Restoration Program could result in the following impacts on utilities and public services:

- Increased electricity requirements for water pumping.
- Additional public services required for new parks and refuges.
- Increased need for public services at existing parks and refuges because increases in recreational fishing stocks and waterfowl could result in a greater number of fisher/hunter days per year.

Program actions are not expected to require public services in excess of current regional capacity. Except for actions that require relocation or modification of major infrastructure, impacts on utilities and public services associated with ecosystem restoration are considered less than significant.

Although unlikely, a slight possibility exists that some infrastructure would need to be relocated or modified as a result of the Ecosystem Restoration Program. These infra-structure components could include electrical transmission lines and substations, communication lines, natural gas lines, or water conveyance structures. Relocation and modification of existing major utility infrastructure may result in potentially significant adverse impacts. These changes are not expected to require construction or development of additional utility capacity. Mitigation is available to reduce impacts to a less-than-significant level.

Water Quality Program

Implementation of the Water Quality Program could result in the following impacts on utilities and public services:

- Relocation of water supply intakes and conveyance infrastructure.
- Upgrades to treatment processes.
- Land conversion to avoid creation of salt drainage.
- Upgrades to stormwater systems.
- Installation of treatment facilities, requiring electricity and water conveyance infrastructure.
- Implementation of BMPs, such as alterations in irrigation.

Increased utility demands are expected to be met by existing capacity. The Water Quality Program is expected to increase recreational use by reducing pollutant loadings (for example, lower toxic levels for humans and wildlife). Any increase in the need for public services is not likely to exceed existing capacity. Mitigation is available to reduce impacts to a less-than-significant level at the project-specific level.

Water Use Efficiency Program

The Water Use Efficiency Program may require development of new pipelines, well fields, and pump stations. Distribution systems would be needed to provide the increased levels of recycled water to potential customers. Impacts associated with the establishment of these systems can be mitigated to less-than-significant levels at the project-specific level.

Water Transfer and Watershed Programs

The Water Transfer and Watershed Programs are not expected to affect utilities or public services in any region.

In addition to the impacts applicable to all regions, region-specific impacts for specific programs are identified below.

7.6.7.2 DELTA REGION

Levee System Integrity Program

Modification and relocation of existing levees under the Levee System Integrity Program may require the displacement or modification of utility infrastructure, including natural gas and electric transmission lines and communication infrastructure. These actions are not expected to affect major infrastructure components and are not anticipated to result in potentially significant adverse impacts. Construction associated with implementation of the program could cause an increased risk of gas line rupture, in particular to lines that cross exterior levees. These impacts can be mitigated to less-than-significant levels.

Beneficial impacts on utilities are associated with improvement of existing levees. Natural gas and electrical transmission lines and facilities, and communication infrastructure would benefit from the overall reduced risk of levee failure in the area.

Storage

Storage features could affect existing infrastructure. Natural gas and electric transmission lines, and communication infrastructure could be displaced by storage facilities. Mitigation is available to reduce potentially significant impacts to less-than-significant levels.

7.6.7.3 Sacramento River and San Joaquin River Regions

Storage

The potential impacts associated with the development of groundwater storage include increased energy consumption for pumping and relocation of minor infrastructure. These impacts are not anticipated to be potentially significant.

Surface water storage projects could result in a range of potentially significant impacts on existing utilities and public services. Beneficial and adverse impacts would differ only in magnitude in these regions, depending on the quantity of storage facilities developed. The majority of impacts would be related to hydropower output modifications, storage facility construction phases, and the potential stimulation of M&I development. Please refer to Section 7.9, "Power Production and Energy."

Greater storage could facilitate habitat rehabilitation and perhaps recreation. Although the demand for public services is likely to increase under such circumstances, it is not likely to exceed existing capacity.

During construction of storage facilities, infrastructure could be displaced. New structures could require relocating or modifying natural gas, electric, and communication transmission lines and other major infrastructure, resulting in potentially significant adverse impacts. Mitigation is available to reduce impacts to a less-than-significant level.

Because of opportunities created through water-related facilities, development of M&I facilities is possible. The potential effects of development include increased demand for utilities and public services. These increases in power demand are expected to be met by existing facilities and agencies.

7.6.7.4 Other SWP and CVP Service Areas

Storage

Although storage facilities are not proposed for the Other SWP and CVP Service Areas, electric power, possibly generated in these areas, would be needed to convey water throughout different areas of the state. The operation of additional water storage facilities could affect the amount of power required and the amount available. Please refer to Section 7.9, "Power Production and Energy," for a discussion of impacts on power and energy.

7.6.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For utilities and public services, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.6.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Construction of floodways, setback levees, intake structures, interties, and channel conveyance modifications could displace infrastructure in the Delta Region, resulting in potentially significant adverse impacts. Natural gas and electric transmission lines, and communication infrastructure may need to be relocated. Relocation of major transmission lines are considered a potentially significant impact. Mitigation is available to reduce impacts to a less-than-significant level.

New water storage and conveyance facilities—in addition to increased pumping at existing facilities—would require additional power. Please refer to Section 7.9.7, "Power Production and Energy—Consequences: Program Elements Common to All Alternatives."

Impacts on public utilities infrastructure that are associated with the Conveyance element primarily involve the Delta Region. Although conveyance facilities are not proposed for areas outside the Delta, electric power is used to convey water throughout different areas of the state. The operation of additional infrastructure could affect the amount of power required and the amount available.

7.6.8.2 ALTERNATIVES 1, 2, AND 3

Impacts on utilities and public services under Alternatives 1, 2, and 3 would be similar to those described for the Preferred Program Alternative, differing in magnitude depending on the conveyance facilities being constructed. Alternative 1 includes the fewest facilities; therefore, construction- and operations-related impacts would be less than those for the Preferred Program Alternative.

Although similar facilities are involved in Alternative 2 as those described for the Preferred Program Alternative, energy requirements most likely would be greater than those of the Preferred Program Alternative because of the higher rate of pumping. Alternative 3 likely would require more power than other alternatives because of the higher rate of pumping. Please refer to Sections 7.9.7.2, 7.9.7.3, and 7.9.7.4 for additional information on energy use associated with the alternatives.

Construction-related impacts on utilities and public services under Alternative 3 would be greater than those described for the Preferred Program Alternative because more facilities would be constructed.

Construction of an isolated facility with possible dual points of intake would result in greater potential for displacement of existing infrastructure. These impacts are considered potentially significant. Based on information currently available, mitigation strategies are expected to avoid or mitigate displacement of existing major infrastructure. However, until site-specific engineering designs are prepared, it is impossible to predict the locations of facilities with any certainty.

7.6.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were the same impacts as those identified in Sections 7.6.7 and 7.6.8, which compare the Program alternatives to the No Action Alternative.

The impacts of Program alternatives on utilities and public services could be slightly greater when compared to existing conditions than when compared to the No Action Alternative because existing demands for utilities and public services are less than those projected under the No Action Alternative. Relocation or modification of major infrastructure components has been identified as the most probable potentially significant impact associated with the Program. Impacts on utilities and public services from conversion of land to urban or industrial uses that was retired because of drainage problems also has been identified as a potentially significant impact. The magnitude of these impacts would not differ between the No Action Alternative and existing conditions because retirement of these lands is included in the No Action Alternative.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional potentially significant environmental con-sequences than were identified in the comparison of Program alternatives to the No Action Alternative.

The reduced risk of structural failure of utilities would result from increased levee stability due to the Levee System Integrity Program, when compared to existing conditions.

The following potentially significant environmental consequences are associated with the Preferred Program Alternative:

- Possible need for relocation or modification of infrastructure components from Ecosystem Restoration and Levee System Integrity Programs, and Storage and Conveyance element actions.
- Increased risk of gas line rupture during the construction phase.

No potentially significant unavoidable impacts on utilities and public services are associated with the Preferred Program Alternative.

7.6.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For utilities and public services, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.6.1 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate them. At the programmatic level, the analysis did not identify any impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level. Sections 7.6.7 and 7.6.8 elaborate on long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on utilities and public services in the Delta, Sacramento River, and San Joaquin River Regions: American River Water Resource Investigation, American River Watershed Project, other CVPIA actions not yet fully implemented, Delta Wetlands Project, CCWD Multi-Purpose Pipeline Project, Delta Wetlands Project, ISDP, Montezuma Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento River Flood Control System Evaluation, Sacramento Water Forum process, EBMUD Supplemental Water Supply Project, Sacramento County municipal and industrial water supply contracts, urbanization, West Delta Water Management Program, and Sacramento River Conservation Area Program. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.6.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The Program could result in short-term disruption of utilities during construction. Long-term impacts could be caused by increased demand for energy and public services. Impacts associated with the increased demand for utilities and public services would be offset by the overall long-term productivity and improved ecosystem health of the Bay-Delta system resulting from the Program.

Irreversible and Irretrievable Commitments. Construction, operation, and maintenance of the project facilities could increase demand on energy, utility infrastructure, and transmission line capacity. Any significant increased demand on energy, utility infrastructure, or transmission line capacity would result in an irreversible and irretrievable commitment of resources. Program actions are not expected to require construction or development of additional utility capacity, or to require public services in excess of current regional capacity.

7.6.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during specific project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

Mitigation strategies that could be implemented to avoid impacts include:

- Siting project facilities to avoid existing infrastructure.
- Constructing overpasses, small bridges, or other structures to accommodate existing infrastructure.
- Coordinating construction activities with utility providers.

Mitigation strategies that could be implemented to reduce impacts include:

- Designing and operating facilities to minimize the amount of energy required and to maximize the amount of energy created.

- Designing project facilities to avoid or minimize their effect on existing infrastructure.

7.6.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable impacts on utilities or public services are associated with the Preferred Program Alternative.

7.7 Recreation Resources

The CALFED Bay-Delta Program is expected to provide an overall increase in both recreation opportunities and the quality of recreation experiences.

7.7 Recreation Resources

7.7.1 SUMMARY

The ability to enjoy "the great outdoors" is a much cherished value to many people, one that some think priceless. Wildlife viewing, fishing, hunting, and water-based recreation such as swimming, motor boating, sailing, and windsurfing are popular throughout the state, and particularly in the Bay-Delta Regions. Recreation is a multi-million dollar industry in the state. The demand for recreation resources in California is expected to increase with future population growth. Increasing demand is expected to put additional pressure on limited recreation resources and potentially contribute to deterioration of the quality of recreational experiences.

Preferred Program Alternative. Recreational resources would benefit from increased open space, enhanced or restored wetland or wildlife habitat, improved water quality, more protection against flooding, and increased fish and waterfowl populations. Many Program elements will either directly or indirectly benefit recreational experiences. Ecosystem Restoration and Levee System Integrity Programs will result in increased open space and habitat improvements, which will result in increases in fish and wildlife populations. This increase will provide additional recreational opportunities and improvements in fishing, hunting, and wildlife viewing. The Water Quality Program will provide direct improvements for recreation and indirect benefits to fish, wildlife, and habitat. Water Use Efficiency may provide water supplies for habitat or fish recovery. Overall, the CALFED Bay-Delta Program (Program) could increase recreation use and create more recreation-related jobs than under the No Action Alternative.

Trade-offs or changes in the type of recreational use may occur in a given area. For example, habitat restoration activities in the Delta may restrict speeds and access for motorized boating in some areas but provide increased opportunities for non-motorized boating like canoeing or kayaking. Enlarging existing reservoir facilities could adversely affect on-stream recreation activities but provide new open water recreation opportunities. Some existing recreation sites may be temporarily or permanently altered. Mitigation strategies have been developed which, when implemented, are expected to reduce most potential adverse impacts to a less-than-significant level.

Alternatives 1, 2, and 3. Alternatives 1, 2, and 3 would result in similar benefits and adverse impacts as those identified for the Preferred Program Alternative. Alternatives 2 and 3 have greater potential for short-term construction-related impacts. However, these alternatives may have other long-term benefits, including improved flow conditions or increases in fish, wildlife, and habitat that would provide recreation benefits. Conversely, Alternative 1 and the Preferred Program Alternative result in less short-term impacts on existing facilities but may have less potential for overall long-term benefits.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Temporary closure of recreation areas during construction (1,2,3,6,7,8,9,10,15,16,17).

Increased speed zone restrictions or prohibition of motorized boating in some areas (1,2,3,6,8,9,17).

More stringent regulation of boat discharges (1,9,11).

Temporary or permanent changes in boating access and navigation (1,2,3,4,5,6,7,8,9,17).

Permanent closure of some recreation facilities (1,2,9, 11,15,17).

Increases in boat traffic in some areas because of speed and access restrictions (1,2,3,4,5,6,7,8,9,17).

Decrease in recreation opportunities because of speed and access restrictions (1,2,3,4,5,6,7,8,9,17).

Potential decrease in flooded lands suitable for wildlife, hunting, and fishing as a result of water use efficiency actions (1,9,10,11,14).

Potential for reduced water-contact recreation quality from releases of reservoir cold water (1,9,15,16,17).

Displacement of fish and wildlife from new off-stream or expanded on-stream reservoirs (9,14).

Potential loss of terrestrial and on-stream recreation from new off-stream or expanded on-stream reservoirs (1,9,14,15,17).

Potential for reduced access to recreation facilities and decreased recreation opportunities from changes in reservoir levels (1,9,10,11,12,13,17).

Potential short-term construction impacts of dredging, such as obstructing or closing channels and creating noise and visual impacts (7).

Mitigation Strategies

1. Incorporating project-level recreation improvements and enhancements.
2. Maintaining boating access to prime areas.
3. Identifying and marking alternate boating routes.
4. Constructing portage facilities.
5. Constructing boat locks.
6. Providing public information regarding alternate access.
7. Avoiding construction during peak-use seasons and times.
8. Posting warning sings and buoys in channels.
9. Working with recreational interests to protect and enhance recreation resources.
10. Providing in-kind recreation facilities.
11. Relocating or constructing new recreation facilities and infrastructure.
12. Maintaining reservoir levels as high as possible during the recreation season.
13. Minimizing water level fluctuation and establishing minimum pool levels.
14. Purchasing trail rights-of-way or recreational easements.
15. Providing or improving vehicle access and parking for recreation areas.
16. Providing access to waterfront areas and island edges.
17. Creating new day-use boating and camping areas.

Bold indicates a potentially significant unavoidable adverse impact.

7.7.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Below is a brief description of the areas of controversy for this resource category. Given the programmatic nature of this document, many of these areas of controversy cannot be addressed; however, subsequent project-specific environmental analysis will evaluate these topics in more detail.

An economic evaluation of recreation resources inherently relies on the development of assumptions and methodologies that may result in disagreements among technical experts and, therefore, be an area of controversy as used by CEQA. The use of alternative assumptions and methodologies may lead to different conclusions concerning the economic importance of a resource.

The Program recognizes the economic importance of recreation to regions potentially affected by Program actions. As a multi-million dollar industry, recreation is the basis of livelihood for many small communities throughout the Central Valley and Bay-Delta. Although user groups may disagree about the magnitude of regional economic effects related to recreation activity and the distribution of these effects, the fact that recreation is an important economic base in California is not at issue. Regardless of disagreements over the measurement of its effects, the Program recognizes the economic importance of recreation activity to the businesses, communities, and regional economies that depend on it. At the programmatic level of analysis, any potential adverse effect on recreational opportunities that substantially affects individuals or businesses dependent on recreation activity for their livelihood is considered a potentially significant effect. Subsequent project-specific environmental analysis will evaluate these effects at a greater level of detail, including consideration of regional differences.

Other controversial issues regarding effects of Program actions on recreational resources do not meet the CEQA definition of "areas of controversy." For example, the effects on motorized boating in the Delta or flooding of free-flowing rivers by enlargement of existing reservoirs are controversial issues. The environmental consequences of Program actions to these and other recreational resources are presented and disclosed in the "Environmental Consequences" section of this chapter. Strategies are presented to mitigate adverse impacts.

7.7.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

Recreation activities in the Program study area include both water-based and land-based activities and their supporting infrastructures. Commercial fisheries also are discussed.

7.7.3.1 DELTA REGION

Prior to the 1850s, the Delta was an extensive tidal marsh that was subject to seasonal flooding. Since the 1950s, the land use trends in the Delta Region have included a reduction in agricultural acreage, an increase in urban development and acreage, and the continued loss of open space lands.

Recreation use of the Delta has increased substantially over the past 45 years. In 1958 and again in 1963, recreation use was estimated at approximately 2.5 million visitor days, with a visitor day representing one person spending a day or portion of a day in one or more types of activities. By 1978, recreation use in the Delta was estimated to range from 7 to 12 million visitor days. Hunting, sport fishing, boating, and other water-based activities have continued to be the most important recreation activities in the region.

Before 1960, the majority of facilities available to boaters and other non-consumptive-use recreational users centered on the use of commercial marinas and a limited number of city or county public access areas. Delta yacht or ski clubs were popular at this time and became instrumental in organizing and promoting waterborne recreation in the Delta. The increasing demand for more Delta recreation opportunities spurred the State to establish Brannan Island State Recreation Area (SRA) in 1965 and Franks Tract SRA in 1966. Development of these SRAs enabled the State to collect fees for use of the areas.

Prior to World War II, the majority of waterfowl and pheasant hunting occurred on private farmland. After the war, the popularity of this sport brought an increasing number of hunters to private farmland. As Delta marshlands were drained and converted to agricultural use, land use conflicts with farmers spurred the development of alternative hunting areas, including Grizzly Island, Joice Island, and Sherman Island Wildlife Management Areas (WMAs), in addition to a variety of state cooperative hunting areas. Although private duck clubs and WMAs have remained popular hunting areas, the state cooperative hunting areas declined in popularity during the 1960s.

Historically, recreational sport fishing has been a major activity in the Delta area, occurring throughout the year from shore locations, piers, and boats. According to the Delta Protection Commission, sport fishing tournaments are an important recreation activity in the Delta that contribute to the local economy. Important sport fishing species included striped bass, shad, black bass, catfish, and steelhead. Although commercial fishing for striped bass was abolished in 1935, a sport fishery was allowed to continue. By the early 1960s, most of the bass angling was concentrated in the Delta. Sport-catch records indicate a declining trend, with an average annual catch ranging from a high of 750,000 fish during the 1960s to a low of approximately 150,000 fish during the early 1980s.

American shad has long been a popular sport fish; however, a sport fishery for this species did not become well established until 1957. Although historical statistics on the shad sport fishery in the Delta are lacking, one operator in the Delta estimated a catch of 30,000 fish by 2,500 anglers in 1954.

In 1954, following a 35-year moratorium on sport fishing for sturgeon, a sport fishery in the Bay-Delta was reestablished. Most of the fishery is concentrated in San Pablo Bay. Although exact sport-catch data are not available, the catch rate for sturgeon is estimated to have increased by 40% over the last two decades. This increase may indicate that fishing for sturgeon has become more popular as stocks of other game fish, such as striped bass, have declined.

Crayfish have been commercially harvested in the Delta and sold locally for many years. Currently, the Delta supports the commercial harvest of crayfish and bait fish species, such as bay shrimp and shad. Other species are harvested incidentally. Crayfish harvesting is the largest commercial fishing activity in the Delta Region. Crayfish are harvested in various locations throughout fresh water areas of the Delta, although most are offloaded at Stockton. Most crayfish are sold for human consumption, and a portion of the harvest is exported. Most of the harvest for bait is sold locally. Based on commercial landing data for 1986 and 1995, the commercial crayfish harvest in the Delta has remained relatively stable at about 12,000 pounds per year in recent years.

The Delta is conveniently located near several large population centers and serves a growing urban population. According to the Delta Protection Commission's 1996 survey of boaters and anglers, approximately half of Delta recreators live within 50 miles of the Delta, and four out of five recreators live within 100 miles of the Delta. The population of the five counties adjoining the Delta is expected to increase to 5.2 million by 2005.

Current Delta use patterns indicate that a majority of the visitors stay in the Delta 1 day or less. The peak recreation period occurs from May through September. Spring and summer (March to September) account for an estimated 75% of total annual use.

Most of the navigable waterways in the Delta are public, and most of the land is private. The lack of public lands serves to limit the use of the Delta for recreation. Public use of the Delta is concentrated in a few areas where marinas and other facilities provide recreational opportunities and access to the Delta waterways. There are few public parks. Some of the recreation areas in the Delta are accessible only by boat, further limiting access to the Delta for some recreationists, mainly bank anglers. Because much of the levee system is privately owned, bank anglers often are trespassing.

Current recreation in the Delta is primarily water-oriented. Fishing and boating are the most popular activities in the Delta, accounting for approximately 70% of total use. Almost every type of recreation boating activity can be found in the Delta waterways, including houseboats, sailboats, fishing boats, personal watercraft, speedboats, canoes, rowboats, and inflatable boats. Water-based recreation activities include fishing from a boat, water-skiing, sailing, cruising, operating personal watercraft, canoeing, kayaking, houseboating, hunting from a boat, swimming from a boat, boat camping, swimming from shore, bank fishing, and windsurfing.

Marinas account for most recreation facility types in the Delta, totaling approximately 120. Marinas provide many services in addition to boat berthing and boat fuel, including ski boat and houseboat rentals; boat services, such as boat launching and marine supplies; camping and picnicking facilities; guest docks and fuel stations; and food and beverage services. Marinas are not equally distributed throughout the Delta but are concentrated in a handful of locations. The most heavily used areas include Bethel Island in Contra Costa County and Lower Andrus Island in Sacramento County. Bethel Island is very congested, with resorts and 33 marinas providing 1,185 berths. In addition to marina berths, the private facilities at Bethel Island include a large number of support and service facilities. Andrus Island, by comparison, is more rural but provides nearly 1,700 berths.

While the inventory of marinas in the Delta indicates over 12,000 berths as of December 31, 1996, the number of registered vessels in nine Bay Area counties and the Delta counties totals almost 250,000, representing more than 28% of vessels registered statewide. Sacramento and San Joaquin Counties alone have 67,613 registered vessels that range from a large sailing vessel to a personal watercraft.

Popular access points for boating, water-skiing, and personal watercrafting include Windmill Cove near SR 4; King Island, Paradise Point, and Herman & Helens near Eight Mile Road; Tower Park near SR 12; and Dels Boat Harbor near the city of Tracy. Houseboating also is concentrated along Eight Mile Road. Windsurfing, a fast-growing sport in the Delta, typically occurs along SR 160 between Sherman Island and Rio Vista and at Windy Cove. Windy Cove is a new facility constructed at Brannan Island SRA and is the only formal windsurfing site in the study area. The limited number of boating access points across the Delta and the lack of readily available rentals for ski boats and personal watercraft continue to be issues for recreational users.

Fishing access in the Delta primarily occurs from four designated access areas and from a variety of roadside locations and levee banks. Of all Delta species, striped bass historically has been the most popular, with an average annual sport catch of 18,900, followed by American shad, salmon, and sturgeon. According to the Delta Protection Commission, total effort in the black bass fishery currently meets or exceeds effort for striped bass.

Not all recreation activities in the Delta are associated with water. The more popular land-based recreation activities include hunting, camping, picnicking, walking for pleasure, bicycling, wildlife viewing, photographing wildlife, sightseeing (driving for pleasure), and attending special events.

Much of the open space in the Delta is used for public parks and wildlife refuges. The California Department of Parks and Recreation owns 5,000 acres in the Delta, including Brannan Island; Franks Tract (flooded) for recreation; Delta Meadows, a scenic waterway near Locke that is popular with boaters; and over 1,000 acres in the Stone Lakes NWR. Significant amounts of acreage in the Delta have been purchased in recent years by state, federal, and nonprofit agencies for enhancement and management as wildlife habitat. For example, DFG owns 8,080 acres of land in the Delta, including underwater land in the Lower Sherman Island Wildlife Area; portions of the Yolo Bypass, Woodbridge Ecological Reserve, Calhoun Cut Ecological Reserve; and Webb Tract berms and islands. Approximately 23 public recreation facilities are located in the Delta. Three state agencies maintain five recreation areas in the Delta. The remaining recreation areas are operated by county and city agencies.

During the past 10 years, hunting has continued on private lands, as well as in public areas, on waterways, and on various small Delta islands. Popular areas include Sherman Island WMA, Twitchell Island, Franks Tract SRA, and Clifton Court Forebay.

Estimates of recreation use of the Delta vary considerably. Total recreational use of the Delta has been estimated at 11.9 million visitor days from 1977 to 1978, and 12.9 million for 1985. Water-dependent activities in the Delta are estimated to have accounted for 6.4 million visitor days from 1977 to 1978 and 6.95 million visitor days in 1985. Average expenditures per person per day were estimated at approximately $16.50 for visitors to the Delta and $7.90 for residents of the Delta. Annual recreation expenditures were estimated to total approximately $185.2 million in 1985.

Based on 1985 estimates expanded to account for population growth in the region, current use levels could be as low as about 10 million visitor days. Based on recent surveys conducted for the Delta Protection Commission, the potential level of use could be upwards of 40 million visitor days. Total annual spending by recreationists using the Delta is estimated to range from $290 million to as much as $1.1 billion, although this level of spending is considered very unlikely. An estimated 50% of this amount is spent within the boundaries of the Delta, which includes portions of Sacramento, San Joaquin, Solano, and Contra Costa Counties.

7.7.3.2 Bay Region

This section focuses on water-dependent recreation, including sport fishing. Other recreation activities are not addressed in detail because they are not expected to be substantially affected by Program actions in the Bay Region.

For purposes of this description, the Bay Region includes San Francisco Bay, San Pablo Bay, Suisun Marsh and Bay, and the coastal regions in California and Oregon that support ocean sport and commercial salmon fishing.

Large undeveloped areas of land are found in the western, northern, and southern parts of the Bay Region. Lakes and reservoirs are popular day-use destination sites for local residents. These lakes and reservoirs and the surrounding parks accommodate recreation activities year-round because of their proximity to major metropolitan areas. Water resources operated by the San Francisco Water District do not substantially contribute to recreation use in the Bay Region because of access restrictions.

As elsewhere in California, the quality of recreation at lakes and reservoirs in the Bay Region depends largely on surface water levels. During severe drawdown conditions, access to boat ramps and swimming areas is substantially reduced or eliminated. Water-enhanced activities, such as picnicking and hiking, also can be affected as water levels fall.

The Suisun Bay and Suisun Marsh historically have been popular areas for waterfowl hunters. Past estimates of total annual waterfowl hunter-days in the marsh, including use of public hunting areas, range from approximately 48,000 to 62,000 days per hunting season.

In addition, the state owns 15,000 acres in Suisun Marsh at the western edge of the Delta, including approximately 6,000 acres of public hunting areas that compose the Grizzly Island WMA. According to DFG staff, a total of 33 private hunting clubs in the Delta comprise about 52,000 acres.

The San Francisco Bay Estuary supports important sport fisheries for sturgeon, salmon, and striped bass in California. In 1954, following a 35-year moratorium on commercial and sport fishing for sturgeon, a sport fishery in the Bay Region was reestablished. Most of this fishery was centered in San Pablo Bay. Between 1954 and the mid-1960s, most sturgeon were taken incidentally by striped bass anglers. Although exact sport-catch data for white sturgeon are not available, the catch rate for sturgeon is estimated to have increased by 40% over the last two decades. This increase suggests that fishing for sturgeon has become more popular as stocks of other game fish, such as striped bass, have declined. In response to increased angler success, catch regulations were modified.

The salmon sport fishery in California did not become important until after World War II, long after the commercial salmon fishery was established. Historically, the sport fishery has harvested approximately 14% of the salmon landed within the California coastal region, with commercial fishing accounting for 86%. Salmon landings data between 1940 and 1985 show that salmon fishing activity reached major peaks in 1955, 1968, and 1972. These data also indicate that fishing activity reached lows in 1957, 1960, and 1978.

Historically, chinook has been the most important salmon species caught in the California coastal fishery, accounting for 79% of the total salmon sport catch. Most of the ocean salmon sport catch has occurred in the San Francisco area, accounting for 67% of total sport landings between 1979 and 1985.

Commercial sport fishing vessels have played an important role in the history of the ocean sport fishery, accounting for an estimated 65% of the total sport harvest of salmon in the California coastal region. Most of these vessels have originated from the San Francisco Bay Area.

Currently, the quality of sport fishing activities in the Bay Region is associated with abundance, migration patterns, and fishing regulations. Sport fishing in the region occurs year-round from private vessels, from charter boat vessels, and along the shore. The popularity of shore and boat fishing is associated with the type of sport fish being sought. Most fishing occurs aboard private vessels. Charter boat operators indicate a sustained decline in the popularity of fishing aboard these vessels.

White sturgeon is one of the popular game fish sought in the Bay Region. Sturgeon are popular game fish because of their large size; however, they have one of the lowest catch rates per hour of angler effort for sport fish in the region. Fishing trips for sturgeon are taken aboard private and charter boat vessels. Sturgeon fishing continues year-round in San Pablo Bay. Fishing success probably is associated with the movement of the fish in response to changing salinity conditions in the Bay-Delta, which is influenced by river flows into the Delta. Sturgeon are more likely found in San Pablo Bay during wet years and further upstream in the Suisun Bay area in dry years.

Ocean sport fishing for salmon in the California coastal areas accounted for an estimated 127,000 visitor days in 1992. This level of use generated an estimated $10.4 million in trip-related expenditures. Nearly 50% of the expenditures generated by sport fishing occurred in the San Francisco region.

Although salmon support a large sport fishery in the ocean, the current salmon sport fishery in the Bay is relatively small. Salmon typically are caught in the area around the Golden Gate Bridge and upstream of the Carquinez Strait.

Currently, striped bass is the most important sport fish caught in San Francisco Bay. Fishing for striped bass occurs aboard private and charter boat vessels or from shore. Most of the catch of striped bass in California occurs in the Bay-Delta Region. The quality of striped bass angling in the Bay-Delta region depends on location, abundance, and regulations. During winter, striped bass are relatively inactive and fishing success is relatively low. Fishing increases in spring as the fish begin to move up through the Bay and the Delta to spawn. Delta conditions are believed to affect the early life stages of striped bass. Although not directly affecting fishing success, size and possession limits can restrict total angling efforts for striped bass.

Overall, sport fishing in the Bay Region has been declining. Consequently, recreation-related spending associated with sport fishing also has decreased in its contribution to the local and regional economy. Economic declines associated with affected sport fisheries also are indicated by historical reductions in the number of charter boats operating in the Bay Region.

The ocean commercial salmon fishery in California began operating in the 1880s in Monterey Bay. Historically, on average, approximately half of all commercial fishing vessels in California land salmon. Since a limited-entry program was established for salmon in 1982, about 77% of all California vessels have been in possession of a salmon permit, and 63% of all permit holders have actually landed salmon. Between 1916 and 1943, ocean landings of chinook salmon in California ranged from 2.2 to 7.2 million pounds and averaged 4.5 million pounds per year. Landings experienced a general upward shift during 1944 to 1982, from 3.7 to 10.3 million pounds, respectively. Important factors contributing to this upward shift were the termination of gill-netting in inland waters in 1957 and the development of fish hatcheries in the American and Feather Rivers in the 1960s.

Salmon originating from the Sacramento and San Joaquin River systems also are caught in Oregon coastal fisheries. Approximately 10–20% of the fish caught in the commercial chinook salmon fishery in Oregon are from the Central Valley. Between 1952 and 1993, commercial landings of chinook salmon in Oregon, where the fishery is much smaller than in California, ranged from 53,000 to 530,000 pounds. California coastal landings over the same period ranged from 1.6 to 14.8 million pounds. Landings in Oregon have been subject to wide fluctuations, similar to the variability of California landings. Oregon commercial salmon landings averaged 212,500 pounds from 1967 to 1993.

A change that has occurred over the years has been the disappearance of spring-run chinook salmon from the ocean harvest. Most of the fish caught today in the commercial harvest are fall-run chinook salmon. Another change has been an increasing proportion of hatchery fish in the catch, with recent estimates ranging from 30-40% overall, and as high as 86% on rivers with terminal hatcheries. Although this change has served the hatcheries' initial purpose (to offset the loss to the populations of fish that would have spawned above major impoundments), it may contribute to the instability recently seen in ocean catch, with a boom-and-bust pattern of harvest dependent on survival of broods from a few major facilities.

Commercial landings of striped bass ceased after 1935 when the commercial fishery for this species was closed, and American shad landings ceased after 1957 when the Sacramento and San Joaquin Rivers were closed to all commercial fishing. Historically, salmon has dominated the commercial harvest of anadromous species, even in years when other anadromous species were landed in significant numbers.

Of all the anadromous fish species addressed in this report, only chinook salmon continues to support a commercial fishery. Commercial fishing for striped bass, sturgeon, and steelhead trout ended before development of the CVP. The commercial fishery for American shad officially ended in 1957, when most commercial fishing in the Bay and Delta was banned by the state legislature.

Key economic indicators of the commercial salmon fishing industry are the relative poundage and ex-vessel value of salmon landed at different ports in proportion to the total pounds and value for all commercial seafood landed at these ports. In 1992, salmon accounted for 0.03% of the total pounds of seafood landed and 0.13% of the total ex-vessel value of seafood landed at ports in the North Coast region, 2.0% of total pounds of seafood landed and 8.0% of the ex-vessel value of all seafood landed at ports in the San Francisco area, and 0.83% of the total pounds of seafood landed and 4.2% of the ex-vessel value of all seafood landed at ports in the Central Coast area.

Another important indicator of the economic health of the commercial salmon fishing industry is the number of permit holders. In 1993, the number of salmon fishing permit holders in California was 2,740, a 54% reduction from the 5,964 permit holders at the inception of the limited entry program in 1982. The percentage of salmon permit holders who actually fished for salmon also has declined over time, and the size of the fleet has declined to record low levels. The decline has been particularly acute for vessels that obtain a relatively significant amount of income (more than $5,000 annually) from salmon fishing; these vessels account for 85% of the total revenue generated from the fishery. A gradual aging of the fleet has occurred since the early 1980s, perhaps due to declining fishing opportunities. The state's limited entry program also has contributed to this aging by restricting the entry of new vessels into the fishery.

The relative amount of personal income generated by the salmon industry also indicates the economic importance of the industry to a region. In 1992, the salmon industry in the North Coast region, including harvesting and processing activities, generated $100,000 in personal income, which accounted for less than 0.01% of the total personal income generated within the region. In the San Francisco area, the salmon industry generated $5.9 million in 1992, which accounted for 66% of all income generated by the salmon industry in the California coastal areas but only about 0.01% of the total personal income generated within the region. In the Central Coast area, the salmon industry generated $2.9 million in 1992, accounting for approximately 33% of all income generated by the salmon industry in California coastal areas but only about 0.01% of the total personal income generated in the region.

It should be noted, however, that 1992 was a poor year for salmon harvest at many California ports, particularly in the North Coast region. More representative data from 1986 to 1990 show that personal income from salmon harvesting in the North Coast region averaged $16.2 million annually, representing 0.5% of total income in the region.

Fishing-dependent coastal communities, as a whole, have varied in their ability to adjust to declines in commercial and sport fishing activity. Communities in the southern and inland portions of the California coastal region adjusted to the decline by turning to other industries for economic growth. The transition to other industries has been more difficult for communities in the northern portion of the California coastal region.

7.7.3.3 Sacramento River Region

Major recreation areas in the Sacramento River Region include lakes and reservoirs, rivers and streams, and federal wildlife refuges and state WMAs. Private lands also support considerable waterfowl hunting activity in the region.

Overall, recreation use at important reservoirs, rivers, and wildlife refuges in the Sacramento River Region has paralleled increased population growth in the region. Consequently, recreation-related spending associated with increased visitation has become an important contributor to the local and regional economy.

Recreation opportunities in the Sacramento River Region have been shaped by the construction of large reservoirs and the alteration of major rivers. Construction of Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, New Bullards Bar Reservoir, and Englebright Lake provided extensive reservoir recreation opportunities, including flat-water recreation.

Shasta Lake was the CVP's first major multipurpose facility, constructed in 1945. Initial recreation use did not occur until 1948, when the reservoir was filled. The U.S. Forest Service (USFS) began developing and managing recreation resources at Shasta Lake after the Whiskeytown-Shasta-Trinity National Recreation Area (NRA) was established. Historically, Shasta Lake has been the most popular recreation reservoir. Whiskeytown Lake, constructed in 1963, also is located in the NRA, with recreation facilities managed by National Park Service. Between 1970 and 1985, annual recreation use at Whiskeytown Lake ranged from a low of 804,000 visitor days in 1974 to a high of 1.6 million visitor days in 1976 and then declined through the early 1980s.

Folsom Lake, completed in 1955, was the second major lake or reservoir constructed by Reclamation in the region. DPR manages the lake's recreation facilities. Visitation is not well documented between 1955 and 1970. After 1970, visitation declined from approximately 2 to less than 1 million visitor days in 1977 but increased to nearly 2.8 million visitor days in 1985. Lake Oroville, a part of the SWP, was completed in 1968, with recreation facilities operated by DPR. Since 1968, visitor use has fluctuated substantially, ranging from 288,000 visitor days in 1968 to 939,000 visitor days in 1981. Visitation declined substantially in 1985 to 771,000 visitor days.

Other major lakes or reservoirs in the region include Englebright Lake and New Bullards Bar Reservoir. Visitation at both has increased steadily from 1941 to 1985. Because Englebright Lake was constructed to control mining debris, recreation use did not begin until new techniques for controlling debris were developed in the early 1960s. From 1970 to 1985, annual visitation at Englebright Lake increased from

66,000 to nearly 116,000 visitor days. Recreation use at New Bullards Bar Reservoir increased steadily from 1970 to 1985, although historical records appear to understate the total amount of recreation known to have occurred at this facility.

Major rivers that could be affected by Program actions include the Sacramento, American, and Feather Rivers. Tributaries to the Sacramento River that could be affected by stream restoration measures include Cottonwood, Cow, Deer, Bear, Battle, Mill, Paynes, Antelope, Butte, Big Chico, Thomes, and Elder Creeks and the Colusa Basin Drain.

Recreation activities along rivers in the Sacramento River Region were modified with the construction of dams on the Sacramento, American, and Feather Rivers. Before major dams were constructed, flows and water temperatures fluctuated seasonally. Low flows and relatively high water temperatures occurred in summer, and high flows and low water temperatures occurred in winter. In some instances, modification to river flows resulted in substantial changes to sport fisheries.

Before Shasta Lake was built, summer flows in the Sacramento River were low, water temperatures rose above optimum ranges for salmon, and only warm water species were present below the dam site during summer. The most common summer game fish in the river before construction of the lake were striped bass and catfish. After Shasta Lake was constructed, water temperatures and flows in the river were altered to such a degree that a year-round salmonid sport fishery was created. Chinook salmon, steelhead trout, and rainbow trout made the greatest contribution to the fishery.

The popularity of the Sacramento River is indicated by the growth in the number of recreation-related facilities. On the reach of the river between Orland and Redding, the number of boat landings to serve the growing sport fishery increased from zero in 1945 to 11 in 1949. An estimated 46 establishments (such as resorts and bait shops) serving the sport fishery were in operation along the river in 1949. Between May 1948 and February 1949, an estimated 8,000 salmon and 3,800 rainbow trout and steelhead were caught on the reach of the river between Orland and Redding. Between 1968 and 1975, an estimated annual average of 17,500 salmon were landed in the entire river.

The Feather River below Lake Oroville and the Yuba River below Englebright Lake continued to support an important anadromous fishery, although not as extensive as that on the Sacramento River. Changes in water flow and temperature in the Feather River after completion of Lake Oroville did not substantially alter the number of fish species present in the lower portion of the river. Averages based on angler surveys conducted from 1968 to 1974 indicate that 530 striped bass, 1,800 steelhead trout, and 644 chinook salmon were caught annually.

Wildlife refuges in the Sacramento River Region provide fishing, hunting, and wildlife viewing opportunities. These refuges include Sacramento, Colusa, Sutter, and Delevan NWRs and Gray Lodge WMA.

Gray Lodge WMA, the first wildlife refuge in the Sacramento River Region, was established in 1931. Historically, Gray Lodge WMA has been the most popular of the five refuges in the region, accounting for approximately 61% of total use at all refuges in the region between 1973 and 1985. Use at the refuge increased by approximately 95% between 1973 and 1985. The Sacramento NWR, established in 1937, historically has been the second most popular refuge in the Sacramento River Region. Non-consumptive uses accounted for approximately 73% of total use during 1973 and 1985. Colusa NWR, established in 1944, has been the third most popular refuge in the region, with an annual average of 8,000 visitor days between 1973 and 1985. Non-consumptive and consumptive uses historically have been equally popular at the refuge, each accounting for 50% of total use. Sutter and Delevan NWRs, established in 1944 and 1963, respectively, have been used almost exclusively for hunting. Between 1973 and 1985, annual hunting activity averaged approximately 2,500 visitor days at Sutter NWR and 5,500 visitor days at Delevan NWR.

Water-dependent activities at these potentially affected reservoirs, rivers, and wildlife refuges in the Sacramento River Region generated approximately 5 million visitor days in 1992. This level of activity generated an estimated $100 million in recreation-related spending. Because 1992 was a dry water year, this level of activity likely understates what occurs in most years.

7.7.3.4 SAN JOAQUIN RIVER REGION

Reservoirs, rivers, and wildlife refuges in the San Joaquin River Region support a variety of recreational activities, including sport fishing, hunting, boating, camping, swimming, picnicking, and sightseeing. Private lands also support considerable waterfowl hunting activity in the region.

Important reservoirs and lakes in the San Joaquin River Region include San Luis, Millerton, New Melones, New Don Pedro, McClure, and New Hogan. Except for New Melones Reservoir, these reservoirs were constructed in the 1960s and 1970s. Important historical use trends at these reservoirs include substantial increases in use during the 1970s and 1980s, particularly at San Luis Reservoir, Lake McClure, and New Hogan Lake.

Important rivers in the San Joaquin River Region include the San Joaquin, Stanislaus, Tuolumne, and Merced. Millerton Lake modified the flows and temperature of the San Joaquin River. During the irrigation season, the river was diverted substantially, creating hazards for chinook salmon, steelhead trout, striped bass, American shad, and sturgeon.

The Stanislaus River downstream of Goodwin Dam historically supported resident populations of warm water game species, including largemouth and smallmouth bass, channel and white catfish, black crappie, bluegill, and green sunfish. Historical anadromous fish populations below Goodwin Dam included chinook salmon, steelhead trout, striped bass, American shad, and sturgeon. Salmon production in the Stanislaus River contributed to sport and commercial catches in the ocean and lower San Francisco Bay.

The Tuolumne River historically supported a significant trout fishery in the upper cold water reaches of the river. Rainbow, brown, brook, and golden trout ranged as far downstream as the present location of New Don Pedro Reservoir. Largemouth and smallmouth bass, bluegill, white catfish, and other warm water fish species were common in the lower foothill and valley reaches of the river. Before impoundment of the lower reach, the Tuolumne River supported steelhead and annual chinook salmon runs of up to 100,000 fish.

The Merced River historically supported significant populations of spring- and fall-run chinook salmon. The salmon run on the Merced River declined and was in poor condition for at least 20 years before the construction of Lake McClure. Operation of the dam has improved the project flow conditions, and salmon habitat improvement projects have effectively maintained chinook salmon populations.

Overall, recreation use data for these rivers are limited. In 1962, DFG estimated that the Stanislaus River chinook salmon run supported an average annual use of 10,000 angler days of sport fishing. No other use data for the Stanislaus River or other important rivers in the San Joaquin River Region are available.

Wildlife refuges in the San Joaquin River Region provide fishing, hunting and wildlife viewing opportunities. Important wildlife refuges in the San Joaquin River Region include Los Banos and Volta WMAs; and Kern, Kesterson, Merced, Mendota, Pixley, and San Luis NWRs. Historical use data for NWRs are not available; however, overall use trends at the NWRs probably resemble the trends at the WMAs. Recreation use at Los Banos WMA and Volta WMA increased from an estimated 36,400 visitor days in 1973 to an estimated 69,300 visitor days in 1985. Recreation opportunities for both non-consumptive and consumptive activities are provided at all wildlife refuges in the region.

Overall, recreation use at important reservoirs, rivers, and wildlife refuges in the San Joaquin River Region has been increasing since the 1940s. Consequently, recreation-related spending associated with increased use by visitors to the recreation areas has been increasing and has become an important contributor to local and regional economies.

Other potentially affected lakes and reservoirs in the region include Bethany Reservoir, O'Neill Forebay, New Hogan Lake, Camanche Reservoir, and other reservoirs located upstream of major reservoirs. Fishing opportunities also occur along the California Aqueduct and the Delta-Mendota Canal.

Overall, water-dependent activities at potentially affected reservoirs, rivers, and wildlife refuges in the San Joaquin River Region generated approximately 3 million visitor days in 1992. This level of activity generated an estimated $60 million in recreation-related spending. Because 1992 was a dry water year, this level of activity likely understates what occurs in most years.

7.7.3.5 OTHER SWP AND CVP SERVICE AREAS

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

Development of the SWP and CVP created recreational opportunities at facilities constructed outside the Central Valley. Use of these facilities has generated spending in local economies and benefitted recreationists. Most of the recreational use of SWP and CVP facilities occurs at storage reservoirs.

In southern California, recreational opportunities are provided at Castaic, Pyramid, Silverwood, and Perris Lakes. Recreation-related spending and benefits to users of these facilities generally have grown in proportion to population growth. In 1992, recreation use of these facilities was estimated at 3.1 million visitor days, generating about $130 million in trip-related spending.

7.7.4 ASSESSMENT METHODS

Both qualitative and quantitative methods were used to assess changes in recreation opportunities, use of affected facilities, and related economic effects. Quantitative methods included consideration of thresholds at which recreation opportunities are affected (for example, the reservoir level at which boat ramps become unusable and use declines). More qualitative methods used to assess recreation impacts included consideration of potential effects on the availability and accessibility of recreation sites; support facilities at affected recreation sites (for example, boat launches and docks); and the abundance of fish and wildlife, particularly waterfowl and other bird species.

The effects of the alternatives on each of these recreation opportunity indicators were evaluated at representative locations in each region. Information on potential changes in hydrologic conditions and results of the biological assessment were used to conduct the analysis. The overall impact on recreation resources in the regions also was considered.

Important economic indicators that were considered include changes in spending by visitors to affected recreation areas. Although the economic indicators were not quantified (except for the No Action Alternative), the magnitude of potential changes is described. (For the No Action Alternative, spending values were estimated by adjusting the values for existing conditions by the percentage change in population between 1995 and 2020.) The effect on recreation use of allocating potential costs of the Program to recreation users was not explicitly considered because these costs are unknown at this time.

Potential impacts on commercial fishing in the Delta and Bay Regions were evaluated qualitatively.

7.7.5 SIGNIFICANCE CRITERIA

Program actions would result in a potentially significant adverse impact on recreation resources if recreation opportunities at affected facilities were substantially reduced, which also could lead to substantial effects on recreation-serving businesses. Although professional judgment must be relied on in evaluating the significance of these impacts, a conservative approach was used. Any measurable reduction in recreation opportunities or use was considered potentially significant unless otherwise noted.

Conversely, if Program actions could enhance recreational opportunities at affected resources or increase use, the impact was considered beneficial.

Among the types of Program-induced effects that could result in potentially significant impacts on recreational opportunities are:

- Fluctuation in lake or reservoir water levels.
- Changes in fresh water flows in rivers and the Delta during the recreational season.
- Changes of river temperature that reduce recreational swimming, tubing, canoeing, kayaking, and rafting.
- Temporary restriction of recreation activities due to construction.
- Conversion of recreation facilities to other uses.
- Changes in aesthetic conditions that could affect visitor appreciation of an area.
- Reduction of opportunities for one activity resulting in an increase in visitor days for other recreational uses in the Delta (shifting activities).

- Changes in fishing or hunting opportunities.

- Changes in accessibility to recreation sites.

7.7.6 NO ACTION ALTERNATIVE

7.7.6.1 DELTA REGION

Historical land use trends are expected to continue through 2020. Population trends in the Delta are expected to continue. The increased population is expected to increase demands on existing recreational resources, which could reduce the quality of recreation resources.

Adverse impacts on fisheries and wildlife habitat noted in other sections of this report will result in potentially significant reductions in opportunities associated with recreation resources. Future development of land-based recreational facilities (such as parks, camping and picnic areas, and pedestrian and cycling facilities) and facilities that support water-based activities (such as boating, fishing, swimming, and water-skiing) may place additional demands on terrestrial and aquatic habitat, leading to further reductions or trade-offs in available recreational opportunities.

Other actions that could affect recreational resources in the Delta Region include implementation of the CVPIA, which would improve fishing conditions for anadromous species in Delta waters. With fishery flows implemented under the CVPIA, fishery populations are expected to increase and the availability of water will increase. These changes could substantially increase opportunities for sport fishing, thereby also increasing sport fishing-related spending in the Delta Region.

Based on the additional recreation use generated by regional population growth and the increased use associated with implementation of the CVPIA, spending within the region related to recreational use of the Delta is projected to total approximately $400 million by 2020.

Commercial fishing for crayfish and bait fish species in the Delta and Suisun Bay would not change appreciably under No Action Alternative conditions relative to current resource conditions. Harvest revenue and net income generated by commercial fishing have not been estimated but were assumed to be minor, especially in the context of the regional economy.

7.7.6.2 BAY REGION

Increased population levels are expected to increase demands on existing recreational resources in the Bay Region which could reduce the quality of recreation resources. As described for the Delta Region, increased recreational use of Bay waters and shoreline areas may result in adverse impacts on the recreational value of terrestrial and aquatic resources if facilities are not expanded or managed to prevent degradation from overuse.

Sport fishing opportunities for anadromous species in Bay and coastal waters could increase under No Action Alternative conditions as a result of implementation of the CVPIA. Relative to current conditions, implementation of the CVPIA could result in small increases in benefits and sport fishing-related spending in the North Coast region but larger increases in the San Francisco and Central Coast regions. Based on additional demand generated by regional population growth and enhancements associated with implementation of the CVPIA, spending in the Bay Region (including outer Bay and nearshore areas) related to ocean salmon sport fishing is projected to total approximately $23 million by 2020.

Commercial fishing for anadromous species in Bay and coastal waters could increase under No Action Alternative conditions due to implementation of the CVPIA. (Regional population growth, while adding pressure on the fishery, would not necessarily result in increased fishery-related economic activity because catch is regulated by state and federal resource management agencies.) Improvements in fishery habitats under the CVPIA could substantially increase ocean commercial harvest values and net income derived from the catch of salmon.

7.7.6.3 Sacramento River Region

Higher population levels are expected to increase the demands on existing recreation facilities in the Sacramento River Region which could reduce the quality of recreation resources. Trends not related to population growth, such as the conversion of crops that are associated with wildlife habitat (for example, rice) to other types of crops, also may affect recreation opportunities for hunting and wildlife viewing in the Sacramento River Region.

Other actions that could affect recreational resources in the Sacramento River Region include reoperation or expansion of Folsom Reservoir, development of the Stone Lakes NWR, and implementation of the CVPIA. Reoperating Folsom Reservoir could affect existing recreation opportunities at the reservoir by lowering lake levels during the peak-use recreation season; expanding Folsom Reservoir could enhance opportunities for flat-water recreation. The extent and type of impacts would vary, depending on the amount of flood storage required. Similarly, benefits to recreation could be realized downstream of the reservoir if releases were greater. The overall effect on recreation opportunities both at the reservoir and downstream is uncertain at this time.

The Stone Lakes NWR provides opportunities for non-consumptive recreation activities, such as nature walks and wildlife viewing. Ultimate development of the refuge would increase opportunities for wildlife-related recreation in the Sacramento River Region.

Implementation of the CVPIA could substantially increase sport fishing opportunities in the Sacramento, Feather, American, and Yuba Rivers and could marginally reduce flat-water recreation opportunities at reservoirs such as Shasta and Oroville. Wildlife refuges in the region could experience substantial increases in wildlife viewing and waterfowl hunting opportunities because of improved wildlife habitat conditions in refuges that result from implementation of the CVPIA.

Relative to current conditions, projected changes in the overall operation of CVP and SWP reservoirs to meet downstream water demands are expected to have minor impacts on water-dependent recreation opportunities during the peak summer recreation season.

Under the No Action Alternative, recreation-related expenditures would increase substantially as a result of the 69% increase in population projected for the Sacramento River Region between 1995 and 2020. Additionally, a number of projects and actions, including reoperation or expansion of Folsom Reservoir, development of the Stone Lakes NWR, and implementation of the CVPIA, could affect recreation-related economic activity in the Sacramento River Region under No Action Alternative conditions. Based on population growth and effects of projects under No Action Alternative conditions, 2020 levels of recreation-related expenditures are projected to total about $130 million in the Sacramento River Region.

7.7.6.4 San Joaquin River Region

Population levels in the San Joaquin River Region are expected to increase by 68% between 1995 and 2020. The larger population would substantially increase the demands on existing recreational resources in the region which could reduce the quality of recreation resources. Possible future retirement of agricultural lands on the west side of the San Joaquin River Region could positively affect the region if the lands were made available for recreational use.

Other actions that could affect recreational resources in the San Joaquin River Region include implementation of the CVPIA, which would affect recreation opportunities at many of the region's rivers, reservoirs, and wildlife refuges. Relative to current conditions, projected changes in the overall operation of CVP and SWP reservoirs are expected to potentially reduce opportunities for flat-water recreation during the peak recreation season at reservoirs in the San Joaquin River Region. However, corresponding changes in recreation use of the reservoirs and rivers and related spending would most likely be small. Spending generated by visitation at the region's wildlife refuges would most likely increase substantially relative to existing levels.

Based on regional population growth and likely effects of the CVPIA, No Action Alternative levels of recreation-related spending are projected to total $102 million in the San Joaquin River Region in 2020.

7.7.6.5 Other SWP and CVP Service Areas

Increased population levels are expected to increase the demand on existing recreational resources in the Other SWP and CVP Service Areas which could reduce the quality of recreation resources. Recreational use of existing facilities is expected to increase under the No Action Alternative.

Spending and benefits associated with recreational use of reservoirs in the Other SWP and CVP Service Areas could be affected by population growth and projects such as the CVPIA and MWD's Diamond Valley Reservoir. Important lakes that could be affected include Castaic, Pyramid, Silverwood, and Perris. Based on the 46% increase in population growth projected for counties containing these lakes, recreation spending could annually total a projected $193 million by 2020.

7.7.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For recreation resources, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program Alternatives. The environmental consequences of the Conveyance element, which vary among Program alternatives, are described in Section 7.7.8.

7.7.7.1 DELTA REGION

Ecosystem Restoration Program

In general, the Ecosystem Restoration Program is expected to increase recreation opportunities and improve the quality of recreational activities in the Delta. In addition, new recreational opportunities for consumptive and non-consumptive recreation activities are likely to occur as a result of ecosystem restoration actions.

The Ecosystem Restoration Program would result in increased open space for hiking, wildlife viewing, hunting, and fishing. Fish and wildlife populations are expected to increase as a result of Ecosystem Restoration Program actions. Restoration actions are expected to result in increased use of restored and adjoining areas by birds and other wildlife, which could result in improved success for wildlife viewing, hunting, and fishing. Restoring fresh-water marshes, tidal wetlands, and other terrestrial habitat areas could create new opportunities for hunters. Restoration actions are also likely to enhance visual resources, resulting in an overall improvement in quality of the recreation experience. The Ecosystem Restoration Program could result in construction of new deep-water areas and tidally influenced channels that could create new opportunities for boaters.

The Ecosystem Restoration Program also is expected to result in large, positive changes in populations of bird species important for wildlife viewing and hunting. Increases in populations of anadromous and resident fish species are expected to lead to increased recreational opportunities, including sport fishing. These actions are expected to increase recreation use and result in a corresponding positive effect on user benefits in the Delta Region.

Although the overall impact of habitat restoration would be positive, restoration activities may result in potentially significant adverse impacts on recreation. During construction, some recreation areas or facilities may be temporarily closed to the public. Certain recreation facilities, such as piers or marinas, would be temporarily or permanently closed following restoration actions. Temporary, seasonal, or permanent closure of Delta waterways could result in potentially significant adverse impacts on boating access and circulation. Impacts associated with temporary and seasonal closures of Delta waterways can be mitigated to a less-than-significant level. Permanent closure of Delta waterways would result in a potentially significant unavoidable adverse impact.

The Ecosystem Restoration Program includes potential actions for constructing fish control barriers. Constructing the barriers could adversely affect boating access and circulation, thereby reducing recreational opportunities. This is considered a potentially significant adverse impact that can be mitigated.

The Ecosystem Restoration Program includes a provision to reduce boat traffic and boat speeds in areas where levees or channel islands and their associated shallow-water and riparian habitat are susceptible to wake damage. The legal authority for implementing these controls rests at the local level, in which Section 660(a) of the state's Harbors and Navigation Code provides local entities with the authority to establish speed zones, time of day restrictions, special use areas, and regulations for sanitation and pollution control. Reduction of boat traffic in some areas could result in an increase in traffic in other areas, causing congestion during peak-use days in summer. Mandatory speed reductions in some areas could result in a shift from motorized boating to non-motorized boating, swimming, and fishing in restricted areas. Speed limits in the Delta are determined by local ordinances, except for the 5-mph speed limit within 200 feet of docks, launching areas, and swimming areas and within 100 feet of swimmers, as required by state law. Although the Ecosystem Restoration Program does not specify proposed speed requirements, the Ecosystem Restoration Program could alter personal watercraft and boat use, and decrease the number of use-days for boating in the Delta. This decrease is considered a potentially significant unavoidable adverse impact.

Overall, the Ecosystem Restoration Program is expected to enhance recreation opportunities in the Delta Region, which should lead to increased use of recreational resources in the region. Increased use would generate more recreation-related spending at local businesses that provide goods and services to recreationists, including retail stores, lodging places, and eating and drinking establishments; and businesses that provide recreation services, such as guiding and marina operations. The number of jobs in recreation-serving businesses should increase, which is considered a beneficial impact on the region.

Commercial fishing for crayfish and bait fish species in the Delta and Suisun Bay would not change appreciably under the Preferred Program Alternative.

Water Quality Program

The Water Quality Program is intended to provide improved water quality in the Delta that will directly and indirectly benefit recreation resources. Elements of the Water Quality Program could result in improved fishery, river recreation, and wildlife refuge conditions throughout the Delta Region. Improved water quality in the Delta could result in improved water clarity for swimming, boating, and other aquatic uses. Improved water clarity could result in improved aesthetics for all types of recreational use. Existing health hazards related to ingesting raw water from the Delta during recreational activities would diminish. Improved water quality is expected to benefit fish and wildlife populations, resulting in improved wildlife viewing, hunting, and fishing.

Improvements in recreational opportunities and the overall quality of recreational experiences would enhance user benefits and result in increased use of recreational resources in the region. Increased use would generate additional visitor spending in the Delta Region, which should lead to more jobs in recreation-serving businesses in the region.

Levee System Integrity Program

Many of the Levee System Integrity Program actions proposed for the Delta are closely linked with the Ecosystem Restoration Program and incorporate habitat improvements into levee restoration. Levee improvements could include setback levees that would increase waterside habitat and beach areas, construction of oversize levees with habitat development on the landward slope, and development of permanent wetlands to control soil subsidence adjacent to levee slopes. Generally, the Levee System Integrity Program is expected to result in beneficial impacts on recreation facilities and opportunities. In addition to the benefits described for the Ecosystem Restoration Program, the Levee System Integrity Program is intended to reduce the risk to land uses from catastrophic breaching of Delta levees. Currently, many recreation areas in the Delta, such as camping facilities and boat launches, are at risk of damage if a levee in the vicinity were to be breached. The Levee System Integrity Program would provide increased levels of flood protection to recreational facilities in the Delta.

Levee System Integrity Program activities may result in some potentially significant adverse impacts on recreation. During construction, certain recreation areas or facilities may be temporarily closed to the public. Certain recreation facilities, such as piers or marinas, would be temporarily or permanently closed following levee restoration actions. Temporary, seasonal, or permanent closure of Delta waterways could result in potentially significant impacts on boating access and circulation. Impacts associated with temporary and seasonal closures of Delta waterways can be mitigated. Permanent closure of Delta waterways would result in a potentially significant unavoidable adverse impact.

The Levee System Integrity Program is expected to indirectly result in positive changes in populations of bird species important for wildlife viewing and hunting. Increases in populations of anadromous and resident fish species are expected to lead to increased recreational opportunities, including sport fishing. These actions are expected to result in a corresponding positive effect on user benefits in the Delta Region.

Levee modification activities in the Suisun Marsh would occur primarily on private lands that do not allow public access but would provide flood protection benefit to a large number of private duck clubs. Some levee repairs would occur in areas where public fishing opportunities exist; however, impacts on these resources would be minimal and temporary.

Overall, the Levee System Integrity Program is expected to enhance recreational opportunities in the Delta Region, which should lead to increased use of Delta recreation resources and facilities. This increase in use should, in turn, generate additional spending by visitors to the region, which would benefit recreation-serving businesses.

Levee System Integrity Program actions would directly affect recreation resources only in the Delta Region. This program therefore is not addressed under the remaining Program regions.

Water Use Efficiency Program

Water Use Efficiency Program measures could potentially reduce the extent of waterfowl habitat in the Delta. The extent of this reduction is unknown but could be influenced by reductions in return flows or after-harvest flooding of fields. This reduction could adversely affect the availability of lands for recreational hunting and for bird watching. These impacts are not expected to be significant in the Delta Region. Improved water conservation from the Water Use Efficiency Program may provide more water in reservoirs for recreational use.

Water Transfer Program

No impacts on recreation are expected in the Delta Region as a result of the Water Transfer Program.

Watershed Program

The Watershed Program would result in little or no effect on recreation in the Delta Region.

Storage

New off-stream or expanded on-stream storage facilities have the potential to provide important environmental water supplies and operational flexibility, which could be used to improve habitat and assist in the recovery of fish and wildlife populations. These facilities would benefit recreation users by providing new opportunities for flat-water recreation in the Delta and by indirectly enhancing recreation quality throughout the Delta Region.

Any new storage facilities developed in the Delta may result in potentially significant impacts on existing recreation resources due to inundation or other impacts related to construction. Flooding of reservoir sites could displace wildlife and increase usage of other recreational facilities in the area. Changes in reservoir operations related to water transfers, water supply needs, or fish recovery could affect existing minimum pool levels and adversely affect recreational opportunities related to specific water surface elevations, including access to marinas and boat launching facilities. Changes in reservoir operations resulting in increased cold-water flows could adversely affect water-contact recreation, such as swimming, windsurfing, and the use of personal watercraft; but the impact is considered less than significant.

Overall, surface storage facilities are expected to enhance recreation opportunities in the Delta Region, which should increase the use of Delta recreation resources. This increase in use should, in turn, generate additional spending by visitors to the region, which would benefit recreation-serving businesses.

Without construction of surface storage under the Preferred Program Alternative, areas that provide recreation opportunities in a natural setting, such as fishing, wildlife viewing, and boating, would not be inundated. Without storage, less water would be available for environmental water flows for Ecosystem Restoration Program habitat restoration. Without storage, opportunities for flow-related recreation in the Delta would be less than under the Preferred Program Alternative with storage.

7.7.7.2 BAY REGION

Ecosystem Restoration and Levee System Integrity Program

In general, Ecosystem Restoration and Levee System Integrity Program actions in the Bay Region, including the Suisun Marsh, would be similar to those proposed for the Delta Region and are anticipated to result in similar impacts on recreation activities.

A number of programmatic actions in the Ecosystem Restoration Program could improve spawning, rearing, and survival conditions for sport fish species, including chinook salmon. The improved conditions should lead to increased populations of sport fish in the Bay Region and enhanced opportunities for sport fishing, which would generate positive changes in recreational spending and benefits to sport anglers in the Bay Region.

Ecosystem Restoration Program actions also could lead to larger populations of chinook salmon originating from the Central Valley river systems. It is difficult to assess the extent of this benefit to the ocean sport and commercial fishing industries. Ocean populations are comprised of salmon originating from various systems along the Pacific Coast, including Klamath and Snake River salmon whose populations are protected by catch restrictions. Because populations are intermingled, restrictions on the catch of Klamath and Snake River salmon can severely restrict the harvest of Central Valley chinook salmon. Assuming that ocean commercial and sport salmon harvest restrictions are eased in the future for protected stocks, increases in populations of Central Valley chinook would lead to substantially increased salmon catch levels. Increased catch levels would result in a corresponding positive economic impact on the commercial fishing industry, charter boat operators, and ocean sport anglers.

Water Quality Program

Elements of the Water Quality Program could result in improved fishery, river recreation, and wildlife refuge conditions in the Bay Region. Improved water quality in San Francisco Bay should lead to healthier anadromous fish populations and improved conditions for water-contact recreation in the Bay Region. These enhanced recreation opportunities could lead to increased use and visitor spending at recreation-serving businesses in the Bay Region.

Water Use Efficiency and Water Transfer Programs, and Storage

The Water Use Efficiency and Water Transfer Programs and the Storage element would not result in potentially significant impacts on recreation resources in the Bay Region.

Watershed Program

Vegetation and habitat restoration activities and channel improvements in the upper watershed areas of the Bay Region could result in beneficial impacts on recreation resources. For example, restoring fresh-water marshes and tidal wetlands may create new recreation opportunities for hunters. To the extent that restoration actions result in increased visitation by birds and other wildlife, expanded opportunities for wildlife viewing likely would result.

Restoration and channel improvement activities may result in some adverse impacts on recreation resources from construction activities. During construction, recreation areas may be temporarily closed to the public; certain recreation facilities, such as piers or marinas, could be temporarily or permanently closed. Closure is considered a potentially significant adverse impact that can be mitigated. Potential road improvements would not adversely affect recreation opportunities, although road removals could limit access to recreation areas in the watershed.

Overall, the Watershed Program is expected to enhance recreation opportunities in the Bay Region, which could lead to increased use that would benefit recreation-serving businesses.

7.7.7.3 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Ecosystem Restoration Program

A large number of the Ecosystem Restoration Program actions planned for the Sacramento River and San Joaquin Regions have been developed to recover declining fish populations. Recovery of fish populations could improve sport fishing opportunities. Restoration of riparian habitat is likely to improve fish and wildlife populations—and may also increase recreation opportunities, including hiking, hunting, wildlife viewing, and sport fishing, by providing additional areas for shoreline access.

Adverse impacts on recreation could result from temperature changes of reservoir releases, depending on the timing and extent of temperature changes. If water released is significantly cooler than the existing conditions, recreation use for activities such as swimming, tubing, canoeing, kayaking, and rafting could be reduced. However, cooler water temperatures would create beneficial fish habitat and improve fish populations in the Sacramento River and San Joaquin River Regions.

Overall, the Ecosystem Restoration Program is expected to enhance recreation opportunities in the Sacramento River and San Joaquin River Regions, which should lead to increased use of recreational resources. Increased use would generate more recreation-related spending at businesses that cater to recreationists. The number of jobs in these businesses should increase, which is considered a beneficial impact on the regions.

Water Quality Program

Elements of the Water Quality Program could result in improved fishery, river recreation, and wildlife refuge conditions throughout the Sacramento River and San Joaquin Regions. The benefits of improved water quality to users of affected recreation resources are difficult to judge; however, improved water quality in rivers should lead to healthier anadromous fish populations and improved conditions for water-contact recreation.

Water Use Efficiency Program

The Water Use Efficiency Program could lead to reduced diversions, which would provide more water for in-stream purposes. Improved water conservation may provide more water in reservoirs for recreational use. These changes could provide greater opportunities for water-dependent recreation activities, both along affected rivers and at reservoirs. Recreation use at affected rivers and reservoirs, and associated spending and net benefits could increase.

The Water Use Efficiency Program could result in reduced opportunities for waterfowl hunting and wildlife viewing. Associated spending and net benefits could be reduced from potential decreases in wetlands and riparian areas that depend on irrigation runoff and after-harvest field flooding. These effects on spending and net benefits are expected to be less than significant.

Water Transfer Program

Increased water transfers based on storage releases that result from the Water Transfer Program could increase the drawdown of recreational reservoirs, which has been shown to decrease the quality of the recreational experience and could result in reduced use of the affected reservoirs. In addition to adversely affecting reservoir users, decreased reservoir use could adversely affect businesses that rely on visitor spending. Enhanced flows in rivers below the affected reservoirs could benefit river users and offset some of the regional impacts related to reduced spending at reservoirs. Mitigation strategies described in Section 7.7.11 can reduce the potential recreation impacts to a less-than-significant level and also can minimize recreation-related economic effects. Specific water transfers can be conditioned to mitigate these impacts.

Watershed Program

Potential impacts on recreation resources from vegetation and habitat restoration activities, as well as from channel improvements, generally would be the same as those described above for the Bay Region. Road improvements would not adversely affect recreation resources in these areas, although road removals could limit access to recreation areas in the watershed.

Storage

New off-stream or expanded on-stream storage facilities have the potential to provide important environmental water supplies and operational flexibility, which could be used to improve habitat and assist in the recovery of fish and wildlife populations. Storage facilities would benefit recreation users by providing new opportunities for flat-water recreation in the Sacramento River and San Joaquin River Regions and by indirectly enhancing recreation quality throughout the regions.

Any new storage facilities developed may result in potentially significant impacts on existing recreation resources due to inundation or other impacts related to construction. Flooding of reservoir sites could displace wildlife and increase usage of other recreational facilities in the area. Based on predicted hydrologic conditions, changes in reservoir operations could affect existing minimum pool levels and adversely affect recreational opportunities related to specific water surface elevations, including access to marinas and boat launching facilities. Changes in reservoir operations resulting in increased cold water flows could adversely affect water-contact recreation such as swimming, windsurfing, and the use of personal watercraft, but the impact is considered less than significant.

Overall, surface storage facilities are expected to enhance recreation opportunities in the Sacramento River and San Joaquin River Regions, which should increase the use of recreation resources. This increase in use should, in turn, generate additional spending by visitors to the region, which would benefit recreation-serving businesses.

Without construction of surface storage under any alternative, areas that provide recreation opportunities in a natural setting, such as fishing, wildlife viewing, and boating, would not be inundated. Without storage, less water would be available for environmental water flows for Ecosystem Restoration Program habitat restoration, and opportunities for flow-related recreation in the regions would be less than under an alternative with storage.

7.7.7.4 Other SWP and CVP Service Areas

Ecosystem Restoration, Water Quality and Watershed, and Storage

These programs would result in no potentially significant impacts on recreation resources in the Other SWP and CVP Service Areas.

Water Use Efficiency Program

The Water Use Efficiency Program may provide an opportunity to reoperate some reservoirs, which could change the availability of water to support recreation activities. It is expected that implementing more stringent conservation measures would help conserve existing supplies to meet a greater future demand.

Water Transfer Program

To the extent that reservoirs in the region are operated to facilitate the transfer of water, potential adverse impacts on recreation could occur through more frequent drawdown of water levels. Specific water transfers can be conditioned to mitigate these impacts.

7.7.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For recreation resources, the Conveyance element results in environmental consequences that differ among the alternatives. This section describes the direct effects of the Conveyance element on recreation resources; indirect effects of the Conveyance element on other Program elements also are identified, where relevant.

7.7.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Delta Region

A diversion facility on the Sacramento River and accompanying conveyance channel and channel modifications to improve conveyance may result in temporary recreation impacts during construction. Some of these actions could permanently displace such land-based recreation opportunities as camping, hiking, and picnicking; however, some actions could increase aquatic-related recreation opportunities, including fishing, wildlife viewing, and boating. Open-water habitat created as part of conveyance modifications could generate new waterfowl hunting opportunities. Dredging could result in short-term construction impacts, such as obstructing or closing channels and creating noise and visual impacts.

Operating fish and flow control barriers in the south Delta could negatively affect boating circulation patterns in that area. Barrier placement for fish and flow control in the Delta could restrict boat travel. Impacts on boating, marina access and use, and fishing are the primary types of recreational effects that would occur as a result of installing temporary or permanent barriers. Depending on location, these adverse impacts could be potentially significant and unavoidable.

Changes in project operations are expected to be beneficial for fish populations and related fishing activities in the Delta. These changes are not anticipated to adversely affect recreational resources. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation.

In summary, construction and operation of conveyance facilities would benefit certain recreation activities (primarily sport fishing) and potentially adversely affect other activities (primarily boating and activities at facilities near construction under the Preferred Program Alternative).

Bay Region

Under the Preferred Program Alternative, impacts on recreational resources in the Bay Region due to construction of conveyance features are expected to be negligible.

Changes in project operations could benefit fish populations and related fishing activities in the Bay Region. These changes are not anticipated to adversely affect recreational resources at existing facilities. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation resources.

Sacramento River and San Joaquin River Regions

Based on predicted hydrologic conditions, changes in operations are not anticipated to adversely affect recreational resources in the Sacramento River or San Joaquin River Region. Flows and timing of flows may be changed in the Sacramento River and Feather River as a result of reservoir release changes made in response to operational changes at the water export pumps in the Delta. These changes are not expected to significantly affect recreation resources. Variations in water storage levels at San Luis Reservoir may occur due to changes in the amounts of water exported at the pumping plants, but the variations are not expected to be significant.

The addition of storage generally would result in only minor effects on water-dependent recreation opportunities at existing facilities.

In conclusion, changes in operations to meet downstream water demands are not expected to significantly affect water-dependent recreation opportunities at facilities in the Sacramento River or San Joaquin River Region under the Preferred Program Alternative.

Other SWP and CVP Service Areas

The Conveyance element would not affect recreation in the Other SWP and CVP Service Areas.

7.7.8.2 ALTERNATIVE 1

Delta Region

Conveyance channels and channel modifications to improve conveyance in the south Delta may result in temporary recreation impacts during construction. Some of these actions could permanently displace such land-based recreation opportunities as camping, hiking, and picnicking; however, some actions could increase aquatic-related recreation opportunities, including fishing, wildlife viewing, and boating. Habitat created as part of conveyance modifications could generate new waterfowl hunting opportunities. Dredging could cause short- term construction impacts such as obstructing or closing channels and creating noise and visual impacts.

Operating fish and flow control barriers in the south Delta could negatively affect boating circulation patterns in that area. Barrier placement for fish and flow control in the Delta could restrict boat travel. Impacts on boating, marina access and use, and fishing are the primary types of recreational effects that would occur as a result of installing temporary or permanent barriers. Depending on location, these adverse impacts could be potentially significant and unavoidable.

Changes in project operations are expected to benefit fish populations and related fishing activities in the Delta. These changes are not anticipated to adversely affect recreational resources. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation resources.

In summary, construction and operation of south Delta conveyance facilities would benefit certain recreation activities (primarily sport fishing) and potentially adversely affect other activities (primarily boating and activities at facilities near construction under Alternative 1).

Bay Region

Under Alternative 1, no impacts on recreational resources in the Bay Region would result from construction of south Delta conveyance features.

Changes in project operations could benefit fish populations and related fishing activities in the Bay Region. These changes are not anticipated to adversely affect recreational resources at existing facilities. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation.

Sacramento River and San Joaquin River Regions

Based on predicted hydrologic conditions, changes in operations are not anticipated to significantly affect recreational resources in the Sacramento River or San Joaquin River Region. Flows and timing of flows may be changed in the Sacramento River and Feather River as a result of reservoir release changes made in response to operational changes at the water export pumps in the Delta. These changes are not expected to significantly affect recreation. Variations in water storage levels at San Luis Reservoir may occur due to changes in the amounts of water exported at the pumping plants, but the variations are not expected to be significant.

With storage, adverse impacts on recreation opportunities at existing facilities would slightly increase at facilities in the Sacramento River Region (because of the timing of releases) and slightly decrease at facilities in the San Joaquin River Region.

In conclusion, changes in operation to meet downstream water demands are not expected to significantly affect water-dependent recreation opportunities at facilities in the Sacramento River and San Joaquin River Regions under Alternative 1.

Other SWP and CVP Service Areas

Under Alternative 1, the Conveyance element would not affect recreation resources in the Other SWP and CVP Service Areas.

7.7.8.3 ALTERNATIVE 2

Delta Region

A 10,000-cfs water diversion facility on the Sacramento River and accompanying conveyance channel and channel modifications to improve conveyance may result in temporary recreation impacts during construction. Some of these actions could permanently displace such land-based recreation opportunities as camping, hiking, and picnicking; however, some actions could increase aquatic-related recreation opportunities, including fishing, wildlife viewing, and boating. Habitat created as part of conveyance modifications could generate new waterfowl hunting opportunities. Dredging could cause short-term construction impacts such as obstructing or closing channels and creating noise and visual impacts.

Operating fish and flow control barriers in the south Delta could negatively affect boating circulation patterns in that area. Barrier placement for fish and flow control in the Delta could restrict boat travel. Impacts on boating, marina access and use, and fishing are the primary types of recreational effects that would occur as a result of installing temporary or permanent barriers. Depending on location, these adverse impacts could be potentially significant and unavoidable.

Changes in project operations are expected to benefit fish populations and related fishing activities in the Delta. These changes are not anticipated to adversely affect recreational resources. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation resources.

In summary, construction and operation of south Delta conveyance facilities would benefit certain recreation activities (primarily sport fishing) and potentially adversely affect other activities (primarily boating and activities at facilities near construction under Alternative 2).

Bay Region

Under Alternative 2, construction of conveyance features would not affect recreation resources in the Bay Region.

Changes in project operations could benefit fish populations and related fishing activities in the Bay Region. These changes are not anticipated to adversely affect recreational resources at existing facilities. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation resources.

Sacramento River and San Joaquin River Regions

Based on predicted hydrologic conditions, changes in operations are not anticipated to adversely affect recreational resources in the Sacramento River or San Joaquin River Region. Flows and timing of flows may be changed in the Sacramento River and Feather River as a result of reservoir release changes made in response to operational changes at the water export pumps in the Delta. These changes are not expected to significantly affect recreation resources. Variations in water storage levels at San Luis Reservoir may occur due to changes in the amounts of water exported at the pumping plants, but the variations are not expected to be significant.

With storage, the adverse impacts on recreation opportunities at existing facilities would slightly increase at facilities in the Sacramento River Region (because of the timing of releases) and would slightly decrease at facilities in the San Joaquin River Region.

In conclusion, changes in operation to meet downstream water demands are not expected to significantly affect water-dependent recreation opportunities at facilities in the Sacramento River or San Joaquin River Region under Alternative 2.

Other SWP and CVP Service Areas

Under Alternative 2, the Conveyance element would not affect recreation resources in the Other SWP and CVP Service Areas.

7.7.8.4 ALTERNATIVE 3

Delta Region

An isolated conveyance facility could improve spawning, rearing, and survival conditions for fish species and lead to increased fish populations. Larger populations could lead to increases in associated recreational activities like sport fishing. Constructing an open-channel isolated facility likely would result in potentially significant adverse impacts on existing recreation resources. An open-channel isolated conveyance facility could be constructed at locations that would affect several existing recreation areas, including Stone Lakes NWR, fishing and boating access areas along several sloughs, and several trails and parks in San Joaquin County. Depending on the location of the conveyance facilities, construction could require temporary disruption of existing facilities. Operation may result in closing several existing facilities to allow for construction of the pumps, siphons, access roads, storage buildings, and utilities. Such closure is considered a potentially significant adverse impact that can be mitigated.

Areas where fish and wildlife habitat could be developed by the Ecosystem Restoration Program may differ between Alternative 3 and the other Program alternatives. Associated recreational opportunities and improvements would occur in areas where habitat restoration occurs. For Alternative 3, habitat and corresponding recreation improvements would be limited to establishing a riparian corridor along the North Fork of the Mokelumne River. Shallow-water habitat and corresponding recreation improvements for Alternative 3 would be located in the east Delta along the South Fork of the Mokelumne River.

Conveyance channels and channel modifications to improve in-Delta conveyance may result in temporary recreation impacts during construction. The magnitude of in-Delta conveyance and its impact would be related to the amount of channel improvements required for a dual-Delta water conveyance system. A smaller isolated facility could require more in-Delta conveyance, and a larger isolated facility could require less. Conveyance channel and channel modifications could displace such land-based recreation opportunities as camping, hiking, and picnicking; however, some actions could increase aquatic-related recreation opportunities, including fishing, wildlife viewing, and boating. Habitat created as part of conveyance modifications could generate new waterfowl hunting opportunities. Dredging could cause short- term construction impacts such as obstructing or closing channels and creating noise and visual impacts.

Operating fish and flow control barriers in the south Delta could negatively affect boating circulation patterns in that area. Barrier placement for fish and flow control in the Delta could restrict boat travel. Impacts on boating, marina access and use, and fishing are the primary types of recreational effects that would occur as a result of installing temporary or permanent barriers. Depending on location, these adverse impacts could be potentially significant and unavoidable.

Changes in project operations are expected to benefit fish populations and related fishing activities in the Delta. These changes are not anticipated to adversely affect recreational resources. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation.

In summary, construction and operation of an isolated conveyance facility would benefit certain recreation activities (primarily sport fishing) and potentially adversely affect other activities (primarily boating and activities at facilities near construction under Alternative 3).

Bay Region

Under Alternative 3, construction of conveyance features would not affect recreational resources in the Bay Region.

Changes in project operations could benefit fish populations and related fishing activities in the Bay Region. These changes are not anticipated to adversely affect recreational resources at existing facilities. Flows and timing of flows may be changed within Delta waterways due to changes in pumping patterns at the export pumps, but the changes are not expected to significantly affect recreation.

Sacramento River and San Joaquin River Regions

Based on predicted hydrologic conditions, changes in project operations to meet down-stream water demands are expected to adversely affect water-dependent recreation opportunities at existing facilities in the Sacramento River Region. These impacts could be mitigated by maintaining higher reservoir levels at facilities that would be most affected. Water availability throughout the system is sufficient if additional storage is added that improves flexibility. Changes in project operations would be beneficial for recreation opportunities at existing facilities in the San Joaquin River Region.

Other SWP and CVP Service Areas

Under Alternative 3, the Conveyance element would not affect recreation resources in the Other SWP and CVP Service Areas.

7.7.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions are essentially the same impacts as those identified in Sections 7.7.7 and 7.7.8, which compare the Program alternatives to the No Action Alternative.

The analysis indicates that recreation resources would experience an overall beneficial effect when the Program alternatives are compared to existing conditions. As population levels and demand would not increase under the existing conditions scenario, the benefits to recreation resources would be slightly higher under existing conditions than when compared to the No Action Alternative. At the programmatic level, however, these differences would not be significant.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative. The potentially significant impacts associated with the Preferred Program Alternative include:

- Temporary closure of recreation areas during construction.
- Increased speed zone restrictions or prohibition of motorized boating in some areas.
- More stringent regulation of boat discharges.
- **Temporary or permanent changes in boating access and navigation.**
- Permanent closure of some recreation facilities.
- Increases in boat traffic in some areas because of speed and access restrictions.
- Decrease in recreation opportunities because of speed and access restrictions.
- Potential decrease in flooded lands suitable for wildlife, hunting, and fishing as a result of water use efficiency actions.
- Potential for reduced water-contact recreation quality from releases of reservoir cold water.
- Displacement of fish and wildlife from new off-stream or expanded on-stream reservoirs.

- **Potential loss of terrestrial and on-stream recreation from new off-stream or expanded on-stream reservoirs.**

- Potential for reduced access to recreation facilities and decreased recreation opportunities from changes in reservoir levels.

Bold indicates a potentially significant unavoidable impact.

7.7.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. If identified in the analysis, this section also presents any potentially significant adverse cumulative impacts that remain unavoidable regardless of efforts to avoid, reduce, or mitigate them. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For recreation resources, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.7.1 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate them. At the programmatic level, the impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level are noted on the list in **bold type**. Sections 7.7.7 and 7.7.8 elaborate on long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on recreation resources: American River Watershed Project, American River Water Resource Investigation, CVPIA Anadromous Fish Restoration Program and other CVPIA actions not yet fully implemented, Delta Wetlands Project, and Pardee Reservoir Enlargement Project. At the programmatic level of analysis, most of the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.7.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level. The exceptions are the temporary or permanent changes in boating access and navigation in the Delta Region and the potential loss of terrestrial and on-stream recreation from new off-stream or expanded on-stream reservoirs in the Sacramento River and San Joaquin River Regions. These impacts are discussed in Section 7.7.12. At the programmatic level of analysis, it is not anticipated that the CALFED Program's contribution to these cumulative impacts can be avoided, reduced, or mitigated to a less than cumulatively considerable level. Therefore, this analysis concludes that these impacts are cumulatively significant and unavoidable. This conclusion is based on currently available information and the high level of uncertainty as to whether these impacts can be avoided, mitigated, or reduced to a level that is less than cumulatively considerable.

Growth-Inducing Impacts. Construction of new reservoirs and associated recreational enhancement of the area could foster new growth. At this programmatic level, it is unknown where any increases in population growth or construction of additional housing would take place, or what level of growth might be associated with reservoir construction. When and if they occur, these changes will be subject to local land use decisions by individual cities and counties. Future development at the local level is guided by many considerations. These other factors include the policies in local general plans and zoning ordinance restrictions; the availability of a wide range of community services and infrastructure, such as sewage treatment facilities and transportation infrastructure; the availability of developable land; the types and availability of employment opportunities; and the analysis and conclusions based on an environmental review of proposed projects pursuant to CEQA. These local land use decisions and the environmental impacts associated with these site-specific decisions are outside the scope of this Programmatic EIS/EIR but can and should be considered by the local governments acting on future development proposals.

Short- and Long-Term Relationships. The Preferred Program Alternative generally would maintain and enhance long-term productivity of recreation resources but may cause adverse impacts on recreation resources resulting from short-term uses of the environment.

Substantial overall benefits to the long-term productivity of recreation resources would result from Program actions. Benefits resulting from increased fish and wildlife populations, improved water quality, increased open space, and new recreation opportunities at new off-stream or enlarged existing reservoirs generally would outweigh the short-term adverse impacts.

Short-term, construction-related impacts on recreation resources would be localized and cease after construction is completed. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on these resources. Potentially significant long-term unavoidable impacts on motorized boating in the Delta Region and possible stream inundation through enlargement of existing reservoirs in the Sacramento River and San Joaquin Rivers were identified in this impact analysis.

Irreversible and Irretrievable Commitments. The Ecosystem Restoration Program, Levee System Integrity Program, Storage, Conveyance, and other elements of the Preferred Program Alternative can be considered to cause potentially significant irreversible changes in recreational resources. Avoidance and mitigation measures can be implemented to lessen adverse effects, but changes will be experienced by future generations. The long-term beneficial irreversible changes include the beneficial impacts of improved recreational opportunities and use due to the increases in fish and wildlife populations and increased recreational access and facilities associated with the development of the Preferred Program Alternative. Long-term adverse irreversible changes include displacement of recreational opportunities and use caused by development of the Preferred Program Alternative, caused by changes in boating access and circulation patterns in the Delta Region, and inundation of flowing streams and rivers by new off-stream or enlarged existing storage reservoirs.

7.7.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

To minimize adverse effects and maximize beneficial effects, the Program will develop a comprehensive recreation planning program concurrent with project-specific implementation planning for Program actions. The planning will identify and prioritize recreation enhancement and mitigation projects to be included in implementation of the Preferred Program Alternative. This recreation program will address existing deficiencies in recreation, particularly in the Delta, as well as provide for appropriate modifications and additions to recreational facilities that may be required to accommodate other Program actions. The timing of such a process would be consistent with the Phase III documentation and implementation schedule, ensuring that recreation resources are appropriately considered as part of the Bay-Delta solution. Recreation enhancement will be included with site-specific development.

The following mitigation strategies could be used to minimize adverse impacts on recreation resources:

- As part of the project-specific implementation strategy and planning for all Program actions, considering and incorporating to the extent feasible recreational improvements and enhancements as part of project features.

- Working with recreational interests, including water-skiing groups, boating manufacturers, resort owners, and other boating interests, to protect and enhance recreational boating and other recreational resources in all project areas.

- Conducting an analysis of boating circulation to ensure that appropriate alternative routes are identified and clearly marked if boating circulation in the Delta is to be modified due to temporary, seasonal, or permanent channel closures or to speed restrictions.

- Restoring and designing existing and new levees to accommodate vehicular access and parking for shoreline fishing, boat launching, swimming, hiking, bicycling, and wildlife viewing whenever feasible.

- Maintaining boating access to prime boating areas, including Grant Line, Fabian, Bell, and Victoria Canals, for recreational purposes even if flow control barriers are constructed.

- Offsetting adverse impacts resulting from temporary and permanent barriers on boating, marina access and use, and fishing by providing portage facilities, boat locks, and public information regarding alternate access.

- Reducing adverse impacts associated with temporary and permanent barriers by avoiding construction activities during peak-use times, posting warning signs and buoys in channels, and providing information and education regarding alternate access and access facilities.

- Minimizing construction impacts by avoiding construction activities during peak-use times, posting warning signs and buoys in channels, and providing information and education regarding alternate recreation and access facilities.

- Replacing facilities in kind when existing facilities are temporarily eliminated and relocating or building similar recreational facilities if Program actions require the permanent closure of a recreation facility. Including local interests in the decision-making process for designing and locating these facilities.

- Minimizing water level fluctuation of existing and new reservoirs. Establishing operating criteria that designate minimum pool levels and maintain reservoir levels as high as possible throughout the recreation peak-use season. Coordinating operation of all reservoir facilities, including new facilities, to minimize adverse reservoir fluctuations in any particular facility.

- Acquiring and protecting open space recreation areas through the purchase of trail rights-of-way or recreational easements.

In addition to these strategies, mitigation is described in this document for impacts on other resources that will affect recreation opportunities, including fisheries, vegetation and wildlife, and water quality. These mitigation strategies include methods to avoid, minimize, protect, and compensate for potentially significant adverse impacts on fish and wildlife resources resulting from new off-stream or expanded in-stream reservoirs. These strategies are presented in Chapters 5 and 6. The reader should refer to these sections of the Programmatic EIS/EIR for additional mitigation that could indirectly affect recreation resources and opportunities.

7.7.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

Potentially significant unavoidable impacts on recreation resources could include: (1) loss of terrestrial and on-stream recreation from new off-stream or expanded on-stream reservoirs; and (2) temporary or permanent changes to motorized boating recreation from speed limits, channel closures, and the installation of flow and fish control barriers in the Delta.

7.8 Flood Control

The CALFED Bay-Delta Program would substantially improve flood protection in the Delta Region. The benefits of an improved Delta levee system include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and conveyance facilities.

7.8 Flood Control

7.8.1 SUMMARY

The benefits of an improved Delta levee system include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and conveyance facilities. The wide range of beneficiaries of improved flood protection in the Delta Region includes Delta local agencies; landowners; farmers; boaters; wildlife; and operators of railroads, state highways, utilities, and water distribution facilities. Delta water users and exporters also benefit from increased protection of water quality. Federal interests benefit from improvements to conveyance, navigation, commerce, and the environment and from reduced flood damage.

One objective of the CALFED Bay-Delta Program (Program) is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees. To accomplish this, CALFED would build on existing programs to maintain and improve the integrity of the Delta levee system.

Preferred Program Alternative. Flood stages generally would be similar to existing levels. Localized south Delta stage increases could result during the non-flood season due to minor flow impediments but would not significantly affect the flood control system. Seepage through levees would continue as an ongoing process, especially in the Delta Region.

Increases in shallow flooding for habitat would increase the potential for seepage. Inspection, maintenance, and repair of the flood control system would be easier because setback levees would be designed to facilitate these tasks. However, emergency response capabilities would not be significantly changed until the Levee System Integrity Program is fully implemented.

Minor increases in sedimentation could result from generally reduced velocities in shallow flooded areas established for habitat. Extensive consolidation and settlement are expected for levees that could be set back as far as 500 feet from the current levee locations, requiring long construction periods and increased initial maintenance. Channel capacities would be similar to existing conditions, with minor decreases in capacity possible where sedimentation accompanies slow velocities.

Watershed Program actions that restore water retention features of watersheds, such as revegetation and runoff control, could benefit flood control resources.

Levee scour would be reduced at locations where channel widening is planned. Channel widening would improve flood flow conveyance capacities.

Subsidence would continue to occur on the interior of the islands where peat soils degrade, but levee design will address subsidence adjacent to the levee in critical areas. Wind-generated wave erosion would increase near setback levees and on flooded islands, as greater expanses of water would be subject to wind-fetch.

Under all alternatives, annual loss is estimated to decline by as much as 65%, to about $140 million on an expected annual basis. Costs associated with flood control also are estimated to be substantial. Depending on how these costs are allocated to beneficiaries, they could induce changes in land use, water use, property values, and regional economic activity.

Additional changes in costs and benefits could occur in the Sacramento River and San Joaquin River Regions due to reoperation of reservoirs for Ecosystem Restoration Program flows and diversion of water to off-stream storage. Construction of additional water storage sites could provide flood control benefits to downstream residents, and could allow some reoperation of existing reservoirs for potential flood control benefit. No Program actions are expected to influence flood control costs or benefits in the Bay Region or in the Other SWP and CVP Areas.

Alternatives 1, 2, and 3. Except for decreased flood stages in the north Delta under Alternatives 2 and 3, conditions under Alternatives 1, 2, and 3 related to flood control would be similar to those described for the Preferred Program Alternative.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Impacts on levee stability from levee and berm vegetation management practices for habitat purposes (1,2).

Reduced levee stability from habitat restoration using conservation easements along riparian corridors (1,2,4).

Increased seepage on adjacent islands, possibly leading to flooding from seepage-induced failure from shallow flooding of Delta islands susceptible to subsidence (5,6,7,8).

Increases in wind-fetch and wave erosion on landside levee slopes from island flooding (9,10,11).

Increased levels of flooding downstream of diversions after removal of diversion structures and other obstructions to flow in the Sacramento River tributaries (3).

Increased flood stages along streams due to increases in the roughness of the stream channel from vegetation on stream banks (4).

Potential localized subsidence, resulting in levee slumping or cracking if occurring near levees, caused by potential increases in groundwater pumping (12, 13,14).

Increased stage upstream of and possibly decreased stage downstream from gate structures located in channels that reduce the channel's flood flow conveyance (15).

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative (continued)

Mitigation Strategies

1. Allowing reasonable clearing of deep-rooted trees and shrubs from levee side slopes to support inspection, maintenance, repair, and emergency response, while preserving some habitat values.

2. Permitting clearing of deep-rooted shrubs and trees on levee side slopes. Trees and shrubs should be allowed to grow only on adjacent berms. If roots penetrate levees, fill materials should be added to levee landside slopes in order to construct a partial setback levee and increase stability.

3. Widening streams downstream of removed water diversion structures to increase conveyance capacity.

4. Incorporating flood control criteria into the design of stream bank revegetation projects. For example, by increasing the width of vegetated sections to maintain conveyance capacity, the net effect of vegetation on flood control would be negligible.

5. Identifying locations susceptible to seepage-induced failure on Delta islands that may be intentionally flooded for habitat.

6. Implementing a seepage monitoring program on nonflooded islands adjacent to potential shallow-flooded islands.

7. Developing seepage control performance standards to be used during island flooding and storage periods to determine net seepage caused by shallow flooding.

8. Improving levees to withstand expected hydraulic stresses and seepage.

9. Designing erosion protection measures to minimize or eliminate wave splash and run-up erosion.

10. Using riprap or another suitable means of slope protection to dissipate wave force.

11. Constructing large wind/wave breaks in the flooded islands to reduce wind-fetch and erosion potential.

12. Investigating the cost effectiveness and safety of using sediment traps as a source of borrow.

13. Identifying existing or planned wells that could affect groundwater and substrate conditions underlying nearby levees or flood control facilities.

14. Providing incentives to terminate use of wells that can adversely affect levee stability, reducing their pumping volume to safe withdrawal levels as they affect substrate stability, or otherwise replacing them with sources that could not affect levee stability.

15. Designing structures to minimize the loss of channel conveyance at gate structures located in channels.

No potentially significant unavoidable impacts on flood control are associated with the Preferred Program Alternative.

7.8.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Below is a brief description of the areas of controversy for this resource category. Given the programmatic nature of this document, many of these areas of controversy cannot be addressed; however, subsequent project-specific environmental analysis will evaluate these topics in more detail.

Sea-level rise can be important to flood control plans, as it raises predicted water surface profiles over time. The rate of sea-level rise in the Delta is unknown.

Historically, dredging has been controversial in the Delta because permits are issued on a case-by-case basis for such a common and necessary activity. The development of a general permit is hindered by the lack of available data regarding impacts associated with dredging. The Program plans to develop this information. Until such a permit is developed, existing case-by-case permits will be used.

7.8.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The flood control systems described here are governed by federal, state, and local agencies. Levee systems are referred to as federal project levees or local non-project levees.

Project levees are associated primarily with conveying flood flows and maintaining the Sacramento Deep Water Ship Channel. The project levees work in conjunction with upstream reservoirs and bypass systems to protect adjacent lands against flooding, and to maintain flow velocities adequate to carry out sediments that might impede navigation. The San Joaquin River Flood Control Project and the Sacramento River Flood Control Project (SRFCP), built by the Corps and turned over to the state for maintenance, provide flood control for the lower reaches of these rivers and into the Delta. Project levees in the Delta are maintained to federal standards by the State or by local landowners under state supervision.

Non-project levees are levees constructed and maintained by local reclamation districts. Non-project levees constitute about 65% of levees in the Delta flood control system. Maintaining non-project levees largely is financed by landowners, and the costs are shared with the State. Non-project levees often are maintained to widely ranging and less stringent standards than those applied to project levees.

Flood management operations are coordinated by an integrated team of representatives from federal, state, and local agencies.

In general, reservoir water level management is governed by an approved flood control diagram. This diagram essentially defines the amount of space that should be available to store flood waters at various times of the year. Each reservoir has a unique flood control diagram that is based on the following criteria:

- The flood response characteristics of the basin.
- Agreements for the level of flood protection to be provided by the reservoir.
- Obligations for water conservation.
- Requirements necessary to maintain environmental conditions in the downstream water courses.

The primary issues of concern to upper watersheds are particular land use practices that can cause reductions in the retention and storage time of flows from the upper watershed areas, possibly resulting in increased peak runoff events and excessive erosion of hill slopes, stream banks and stream beds, and subsequent sedimentation in reservoirs.

7.8.3.1 DELTA REGION

Overview of Flood Control Development. Until the 1850s, the Delta Region was mostly a tidal marsh, part of an interconnected estuary system that included the Suisun Marsh and San Francisco Bay. During the flood season, the Delta became a great inland lake, and when the flood waters receded, the network of sloughs and channels reappeared throughout the marsh. Early settlers avoided the Delta for two reasons. First, the attempts at levee construction were hampered by high costs and lack of mechanical equipment. Second, laws were inadequate to give landowners clear title to wetlands and seasonally flooded lands. The discovery of gold at Sutter's Mill in the foothills of the Sierra Nevada resulted in a large inflow of people. The growing population increased the demand for food. Congress passed the "Arkansas Act" in 1850, which warranted title of wetlands and flooded lands to private ownership. The higher demand for food and clear ownership laws accelerated land reclamation in the Delta.

Development of the Delta began in late 1850 when the Federal Swamp Land Act conveyed ownership of all swamp and overflow land, including Delta marshes, from the Federal Government to the State of California. Proceeds from the state's sale of swampland were to go toward reclaiming them, primarily for conversion to agricultural land.

In 1861, the State Legislature created the Board of Swamp and Overflowed Land Commissioners to manage reclamation projects. In 1866, the board's authority was transferred to county boards of supervisors. The first reclamation projects began in 1869, when developers constructed 4-foot-high by 12-foot-wide levees on Sherman and Twitchell islands using the peat soils of the Delta. Since then, levee construction has improved and expanded to 1,100 miles throughout the Delta to protect agricultural and urban lands against flooding.

Shortly after the completion of the levees in 1913, the construction of a complicated series of human-made waterways and water development facilities began in the Delta. The purpose of constructed waterways was to provide navigation, improve water circulation, or obtain material for levee construction. Water development facilities were constructed to ship water from the Delta to other parts of the State for agricultural, urban, and other uses.

In the study area, the extensive levee system, constructed waterways (the Contra Costa Canal and Stockton Deep Water Channel), water development facilities, groundwater development, and railroads enabled irrigated agriculture and urban communities to extend deeper into the Delta. Between 1920 and 1950, irrigated agriculture development increased rapidly from 2.7 to over 4.7 million acres for the entire Central Valley. During the same period, urban land use also expanded. Private water development projects by cities and utility districts assisted in the expansion of urban development throughout California.

Approximately 71,000 acres of the Delta are developed for urban uses, with most of the development located on the periphery of the Delta in Sacramento, San Joaquin, and Contra Costa Counties. The majority of urban development is located in the legal Delta, with less than 1,800 acres of developed land in the Suisun Marsh and Bay Area. Urban development includes residential, commercial, industrial, and other urban uses.

Much of the urban development in the study area is located in the incorporated cities (Antioch, Brentwood, Isleton, Pittsburg, Rio Vista, and Tracy are located entirely within the Delta; and Sacramento, Stockton, and West Sacramento are located partially within the legal Delta) and the 14 unincorporated communities within the legal Delta (Discovery Bay, Oakley, Bethel, Courtland, Freeport, Hood, Ryde, Walnut Grove, Byron, Terminous, Thornton, Hastings Tract, and Clarksburg).

Flood Control Facilities. The flood control facilities that currently protect the Delta Region include the following elements:

- Delta levees
- Delta Cross Channel (DCC) Control Gates
- Yolo Bypass

Flooding of reclaimed Delta lands was a frequent result of levee erosion and overtopping during high-flow events. Since construction of the CVP and SWP, the frequency of levee failure due to overtopping from flood flows has decreased. Delta levees still fail, but the most frequent cause is either seepage, resulting in piping and stability failures, or overtopping due to high tides and high winds.

With the advent of the large state and federal water projects that allow more control over flood flows, flooding generally has been restricted to inundation of individual islands or tracts resulting from levee instability or overtopping. Since 1950, the construction of upstream dams has allowed dam and reservoir managers to detain flows. This management ability and control of flood waters have further reduced the threat of overtopping. Between 1950 and 1986, 60% of levee failures have been due to mass instability, commonly caused by a combination of seepage and historical subsidence, and 40% has been due to overtopping.

The Delta levee system initially served to control island flooding during periods of high flow. Because of island reclamation and subsidence due to peat oxidation, however, it is now necessary for the levee system to prevent inundation during normal runoff and tidal cycles. About 1,100 miles of levees in the Delta provide flood protection to the 76 islands and tracts located there. Figures 7.8-1a and 7.8-1b show the general locations of the federal project levees and local non-project levees in the Delta.

The major factors influencing Delta water stage include high flows, high tide, and wind. Historically, the highest water stages usually have occurred from December through February, when high runoff combines with high tides, low barometric pressure, and wind-generated waves. Flood stage elevation of rivers and channels surrounding the Delta islands generally range from 6.5 to 7.5 feet above mean sea level (msl) in the west and central Delta, where the most tidal influence is present. However, the 100-year flood stage ranges from 14.0 to 17.0 feet above msl in the north Delta (near New Hope Tract and Courtland, respectively) and in the south Delta (near Stewart Tract on the Old and Middle River channels), where the stream flows become dominant during large floods. These flood stage ranges (from 6.5 to 17.0 feet above msl) emphasize the importance of maintaining levees to varying heights and strengths throughout the Delta to protect against flooding where channel geometry and flow conditions can cause rapid stage increases during storms.

The DCC control gates are closed during high flows and floods on the Sacramento River. During floods, when stages on the Sacramento River exceed those on Mokelumne River channels, the gates prevent water from spilling out of the Sacramento River into the Mokelumne River and flooding leveed and non-leveed lands. If storms hit central California while the river stages are lower on the Sacramento River, the DCC

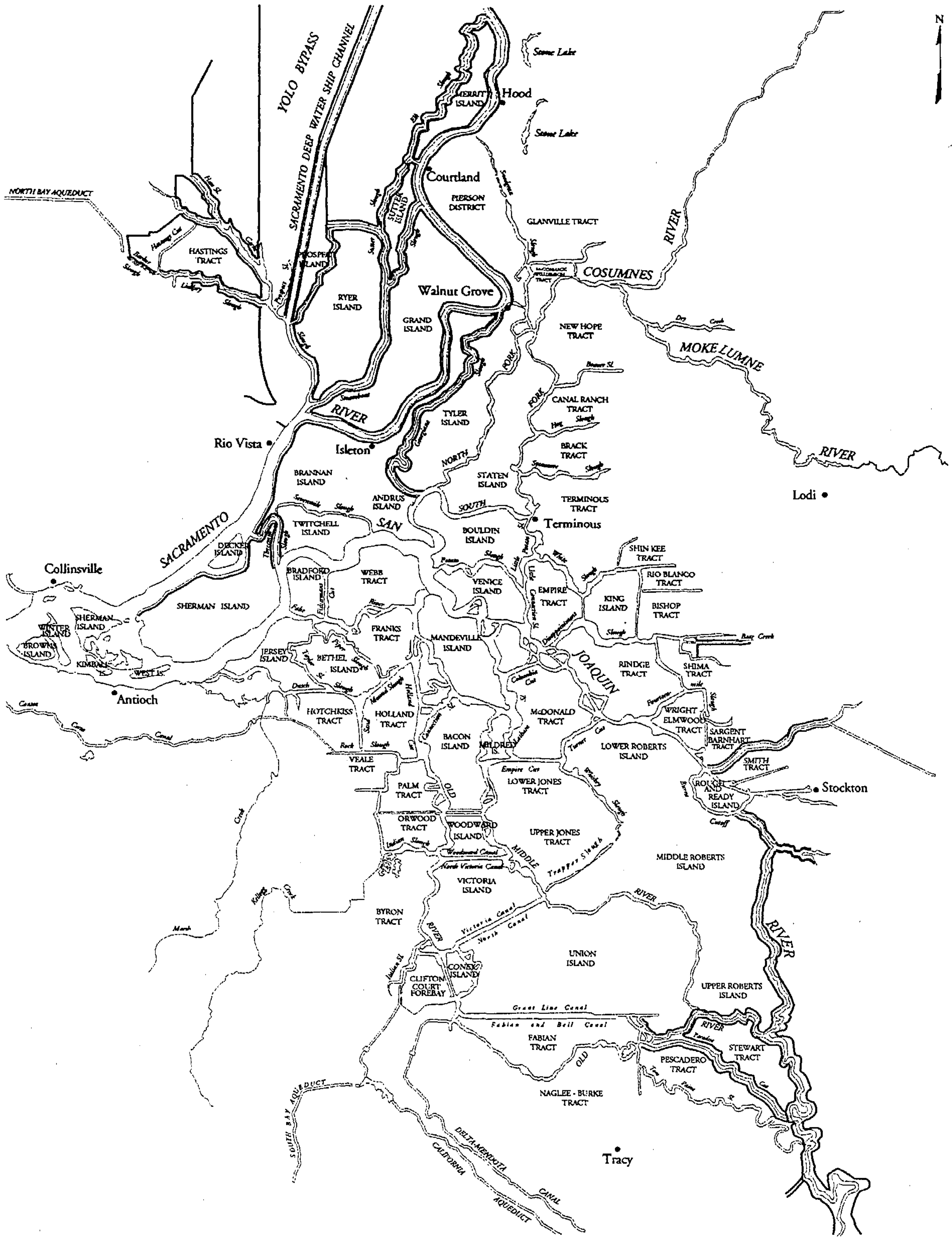


Figure 7.8-1a. Federal Flood Control Project Levees

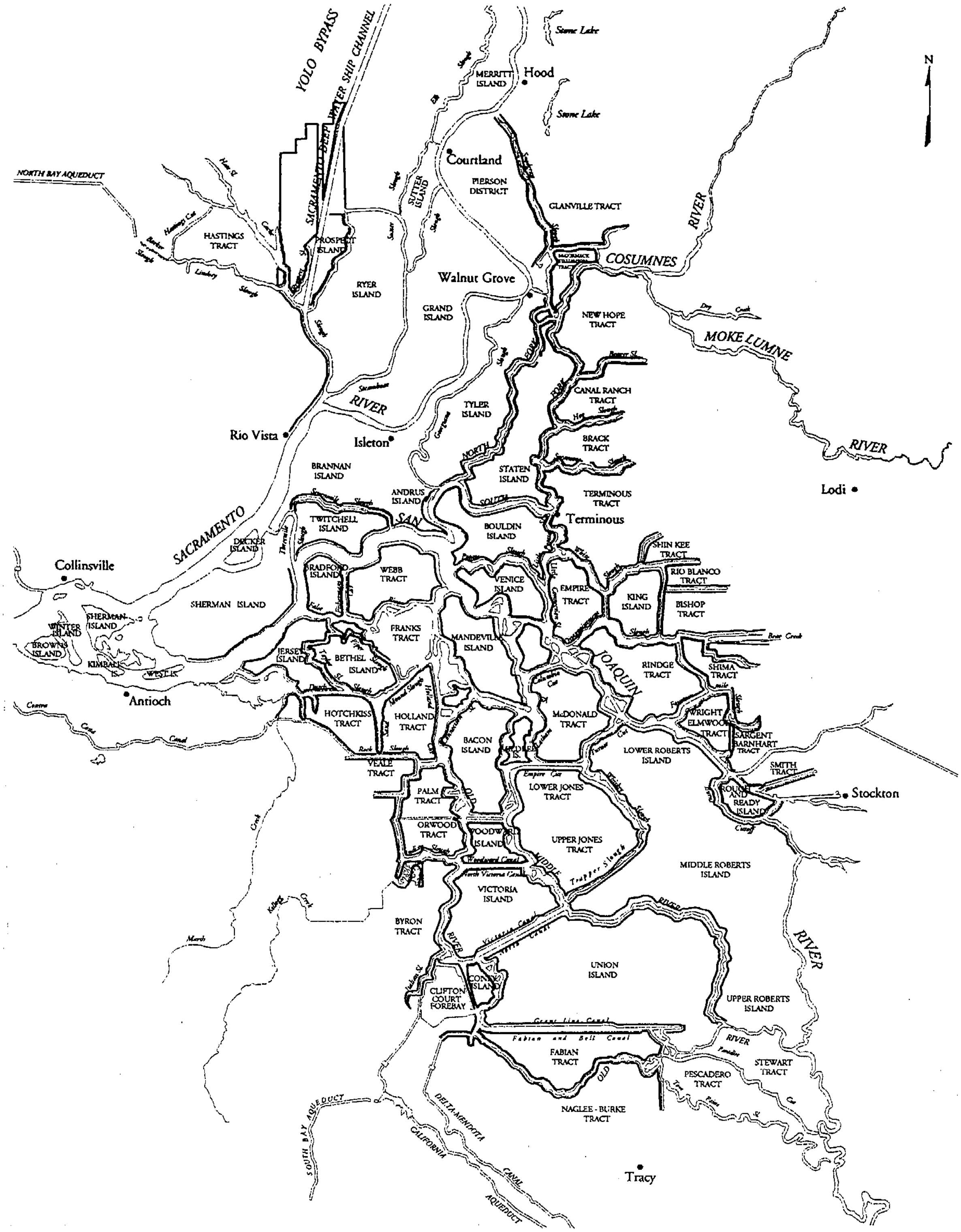


Figure 7.8-1b. Local Non-Project Levees in the Delta

gates can be opened to spill high flows out of the Mokelumne River system and reduce stages on the north and south forks of the Mokelumne River. This transfers flood water from the non-project levees of the Mokelumne River to the Sacramento River, which is protected with project levees. The SRFCP keeps the Sacramento River from flooding the Delta.

Unlike the system of reservoirs and weirs that control the magnitude of flooding on the rivers upstream of the Delta, the flood control system in the Delta (aside from the DCC control gates) operates passively. However, the levee system does require maintenance, monitoring, and improvement, particularly during floods, to maximize the level of protection provided by the levee system.

Levee Stability. The stability of a levee depends on the strength of its foundation materials and its internal strength. If used in the proper proportions and engineered correctly, sands, silts, and clays can be used to build stable levees. High percentages of sands or peat within or beneath a levee, however, can weaken its stability. East Delta levees generally are supported by foundation materials composed of clay, silt, and sand; but some central and west Delta levees primarily rest on peat with some alluvial clay, bay mud, sand, and silt layers. While inorganic materials (sands, silts, and clays) provide adequate foundations, uncompressed peat is highly deformable and unstable.

Of the Delta lowlands, approximately 380,000 acres primarily consist of peat soil. When exposed to air, the peat oxidizes and decomposes, resulting in land subsidence. Cultivation accelerates the oxidation of peat soils. Land subsidence adjacent to the levees is a problem in the Delta because it could jeopardize the stability of the levees, which in turn, could cause flooding.

Table 7.8-1. Historical Floods in the Sacramento-San Joaquin Delta, 1900 to 1982

YEAR	ACRES INUNDATED (1,000)
1900	12.9
1901	20.8
1902	14.7
1904	75.9
1906	63.1
1907	114.7
1908	12.4
1909	43.5
1911	9.2
1925	11.8
1926	3.4
1927	2.2
1928	8.9
1932	3.0
1936	5.1
1937	3.0
1938	19.0
1950	20.9
1955	11.5
1958	11.2
1969	10.9
1972	13.0
1980	15.7
1982	9.4

Sources:
Data for 1900 to 1958, Association of State Water Project Agencies 1976.
Data for 1969 to 1982, DWR 1984.

Levees can fail by three often interrelated mechanisms: overtopping, seepage and piping, and instability. Several other factors can damage levees and eventually lead to levee failure. These include erosion, seismic movements, burrowing from small mammals, wind and wave action, and dead or decaying roots from levee vegetation (living vegetation also can provide some protection against levee erosion by reducing wave and wind action). From 1950 to 1986, fifteen stability-failure floods and eight overtopping floods occurred in the region.

The Delta is subject to seismic activity from several faults. The San Andreas Fault system has the greatest potential to affect Delta seismicity. The Hayward Fault is closer to the Delta and has the second highest potential to affect Delta seismicity, with perhaps a slightly decreased level of shaking than could result from the San Andreas Fault. Other faults, including the Healdsburg-Rogers Creek Fault, Maacama Fault, Coast Range Sierra Nevada Boundary Zone, and Green Valley-Cordelia and Concord Faults, could affect Delta seismicity to a much lesser level of shaking and duration.

Since reclamation, each of the 70 major islands or tracts have flooded at least once (as shown in Table 7.8-1). About 100 failures have occurred since the early 1900s. Except for Big Break, Little Franks, Franks, and Little Holland Tracts and

Little Mandeville, Lower Sherman, and Mildred Islands, flooded islands historically have been restored even when the cost of repairs exceeded the appraised value of the land.

Levee Maintenance. Costs of maintaining and repairing the levee system in the Delta are substantial. The average annual cost of levee maintenance on non-project levees in the Delta ranged from $3,000 to $165,000 per levee mile, averaging $11,800 per levee mile between 1981 and 1991. From 1981 to 1991, $63 million was spent to repair levees. Beginning in 1988, state cost-sharing authorization was increased to 75% of costs exceeding $1,000 per mile under the Delta Flood Protection Act of 1988. The act provided $60 million over 10 years to control subsidence and rehabilitate levees on eight west Delta islands and an additional $60 million for Delta-wide levee maintenance and upgrades.

Emergency expenditures by federal and state governments under the Federal Emergency Management Act (FEMA) and the Natural Disaster Assistance Act, respectively, from 1980 to 1986 was $137.3 million ($65 million FEMA, $26.5 million Natural Disaster Assistance Act, and $45.8 million by local sponsors). The cost per island acre of these repairs ranged from less than $410 to $4,000. Additionally, the Corps has spent up to $120 million in 1997 under their PL 84-99 flood fight and rehabilitation authority.

Although flooded islands can be drained by pumping flood waters from the island after the levees are closed and reinforced, the cost can be substantial. According to DWR estimates, the total emergency cost resulting from levee failures was $97 million between 1980 and 1986. (This cost was part of the total FEMA and Natural Disaster Assistance Act costs.) In addition, Delta levee maintenance program expenditures were estimated at $64 million between 1981 and 1991.

7.8.3.2 BAY REGION

The land in the Bay Region historically has suffered little from flooding emanating from the Sacramento-San Joaquin River system. Extensive local flooding has occurred in the Bay Region; however, this flooding has been a result of waters emanating from sources other than the Delta.

Bay water is usually saline to brackish, making reclamation of the surrounding marshlands unattractive for agricultural purposes. The Suisun Marsh, located in the Bay Region, is an example of a brackish tidal marsh that was partially converted for agricultural purposes. Thus, improvements to control flooding have been minimal and now are directed mainly toward ecological habitat creation and preservation.

The broad, deep channels and large bays present downstream from the Suisun Marsh have not demonstrated significant variability in water level beyond that which occurs as a result of natural tidal fluctuations (except for sea level rise). Historical records indicate that the sea level has the potential to affect long-term flooding, water quality, and water management in the Delta. Potential sea level changes associated with climate change are discussed in Chapter 8, "Compliance with Applicable Laws, Policies, and Plans and Regulatory Framework."

The upper watersheds of the San Francisco Bay Region are characterized by small, steeply sloping watersheds, and rapid runoff. The eastern slopes of the coastal hills once contained redwood forests that were largely logged off by the end of the nineteenth century. Most of the urban development and road building in upland areas has occurred since World War II.

Average annual precipitation in the upper watershed areas ranges from 25 to 50 inches. Average annual runoff ranges from 10 to 20 inches. Flooding generally is confined to reclaimed marshland along the Bay margin and occurs when high-runoff conditions are combined with high tides in the Bay. Besides direct flooding, flood-related problems include insufficient capacity of some municipal wastewater treatment plants that must discharge to the Bay.

No significant flood control resources are at work in the Bay Region to control floods emanating from the Delta. The Suisun Marsh Salinity control gates project was implemented in 1988. The gate system works primarily to protect the marsh from the saline waters of the Bay during periods of low Delta outflows. The Suisun Marsh salinity control gates do not play a specific role in flood control but are part of the affected environment that should be considered during Program solution evaluation.

7.8.3.3 SACRAMENTO RIVER REGION

Overview of Flood Control Development. The bottomlands of the Sacramento River Region consisted of tule marshlands prior to the Gold Rush of the mid-nineteenth century. Before the beginning of agricultural development in the Sacramento Valley, large portions of the valley were subject to periodic inundation by flood flows from the Sacramento River and its tributaries. The floodplain varied in width from 2 to 30 miles.

Individual landowners began flood control system development in the mid-1800s, when the Gold Rush increased demands for food. By 1884, many miles of levees had been completed, and some areas had formed flood protection districts. These first levees were constructed by hand and were demonstratively inadequate, based on the damage that occurred during high-flow periods.

This damage was exacerbated by hydraulic mining in the mountains. The mining activities resulted in large volumes of silt, sand, and gravel being deposited into the rivers of the Sacramento Basin. These sediments were deposited in the channels and increased the flood stages associated with high-flow events by reducing channel capacity.

Federal flood control activities were initiated in 1917 when Congress authorized the SRFCP. This project consisted of a comprehensive system of levees, overflow weirs, outfall gates, pumping plants, leveed bypass floodways, overland floodway areas, enlarged and improved channels, and dredging in the lower reach of the Sacramento River. The effectiveness of the SRFCP was increased by the completion of multi-purpose reservoirs that provide flood control storage. The reduction of the flood hazard has encouraged extensive development in the protected areas and has prevented billions of dollars in flood damage since project completion.

Flood Control Facilities. Multi-purpose reservoirs and a system of weirs and bypasses contribute to the flood control system in the Sacramento Basin by storing or diverting water during periods of high runoff, thereby reducing the ultimate load placed on the levee system during floods. Levees also provide flood control in the region.

Stability issues affecting the project levees in the Sacramento River Region include settlement, erosion, and seepage. These issues are the same as those described for the Delta Region; additional detail may be found in the Flood Control Technical Report.

Although non-project levees are present in the Sacramento River Region, these levees do not substantially affect the overall level of flood protection.

Major reservoirs that provide flood protection to the Sacramento River Region are:

- Folsom Lake
- Lake Oroville
- Shasta Lake

Other important reservoirs include:

- Black Butte Reservoir
- Camp Far West Reservoir
- Union Valley Reservoir
- French Meadows Reservoir
- Clear Lake
- East Park Reservoir
- Englebright Reservoir
- Lake Almanor
- New Bullards Bar Reservoir
- Rollins Reservoir
- Stony Gorge Reservoir
- Whiskeytown Reservoir
- Berryessa Reservoir

The reservoirs were constructed and are maintained by state, federal, and local agencies that cooperate in their funding, administration, operation, and maintenance.

A system of weirs and bypasses was constructed by the Corps on the Sacramento River. The system includes five bypasses: the Butte Basin, Sutter Bypass, Yolo Bypass, Tisdale Bypass, and Sacramento Bypass. Moulton and Colusa Weirs feed flood waters into the Butte Basin Bypass, Tisdale Weir flows into Sutter Bypass, and Fremont Weir and Sacramento Bypass flow into the Yolo Bypass.

The Yolo Bypass carries five-sixths of the volume of the Sacramento River at peak flood flows. The lower end of the bypass is in the Delta and provides significant spawning habitat for Delta smelt.

The bypasses are large tracts of undeveloped or minimally developed land. Development within the bypasses typically is limited to agricultural activities that require minimal infrastructure. Water released to the bypass system flows south into the Delta, in effect creating a short-term storage system for the flood waters. Additionally, a significant volume of the water released to the bypass system infiltrates into the ground, recharging groundwater supplies, although this volume is small compared to the total volume of a flood.

When a flood occurs, reservoirs can restrain the high-volume flows and store water for later release back into the river. The system allows flood waters to be transported downstream in a controlled manner starting days before and continuing until weeks after a flood.

By varying the amount of water kept in reservoirs during different times of the year, the system can be modified to maximize flood control capabilities during the early part of the flood season and to maximize water storage later as the flood risk abates. The water stored in the reservoirs can be used to maintain fisheries flows during dry periods and supply power to municipalities and industries.

When flooding occurs, the weir and bypass system diverts water to protect the levee system and frees flood storage capacity in the reservoirs. The weir system works by diverting flood waters in the leveed rivers into the bypasses.

Upper Watershed Areas. In the upper watersheds of the Sacramento River Region, fire historically has been the principal mechanism by which nutrients in forest material were recycled. However, since the late 1800s, the frequency of fires has been reduced in the upper watershed, with the effect that less frequent fires burn larger areas with higher intensity and greater environmental damage. Catastrophic wildfires produce more intensive and extensive changes in watershed conditions that any other form of disturbance. As a consequence of fire suppression and logging practices during the last century, the character of forests has changed dramatically, and there has been a large increase in dead wood fuels near the forest floor. Severe fires accelerate runoff from the watershed by reducing organic matter in soil and forming impervious soil layers.

Improper location and construction of roads and culverts may be the most significant cause of accelerated erosion in western montane forests.

Past grazing policies also may have affected land in the Sierra Nevada. Loss of streamside vegetation from grazing has promoted soil compaction and erosion. Removal of riparian vegetation by livestock in headwater valleys of the North Fork Feather River, for example, has led to rapid channel widening and massive sediment loads.

Rapid runoff due to poor timber and grazing practices, combined with increased urban development, has increased the local flood hazard and exposure in some upper watershed areas. Accelerated erosion increases the rate of reservoir sedimentation, reducing reservoir capacities available for flood control downstream.

7.8.3.4 San Joaquin River Region

Work on flood control projects in the San Joaquin River Region began early in the twentieth century. Improvements have included the construction of levees and bypasses, maintenance or improvement of stream channels, and completion of a system of reservoirs. These projects have been completed primarily to provide flood control and to augment agricultural opportunities.

The flood control resources currently employed in the San Joaquin River Region include levees, reservoirs, weirs, and bypasses.

Stability issues affecting the project levees in the San Joaquin River basin include settlement, erosion, and seepage. One major issue for the San Joaquin River system is inadequate flood carriage capacity. On many of the tributaries, such as the Stanislaus River, non-project levees are very important for the flood system.

Reconnaissance studies conducted by the Corps on levees on both banks of the San Joaquin River, from Friant Dam downstream to Old River, Mariposa Bypass, Eastside Bypass, and Chowchilla Bypass, indicated that materials used to construct levees on the San Joaquin River mainstem generally range from clay to silty sand. Evaluations of levee reaches ranged from "fair" to "acceptable and well maintained" to "good." Overall, the flood control project features were summarized as "adequate." The primary problem is a lack of maintenance. Local bank protection is needed. Setback levees in some reaches may be needed in the future. Because the levees were inspected during relatively low summer water levels, seepage conditions could not be fully evaluated.

Major reservoirs that protect the San Joaquin River Basin from floods include:

- Hensley Lake
- H. V. Eastman Lake
- New Exchequer Reservoir
- New Melones Lake
- Friant Reservoir
- Terminus Reservoir
- Success Reservoir
- Pine Flat Lake
- New Don Pedro Lake

A system of weirs and bypasses has been established on the San Joaquin River system. The system includes three bypasses (the Mariposa, Eastside, and Chowchilla Bypasses) fed by weirs. The San Joaquin River bypass system operates similarly to the Sacramento River bypass system during flood events.

The levee and reservoir system in the San Joaquin River basin is operated to control floods with the same methods described for the Sacramento River Region. Historically, the San Joaquin Valley basin has been subject to floods occurring during late fall and winter, primarily as a result of prolonged rainstorms; and to floods occurring during spring and early summer months, primarily as a result of unseasonable and rapid melting of the winter snowpack in the Sierra Nevada.

7.8.3.5 Other SWP and CVP Service Areas

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

No Program alternative includes actions that would significantly affect flood control resources in the Other SWP and CVP Service Areas. If new storage or conveyance facilities are constructed under the Program alternatives, their operations would be integrated with current flood control operations criteria for existing facilities in the region. No further discussion of this region is included in this section.

7.8.4 ASSESSMENT METHODS

The discussion of assessment methods is separated into three sections: flood management operations, levee system, and flood control economics. The flood management operations discussion focuses on the flood control system's ability to handle flood flows under the project alternatives from a conveyance and storage perspective. The analysis of the levee system focuses on the system's ability to handle the flood flows from a structural perspective. The economics of flood control compares flood control benefits with flood control costs.

For those Program actions that generally involve north Delta modifications, the North Delta Program Draft EIR/EIS was reviewed. Flows and elevations from the 1984 flood and a predicted 100-year flood were analyzed. For the south Delta modifications, the Interim South Delta Program (ISDP) EIR/EIS was reviewed.

To provide an additional measure of the relative flood control importance of Program actions, data on large flood events in the Sacramento and San Joaquin Rivers were used. For the Sacramento River, daily flow data from the February 1986 flood were used. For the San Joaquin River, daily flow data from the floods of 1980, 1983, and 1997 were used. For each alternative, proposed additions to storage were compared to the measured flood flows for these large events. These comparisons then were used to determine whether the additional storage proposed for each alternative would substantially increase flood management capabilities relative to expected flood flows.

Simulated changes in conveyance capacity resulting from channel widening were analyzed using the Corps' HEC-RAS model. This model simulates water surface elevations for a given channel geometry and flow rate. Using this model, different channel configurations in the alternatives were compared to the base case to determine whether these configurations would significantly change conveyance capacity in the potentially affected channels.

Potential impacts on the levee system were assessed by literature reviews and interviews with geotechnical specialists to develop the existing conditions and No Action Alternative trends, and to identify potential impacts and mitigation strategies.

Flood control benefits are damages and losses avoided in the future that are expected as a result of the flood control project. Flood control costs are those necessary to implement and maintain the project under evaluation. Costs generally are well determined for specific flood control projects for which engineering design studies have been completed. Benefits, however, must be estimated because they depend on the improved performance of the levee to prevent future damages to agriculture (soils and crops) and buildings or facilities. The timing and severity of flood events also must be estimated to determine benefits.

Direct benefits include avoided damages to soils, ecosystem habitat, crops, buildings and their contents, and infrastructure; avoided functional losses, including building rent; avoided business income losses; avoided emergency response costs; avoided loss of life; and avoided loss of public and nonprofit services. Benefits are those expected future benefits that are estimated over the useful lifetime of the flood control project and discounted to present values.

Procedures for the economic assessment of flood control impacts include:

- An inventory and estimated values of land, crops, buildings, associated uses, and infrastructure.
- Estimates of the effectiveness of the project to reduce damages and functional losses.
- Estimates of the flood risk associated with the project.

Secondary economic benefits and costs also arise from flood control projects. Secondary economic effects result when local firms purchase production inputs and sell products to other firms in the region. Indicators of secondary benefits (and costs) are changes in related asset values, incomes, employment, tax revenues, the cost of providing public services, and population. Secondary economic benefits and costs can be calculated using existing data after the direct economic effects are estimated.

7.8.5 SIGNIFICANCE CRITERIA

The description of flood management system impacts is qualitative because of the general level of definition of the programmatic alternatives.

For this analysis, an impact on flood management system operations is considered significant if a Program action has the potential to:

- Substantially raise flood stage elevations
- Increase the frequency of flooding

An impact on flood management system operations is considered less than significant if a Program action would not:

- Substantially raise flood stage elevations
- Increase the frequency of flooding

An impact on the levee system is considered potentially significant if a Program action would substantially increase any of the following:

- Seepage
- Levee settlement
- Wind erosion
- Flood stage hazards
- Scour
- Sedimentation
- Subsidence adjacent to levees

In addition, an impact on the levee system is considered potentially significant if a Program action would substantially decrease any of the following:

- Levee stability
- Inspection, maintenance, or repair capabilities
- Levee slope protection

- Emergency response capabilities
- Channel capacity
- The ability of levees to withstand seismic loading

Economic criteria can be used to judge the significance of physical changes to the environment. Costs and expected benefits are described for each alternative and quantified where possible. Changes that exceed 10% in either costs of flood control or expected benefits are considered potentially significant (adverse and beneficial, respectively) for this analysis.

Values for the significant flood control parameters were projected for the No Action Alternative and the four proposed alternatives. These values then were used to develop the expected annual cost of levee failure and the annual cost of flood protection. The expected annual cost of levee failure is an indication of potential flood control benefits, assuming that the levee system is 100% effective to the design elevation. The annual cost of flood protection represents the level of effort with the assumption that levees would be effective to their designed level of effectiveness. An annual cost of $15 million is used. If the flood protection program was 100% effective, the benefit cost ratio for the program could be calculated by dividing the annual potential benefits by the annual cost.

7.8.6 NO ACTION ALTERNATIVE

7.8.6.1 DELTA REGION

Under the No Action Alternative, continued deterioration of the levees and diminished ability to handle flood flows are expected. As with other public infrastructure, funding is inadequate to eliminate the maintenance backlog. The inadequacy of funding is expected to continue.

The inability to compete for limited funding could cause some participants to delay or forego paying for levee repairs. As more participants delay repairs, more levees could deteriorate, resulting in decreases in overall levee system stability and integrity. It is likely that some Delta islands with less capital improvements would not be reclaimed if they became flooded due to levee failures, resulting in land use, lost habitat, and water quality resources.

Much of the immediately foreseeable levee improvement funding is expected to be spent for levee stability and habitat improvements to protect valuable economic, water quality, and habitat resources. Levees surrounding west Delta islands define major Delta channels in the area where fresh water and salt water mixes. Levee failure and island flooding could result in undesirable salt-water intrusion and other adverse water quality impacts.

In other locations, funding could be adequate to improve existing levees or to construct new ones. For example, levee assessments and funding may increase in areas where urbanization continues. Levees could be eligible for federal funds as part of cost sharing for post-flood assistance if they have been: (1) maintained to the PL 84-99 criteria requiring that levees be restored to the geometry and level of protection provided prior to a flood event, and (2) approved prior to a flood that has been declared a national disaster.

Physical processes cause gradual deterioration of levees and increased pressures on the levees. These processes include settlement, erosion from waves and current scour, burrowing from small mammals, internal levee and foundation erosion, and subsidence adjacent to the levee. All of these processes could lead to an increased risk of levee overtopping and stability failures, especially during flood events.

As levee deterioration continues under the No Action Alternative, the ability of the system to handle peak flows would be increasingly jeopardized. In addition, long-term settlement of levees due to ongoing consolidation or migration of foundation soils, especially peat, would reduce the levees' crest elevation. Scour and erosion could cause loss of levee material. If supporting material is lost at the base, or water-side "toe," of a levee slope, stability failures could result. Internal erosion, or piping, is frequently exacerbated by animal burrows and decaying tree roots, which also could lead to instability or overtopping. Deterioration of levee systems and subsidence would continue.

Delta dredging is limited to 45 days (from August 1 to September 15) by regulatory constraints and species considerations, making the Delta a limited source of dredged borrow material. Timing of future Delta dredging is expected to remain limited.

Coordinated habitat restoration efforts probably would continue. Senate Bill (SB) 1065, enacted in 1991 (California Water Code Sections 12306 and 12307), required habitat protection as part of levee maintenance work. SB 1065 directed future mitigation associated with levee maintenance to result in no net long-term loss of habitat. California Water Code Section 12987(d) requires DFG to make a written determination, as part of its review and approval of a plan or project, that program expenditures are consistent with a net long-term habitat improvement program and result in a net benefit for aquatic species in the Delta.

Urbanization pressures from the perimeter of the Delta Region could continue. Residents and users of new developments could accelerate levee deterioration through increased access, erosion induced by boat wakes, and vandalism (for example, unauthorized recreational driving on levee slopes and disturbance or removal of rock protection). As urbanization continues in and around the Delta, and near its tributary streams and rivers, runoff is expected to increase. Increased runoff could lead to increased river stage in the Delta.

The overall effect of the interim reoperation of Folsom Dam and Reservoir on the Delta flood control system is beneficial. Interim reoperation delays the timing of flood flows and consequently reduces the possibility that flood peaks from the American River watershed could reach the Delta. Interim reoperation of Folsom Dam and Reservoir could continue to require release of more water than usual in fall to create reservoir space for spring runoff from the American River watershed. The ability of Folsom Dam and Reservoir to detain a much greater volume of runoff than has been historically possible under traditional flood-curve operating criteria is important. During a flood, detention could allow flood managers to maintain safe flows on the American River through the city of Sacramento to its confluence with the Sacramento River. The reoperation, however, increases the risk of not filling Folsom Lake, reducing the available water supply.

Levee reconstruction along the Sacramento River and the Colusa Basin Drain as a part of the SRFCP could reduce the risk of flood stage hazards in the Delta Region. However, some accidental upstream levee failures have acted as beneficial safety valves by unintentionally causing the release of waters before they could have otherwise flooded the Delta. After these accidental upstream releases, the reduced flow volume in the Sacramento River channel resulted in lower flood stages and hazards in the Delta. Future flood risk hazards in the Delta therefore could increase if upstream levee repairs are made at these "safety valve" locations before repairs are made to downstream Delta levees.

Flood control projects implemented upstream of the Delta could result in hydraulic impacts on Delta levees.

The occurrence of the Loma Prieta Earthquake in 1989 has intensified concerns relating to the stability of levees in the Sacramento-San Joaquin Delta. Assessments of the susceptibility of Delta levees to damage from future earthquakes and an evaluation of the opportunity for that damage to occur are presented in the report "Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees," which is Appendix G of the Levee System Integrity Program Plan.

The real value of land, buildings, and related contents is estimated to increase by 25% in all use categories by 2020 (see Table 7.8-2). This increase is based on extrapolation of recent trends in land uses, including increased orchard and vineyard acreage and more intensive residential, commercial, and recreational uses. The value of habitat, wetland, open water, and annual expected flood losses also are projected to increase by 25%. The annual cost of flood prevention, which is measured in the State Subvention Program expenditures, is assumed to remain constant.

Under the No Action Alternative, land and property values in the Delta Region are expected to increase, but flood protection levels would slightly decline. The Delta Region may experience up to $400 million in annual losses to land and property from flooding. Ongoing programs would provide increased levels of flood protection in the Sacramento River and San Joaquin River Regions, but these regions also may contain an increased value of resources at risk of flooding.

It is likely that several levee failures would occur between now and 2020, and that some of these levees may not be repaired. This would reduce the value of property remaining to protect in 2020. In addition, when levees fail, adjacent islands are threatened due to increased wind fetch and seepage, which could lead to more levee failures.

7.8.6.2 Bay Region

Existing flood control resources and those associated with the No Action Alternative are, with few exceptions, located upstream of the Bay Region and would not affect flood control in the Bay Region.

7.8.6.3 Sacramento River and San Joaquin River Regions

The Sacramento River and San Joaquin River Regions include a large amount of flood-prone lands upstream of the statutory Delta on the Sacramento and San Joaquin Rivers and their tributaries. Assessments of flood control needs and potential actions currently are being conducted by the Corps. It is anticipated that some or many of these actions will be undertaken between now and 2020, but specific projects and their impacts on flood control economics have not been identified. Therefore, some improvement in flood control protection and reduction of risk in these regions is likely between now and 2020.

Table 7.8-2. Delta Region Existing and Future Values of Potentially Affected Resources for the No Action Alternative

FLOOD CONTROL ECONOMICS PARAMETER	EXISTING CONDITIONS		NO ACTION ALTERNATIVE	
	ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Residential land values	5k acres @ $20,000	$100,000,000	25%	$125,000,000
Commercial land values	2k acres @ $30,000	$6,000,000	25%	$7,500,000
Industrial land values	6k acres @ $10,000	$60,000,000	25%	$75,000,000
Irrigated land	465k acres @ $3,000	$1,395,000,000	25%	$1,743,750,000
Nonirrigated land	90k acres @ $1,000	$90,000,000	25%	$112,500,000
Residential building and contents values	5k acres @ $200,000	$1,000,000,000	25%	$1,250,000,000
Commercial building and contents values	2k acres @ $300,000	$600,000,000	25%	$750,000,000
Industrial building and contents values	6k acres @ $100,000	$600,000,000	25%	$750,000,000
Agricultural building and contents values	550k acres @ $750	$412,500,000	25%	$515,625,000
Infrastructure value	60k acres @ $100,000	$6,000,000,000	25%	$7,500,000,000
Native vegetation	35k acres @ $1,000	$35,000,000	0%	$35,000,000
Riparian and wetland vegetation	100k acres @ $3,000	$300,000,000	0%	$300,000,000
Open water	90k acres @ $3,000	$270,000,000	0%	$270,000,000
Expected annual cost of levee failure	3% * total value	$317,955,000	25%	$397,443,750
Annual cost of flood protection	Average state subvention costs in Delta	$10,000,000	0%	$10,000,000

Note:
k = thousand (,000).

Concurrently, the real value of resources susceptible to flood damage is expected to increase. Trends causing the increase include the long-term shift toward permanent and vegetable crops, continued residential and other urban development, and increased demand for recreational and environmental resources. Costs of flood protection also are expected to increase. Both regions contain a wide range of flood control resources including levees, weirs, bypasses, and reservoirs.

Current maintenance and repair policies are assumed to continue through 2020. With this assumption, the levees can be expected to perform adequately through 2020. The levees in the Sacramento River and San Joaquin River Regions are subjected to five forces that affect their performance: settlement, slope stability, overtopping, seepage, and erosion. In general, these forces can be handled through the currently authorized maintenance and emergency response mechanisms.

Weirs and bypasses are covered by federal and state agreements, and would continue to operate under the No Action Alternative as they do today. Likewise, the reservoirs are covered under a variety of federal, state, and cooperative agreements that ensure their effective operation through 2020.

7.8.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For flood control, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as discussed in Section 7.8.8.

7.8.7.1 ALL REGIONS

Most of the economic benefits of flood control are embodied in the provisions of the Ecosystem Restoration Program and in the Levee System Integrity Program, with the specific objective to improve all levees to PL 84-99 standards. Generally, the alternatives are projected to increase the acreage of native vegetation, riparian and wetland habitat, and open water at the expense of agricultural land. The values of commercial, industrial, and residential land are projected to increase slightly due to improved flood control effectiveness.

All alternatives are expected to increase the value of agricultural land due to better flood control.

7.8.7.2 DELTA REGION

Ecosystem Restoration Program

Reduced levee and berm vegetation management practices may result in significant and adverse long-term impacts on levee stability. Reduced pruning and clearing would allow more deep roots to penetrate levees and more dense vegetative canopies on levee surfaces. Dense vegetation could substantially reduce inspection capabilities by hiding rodent holes, cracks, or other potential causes of levee degradation. Thick understory vegetation also would limit access to levee side slopes, thereby reducing maintenance, repair, and emergency response capabilities.

Habitat restoration using conservation easements along riparian corridors could significantly and adversely reduce levee stability. Over time, deep-rooted and dense riparian trees and shrubs could increase the opportunity for roots to penetrate levees. Increased cracking and fissures could allow water to enter the levee interior, resulting in reduced structural stability. Small cracks, fissures, and root voids also could allow increased seepage beneath the levee, which could increase levee instability.

Shallow flooding of Delta islands susceptible to subsidence could significantly and adversely increase seepage on adjacent islands, and lead to substantial flooding from seepage-induced failure. The amount of seepage depends on soil permeability, seepage paths through the levee and its foundation, and the water stage.

Island flooding results in significant increases in wind-fetch and wave erosion on landside levee slopes. Waterside slopes also could experience significant erosion from increased wind-fetch and waves if the existing levees are not left intact. Erosion may be a gradual problem with impacts not detected until a significant amount of levee slope material has been removed.

Under the Ecosystem Restoration Program, the construction of new setback levees to increase the conveyance of selected Delta channels would have a beneficial impact on flood control.

The construction of overflow basins and conversion of levee lands to wetlands would reduce peak flood flows to areas downstream of the overflow basins. The sizes of the overflow basins have not yet been determined; therefore, the reduction in flood flows cannot be quantified. However, given the flood sizes that have occurred in the north Delta, the impacts on the flood control system are expected to be small or localized unless sufficient area is made available for flood storage.

Using setback levees, widening and providing floodplain areas along Delta channels would increase channel water conveyance capacity in new overflow basins or wetland areas, resulting in a beneficial impact on the flood control system. The relative impacts would be minor on large channels and greater on small channels.

Increased density of shallow-rooted grasses and vegetation could beneficially increase erosion protection on levee side slopes. Shallow roots protect levees against erosion by binding soil particles.

Establishing and enforcing no-wake boating zones would beneficially affect the flood control system by reducing wave run-up and erosion.

Restoration of shallow-water habitat would result in beneficial long-term impacts on Delta levee stability. Flooding islands with elevations below sea level would reduce the oxidation rates of peat soils, which would reduce settlement and related flood-stage hazard risks.

Urban and industrial runoff control measures could provide slight flood control benefits. Design of storm drainage systems targeting maximum stormwater infiltration or stormwater sedimentation facilities would beneficially affect the Delta flood control system. Increased detention and infiltration would reduce the volume of surface flooding. Although stormwater basins would not detain substantial volumes of flood waters, their storage function could slightly reduce local flood-stage hazard risks.

Mitigation is available to reduce all potentially significant adverse impacts on flood control associated with the Ecosystem Restoration Program in the Delta Region to a less-than-significant level.

Water Quality Program

No adverse effects on flood control in the Delta Region are anticipated from Water Quality Program actions. A slight local flood control benefit could occur from reductions in urban and industrial runoff.

Levee System Integrity Program

Raising levee heights, widening levee crowns, flattening levee slopes, and constructing stability berms as part of the Delta Levee Base-Level Protection and Special Improvement Plans would improve Delta levee system stability. When levees meet PL 84-99 criteria, they may qualify for post-flood federal funding assistance.

Providing slope protection, relocating irrigation ditches, and installing drainage systems or slurry cut-off walls as part of the Delta Levee Base-Level Protection Plan would improve Delta levees by reducing erosion and seepage. Implementing these actions in compliance with uniform levee maintenance criteria and uniform guidelines for habitat enhancement and protection would reduce degradation of the levee system and prevent long-term habitat loss.

Improving channel configurations for flood flows, constructing cut-off levees, and creating bypass systems consistent with Delta levee special improvement projects would benefit system flood conveyance capacity by allowing flood inflows to safely pass into the Delta. Improved flood flow conveyance capacity into the Delta would reduce the incidence of instability and overtopping failures in the north Delta.

Purchasing conservation easements adjacent to levees and reducing the intensity of agricultural practices near landside levee slopes as part of the Delta Island Subsidence Control Plan would improve levee stability by reducing subsidence. Easements and less-intense agricultural practices, as nonstructural improvements to the flood control system, would not adversely affect ecosystem restoration activities.

Preparing updated flood risk assessments and arranging for advance equipment contracts, participation agreements, and levee repair materials as part of the Delta Levee Emergency Management Plan would improve flood control system integrity by reducing levees' vulnerability to catastrophic failure. Improved emergency preparedness through multi-agency participation would minimize the extent and severity of flood damage and thereby reduce post-disaster recovery funding needed from FEMA and other disaster-relief agencies.

Preparing updated seismic risk assessments and ground motion mapping, and performing dynamic testing of levee material properties and levee stability analysis would improve the understanding of Delta levee performance during an earthquake. This improved understanding would allow preliminary identification of the locations where levees may be most susceptible to earthquake damage, which could guide future cost-effective expenditure of funds used for strengthening those levees most susceptible to failure during an earthquake.

Special levee stabilization projects based on island resources could beneficially affect the Delta flood control system. Habitat improvement and levee stabilization projects could be implemented according to their potential to improve Delta water quality, agricultural production, life and personal property, recreation, cultural resources, ecosystem, infrastructure, and adjacent island functions and values. These projects could improve levee stability, increase freeboard, and reduce scour and seepage potential at important locations throughout the Delta Region. Existing levees could be rehabilitated and set back in some locations to make these improvements.

Other than in the Bay Region, the Levee System Integrity Program is not addressed under the region-specific discussions that follow.

Water Use Efficiency Program

No actions in the Water Use Efficiency Program would significantly affect the flood control system in the Delta Region.

Water Transfer Program

Generally, the actions in the Water Transfer Program would not substantially affect the flood control system in the Delta. A specific water transfer could result in beneficial or adverse impacts on flood control, depending on the source of water for the transfer and the timing, magnitude, and pathway of each transfer. If a transfer involves releasing water from a reservoir during summer, additional space to store inflow and reduce the threat of downstream flood flows may result.

Watershed Program

No adverse impacts on flood control are anticipated in the Delta Region from Watershed Program actions. Local flood control resources could benefit from Program actions that restore water retention features of watersheds, such as revegetation and runoff control. Some benefits could be substantial, such as sediment reduction and increased storage capacity.

Storage

For actions involving increased storage, new water storage reservoirs may provide flood control benefits downstream if space is dedicated for flood control; and some benefits may occur even without dedicated space. If reservoirs are located offstream in small watersheds, flood control benefits would be relatively small.

Additional surface storage in the Sacramento or San Joaquin Valleys could benefit flood control in the Delta. Groundwater and off-aqueduct storage would not significantly capture and attenuate substantial stormwater runoff flows and therefore would not affect flood flows.

A dam failure could result in severe flooding. Dams would meet all standards and requirements set by the state's Division of Safety of Dams. Storage projects would be designed, constructed, and operated to reduce the potential impact associated with dam failure to a less-than-significant level.

In-Delta storage on the example islands listed in Chapter 4 would provide minimal, if any, flood control benefits because these islands are within the tidal zone of the Delta. In-Delta storage would be more likely to provide flood control benefits on islands closer to the mainstem Sacramento, San Joaquin, or Mokelumne Rivers, where filling a storage island during flood flows could reduce the local water levels and therefore relieve stress on neighboring levees.

In-Delta storage may increase seepage on adjacent islands. In turn, this seepage may lead to piping and the loss of levee material, which could lead to levee instability on these adjacent islands. Seepage should be monitored on adjacent islands before and after flooding an island for in-Delta storage. The potential effect of increased seepage on levee stability can be offset by several remedial measures. These seepage control measures could include installing relief wells near the toes of existing levees on neighboring islands, constructing toe berms with an internal drainage system on neighboring islands, lowering the pool elevation on the storage island, developing wetland easements adjacent to levees on neighboring islands, constructing a combination of seep and interior ditches and increasing pumping rates, installing clay blankets, and installing impervious cutoff walls through storage island levees.

Construction of roads, structures, or other facilities in stream channels could result in increased potential for downstream flooding, if the construction activity reduces the carrying capacity of the channel and does not provide an adequate mechanism for controlled release of resulting impounded water. Construction designs routinely include flow diversion and control structures at dams and stream crossings to avoid the potential for uncontrolled releases. Therefore, this impact is considered less than significant.

7.8.7.3 BAY REGION

Ecosystem Restoration and Levee System Integrity Programs

No potentially significant impacts are associated with the Ecosystem Restoration and Levee System Integrity Programs in the Bay Region, including the Suisun Marsh. However, the Ecosystem Restoration Program includes several actions that would modify flows in the Bay Region, including the establishment of shallow-water habitat, open-water habitat, tidal sloughs, seasonal wetlands, and riparian and shaded riverine habitat. The proposed modifications to flows under the Ecosystem Restoration Program are minor relative to the volume of water in the Bay Region.

In the Suisun Marsh, about 230 miles, or almost 95%, of the levees are non-project levees. Non-project levees are maintained by local reclamation districts, and maintenance is financed largely by landowners and cost shared by the State.

Maintaining a consistent levee standard in the Suisun Marsh would improve protection of private houses, roads, SWP infrastructure, and critical habitat from floods due to levee failure or over-topping. Levee modifications would protect these structures and resources as well as improve water quality conditions in the western Suisun Marsh.

Watershed Program

No adverse impacts on flood control are anticipated in the Bay Region from Watershed Program actions. Benefits to local flood control resources could occur from Program actions that restore water retention features of watersheds, such as revegetation and runoff control.

Water Quality, Water Use Efficiency, and Water Transfer Programs, and Storage

No actions in the Water Quality, Water Use Efficiency, and Water Transfer Programs or the Storage element relate to flood control in the Bay Region.

7.8.7.4 SACRAMENTO RIVER REGION

Ecosystem Restoration Program

Restoring the 50- and 100-year floodplains would provide positive flood control benefits. The level of benefit would depend on the existing flood conveyance capacities of the stream channels chosen for improvements. The protection of existing floodplains would provide no benefits over existing conditions. To the extent that future development is prevented in the floodplain, flood benefits would be positive.

Removing diversion structures and other obstructions to flow in the Sacramento River tributaries could increase the level of flooding downstream of these diversions. The level of increase would depend on which diversions and obstructions are removed and the total number of obstructions removed. The relative increase in flooding probably would be small for large flood events (for example, a 100-year flood) and relatively larger for small flood events (for example, a 10-year flood). The change in flood levels would depend on how much attenuation of flood flows the existing structures provide. Common flood management measures, such as dredging, levee maintenance, and snag removal would benefit flood control.

Vegetating stream banks could increase flood stages along streams due to increases in the roughness of the stream channel. On wide channels, the increase in roughness of the stream banks probably would result in only a minor impact on flood stage. On small streams, the increase could be significant. Vegetative banks, however, would provide stabilization, thereby benefitting flood control.

Mitigation is available to reduce all potentially significant impacts on flood control that are associated with Ecosystem Restoration Program actions in the Sacramento River Region to a less-than-significant level.

Water Quality and Water Transfer Programs

Effects of the Water Quality and Water Transfer Programs on flood control in the Sacramento River Region are the same as those described for the Delta Region.

Water Use Efficiency Program

Some actions under the Water Use Efficiency Program could affect flood control in the Sacramento River Region. Installation of on-farm efficiency improvements, such as drip and micro-irrigation systems, may require more frequent deliveries from surface water sources or may result in an increased reliance on groundwater. Even at reduced overall volumes, as farmers seek to increase their access to irrigation water, they may need to turn to groundwater pumping if surface water deliveries are unavailable. Increased groundwater pumping may lead to localized ground subsidence. Pumping and subsidence occurring near levees or other flood control facilities could cause settlement of the underlying substrate, resulting in levee slumping or cracking, or more significant damage. Mitigation is available to reduce potentially significant impacts to a less-than-significant level.

Construction and installation of on-farm water use efficiency improvements, including tailwater recovery ponds or pressurized irrigation systems, could beneficially affect the flood control system by reducing the volume of sediment transported to flood control channels. As sediment load in the receiving channel decreases, the conveyance capacity of the downstream channels is maintained. Further, a lower rate of sediment loading into these channels would require less dredging, thereby reducing flood control system maintenance costs.

Watershed Program

No adverse impacts are anticipated on flood control from Watershed Program actions in the Sacramento River Region. Benefits to local flood control resources could occur from Program actions that restore water retention features of watersheds, such as revegetation and runoff control.

Storage

Increased storage on Sacramento River tributaries could provide localized flood control. Because no decision has been made concerning whether additional storage would be allocated to flood control, the increased storage is considered unreliable as a flood control measure at this level of analysis.

7.8.7.5 SAN JOAQUIN RIVER REGION

Ecosystem Restoration Program

Reestablishing riparian habitat or preventing the removal of riparian vegetation would result in increasing the roughness of the stream channel and could increase flood stages. On wider channels, the increase in roughness of the stream banks probably would result in only a minor impact on flood stage. On smaller streams, the increase could be significant. Mitigation is available to reduce potentially significant impacts to a less-than-significant level.

Restoring the floodplains along the San Joaquin River south of Vernalis would provide flood control benefits. Presently, the probability of levee failures is high during large storm events in the San Joaquin River Region. By creating a large floodplain, flood stages would be lowered, thereby reducing the pressure on downstream levees. The level of additional protection provided by the floodplain would depend on the size of the floodplain and its location relative to the most vulnerable levees.

Water Quality Program

No adverse effects on flood control are anticipated from Water Quality Program actions. A slight local flood control benefit could occur from reduction in urban and industrial runoff.

Water Use Efficiency and Water Transfer Programs

Impacts on flood control associated with the Water Use Efficiency and Water Transfer Programs in the San Joaquin River Region would be similar to those described for the Sacramento River Region.

Watershed Program

No adverse impacts are anticipated on flood control from Watershed Program actions in the San Joaquin River Region. Benefits to local flood control resources could occur from Program actions that restore water retention features of watershed such as revegetation and runoff control.

Storage

Off-stream storage components could provide some flood control benefit, both by providing additional storage space for flow in the San Joaquin River or Delta and by providing protection to property downstream of the reservoir site. These potential impacts are expected to be minor because no decision has been made concerning whether additional storage would be allocated to flood control. However, the impacts could be important at a local, project-specific level.

7.8.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For flood control, the Conveyance element results in environmental consequences that differ among the alternatives, as described below. Under all Program alternatives, proposed north Delta improvements, levee setbacks, and island flooding may affect the economics of flood control by reducing the amount of agricultural land. The south Delta improvements should not affect the economics of flood control.

7.8.8.1 PREFERRED PROGRAM ALTERNATIVE

This section does not include a description of the consequences of a diversion facility on the Sacramento River because a diversion facility would not result in any impacts on flood control.

Delta Region

Improvements in conveyance through setback levees and dredging under the Preferred Program Alternative likely could result in significant localized reductions in the 100-year flood stages.

The Preferred Program Alternative could include several sets of setback levees. These setbacks could significantly increase the floodplain width and result in lower flood stages. Portions of levees could be removed to flood islands. In addition to increasing conveyance capacity, the levee setback removals would lower local water surface elevations and reduce peak flows. This effect likely would propagate a few miles upstream in the north Delta. Dredging to increase water conveyance capacity would result in similar effects to those associated with setback levees. Dredging to increase channel capacity possibly could result in increased channel velocity and erosion.

Levee setbacks and removals could result in two additional impacts. First, lower water surface elevations could result in a steeper hydraulic gradient and higher flow velocities immediately upstream of the levee removal location. The maximum increase in these velocities is expected to be on the order of 1-2 feet per second. Second, lower water surface elevations could change the flow distribution, possibly increasing the volume of water that discharges through adjacent channels.

Any island flooding associated with the Preferred Program Alternative could provide only limited flood control benefits, as peak flow rates would be reduced. Island flooding is not expected to significantly lower water surface elevations and, in some cases, would raise water surface elevations downstream of the flooded island.

Gate structures located in channels could reduce the channel's flood flow conveyance, resulting in increased stage upstream of the structures and possibly decreased stage downstream. The amount of increase (or decrease) would depend on the final design of the structures.

Channel enlargement could increase the channel's conveyance capacity, which could result in some localized reductions in flooding.

Changes in operations are not anticipated to adversely affect flood control in the Delta Region. Changes in operations generally would occur during the dry seasons when flood control is not an issue. Any changes in operations occurring during flood control periods, such as additional pumping to make up for water exports loss, are not expected to be significant because of the magnitude of flood flows in comparison to pumping rates.

Mitigation is available to reduce all potentially significant impacts on flood control in the Delta Region that are associated with the Conveyance element to a less-than-significant level.

Other Program Regions

Conveyance alternatives and changes in operations would not cause significant impacts on flood control in any of the remaining Program regions.

7.8.8.2 ALTERNATIVES 1, 2, AND 3

Most of the flood control benefits result from actions of the Levee System Integrity and Ecosystem Restoration Programs, which are common to all three alternatives and the Preferred Program Alternative. Therefore, differences in flood control impacts between the alternatives and the Preferred Program Alternative would be limited to site-specific setback levees and other Delta conveyance facilities.

Since the Preferred Program Alternative includes the potential widening of Delta channels in addition to Alternative 1 elements, the Preferred Program Alternative would result in a slightly more positive flood control impact than Alternative 1.

Because Alternative 2 includes widening Delta channels to increase channel water conveyance capacity more than the Preferred Program Alternative, Alternative 2 may result in slightly more positive flood control benefits than those of the Preferred Program Alternative or Alternative 1.

Under Alternative 3, an open-channel isolated facility from Hood or Freeport on the Sacramento River to CCFB would not significantly reduce flood flows. A larger isolated facility (15,000 cfs) could lower flood flows for small floods (10-year and smaller), but would not significantly affect large floods (100-year and larger). If the 100-year flood flows downstream of Hood or Freeport could be reduced by 15,000 cfs, they would be equivalent to about a 20-year event. This event still would be sufficiently large to cause considerable flooding. If an isolated facility were constructed to prevent flood flows into, over, under, or around it, the facility could act as a dam during similar flooding events. This could cause increased flooding east of the facility and lengthen the time needed for pooled water to drain after the flood wave passes.

7.8.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

The programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions are similar to those identified in Sections 7.8.7 and 7.8.8, which compare Program alternatives to the No Action Alternative. Additionally, the analysis indicates that an overall benefit on flood control would result when the Program alternatives are compared to existing conditions.

The comparison of Program alternatives to existing conditions is similar to the comparison of Program alternatives to the No Action Alternative because existing funding, physical trends, and environmental trends are expected to continue to affect the levee system under the No Action Alternative. Because levees will continue to deteriorate under the No Action Alternative, compared to their current status under existing conditions, the effects of the Program alternatives would result in a somewhat greater benefit. Adverse effects would be essentially the same when compared to either existing conditions or the No Action Alternative.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any potentially significant environmental consequences other than those identified in the comparison of Program alternatives to the No Action Alternative.

The following potentially significant impacts on flood control are associated with the Preferred Program Alternative:

- Impacts on levee stability from levee and berm vegetation management practices for habitat purposes.
- Reduced levee stability from habitat restoration using conservation easements along riparian corridors.
- Increased seepage on adjacent islands, possibly leading to flooding from seepage-induced failure from shallow flooding of Delta islands susceptible to subsidence.
- Increases in wind-fetch and wave erosion on landside levee slopes from island flooding.
- Increased levels of flooding downstream of diversions after removal of diversion structures and other obstructions to flow in the Sacramento River tributaries.
- Increased flood stages along streams due to increases in the roughness of the stream channel from vegetation stream banks.
- Potential localized subsidence, resulting in levee slumping or cracking if occurring near levees, caused by potential increases in groundwater pumping.
- Increased stage upstream of and possibly decreased stage downstream from gate structures located in channels that reduce the channel's flood flow conveyance.
- Adverse effects on water quality from the use of dredged materials.

No potentially significant unavoidable impacts on flood control are associated with the Preferred Program Alternative.

7.8.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For flood control resources, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This similarity is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.8.1 lists in summary form the potentially significant adverse long-term impacts. Section 7.8.1 also identifies mitigation strategies that can be used to avoid, reduce, or mitigate them. At the programmatic level, the analysis did not identify any impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level. Sections 7.8.7 and 7.8.8 elaborate on the long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on flood control resources in the Delta, Sacramento River, and San Joaquin River Regions: CVPIA actions not yet fully implemented, Delta Wetlands Project, Sacramento River Conservation Area Program, and urbanization. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.8.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The Preferred Program Alternative generally would maintain and enhance short-term and long-term productivity of flood control resources. Significant overall benefits to the short-term and long-term productivity of flood control result from Program actions. Benefits resulting from levee improvements and increased channel conveyance capacity outweigh the short-term adverse impacts.

Flood control would not be compromised, even in the short term, during construction of levee system improvements.

Short-term impacts would be related to construction and would cease when construction is complete. Avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on these resources.

Irreversible and Irretrievable Commitments. The Levee System Integrity Program under the Preferred Program Alternative can be considered to cause significant irreversible changes in flood control resources. Avoidance and mitigation measures can be implemented to lessen adverse effects, but changes will be experienced by future generations. The long-term beneficial irreversible changes include improvements in levees, channel conveyance capacity, and other flood control features. The Levee System Integrity Program will cause an irretrievable commitment of resources such as construction materials, labor, energy resources, fill material and land conversion.

7.8.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives, and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

Although the Program is expected to result in an overall substantial benefit to flood control resources, potentially significant adverse effects have been identified from the Ecosystem Restoration, Levee System Integrity, Water Use Efficiency, and Water Transfer Programs, and the Storage and Conveyance elements. The following mitigation strategies would mitigate these impacts to a less-than-significant level.

The following mitigation strategies could be used to reduce impacts associated with implementation of the Ecosystem Restoration Program:

- Allowing reasonable clearing of deep-rooted trees and shrubs from levee side slopes to support inspection, maintenance, repair, and emergency response, while preserving some habitat values.

- Permitting clearing of deep-rooted shrubs and trees on levee side slopes. Trees and shrubs should be allowed to grow only on adjacent berms. If roots penetrate levees, fill materials should be added to levee landside slopes in order to construct a partial setback levee and increase stability.

- Widening streams downstream of removed water diversion structures to increase conveyance capacity.

- Incorporating flood control criteria into the design of stream bank revegetation projects. For example, by increasing the width of vegetated sections to maintain conveyance capacity, the net effect of vegetation on flood control would be negligible.

The following mitigation strategies could be used to reduce impacts associated with flooding areas for habitat or water storage under the Ecosystem Restoration Program or Storage element:

- Identifying locations susceptible to seepage-induced failure on Delta islands that may be intentionally flooded for habitat.

- Implementing a seepage monitoring program on nonflooded islands adjacent to potential shallow-flooded islands.

- Developing seepage control performance standards to be used during island flooding and storage periods to determine net seepage caused by shallow flooding.

- Improving levees to withstand expected hydraulic stresses and seepage.

- Designing erosion protection measures to minimize or eliminate wave splash and run-up erosion.

- Using riprap or another suitable means of slope protection to dissipate wave force.

- Constructing large wind/wave breaks in the flooded islands to reduce wind-fetch and erosion potential.

The following mitigation strategy could be used to reduce impacts associated with the Levee System Integrity Program:

- Investigating the cost effectiveness and safety of using sediment traps as a source of borrow.

The following mitigation strategies could be used to reduce impacts associated with levee settlement due to localized groundwater-pumping-induced subsidence with the Water Use Efficiency and Water Transfer Programs:

- Identifying existing or planned wells that could affect groundwater and substrate conditions underlying nearby levees or flood control facilities.

- Providing incentives to terminate use of wells that can adversely affect levee stability, reducing their pumping volume to safe withdrawal levels as they affect substrate stability, or otherwise replacing them with sources that would not affect levee stability.

The following mitigation strategy could be used to reduce impacts associated with the Conveyance element:

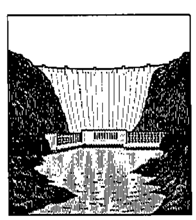
- Designing structures to minimize the loss of channel conveyance at gate structure located in channels.

7.8.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable impacts on flood control are expected in any Program region under the Preferred Program Alternative.

7.9 Power Production and Energy

The CALFED Bay-Delta Program would cause positive and negative effects on power and energy. Potentially significant environmental impacts associated with the Preferred Program Alternative can be avoided or reduced through mitigation measures.



7.9 Power Production and Energy

7.9.1 SUMMARY

CVP and SWP hydroelectric facilities are an important source of power in California. SWP power is used primarily to run the pumps that move state water to the farmlands and cities where it can be applied to economically beneficial uses, and to provide peak power to utility companies through exchange agreements. In addition to furnishing power to the pumping facilities located throughout the Central Valley and Delta Region, CVP power is an important source of electricity in many of California's communities, supplying the power needs of municipal utilities, irrigation districts, and institutions and facilities such as wildlife refuges, schools, prisons, and military bases. CVP electricity is marketed to these entities by the Western Area Power Administration (Western). Western customers have used this power for many years at Western's relatively low power rates. SWP long-term power contracts act as exchange agreements with utility companies supplying them with peak power. Except for surplus conditions in extremely wet years, all SWP power is used for peak power exchange arrangements and to operate pumping facilities. In most years, additional power is purchased by the SWP to meet pumping load power requirements. Both CVP and SWP sell power at rates designed to recover costs, which for CVP historically have been slightly below market rates. Revenue from Western power sales is an important funding source for the CVP Restoration Fund and for repaying project debt incurred building the CVP.

Preferred Program Alternative. Effects of the Preferred Program Alternative are expected to be both positive and negative. The overall effect of the Preferred Program Alternative on power production will depend on the degree to which storage is included in the Program; the water management criterion that is in effect; and the eventual allocation of impacts to specific CVP, SWP, or other resources. Anticipated effects are summarized below:

- Energy use would increase as each component of the CALFED Bay-Delta Program (Program) is constructed or implemented, and as Program elements are maintained. Many Program elements have an associated electric power load, such as a pumping load. To the extent such pumping load increases exceed the increases in project generation from Program actions which alter river or reservoir operations, the increased load will initiate a chain of events leading to additional generation from other sources. For the CVP, such net increases in pumping load will decrease the amount of energy available to sell to CVP preference power customers, requiring replacement from other, generally more expensive sources. Under present conditions these sources will typically be thermal in nature and will result in emissions and other impacts associated with the development and operation of thermal power plants.

- In general, energy use and related energy costs would decrease in areas where water conservation measures are implemented under the Water Use Efficiency Program. Exceptions include cases where agricultural water users switch from gravity-fed irrigation to sprinkler systems, and where water made available through conservation is then transferred by pumping to more remote locations.

- If storage facilities are enlarged under the Storage element, temporary and adverse reductions in available capacity and energy generation at existing hydroelectric facilities could result if such facilities are unable to generate during implementation of the Program. The Storage element also could cause a localized increase in energy use as new storage facilities are filled and perhaps a localized net increase in use if new pumped storage facilities are constructed.

- If storage facilities are developed, and water management Criterion B is assumed, CVP and SWP available capacity and generation would likely increase. However, the increase in CVP and SWP project energy use associated with the Program would be greater than the increase in power production. Therefore, the amount of power available for sale from the projects would be reduced, the amount of power the projects would need to purchase from the market would increase, and Western and/or DWR would likely increase their power rates.

- Pumping- and treatment-related energy use would increase in areas where water transfers occur.

- Long-term energy use in levee maintenance areas would decrease if the Levee System Integrity Program reduces the need for recurring maintenance of levees.

- Pumping- and treatment-related energy use would decline in areas where the Water Quality Program is implemented because of improvements in water quality. Energy use also could be reduced as land use practices that degrade water quality are changed.

- Changes in stream flows and operations caused by the Program could in turn cause beneficial or adverse effects at downstream or other hydrologically connected hydro-electric facilities that are not part of the CVP or SWP.

Alternatives 1, 2, and 3. Alternatives 1, 2, and 3 would cause the same types of effects as those summarized above for the Preferred Program Alternative.

7.9.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy related to power production and energy are identified.

Some controversial topics are listed below (these topics are addressed in Section 7.9.4):

- Issues regarding the level of detail used in the impact assessment and differentiating between CVP and SWP effects.

- Assessing peak-power effects versus average monthly effects.

The Program has no specific objectives for hydropower generation. However, the Program does seek to minimize negative effects on resources, such as hydropower generation, during and after implementation. The Program also seeks to minimize redirected impacts and to maintain linkage between the beneficiaries of actions and the costs of those actions. The Program may result in temporary or long-term changes in river and reservoir operations, which may affect the quantity, timing, and value of hydropower produced by the SWP and CVP. Additional pumping also may increase the amount of project energy use (power consumed by the CVP and SWP to move water through their systems). An increase in project energy use can reduce the amount of surplus hydropower that might otherwise be available for sale from the CVP (necessary to repay the CVP debt) and may increase the amount of power that must be purchased from outside sources to meet SWP project energy use. Under present economic conditions, fossil fuel or other thermal generation likely would be used to meet the increase in project energy use. Power from renewable resources (for example, wind or solar) would only be used if sufficient economic incentives are provided.

The Program is coordinating with Western to ensure that issues are identified and properly framed, so that consequences and options are clear to stakeholders, the public, and Program decision makers. In addition, reservoirs with hydroelectric power facilities present an opportunity for reoperation for multiple benefits. The Program is continuing to assess these opportunities in conjunction with the project owners to achieve Program objectives while endeavoring to maintain equitable cost and benefit linkages.

7.9.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Changes in power supplies and deliveries associated with the Program alternatives would be caused by Program-related actions and other system-wide factors occurring in many different regions throughout the study area. A system-wide analysis is necessary to accurately portray overall effects on power and energy.

7.9.3.1 ALL REGIONS

The Program alternatives primarily will affect the state's two largest water delivery systems, the CVP and SWP and their associated hydroelectric facilities. This section provides a brief overview of the existing conditions for each of the major power production and energy assessment variables.

SWP. Water deliveries from the SWP initially were provided in 1962 to Alameda and Santa Clara Counties through the South Bay Aqueduct. Power generation from SWP facilities first was realized in 1968 with the operation of the Hyatt-Thermalito facilities downstream of Lake Oroville. The primary purpose of the SWP power generation facilities is to meet energy requirements of the SWP pumping plants. To the extent possible, SWP pumping is scheduled during off-peak periods, and energy generation is scheduled during on-peak periods. DWR operates the SWP. Although the SWP uses more energy than it generates from its hydroelectric facilities, DWR has exchange agreements with other utility companies and has developed other power resources. When available, surplus power is sold by DWR to minimize the net cost of pumping energy. Excess power was first sold commercially in 1968.

CVP. CVP power generation facilities initially were developed based on the premise that power could be generated to meet project use loads. The Reclamation Act of 1939 provided for surplus power to be sold first to preference customers, including irrigation and reclamation districts, cooperatives, public utility districts, municipalities, and large educational or government facilities. Surplus commercial power may be sold to non-preference utility companies. The first commercial power generated by the CVP was sold in 1945.

In addition to comprising one of the state's largest water delivery systems, the CVP and SWP are part of an integrated electrical power system within California. All major electrical loads and generators within the state boundaries are synchronized to operate as a single cohesive system by the California Independent System Operator (ISO). In addition to the California ISO, there is a much broader system of electric generation and transmission that the CVP and SWP interact with called the Western Systems Coordinating Council (WSCC). These interactions with the WSCC could extend over the entire West Coast and inland to the desert regions of the Southwest.

Other Hydroelectric Facilities. In addition to CVP and SWP hydroelectric facilities, other hydroelectric facilities are present in the study area. Hydroelectric generation facilities in the study area are owned by investor-owned utility companies, such as PG&E and Southern California Edison (SCE); by municipal agencies, such as the Sacramento Municipal Utility District (SMUD); and by several water and irrigation districts. Some of the larger facilities outside the CVP and SWP systems include SCE's Big Creek System (approximately 790 megawatts [MW] of nameplate capacity) and Mammoth Pool Project (approximately 180 MW of nameplate capacity) in Fresno County; PG&E's Pit System (approximately 317 MW of nameplate capacity) and McCloud-Pit System (approximately 340 MW of nameplate capacity) in Shasta County; PG&E's Upper North Fork Feather River System (approximately 340 MW of nameplate capacity) in Plumas County; SMUD's Upper American River Project System (approximately 640 MW of nameplate capacity) in El Dorado County; Yuba County Water Agency's Yuba River Project (approximately 300 MW of nameplate capacity) in Yuba County; and the New Don Pedro Project (approximately 170 MW of nameplate capacity) jointly owned by Turlock Irrigation District and Modesto Irrigation District in Tuolumne County.

System-Wide SWP and CVP Capacity and Energy Generation. CVP and SWP hydroelectric generation facilities have a total nameplate capacity rating of approximately 3,678 MW (the CVP has a nameplate rating of 2,220 MW, and the SWP has a nameplate rating of 1,458 MW). Under current conditions (1995 level of development), 1,679 MW of the CVP capacity is estimated to be available on average (over the 73-year hydrologic record used in this analysis), and 1,427 MW is estimated to be available during dry conditions. These levels of CVP capacity represent the instantaneous production capability of the facilities; however, the actual capability of the CVP generation to serve load on a sustained basis is considerably less due to the limited amounts of energy it is capable of producing. Approximately 1,490 MW of SWP capacity is available on average during summer, and 1,357 MW of SWP capacity is available during dry conditions. It should be noted that facilities often are not generating at full capacity.

The CVP generates an estimated annual average of 5,265 gigawatt hours (GWh) under existing conditions. The SWP generates an estimated annual average of 4,362 GWh under existing conditions.

Historical system-wide energy generation attributable to the SWP has ranged from about 600,000 MW hours (MWh) in 1968 to 5.4 million MWh in 1983. Total CVP energy generation and supplemental energy purchases (which are made to support sales to preference power customers) have ranged from 2.1 million MWh in 1992 to 8.8 million MWh in 1983. Nameplate CVP capacity was approximately 630 MW in 1960, increasing to approximately 2,220 MW in 1995. SWP nameplate capacity was approximately 1,340 MW in 1968 and 1,670 MW in 1995.

System-Wide SWP and CVP Project Energy Use. Current annual CVP project energy use averages 1,563 GWh, while annual SWP project energy use averages 8,412 GWh. Most of this energy is used to power the surface water pumping facilities of these projects. The SWP's historical system-wide project energy use has ranged from approximately 600,000 MWh in 1968 to 8.4 million MWh in 1990. The CVP's historical project energy use has ranged from approximately 320,000 MWh in 1963 to 1.7 million MWh in 1976.

Western Energy Sales. Western's net energy available for sale under existing conditions is estimated to average 3,702 GWh per year. As with the other CVP-related data in this section, this number is projected using DWR's system operational model (DWRSIM) output based on 1995 level-of-development conditions and reflects the average sales volume over the entire 73-year hydrologic record used in this analysis. Western sells available capacity and energy to its preference customers after all CVP project energy use requirements are met.

Historical energy sales from the CVP have ranged from approximately 2 million MWh in 1960 to 7.9 million MWh in 1992. Historical revenue from CVP energy sales has ranged from approximately $10 million in 1960 to $269 million in 1987.

DWR's power program is designed to meet the pumping energy requirements of the SWP. Unlike Western, DWR does not serve preference power customers.

Net SWP Energy Requirement. The SWP is a net consumer of power because its project energy use exceeds the amount of energy generated at its hydroelectric facilities. Therefore, the SWP's net energy requirement, before considering DWR's off-aqueduct power resources, is the appropriate assessment variable to measure. The SWP's net energy requirement under existing conditions is estimated to average 4,050 GWh over the 73-year hydrologic record. DWR meets SWP net energy requirements by purchasing energy from a variety of sources.

DWR and Western Power Rates. Western's current "composite energy rate" is $20.60/MWh and is equal to the total revenue requirement to be recovered from capacity and energy sales, divided by the amount of energy sales. This rate differs from the actual capacity and energy rates set by Western and was used as a proxy to estimate effects of the Program alternatives. DWR's existing "system energy rate" is $23.80/MWh and is calculated as the net SWP cost of power divided by the SWP energy requirements.

Historically, Western's capacity rates have ranged from $750/MW per month in 1960 to $7,440/MW per month in late 1991 through early 1993. The rate in 1996 was $4,320/MW per month. Western's energy rates have ranged from $3.00/MWh in 1960 through early 1978, to $31.44/MWh in late 1986 through early 1988. In 1994, the energy rate went to a base-and-tier system. The base rate in 1996 was $15.83/MWh, and the tier rate was $26.27/MWh.

The SWP is a water delivery project; DWR does not sell power capacity from the project to its water customers. Since DWR does not charge for capacity in the traditional sense, no capacity rate was calculated. The SWP system energy rate has ranged from a low of $18.40/MWh in 1993 to a high of $32.00/MWh in 1986.

7.9.4 ASSESSMENT METHODS

In general, power and energy effects were defined by comparing conditions associated with the different Program alternatives to related conditions under the No Action Alternative. The criteria defined in Section 7.9.5 were applied to determine whether the economic effects should be addressed and to assess the significance of physical impacts.

Ranges of effects were defined to represent the types of effects that could result from implementing Program actions. Examples of potential alternative components were used to develop the representative ranges of effects because the inclusion of specific components of the Program (for example, specific operating criteria and the size and location of facilities) have not been fully identified for the purpose of this programmatic review. This range of components covers all potential effects.

It is not known at this time how changes in capacity, energy generation, power costs, and project energy use caused by the Program alternatives would be allocated between the CVP and SWP. Therefore, the full range of potential effects on the CVP and SWP has been defined to reflect this uncertainty. Additional information regarding how the Program alternatives would affect the CVP versus the SWP and specific power and water users (that is, the agencies and utilities that purchase power and water from Western and DWR, and their retail customers) cannot be provided at this time. These types of allocation decisions have not been made by the agencies that would implement the Program alternatives and will not be made until after this programmatic analysis. This is why the range of effects are described in this document as *potential* effects on the CVP or the SWP. At one extreme, all of the power supply and power cost effects described herein would be experienced by the CVP and its power and water users, and none would be experienced by the SWP and its power and water users. At the other extreme, the SWP and its power and water users would experience all of the impacts. Neither of these extremes is likely because the effects are expected to be allocated to both the CVP and SWP. Customers of both systems, therefore, would experience effects. However, no basis is available to further delineate CVP versus SWP effects; and such an analysis would be speculative.

Power plants that may be modified were identified, and the existing and proposed nameplate capacities were defined in MW. Changes in capacity and energy generation that would be caused by changes in system operations were estimated. These changes in operation would be caused by potential (1) physical modifications to hydropower plants, (2) new storage projects, and (3) changes in reservoir releases and other measures needed to implement the various Program elements.

The effects assessed include changes in average- and dry-year energy generation. The potential for the CVP and SWP to provide ancillary services in a deregulated market was considered. Changes in annual and monthly project energy use (increases or decreases in pumping load) also were assessed. It is assumed that lost energy generation from the CVP would come as peaking power, that is electricity generated at times when it is most in demand and therefore marketable at the highest price.

Decisions made by Western on how and when to supply electric power or constraints placed on CVP electric generation may influence the operation of other power suppliers within the state and WSCC. If the amount of power available to Western's customers changes at a certain time of day, the customers would need to change their own power generation or make purchases from other power suppliers or the California market. While the overall demand for power may not change, an incremental change in the quantity or timing of power from the CVP or SWP would trigger an offsetting change in other power-generating resources operated in the state or WSCC.

Incremental resources that may be used to make up for reduced CVP and SWP generation are projected to be primarily comprised of combustion turbines (CTs) and combined cycle combustion turbines (CCCTs). According to the WSCC, these two types of power-generating facilities account for nearly one-half of all WSCC resources projected over the next 10 years. Natural gas is the predominant fuel for these technologies. The most economically efficient way of operating hydroelectric generation is to produce power for sale during peak times of demand for electricity. CTs and CCCTs are well suited to this type of operation. For purposes of assessing environmental effects, CTs and CCCTs are assumed to be the incremental resources that make up for lost or less-than-optimally timed hydroelectric generation from the CVP or SWP. It is further assumed that CTs and CCCTs will be used equally in replacing CVP and SWP power.

Land use and air quality emission impact factors are used in conjunction with estimates of lost CVP and SWP generation and load-following capacity to calculate annual quantities of air pollution and land requirements for power plants to replace the lost power. Other impacts, such as solid waste production and water consumption, tend to be of less importance for these technologies. Impact factors are multiplied by estimated changes in generation and capacity to calculate air quality and land consumption impacts. According to Western, the impact factors are as follows:

Nitrogen oxide (NO_x)	750 lb/GWh of generation
Sulfur dioxide (SO_x)	10 lb/GWh of generation
Carbon monoxide (CO)	300 lb/GWh of generation
Particulate matter (PM_{10})	50 lb/GWh of generation
Carbon dioxide (CO_2)	475 tons/GWh of generation
Land requirements	0.16 acre/MW of capacity

The DWRSIM was used to define changes in available capacity and energy generation at affected state and federal hydroelectric facilities. Pumping energy at certain CVP facilities, and monthly capacity at all generating facilities were estimated using a spreadsheet postprocessor to manipulate DWRSIM-estimated reservoir levels and flows. (DWRSIM has been enhanced to directly incorporate Reclamation's PROSIM power module.) A range of operational scenarios have been defined and modeled to help characterize the range of potential effects that would be caused by the Program alternatives. The incremental effects of the Program alternatives were determined by comparing the average- and dry-year model results under each alternative to related conditions under the No Action Alternative.

For purposes of environmental impact assessment, it is assumed that lost generation is a peaking resource. A quantitative analysis of hourly peak effects cannot be conducted with DWRSIM for the quantitative power impact analysis because DWRSIM uses a monthly time-step as opposed to an hourly time-step.

Direct effects of the Program on SWP and CVP power production and replacement costs were estimated based on available information regarding variable costs of operation and maintenance, long-term open-market power rates, and the costs of new facilities and modifications to existing facilities as included in the Program.

It was assumed that Western's preference power customers and DWR would obtain replacement power from other sources as the amount of power available for sale by Western decreases and the net energy requirements of the SWP increase. Because of the long-term planning horizon, the value of DWR's replacement power was estimated based on open-market prices that are expected to be present in a deregulated market.

Estimating the long-range future price of power in California's deregulated power markets is speculative at best, due to unforeseeable future market conditions (for example, technological advancements in the efficiencies of generation resources and power uses, fuel costs, or government policy decisions). Estimates for use in this analysis were made based on the best available information regarding current expectations of conditions in the future deregulated market. The CALFED Program, however, encompasses a 30-year time frame. Several market conditions could change, perhaps even extensively, over such an extended time. To the extent that such conditions change, the accuracy and usefulness of these estimates would decline accordingly.

Publicly available analyses of future power prices in the restructured industry were evaluated, together with market power analyses prepared by California's investor-owned utility companies and the California Energy Commission. These analyses were used to develop an estimated range of future prices that accounted for differences in the value of power during on- and off-peak periods. The range of long-term average power prices established for this analysis varied by approximately 15% and was based on the historical relationship between PG&E's on- and off-peak incremental rates. The ranges used for the low and high forecast are $22.50/MWh (off peak) to $26.00/MWh (on peak), and $30.00/MWh (off peak) to $34.00/MWh (on peak), respectively, in 1998 dollars. The midpoint in the range of off-peak prices was used to estimate the value of incremental pumping energy, and the midpoint in the range of on-peak prices was used to estimate the value of changes in generation. This approach assumes that system operators will continue attempting to generate electricity as much as possible when it is most valuable (during peak periods) and attempting to pump water during off-peak periods.

One of the key indicators for evaluating economic effects and associated environmental impacts of the various Program alternatives on power customers is the change in the CVP and SWP capacity to meet electrical load in a manner that minimizes the need for other power resources. This capacity is generally referred to as load-carrying capacity or load-carrying capability. Measurement of load-carrying capacity is based on the usefulness of the energy available, under adverse hydrologic conditions, in meeting the peaking requirements of customer electrical loads. This capacity is primarily a function of available energy and the characteristics of the electrical load being served. In dry hydrologic periods, it may be difficult to meet peak hourly electrical loads because available capacity is diminished (due to low reservoir levels) at the same time that it is most needed (high use hourly periods). California does not have excess peaking capacity, so a reduction in peaking capacity is generally indicative of a need for new generating capacity to be constructed on the system, with attendant effects. To the extent that all, or a large portion, of the effects associated with re-operation are placed on the CVP system, one can expect significant degradation of the capacity available for marketing by Western and hence the value of the CVP system to Western and its customers.

The analysis carried out for this programmatic report does not provide for the quantification of the effects associated with changes in project load-carrying capacity. As discussed earlier, the modeled time-step for this analysis has been limited to a monthly analysis, rather than an hourly analysis. As has also been discussed, actual effects to the CVP or SWP have not yet been individually identified. This allocation between the two projects will not occur at the programmatic level of this study. Allocations will need to be identified in subsequent project-level studies and environmental documents.

Energy-use effects (other than project energy use) during and after construction (for example, vehicle fuels and space heating) were assessed qualitatively. These types of effects are described but will be assessed in more detail during subsequent project-level studies, when more detailed information about specific construction procedures and conservation measures is available.

7.9.5 CRITERIA FOR DETERMINING EFFECTS

Social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic and social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic and social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic and social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project. Methods to avoid or reduce adverse social and economic effects also must be addressed. The following economic effects and potential indirect physical environmental effects may result from Program actions:

- *Effects on Capacity, Energy Generation, Project Use and Other Pumping Loads, and Related Rates* - Effects on the net (net refers to positive changes less negative changes) capacity of CVP hydroelectric facilities and net energy generated at such facilities were considered adverse if such economic effects would (a) increase Western's rates to levels that are higher than rates available in open-market conditions, (b) reduce the annual energy available for sale to preference customers during an average year by 5.0% or more, (c) reduce the energy available for sale to preference customers during any single month of an average year by 5.0% or more, or (d) cause a decrease in the value of CVP power resulting in an increase in a preference customer's average power cost by $0.50/MWh (in 1998 dollars). SWP power-related effects are measured by how the effects would affect DWR's system energy rate and the net energy requirement of the SWP. Effects on DWR's system energy rate and the SWP net energy requirement were considered adverse if they would cause DWR's water rates to increase significantly. DWR water rate effects are addressed in Section 7.2, "Agricultural Economics," and in Section 7.5, "Urban Water Supply Economics."

- *Effects on DWR and Western Power Customers* - Western and its preference power customers would experience adverse economic effects if Western's rates increase to the point that they exceed rates available on the open market. Such a situation would cause negative economic effects for Western's preference power customers as their power costs increase and their retail customers leave to find cheaper sources of power. Some of Western's preference power customers could experience adverse economic effects even if Western's rates increase to a level below open-market rates, although some customers could withstand rate increases better than others could. Methods to avoid these types of effects are discussed in Section 7.9.7.

  To estimate the effects of the program alternatives on Western power customers, analyses were conducted to examine the effect on an "average" Western customer (for whom CVP power makes up 14% of their total current resource mix), and on a "high allocation" Western customer (for whom CVP power makes up 85% of their total current resource mix).

  Criteria for determining adverse effects have not been developed for DWR power customers because these customers rely on a range of alternative sources of power supply and purchases from DWR do not represent a major long-term resource to them.

- *Effects on CVP Restoration Fund Power Revenues* - If water payments to the CVP Restoration Fund drop, power payments to the fund may need to increase and Western could be forced to raise power rates. This effect is considered adverse from the standpoint of Western and the CVP if Western's rates increase to levels that are higher than rates available on the open market.

- *Energy-Use Effects for Other than Pumping Load During and after Construction* - Energy-use effects for project construction and other uses such as space heating will be assessed in subsequent project-level studies. Project-specific studies will include more detailed information about the specific construction projects, required changes in operations, and proposed energy conservation measures to be followed during and after construction.

- *Land Use Impacts* - Power-related impacts on land use occur when new power plants are built as a result of either reduced generation or additional net energy consumption resulting from Program actions. While the acreage needed for replacement power plants can be calculated at a programmatic level, it is extremely speculative and may not be directly related to Program actions. In addition, the number and location of such power plants cannot be determined until they are proposed. Consequently, land use conflicts can be assessed only at the time of project-level environmental review. Land use conflicts would be considered potentially significant impacts if power plant construction and operation would cause noise thresholds established for adjoining uses to be exceeded, or if sensitive adjoining uses such as residential or public buildings or gathering places would be exposed to potential risk of upset from explosion or the release of toxic or hazardous materials.

- *Air Quality Impacts* – Indirect impacts on air quality may occur if power lost due to reductions in hydrogeneration is replaced with generation from CTs and CCCTs. Air quality impacts can result from power plant construction (temporary impacts) or operations (ongoing impacts). Since the number, location, and type of new power plants to be built is unknown and speculative, construction impacts cannot be assessed until site-specific project level environmental assessment is undertaken prior to construction.

  The level of air quality impacts resulting from the need for replacement power, either from new or existing power plants, will depend on the location of additional generation. Such air quality impacts would be indirect. Attendant air quality effects would be similarly dispersed. Emissions from new generation would be required to meet the air quality standards and mitigation requirements of the district in which the generation occurs.

  The most pronounced effects on hydrogeneration requiring replacement occur in cases with substantial storage. If surface water storage reservoirs are constructed as pumped-storage facilities, a portion of the hydropower consumed bringing water to such facilities would be recouped when the water is released through generators, reducing the need for other replacement generation and attendant air emissions.

7.9.6 NO ACTION ALTERNATIVE

Tables 7.9-1 and 7.9-2 summarize and compare existing conditions and conditions under the No Action Alternative for the power production and energy resources of the CVP and SWP, respectively. Conditions under the No Action Alternative reflect system water demands, pumping and other operations, power production, and energy economics using both water management Criterion A and water management Criterion B.

Power production and energy conditions under the No Action Alternative are generally expected to be similar to those described for existing conditions.

7.9.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

7.9.7.1 PREFERRED PROGRAM ALTERNATIVE

All Regions/All Programs

This section first summarizes potential economic effects and environmental impacts that would occur from the combined and integrated effects of different programs under the Preferred Program Alternative. For example, effects on available capacity, generation, and project use would be caused by a combination of changes in flow releases under the Ecosystem Restoration Program, possible new storage under the Storage element, reductions in water use under the Water Use Efficiency Program and new water transfers under the Water Transfer Program. Beginning with the subsection, "Ecosystem Restoration Program," the remainder of this section presents potential effects on power and energy that are associated with individual programs included in the Preferred Program Alternative.

The Preferred Program Alternative, as well as all other identified alternatives, contains a range of new storage capacity and a range of possible water management criteria. The quantified effects summarized below consider the full range of these possible outcomes by examining within each alternative scenarios for no storage versus full storage and implementation of either water management Criterion A or water management Criterion B. In addition, for purposes of this analysis, the full range of effects to either the CVP or SWP are considered by allocating all potential effects to either the CVP or the SWP, with no allocation between the two projects. Although this scenario is not expected, this approach is taken in order to disclose the maximum potential effect of the Program. Effects may be positive or negative. The minimum effect to either the CVP or SWP will always be zero, reflecting the allocation of all effects to the other project. The maximum positive and negative effects are provided here to present the full range of potential effects. Both positive and negative effects are likely to fall somewhere between zero and the maximum potential effect noted in this section. More detailed information is available in Tables 7.9-1, 7.9-2, and 7.9-3.

Western Energy Available for Sale. If the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented, and water management Criterion B is assumed, the amount of energy available for sale by Western would decrease under the Preferred Program Alternative. Energy available for sale by Western could decline up to approximately 1,235 GWh per year on average, or up to 34%. This is considered an adverse economic effect.

If no storage is implemented and water management Criterion B is assumed, the amount of energy available for sale by Western would increase under the Preferred Program Alternative. Energy available for sale by Western could increase up to approximately 78 GWh per year on average, or up to 2%.

SWP Net Energy Requirements. If the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented, and water management Criterion B is assumed, the SWP's net energy requirement would increase due to the large increase in SWP project energy use. The SWP's net energy requirement could increase up to approximately 1,235 GWh per year on average, or up to 25%. The percentage increase in dry years would be up to approximately 28%.

If no storage is implemented, and water management Criterion B is assumed, the SWP's net energy requirement would decrease under the Preferred Program Alternative. The SWP's net energy requirement could decrease up to approximately 78 GWh per year on average, or up to 1.5%. The percentage decrease in dry years (and assuming water management Criterion A) would be up to approximately 3.5%.

Western and DWR Rates. Western and DWR would experience an increase in power production and replacement costs from the effects summarized above, and possibly from new costs associated with adding new hydroelectric capacity. Western also would experience decreases in revenue as energy sales decline. All of these factors would require Western and DWR to raise their power rates.

Under a worst-case scenario—where all of the Program-related power cost increases are allocated to the CVP, the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented, and water management Criterion B is assumed—Western's composite rate could increase by up to $13.18/MWh (in 1998 dollars), or approximately 68%. If no storage is implemented, and water management Criterion B is assumed, Western's composite rate could decrease by up to $0.55/MWh (in 1998 dollars), or approximately 2.7%.

If the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented and water management Criterion B is assumed, DWR's system energy rate could increase by up to $7.13/MWh (in 1998 dollars), or 27%. If no storage is implemented and water management Criterion B is assumed, DWR's system energy rate could decrease by up to $0.57/MWh (in 1998 dollars), or approximately 2.2%.

There is considerable uncertainty regarding these projections, as reflected by the wide range of these estimates. Actual rate increases likely would be lower than the upper end of these ranges and much uncertainty will diminish once the power effect and cost allocation decisions discussed under Section 7.9.4 are reached.

Under the worst-case scenario for Western, rate increases would not raise rates above open-market rates. Open-market rates are expected to be about $34.00/MWh (in 1998 dollars). Western's rates under their worst-case scenario would approximate $33.26 (in 1998 dollars) (No Action composite rate of $20.08 plus impact of $13.18 if full storage and water management Criterion B are included).

Another consideration for Western is the effect of increased rates on Western's ability to enter into long-term contracts with their customers. The closer that Western's power rates come to equaling power rates in a deregulated market, the less benefit customers will see in entering into long-term contracts. An increase in the proportion of power sales by Western that come from the open market could increase Western's risk in recovering all CVP costs. It is not possible to state at this time, however, how potential long-term contract customers will respond to rates that are higher than current rates but still below market (on the average). This risk will be present regardless of CALFED actions but could be increased by them.

Effects on Western and DWR Power Customers. The potential Western rate increases summarized above could result in potentially adverse effects on Western's preference power customers. Western rate increases would increase the power costs of Western's customers. Many of the preference power customers that are utility companies could experience a competitive disadvantage since they likely would need to increase their own rates to retail customers. Historically, Western's rates have been some of the lowest available in California. Major increases in their rates could cause adverse economic effects on not only preference power customers but also the retail power customers that buy power from the preference power customers.

Table 7.9-1. Comparison of Potential Change in CVP Power Production and Energy Conditions to the No Action Alternative

ASSESSMENT VARIABLES	EXISTING CONDITIONS	NO ACTION ALTERNATIVE		POTENTIAL CHANGE FROM NO ACTION ALTERNATIVE															
				PREFERRED PROGRAM ALTERNATIVE				ALTERNATIVE 1				ALTERNATIVE 2				ALTERNATIVE 3			
				WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Average Energy Available for Sale (GWh)																			
Annual	3,695	3,613	3,642	71	78	-552	-1235	81	79	-638	-1133	-45	-63	-522	-1,152	-75	-279	-581	-1,671
January	195	206	193	10	-59	-11	-115	18	-62	-34	-97	-37	-117	-7	-97	-100	-74	-82	-136
February	231	265	230	1	4	-37	-84	7	6	-57	-55	-34	-38	-37	-57	-42	-7	-60	-64
March	278	287	271	15	57	-71	-84	18	54	-85	-62	-12	26	-65	-63	-12	-11	-37	-121
April	368	391	362	24	44	-41	-87	27	42	-41	-82	22	41	-40	-83	14	-29	-40	-181
May	471	477	465	24	38	-8	-67	27	40	-8	-61	26	41	-8	-63	17	-33	-15	-150
June	491	468	486	20	15	14	-82	7	16	4	-94	53	44	19	-95	48	33	4	-147
July	544	491	539	44	51	-28	-97	36	49	-33	-103	89	97	-16	-104	114	81	7	-117
August	410	360	407	-6	21	-90	-104	4	27	-79	-95	40	71	-94	-100	99	81	-42	-69
September	228	214	219	-14	14	-58	-126	-6	14	-62	-123	9	34	-63	-125	16	12	-65	-165
October	169	157	167	-10	-1	-94	-157	-9	1	-93	-148	-60	-51	-90	-150	-51	-80	-75	-207
November	128	120	124	-17	-29	-73	-121	-22	-31	-78	-116	-73	-83	-70	-117	-60	-102	-68	-160
December	183	178	179	-20	-77	-56	-110	-24	-75	-73	-97	-68	-127	-51	-99	-119	-150	-108	-155
Western Composite Energy Rate ($/MWh)		$20.08	$20.08	-$0.40	-$0.55	$8.57	$13.18	-$0.45	-$0.56	$8.79	$12.65	$0.66	$0.55	$8.38	$12.77	$0.32	$1.12	$8.55	$16.02
Change in "Average" Western Customer's Average Cost of Power ($/MWh)				-$0.09	-$0.09	$0.67	$1.50	-$0.10	-$0.10	$0.77	$1.37	$0.05	$0.08	$0.63	$1.40	$0.09	$0.34	$0.70	$2.03
Change in "High Allocation" Western Customer's Average Cost of Power ($/MWh)				-$0.52	-$0.57	$4.06	$9.09	-$0.60	-$0.58	$4.70	$8.34	$0.33	$0.46	$3.84	$8.48	$0.55	$2.06	$4.28	$12.30

Notes:

A = *Criterion A.*
B = *Criterion B.*

Table 7.9-2. Comparison of Potential Change in SWP Power Production and Energy Conditions to the No Action Alternative

				POTENTIAL CHANGE FROM NO ACTION ALTERNATIVE																	
		NO ACTION ALTERNATIVE		PREFERRED PROGRAM ALTERNATIVE				ALTERNATIVE 1				ALTERNATIVE 2				ALTERNATIVE 3					
	EXISTING			WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE			
ASSESSMENT VARIABLES	CONDITIONS	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B		
Total Available July Capacity (MW)																					
Average conditions	1,519	1,708	1,725	-11	9	97	112	-2	8	90	129	-14	5	94	129	-44	52	82	160		
Dry conditions	1,327	1,413	1,432	-3	5	-80	67	-4	-5	-33	73	-6	-6	-30	60	-247	8	-80	96		
Total Net Energy Requirement (GWh)																					
Average conditions	3,491	3,263	5,034	-71	-78	552	1,235	-81	-79	638	1,133	45	63	522	1,152	75	279	581	1,671		
Dry conditions	3,182	2,886	3,224	-180	-103	542	892	-200	-141	423	869	-162	-49	352	974	117	197	542	1,679		
System Energy Rate ($/MWh)		$26.69	$26.69	-$0.41	-$0.57	$4.94	$7.13	-$0.47	-$0.58	$5.08	$6.91	$0.61	$0.52	$4.83	$6.96	$0.33	$1.09	$4.93	$8.16		

Notes:

A = Criterion A.
B = Criterion B.

Table 7.9-3. Comparison of Potential Change in Air Quality Conditions to the No Action Alternative

	PREFERRED PROGRAM ALTERNATIVE				ALTERNATIVE 1				ALTERNATIVE 2				ALTERNATIVE 3			
	WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE		WITHOUT STORAGE		WITH STORAGE	
ASSESSMENT VARIABLES	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Nitrogen oxide (lbs/day)																
Average conditions	-145	-159	1,134	2,537	-167	-163	1,311	2,328	92	130	1,072	2,328	153	574	1,194	3,433
Dry conditions	-371	-212	1,114	1,834	-412	-289	869	1,785	-332	-101	723	2,001	241	404	1,113	3,450
Sulfur dioxide (lbs/day)																
Average conditions	-2	-2	15	34	-2	-2	17	31	1	2	14	31	2	8	16	46
Dry conditions	-5	-3	15	24	-5	-4	12	24	-4	-1	10	27	3	5	15	46
Carbon monoxide (lbs/day)																
Average conditions	-58	-64	454	1,015	-67	-65	524	931	37	52	429	931	61	230	478	1,373
Dry conditions	-148	-85	446	734	-165	-116	347	714	-133	-40	289	800	96	162	445	1,380
Particulate matter (lbs/day)																
Average conditions	-10	-11	76	169	-11	-11	87	155	6	9	71	155	10	38	80	229
Dry conditions	-25	-14	74	122	-27	-19	58	119	-22	-7	48	133	16	27	74	230

Notes:

A = Criterion A.
B = Criterion B.

If the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented and water management Criterion B is assumed, Western customers could see an increase in their average cost of power under the Preferred Program Alternative. An "average" Western customer's cost of power could increase by up to approximately $1.50/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could increase by up to approximately $9.09/MWh (in 1998 dollars). This is considered an adverse economic effect.

If no storage is implemented and water management Criterion B is assumed, Western customers could see a decrease in their cost of power under the Preferred Program Alternative. An "average" Western customer's cost of power could decrease by up to approximately $0.09/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could decrease by up to approximately $0.57/MWh (in 1998 dollars).

The estimated increases in DWR's system rates are not expected to cause significant effects on DWR's power customers. These customers purchase power from a variety of sources, and they do not have firm contracts with DWR. However, water customers of the SWP could incur increases in their water charges to cover the increases in power costs required to deliver SWP water. This issue is addressed in Section 7.5, "Urban Water Supply Economics."

Costs allocated to CVP project energy use are recovered by revenue received from CVP water users, natural resource agencies, and other environmental beneficiaries. The rate effects in this analysis were estimated by assuming that the beneficiaries of the increase in project use caused by the Program would continue to pay approximately 30% of the estimated cost of replacement energy and that Western's preference power customers make up the difference through increased rates. This is consistent with current practice for projects authorized under Reclamation law. If the beneficiaries of increases in project use (natural resource agencies, other environmental beneficiaries, and water users) paid the full amount of related cost increases; Western power rate effects could be reduced.

The power cost increases associated with additional SWP pumping requirements also could be assigned to beneficiaries of the increased pumping (natural resource agencies, other environmental beneficiaries, and water users). This would be a strategy for reducing the magnitude of DWR system energy rate effects on DWR power customers. The potential adverse effects of the Program alternatives on DWR customers or on Western and its preference power customers would be caused by DWR's or Western's rates increasing to a level higher than open market rates as a result of having less peaking power to sell. Instead, new generation facilities could be built from funds provided by beneficiaries of increased project use (pumping) or changes in river or reservoir operations. The new generation may be operated by Western, Reclamation, the Corps, DWR, or other entities to meet additional pumping requirements or to make up for reduced project generation. Beneficiaries could also purchase additional energy from the California energy market to meet additional pumping requirements. This would decrease lost energy available for sale from the CVP, but would generally shift generation from hydro sources to thermal sources, causing air quality impacts. Another potential mitigation strategy for avoiding significant Western power rate increases would be passing new federal legislation to shift an equitable portion of Western's share of CVP repayment obligations to the beneficiaries of the Program actions that cause the rate effects. This would reduce Western's revenue requirements and avoid pressure to increase the rates that Western must charge its preference power customers.

CVP Restoration Fund Power Payments. Even under the worst-case scenario, Western's composite rate stays below the anticipated open-market rate. This should allow Western to continue to sell power at or below cost in a deregulated market. In this case, Restoration Fund payments should not be affected.

Utility System Impacts. To meet overall increases in state electrical demand, reductions in generation from the CVP or SWP, or increases in project energy use loads would require replacement energy and capacity. Replacement energy would most likely come from a combination of CTs and CCCTs, resulting in the following estimated air emissions. These impacts may be dispersed over a wide geographic area. Emissions caused by generation of power must comply with existing air quality standards where they occur. Therefore, power generation emissions will not exceed air quality standards and are considered less than significant adverse environmental effects.

If the maximum quantity of storage contemplated in the Preferred Program Alternative is implemented and water management Criterion B is assumed, increased replacement energy would be required under the Preferred Program Alternative. NO_x emissions could be increased by up to 2,537 lbs/day under average water-year conditions and up to 1,834 lbs/day under dry water-year conditions. SO_x emissions could be increased by up to 34 lbs/day under average water-year conditions and up to 24 lbs/day under dry water-year conditions. CO emissions could be increased by up to 1,015 lbs/day under average water-year conditions and up to 734 lbs/day under dry water-year conditions. PM_{10} could be increased by up to 169 lbs/day under average water-year conditions and up to 122 lbs/day under dry water-year conditions.

If no storage is implemented and water management Criterion A is assumed, decreased replacement energy would be required under the Preferred Program Alternative. NO_x emissions could be decreased by up to 145 lbs/day under average water-year conditions and up to 371 lbs/day under dry water-year conditions. SO_x emissions could be decreased by up to 2 lbs/day under average water-year conditions and up to 5 lbs/day under dry water-year conditions. CO emissions could be decreased by up to 58 lbs/day under average water-year conditions and up to 148 lbs/day under dry water-year conditions. PM_{10} could be decreased by up to 10 lbs/day under average water-year conditions and up to 25 lbs/day under dry water-year conditions.

Ecosystem Restoration Program. Energy use likely would increase during implementation of the Ecosystem Restoration Program due to construction activities related to wetlands creation and other restoration activities. Some increase in energy use to maintain restored areas is likely, including pumping to deliver water to restored wetlands. In general, net energy use likely would decrease on lands converted from agricultural uses under this program. Many types of energy-consuming agricultural practices would no longer occur on these lands, including tilling, harvesting, pumping water, and applying fertilizer and pesticides. Even though active management of restored areas could require energy use during grading, pumping water, and vegetation management, agricultural practices typically use more energy than restoration activities. These net energy savings would occur on approximately 90,000-110,000 acres in the Delta Region and on about 24,000-35,000 acres in the Central Valley.

Water Quality Program. A primary focus of the Water Quality Program is source control which addresses mine drainage, urban and industrial runoff, and agricultural drainage. These elements may indirectly affect energy, depending on the specific measures that eventually are implemented. Implementing source control measures would include temporary increases in energy use. Examples of implementation procedures that would use energy include earthwork with heavy vehicles and operation of the equipment necessary to install structural water quality controls. Long-term beneficial effects on energy use would occur as water quality improvements reduce treatment requirements.

Water Use Efficiency Program. Water conservation actions are expected to reduce M&I water and energy use but may lead to increases in agricultural energy use. Local water districts and users would determine the specific water efficiency measures. While specific M&I measures and their effects cannot be defined at this time, it is likely that the amount of energy used by water users would be reduced as their water use declines. Examples of energy-related effects that likely would occur once the measures are successfully implemented are listed below:

- Urban water users would experience reductions in water heating requirements as their water use declines. Most of the energy savings would be in the form of reductions in the amount of natural gas that is used to power water heaters.

- Reductions in urban water demands would reduce pumping and treatment requirements for M&I water districts, thus saving additional energy.

- More efficient use of environmental diversions would reduce pumping requirements in certain areas and would lead to more energy savings.

- The water recycling element of the program potentially would delay the construction of new supply projects and related energy use during construction, operation, and maintenance of the projects. On the other hand, water recycling projects would increase the use of energy if they require increased treatment and new pressurized distribution systems. The needs would occur in areas where recycling plants are at the tail end of water systems or downhill from end-users that use the recycled water.

- Agricultural water users may increase energy use as they switch from gravity-fed irrigation systems to pressurized systems.

In the short term, energy use may increase during the implementation phase of the specific conservation measures. Over the long term, the installation of conservation devices and other efficiency measures may decrease overall energy use in the study area, depending on the extent to which increased agricultural pumping in support of sprinkler irrigation is implemented. Any effects are expected to be less than significant.

Levee System Integrity Program. The Levee System Integrity Program would cause direct energy effects during construction. Levee system modifications are relatively energy-intensive activities during their construction phases as energy is needed to power construction equipment, worker vehicles, pumps, and other equipment. The levee modifications could help avoid long-term and recurring levee maintenance procedures that would need to be conducted without major improvements to the system. This long-term beneficial effect could help offset the short-term additional use of energy.

Water Transfer Program. Energy use would increase in areas receiving new water supplies under the Water Transfer Program if the water deliveries result in new urban or agricultural uses that could not occur without the deliveries. Water transfers also may increase energy use at pumping and treatment facilities if the transfers require an increase in pumping or treatment requirements, or if the water being transferred is being conveyed through facilities that would not be required other than for the transfer (for example, Sacramento Valley water transferred to export regions would need to be pumped into the state or federal canals).

Watershed Program. For the short term, the Watershed Program would require relatively minor amounts of energy compared to the amount required to construct the storage, conveyance, and levee improvement components of the Preferred Program Alternative. Some energy would be required to implement activities in both the upper and lower watersheds as fish migration barriers are removed, unstable levees are repaired, stream banks are stabilized, and riparian habitat is improved. These minor and temporary effects would be outweighed by the positive and long-term reductions in energy use caused by this program. The related improvements in water quality could reduce water treatment requirements and associated energy requirements at treatment plants. By reducing stressors and land use practices that degrade water quality, watershed management would indirectly reduce the amount of energy used by related land use practices. Examples of land use practices that degrade water quality include harmful aspects of logging, agricultural pesticide and fertilizer applications, and livestock grazing.

Storage. Under the Preferred Program Alternative, new hydroelectric capacity could be added to enlarged existing or new off-stream storage sites in the Sacramento River and San Joaquin River Regions. Specific reservoir sites have not been selected for this programmatic evaluation. So long as a reasonable amount of discretion exists for scheduling pumping and generation at new storage facilities on a daily basis, a positive effect on capacity resources could result. Energy could be required to fill new pumped off-stream storage facilities. Although some energy may be generated when water is released, operation of such facilities may cause a net increase in energy use at the facility. Energy (primarily in the form of vehicle fuels) also would be needed to power construction vehicles and equipment.

Temporary adverse effects on energy could occur during construction if a storage site with existing hydroelectric facilities is selected. Temporary disruptions of hydrogeneration could be necessary during construction as new hydroelectric capacity is added or as the dams at existing storage sites are enlarged.

Conveyance. The construction of new conveyance facilities would require energy to power a wide variety of construction procedures, including trenching, grading, and reclamation of disturbed areas. Operation of the conveyance facilities would increase energy use at related pumping facilities and during routine maintenance.

Based on the DWRSIM modeling conducted for the different Program alternatives, the different conveyance strategies under consideration by the Program caused only a minor effect on the system-wide assessment variables discussed at the beginning of this section.

Effects at Other Hydroelectric Facilities. The Preferred Program Alternative would change flows in streams below CVP and SWP facilities. This in turn could affect available capacity and energy generation at hydroelectric facilities that are not part of the CVP or SWP but are hydrologically connected. These other hydroelectric facilities may include a City of Redding plant on Clear Creek, Oakdale and South San Joaquin Irrigation District's plants in the Stanislaus River basin, Friant Power Authority plants on the San Joaquin River, and the Monticello Power Plant at Lake Berryessa. Specific effects at these other hydroelectric facilities could be beneficial or adverse and cannot be defined at this time. A wide range of CVP and SWP operational changes currently are being assessed during the Program study. Until more specific information about the potentially affected facilities and the timing and magnitude of CVP- and SWP-related operational changes on specific stream reaches is available, defining the related effects on other hydroelectric facilities is speculative. The effects on other facilities would be influenced not only by the hydrology changes caused by the Preferred Program Alternative but also by (1) the amount of water in storage at affected facilities when the hydrology changes occur; (2) utility-specific water, power, and environmental demands that are in place at the time of the hydrology changes; and (3) the daily, weekly, and monthly operational characteristics of the affected facilities.

Other Types of Effects. The Preferred Program Alternative could indirectly affect energy use at surface water and groundwater pumping facilities owned by local irrigation districts and municipal utility districts. The major environmental improvements resulting from the Preferred Program Alternative likely would improve or create recreation opportunities in the study area, which would indirectly cause an increase in recreation-related traffic and potential air quality impacts. These impacts are considered less than significant.

Actions involving construction of new facilities would require the use of energy (primarily in the form of vehicle fuels) to power construction equipment. This is a temporary effect and not considered significant. Energy efficiency upgrades and energy conservation measures can be applied at the project-specific level.

7.9.7.2 ALTERNATIVE 1

This section summarizes the potential effects associated with Alternative 1 that would differ from the effects described for the Preferred Program Alternative. Like the Preferred Program Alternative, this alternative contains a range of new storage capacity and a range of possible water management criteria.

All Regions

Western Energy Available for Sale. If the maximum quantity of storage contemplated in Alternative 1 is implemented, and water management Criterion B is assumed, the amount of energy available for sale by Western would decrease under Alternative 1. Energy available for sale by Western could decline by up to approximately 1,133 GWh per year on average, or up to 31%. This is considered an adverse effect.

If no storage is implemented and water management Criterion A is assumed, the amount of energy available for sale by Western would increase under Alternative 1. Energy available for sale by Western could increase by up to approximately 81 GWh per year on average, or up to 2%.

SWP Net Energy Requirements. If the maximum quantity of storage contemplated in Alternative 1 is implemented, and water management Criterion B is assumed, the SWP's net energy requirement would increase due to the large increase in SWP project energy use. The SWP's net energy requirement could increase by up to approximately 1,133 GWh per year on average, or up to 23%. The percentage increase in dry years would be up to approximately 27%.

If no storage is implemented and water management Criterion A is assumed, the SWP's net energy requirement would decrease under Alternative 1. The SWP's net energy requirement could decrease by up to approximately 81 GWh per year on average, or up to 2.5%. The percentage decrease in dry years would be up to approximately 7%.

Western and DWR Rates. Western and DWR would experience an increase in power production and replacement costs from the effects summarized above, and possibly from new costs associated with adding new hydroelectric capacity. Western also would experience decreases in revenue as energy sales decline. All of these factors would require Western and DWR to raise their power rates.

Under a worst-case scenario—where all of the Program-related power cost increases are allocated to the CVP, the maximum quantity of storage contemplated in Alternative 1 is implemented, and water management Criterion B is assumed—Western's composite rate could increase by up to $12.65/MWh (in 1998 dollars), or approximately 63%. If no storage is implemented, and water management Criterion B is assumed, Western's composite rate could decrease by up to $0.58/MWh (in 1998 dollars), or approximately 2.8%.

If the maximum quantity of storage contemplated in Alternative 1 is implemented and water management Criterion B is assumed, DWR's system energy rate could increase by up to $6.91/MWh (in 1998 dollars), or 26%. If no storage is implemented, and water management Criterion B is assumed, DWR's system energy rate could decrease by up to $0.58/MWh (in 1998 dollars), or approximately 2.2%.

Effects on Western Power Customers. If the maximum quantity of storage contemplated in Alternative 1 is implemented, and water management Criterion B is assumed, Western customers could see an increase in their average cost of power under Alternative 1. An "average" Western customer's cost of power could increase by up to approximately $1.37/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could increase by up to approximately $8.34/MWh (in 1998 dollars). This is considered an adverse economic effect.

If no storage is implemented and water management Criterion A is assumed, Western customers could see a decrease in their average cost of power under Alternative 1. An "average" Western customer's cost of power could decrease by up to approximately $0.10/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could decrease by up to approximately $0.60/MWh (in 1998 dollars).

Utility System Impacts. If the maximum quantity of storage contemplated in Alternative 1 is implemented and water management Criterion B is assumed, increased replacement energy would be required under Alternative 1. NO_x emissions could be increased by up to 2,328 lbs/day under average water-year conditions and up to 1,785 lbs/day under dry water-year conditions. SO_x emissions could be increased by up to 31 lbs/day under average water-year conditions and up to 24 lbs/day under dry water-year conditions. CO emissions could be increased by up to 931 lbs/day under average water-year conditions and up to 714 lbs/day under dry water-year conditions. PM_{10} could be increased by up to 155 lbs/day under average water-year conditions and up to 119 lbs/day under dry water-year conditions. Since thermal replacement plants are assumed to comply with air quality standards and are not proposed to be built as part of the CALFED Program, these impacts are considered less than significant.

If no storage is implemented and water management Criterion A is assumed, decreased replacement energy would be required under Alternative 1. NO_x emissions could be decreased by up to 167 lbs/day under average water-year conditions and up to 472 lbs/day under dry water-year conditions. SO_x emissions could be decreased by up to 2 lbs/day under average water-year conditions and up to 5 lbs/day under dry water-year conditions. CO emissions could be decreased by up to 67 lbs/day under average water-year conditions and up to 165 lbs/day under dry water-year conditions. PM_{10} emissions could be decreased by up to 11 lbs/day under average water-year conditions and up to 27 lbs/day under dry water-year conditions.

7.9.7.3 ALTERNATIVE 2

This section summarizes the potential effects associated with Alternative 2 that would differ from the effects described for the Preferred Program Alternative. Like the Preferred Program Alternative, this alternative contains a range of new storage capacity and a range of possible water management criteria.

All Regions

Western Energy Available for Sale. If the maximum quantity of storage contemplated in Alternative 2 is implemented and water management Criterion B is assumed, the amount of energy available for sale by Western would decrease under Alternative 2. Energy available for sale by Western could decline by up to approximately 1,152 GWh per year on average, or up to 32%. This is considered an adverse economic effect.

No scenarios under Alternative 2 produce positive effects.

SWP Net Energy Requirements. If the maximum quantity of storage contemplated in Alternative 2 is implemented and water management Criterion B is assumed, the SWP's net energy requirement would increase due to the large increase in SWP project energy use. The SWP's net energy requirement could increase by up to approximately 1,152 GWh per year on average, or up to 23%. The percentage increase in dry years would be up to approximately 30%.

If no storage is implemented and water management Criterion A is assumed, the SWP's net energy requirement would decrease under Alternative 2. The SWP's net energy requirement could decrease by up to approximately 162 GWh per year during dry years, or up to 5.6%.

Western and DWR Rates. Western and DWR would experience an increase in power production and replacement costs from the effects summarized above, and possibly from new costs associated with adding new hydroelectric capacity. Western also would experience decreases in revenue as energy sales decline. All of these factors would require Western and DWR to raise their power rates.

Under a worst-case scenario—where all of the Program-related power cost increases are allocated to the CVP, the maximum quantity of storage contemplated in Alternative 2 is implemented, and water management Criterion B is assumed—Western's composite rate could increase by up to $12.77/MWh (in 1998 dollars), or approximately 64%.

If the maximum quantity of storage contemplated in Alternative 2 is implemented and water management Criterion B is assumed, DWR's system energy rate could increase by up to $6.96/MWh (in 1998 dollars), or 26%.

Effects on Western Power Customers. If the maximum quantity of storage contemplated in Alternative 2 is implemented and water management Criterion B is assumed, Western customers could see an increase in their average cost of power under Alternative 2. An "average" Western customer's cost of power could increase up to approximately $1.40/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could increase by up to approximately $8.48/MWh (in 1998 dollars). This is considered an adverse economic effect.

Utility System Impacts. If the maximum quantity of storage contemplated in Alternative 2 is implemented and water management Criterion B is assumed, increased replacement energy would be required under Alternative 2. NO_x emissions could be increased by up to 2,328 lbs/day under average water-year conditions and up to 2,001 lbs/day under dry water-year conditions. SO_x emissions could be increased by up to 31 lbs/day under average water-year conditions and up to 27 lbs/day under dry water-year conditions. CO emissions could be increased by up to 931 lbs/day under average water-year conditions and up to 800 lbs/day under dry water-year conditions. PM_{10} emissions could be increased by up to 155 lbs/day under average water-year conditions and up to 133 lbs/day under dry water-year conditions.

Since thermal replacement plants are assumed to comply with air quality standards and are not proposed to be built as part of the CALFED Program, these impacts are considered less than significant.

7.9.7.4 ALTERNATIVE 3

This section summarizes the potential effects associated with Alternative 3 that would differ from the effects described for the Preferred Program Alternative. Like the Preferred Program Alternative, this alternative contains a range of new storage capacity and a range of possible water management criteria.

All Regions

Western Energy Available for Sale. If the maximum quantity of storage contemplated in Alternative 3 is implemented and water management Criterion B is assumed, the amount of energy available for sale by Western would decrease under Alternative 3. Energy available for sale by Western could decline by up to approximately 1,671 GWh per year on average, or up to 46%. This is considered an adverse economic effect.

No scenarios within Alternative 3 would produce positive effects.

SWP Net Energy Requirements. If the maximum quantity of storage contemplated in Alternative 3 is implemented and water management Criterion B is assumed, the SWP's net energy requirement would increase due to the large increase in SWP project energy use. The SWP's net energy requirement could increase by up to approximately 1,671 GWh per year on average, or up to 33%. The percentage increase in dry years would be up to approximately 52%.

Western and DWR Rates. Western and DWR would experience an increase in power production and replacement costs from the effects summarized above, and possibly from new costs associated with adding new hydroelectric capacity. Western also would experience decreases in revenue as energy sales decline. All of these factors would require Western and DWR to raise their power rates.

Under a worst-case scenario—where all of the Program-related power cost increases are allocated to the CVP, the maximum quantity of storage contemplated in Alternative 3 is implemented, and water management Criterion B is assumed—Western's composite rate could increase by up to $16.02/MWh (in 1998 dollars), or approximately 80%. This is considered an adverse economic effect because Western's rates could potentially exceed open-market rates.

If the maximum quantity of storage contemplated in Alternative 3 is implemented and water management Criterion B is assumed, DWR's system energy rate could increase by up to $8.16/MWh (in 1998 dollars), or up to 31%.

Effects on Western Power Customers. If the maximum quantity of storage contemplated in Alternative 3 is implemented and water management Criterion B is assumed, Western customers could see an increase in their average cost of power under Alternative 3. An "average" Western customer's cost of power could increase by up to approximately $2.03/MWh (in 1998 dollars). A "high allocation" Western customer's cost of power could increase by up to approximately $12.30/MWh (in 1998 dollars). This is considered a potentially significant adverse effect.

CVP Restoration Fund Power Payments. In a worst-case scenario, where all of the Program power and cost effects are allocated to the CVP and where Western needed to raise its composite rate to a level that is higher than rates available in a deregulated market, Western may be unable to sell energy and recover costs, including payments to the CVP Restoration Fund. The fund would be affected if other revenue sources were not obtained. If Western was forced to attempt retaining its customers by selling power below cost, some other entity could be affected, possibly federal taxpayers. CVP water rates could be raised to obtain additional revenue under such a scenario. However, the water payment "cap" would limit the amount water users could contribute; and other revenue sources eventually could need to be obtained.

To avoid this scenario, a cap on power payments to the fund could be adopted, similar to the cap in effect for water payments to the fund. This action would help to ensure that power users do not have to increase their contributions to the fund if water payments to the fund reach their limit.

CVP power users are not expected to be affected by shortfalls in water payments to the fund. The Preferred Program Alternative is expected to cause an increase in CVP water deliveries to agricultural and M&I water users, which would enable meeting the overall target contribution to the fund from water users. If CVP water deliveries decreased, given the water payment cap in effect, payments by CVP power users to the fund may need to increase in order to make up for the shortfall in water payments to the fund.

Utility System Impacts. If the maximum quantity of storage contemplated in Alternative 3 is implemented and water management Criterion B is assumed, increased replacement energy would be required under Alternative 3. NO_x emissions could be increased by up to 3,433 lbs/day under average water-year conditions and up to 3,450 lbs/day under dry water-year conditions. SO_x emissions could be increased by up to 46 lbs/day under average or dry water-year conditions. CO emissions could be increased by up to 1,373 lbs/day under average water-year conditions and up to 1,380 lbs/day under dry water-year conditions. PM_{10} emissions could be increased by up to 229 lbs/day under average water-year conditions and up to 230 lbs/day under dry water-year conditions. Since thermal replacement plants are assumed to comply with air quality standards and are not proposed to be built as part of the CALFED Program, these impacts are considered less than significant.

7.9.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

The only Program element that differs among alternatives is the Conveyance element. Power production and energy impacts resulting from the inclusion or exclusion of proposed conveyance facilities are estimated within the bounds of impacts resulting from the use of specified water management criteria (water management Criterion A and water management Criterion B). Any environmental consequences resulting from the Conveyance element already are incorporated within the consequences identified in Section 7.9.7.

7.9.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse effects from implementing any of the Program alternatives when compared to existing conditions were the same potential effects as those identified in Section 7.9.7, which compares the Program alternatives to the No Action Alternative.

The analysis indicates different types of positive and negative power and energy effects when the Program alternatives are compared to existing conditions. Under the existing conditions scenario, population levels and power and energy demand would not increase.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative.

7.9.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. This section identifies where Program actions could contribute to potentially significant adverse cumulative effects. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

The power and energy effects of the Preferred Program Alternative, when added to the potential effects of the following projects, could result in potentially significant adverse cumulative effects on power and energy resources in the Delta, Bay, Sacramento River, San Joaquin River Regions and in the Other SWP and CVP Service Areas: American River Watershed Project, American River Water Resource Investigation, CVPIA Anadromous Fish Restoration Program and other CVPIA actions not yet fully implemented, Delta Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento Water Forum Process, Supplemental Water Supply Project (EBMUD), and urbanization. The Trinity River Restoration Project and the ISDP would cause power and energy effects that were considered in the analysis presented in Section 7.9.7. Recent efforts by PG&E to sell its hydroelectric resources would result in a negligible effect on cumulative hydrogeneration in California because the new owners are expected to continue generation at these facilities. There could be a minor reduction in statewide generation if additional efforts are made to retire some diversion structures that cause adverse impacts on aquatic resources, or if additional efforts are made to purchase water for in-stream aquatic resources. In addition, changes in the distribution of CVP and SWP water deliveries could affect the amount of CVP energy available for sale and the net energy requirement of the SWP. An example of this would be if a larger percentage of project water exported from the Delta were supplied to urban water users in southern California. Deliveries to southern California require significantly more energy due to pumping requirements to lift the water over the Tehachapi Mountains at the Edmonston Pumping Plant.

Cumulative effects on power capacity, generation, and energy use are expected to be potentially significant when the sum total effect of anticipated changes in water project operations resulting in net energy reduction, new facilities with associated pumping load, and increased power and energy demands of urbanization are viewed cumulatively together. The cumulative effects on power and energy could be significant. However, increased demands for power and energy resources will cause power and energy providers to seek means to meet demand. This could include construction of new power plants, electrical intertie connections, more efficient energy use, and other power and energy conservation methods.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The short-term power and energy effects caused by the Program alternatives are not expected to affect the long-term productivity of the environment.

The Preferred Program Alternative generally would maintain and enhance the long-term productivity of the environment but may adversely affect power and energy resources. Ways to reduce or avoid these effects are discussed in Sections 7.9.7 and 7.9.13.

Irreversible and Irretrievable Commitments. The Program alternatives would cause irreversible and irretrievable commitments of the nonrenewable energy resources needed to construct, implement, and maintain project structures and programs. These resources include gasoline, diesel fuel, and the fossil fuels used to generate electricity for construction and maintenance. The anticipated increase in project energy use at pumping plants also would cause irreversible commitments of resources if nonrenewable resources are used to generate electricity for the pumping plants. Providing for the construction of new replacement generation from renewable sources would reduce this potential effect.

7.9.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during project planning and development. Specific mitigation measures that are applicable at the project level will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

To the extent that Program actions cause significant reduction in hydrogeneration or increases in project energy consumption without offsetting reduction in other electrical loads, replacement capacity and energy must be obtained to meet the deficit. Increasing the efficiency of existing generators should be examined in connection with major generator maintenance as one option to meet this need. Because California presently has a shortage of peaking power capacity, the replacement power likely would lead to the construction of new power plants with comparable load-following capability.

Construction of new thermal power plants generally causes physical environmental impacts. Regardless of location, there will be air quality impacts and land use impacts. Other environmental impacts also may occur (for example, impacts on wildlife, vegetation, visual, and noise resources) depending on location.

The CALFED Program does not include the construction of new thermal power plants. If needed, new generation will be constructed by other entities. If construction of new power plants are undertaken, the site-specific impacts will be analyzed at the project level by the constructing entity, consistent with all local, state, and federal laws and requirements. The following mitigation strategies can help to reduce adverse energy-related impacts from Program actions and should be considered by any entity that constructs a power plant:

- Carefully selecting the location of new power plants. Plant locations should be selected in unpopulated areas to avoid land use conflicts. In populated areas, compatible types of generation should be selected.

- Obtaining replacement power from non-emitting sources such as other hydro, solar, and wind sources. This can occur through construction of, or the use of incentives to construct, non-emitting power plants. This approach is consistent with state and federal policies related to promoting use of renewable resource type generation as expressed in Public Utility Code Section 381(c) (part of what is commonly referred to as AB 1890) and Executive Order 12902.

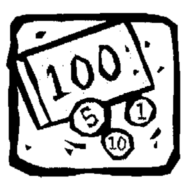
As noted earlier, individual actions (along with their corresponding impacts and effects) will be examined in subsequent project-level studies. The environmental documentation for project-level studies can tier off this Programmatic EIS/EIR. These mitigation strategies will be considered during project planning and development. Specific mitigation measures that are applicable at the project level will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

7.9.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable impacts on power production and energy are associated with the Preferred Program Alternative. Project-specific subsequent analysis is necessary to fully determine the impacts of individual projects on power and energy resources, and the site-specific impacts of actions taken.

7.10 Regional Economics

Most local regional economies would benefit from implementation of the CALFED Bay-Delta Program, but the regional economy of the Delta would be adversely affected by conversion of agricultural land to other uses. Program costs could exceed benefits in some other areas, but the amount and allocation of costs are currently uncertain.



7.10 Regional Economics

7.10.1 SUMMARY

Regional economies are the local systems of producing, delivering, and trading goods and services. Regional economics is concerned with the net effect of all Program actions on local economies. Employment, personal income, and impacts on public costs and finance are addressed in this section. Each of the CALFED Program elements could affect regional economics. Most adverse effects are related to programs that would modify production or require cost shares. Most beneficial effects result from beneficial Program effects on water supply and quality, recreation, and reduced regulatory costs. Some beneficial effects are the result of increased asset values. Improved flood control, for example, could increase land values in the Delta. Economic effects are not judged for significance, and no mitigation is required.

Social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic or social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic or social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project. Methods to avoid or reduce adverse social and economic effects are presented for those regional effects deemed substantial.

Preferred Program Alternative. Most potential adverse effects result from Program costs, but the pattern of cost repayment over regions is currently unknown. Other adverse effects are the result of converting agricultural land to other uses, such as habitat or levee setbacks. Potential adverse effects on income, employment, and public finance are projected to occur in the Delta Region—primarily due to effects on the agricultural sector. Negligible to moderate adverse effects from reduced agricultural production are expected in the Sacramento River and San Joaquin River Regions.

Alternatives 1, 2, and 3. The pattern of potential adverse effects associated with Alternatives 1, 2, and 3 is largely the same as described for the Preferred Program Alternative. The conversion of Delta agricultural land to habitat, and subsequent adverse effects on the Delta economy, would occur under any of the three alternatives. These alternatives differ from the Preferred Program Alternative primarily in their effects on conveyance costs and quality of Delta exports.

7.10.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. For example, opinions concerning the correct size of economic multipliers differ among technical experts. The costs, benefits, and patterns of cost allocation for Program actions have not yet been developed. Economic impacts on small communities cannot be identified until the location of specific projects have been identified. The external effects of Delta land conversion cannot be determined until specific locations and projects have been proposed. These areas of controversy must be addressed and analyzed at the site-specific level of analysis, which will occur as projects are proposed to carry out the Preferred Program Alternative.

Public finance is an area of controversy created by uncertainty in the locations of Program actions and their effects on local expenditures and tax revenues. Local tax revenues may be affected by changes in land use, but current Program actions are not sufficiently defined to quantify such impacts. Local governments have expressed concerns that in-lieu taxes for wildlife habitat are not being paid, and there is no reason to expect that they will be paid in the future. These concerns are valid, but they cannot be addressed quantitatively at the level of detail specified for this programmatic document.

A large number of potential adverse impacts are related to costs of local government. Increase in social services costs, increased staffing costs, conflicts with local plans and policies, and increased maintenance and operations costs could affect local governments and residents. Again, these types of effects cannot be quantified at the level of detail provided by this document.

7.10.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

7.10.3.1 DELTA REGION

The Delta Region study area includes many small communities in the Delta, as well as portions of three urban areas: Pittsburg/Antioch, Stockton, and Sacramento. Parts of five counties (Contra Costa, Solano, Sacramento, San Joaquin, and Yolo) are located in the Delta Region study area. Existing economic output, employment, income, and population data for the Delta Region are presented in Table 7.10-1. Table 7.10-1 shows estimates of final demand, total industry output, employee compensation, property income, place of work income, total value added, and employment for each region included in the regional assessment.

Table 7.10-1. Regional Economic Levels under Existing Conditions, 1992 Dollars

Region/Industry	Final Demand (billion dollars)	Total Industry Output (billion dollars)	Employ Compens. Income (billion dollars)	Property Income (billion dollars)	Place of Work Income (billion dollars)	Total Value Added (billion dollars)	Employ-ment (1,000s of jobs)
Delta Region							
Agriculture, forestry, fisheries	0.4	0.5	0.1	0.1	0.2	0.2	11
Mining	0.2	0.2	0.0	0.1	0.2	0.2	0
Construction	1.1	1.2	0.3	0.1	0.5	0.5	13
Manufacturing	2.9	3.5	0.8	0.6	1.4	1.5	20
Transportation, communication, utilities	0.6	1.1	0.3	0.3	0.5	0.6	8
Wholesale, retail trade	1.3	1.6	0.8	0.2	1.1	1.3	39
Finance, insurance, real estate	1.4	1.9	0.4	0.9	1.3	1.5	16
Services	1.9	2.6	1.2	0.5	1.7	1.7	53
Government enterprise, special industry	1.2	1.4	1.1	0.1	1.2	1.2	34
Total	**11.1**	**14.1**	**5.0**	**2.9**	**7.9**	**8.5**	**194**
Population (1,000s)						348	
Bay Region							
Agriculture, forestry, fisheries	1.2	1.5	0.4	0.3	0.7	0.7	29
Mining	3.6	3.7	0.3	1.5	1.8	2.5	5
Construction	14.8	16.9	5.2	1.6	6.8	6.8	165
Manufacturing	66.0	79.8	20.6	14.2	34.8	35.8	437
Transportation, communication, utilities	13.9	20.9	5.9	5.0	10.9	11.5	150
Wholesale, retail trade	23.3	29.1	14.6	4.2	18.9	23.4	626
Finance, insurance, real estate	24.9	34.4	7.0	16.5	23.6	27.3	262
Services	35.3	51.3	22.9	10.3	33.2	33.8	969
Government enterprise, special industry	15.1	16.6	13.7	0.6	14.0	14.0	406
Total	**198.2**	**254.1**	**90.6**	**54.2**	**144.5**	**155.9**	**3,049**
Population (1,000s)						4,916	
Sacramento River Region							
Agriculture, forestry, fisheries	1.8	2.6	0.3	0.6	0.9	0.9	55
Mining	0.7	0.8	0.1	0.5	0.6	0.6	2
Construction	8.4	9.4	2.4	0.8	3.2	3.3	100
Manufacturing	9.2	11.6	2.6	1.9	4.6	4.9	79
Transportation, communication, utilities	2.9	5.5	1.5	1.4	2.9	3.1	43
Wholesale, retail trade	7.9	9.4	4.9	1.2	6.2	7.5	254
Finance, insurance, real estate	8.9	11.8	2.1	5.5	7.6	9.3	103
Services	11.1	14.5	6.4	2.7	9.2	9.3	314
Government enterprise, special industry	11.2	12.3	9.1	1.2	10.3	10.3	294
Total	**62.1**	**77.9**	**29.5**	**15.8**	**45.3**	**49.4**	**1,244**
Population (1,000s)						2,352	

Table 7.10-1. Regional Economic Levels under Existing Conditions, 1992 Dollars (continued)

Region/Industry	Final Demand (billion dollars)	Total Industry Output (billion dollars)	Employ. Compens. Income (billion dollars)	Property Income (billion dollars)	Place of Work Income (billion dollars)	Total Value Added (billion dollars)	Employ-ment (1,000s of jobs)
San Joaquin River Region							
Agriculture, forestry, fisheries	9.1	12.5	1.4	2.4	3.8	3.9	249
Mining	4.0	4.4	0.2	2.3	2.6	3.1	5
Construction	7.1	8.4	2.1	0.6	2.7	2.8	89
Manufacturing	15.9	19.3	3.5	2.6	6.1	6.6	112
Transportation, communication, utilities	3.5	6.0	1.6	1.4	3.0	3.2	53
Wholesale, retail trade	6.9	8.8	4.7	1.2	5.9	7.2	240
Finance, insurance, real estate	6.5	9.2	1.5	4.6	6.1	7.5	77
Services	9.5	12.1	5.3	2.2	7.5	7.6	264
Government enterprise, special industry	6.7	7.1	6.1	0.3	6.5	6.5	212
Total	**69.3**	**87.9**	**26.4**	**17.7**	**44.1**	**48.4**	**1,302**
Population (1,000s)						2,759.0	
Other SWP and CVP Service Areas							
Agriculture, forestry, fisheries	7.4	9.9	1.9	2.0	3.9	4.0	200
Mining	7.2	7.6	0.6	2.7	3.3	4.9	13
Construction	48.6	55.6	15.1	5.3	20.5	20.7	578
Manufacturing	153.3	189.0	48.3	35.3	83.6	85.5	1,384
Transportation, communication, utilities	25.0	47.0	12.7	11.6	24.4	26.0	365
Wholesale, retail trade	69.3	85.7	41.5	12.2	53.6	68.1	2,044
Finance, insurance, real estate	76.1	104.6	18.9	52.6	71.5	84.0	803
Services	106.4	153.8	66.8	30.0	96.8	98.7	2,884
Government enterprise, special industry	46.5	51.8	41.6	1.6	43.1	43.1	1,329
Total	**540.0**	**705.0**	**247.5**	**153.4**	**400.8**	**435.0**	**9,600**
Population (1,000s)						16,612	

Data for the Delta Region study area were estimated based on county population share living in the Delta and data for the other regions, excluding the statutory Delta. Data from the IMPLAN 1991 database were updated to 1992 dollars. Final demand is value of exports and other sales that originate independently from the regional economy. Total industry output is the total value of sales in the economy. The measure includes sales within the region, but intermediate goods are excluded to avoid double counting. Employee compensation represents wages and salaries; property income includes rents, dividends, interest, and proprietor's incomes. Place of work income combines these categories. Place of work means that the income is paid by industries in the region, as opposed to income paid to regional residents. Value added includes indirect business taxes. Employment is counted in thousands of jobs where some categories of jobs may last less than 1 year.

The 1991 population of the Delta Region study area was estimated to be about 350,000, of which 194,000 persons were employed. The total value of output was estimated at $14 billion. Employees compensation was estimated at $5 billion, and property income was about $3 billion—all measured in 1992 dollars.

In 1991, the population in the five Delta counties was approximately 2.9 million persons. The population grew by 24% from 1986 to 1995, at a rate similar to the state average. Most of this growth occurred in urban centers. As of the 1990 U.S. Census, Caucasians continued to compose the largest proportion of the population, although the relative proportion of all other ethnic groups has continued to rise. Historically, the Delta Region also has seen periods of high population growth. From 1940 to 1985, the population growth rate of the counties partially or entirely within the Delta Region exceeded that of the state as a whole. Contra Costa County's growth reflected the largest increase (611%), and San Joaquin County the smallest (211%). The average annual growth rate in the Delta Region was approximately 4%.

The composition of employment in the Delta Region counties has remained virtually unchanged since 1986. Services (including recreation-based services), government, and trade accounted for approximately 70% of total employment in the Delta Region counties in 1995. Agricultural employment remained at an estimated 2% of total employment from 1986 levels. In 1940, however, agriculture was the largest single employment sector in the Delta Region (21%), followed closely by manufacturing (19%).

Since 1986, total personal income in the Delta Region counties has increased, dominated by the service sector. In 1990, median family incomes ranged from $35,000 in San Joaquin County to $52,000 in Contra Costa County. Poverty rates in the individual counties vary widely, from 7% in Contra Costa County to 17% in Yolo County. Total personal income in the Delta Region has also increased. Farm income as a portion of total personal income has decreased since 1980, while income associated with service and retail sectors has increased.

Total county property tax revenues for the Delta Region counties increased steadily from the 1985/86 fiscal year ($349 million) until the early 1990s ($485 million). Property tax revenues for the 1993/94 fiscal year ($332 million) indicate a substantial reduction in the amount collected by the individual counties, possibly due to the Education Reinvestment Augmentation Fund of 1992 (ERAF).

7.10.3.2 BAY REGION

Table 7.10-1 shows economic variables estimated for the Bay Region. The population in 1991 was estimated at 4.92 million persons, of which 3.05 million were employed. Primary employers were services, trade, and manufacturing. In 1991, total industrial output was estimated at $254 billion, total employee compensation was about $91 billion, and property income was $54 billion.

Historically, the population of the Bay Region counties increased from about 4.54 million in 1970 to 5.48 million in 1990, for an annual growth rate of 2.25%. The growth rate slowed between 1990 and 1995 but increased in the late 1990s.

The largest employers in the Bay Region in 1940 were services, wholesale and retail trade, and manufacturing sectors, respectively. Agriculture, forestry, and fishing accounted for 3.8% of total household employment in the region. By 1992, agriculture, forestry, and fishing accounted for only 0.4% of wage and salary employment in the region.

7.10.3.3 SACRAMENTO RIVER REGION

Table 7.10-1 shows economic variables estimated for the Sacramento River Region. In 1991, the regional population was estimated at 2.35 million persons, of which 1.24 million were employed. Primary employers were services, government, trade, and finance/insurance/real estate. Total industrial output was estimated at $78 billion. Total employee compensation was about $30 billion, and property income was $16 billion. Most of the economic activity in the region is located in the Sacramento area and near Redding. Many small communities are largely dependent on agriculture. The population of the Sacramento River Region counties increased from about 1.23 million in 1970 to 2.21 million in 1990, for an annual growth rate of 3%. The growth rate slowed between 1990 and 1995 but increased in the late 1990s.

In 1940, agriculture was the largest single employer in the Sacramento River Region, providing 20.8% of total household employment in the region. By 1992, agricultural production provided 3.7% of total wage and salary employment in the area, or about 37,000 jobs. From 1940 to 1992, the share of manufacturing employment fell from 12.2% to 7.8%. Transportation, communications, and utilities fell from 9.1% to 4.5%. Conversely, during the same period, wholesale and retail trade increased from 18.4% to 23.2%, services increased from 17.7% to 23.6%, and government increased from 8.2% to 26.9%. Currently, the largest proportions of wage and salary jobs in the region are in the government, services, and wholesale and retail trade sectors, respectively.

Patterns of employment growth in the Sacramento River Region counties reflect the changing rural and urban complexion of the region. While production agriculture provides less than 4% of wage and salary employment, the percentage varies widely among the counties. In 1992, production agriculture accounted for 33% of employment in Colusa County, 19% in Glenn County, and 16% in Yuba County. However, agriculture accounted for less than 1% of employment in the relatively urban Sacramento, Placer, and Nevada Counties.

7.10.3.4 SAN JOAQUIN RIVER REGION

Table 7.10-1 shows economic variables estimated for the San Joaquin Region. In 1991, 1.3 million persons were employed. Primary employers were services, agriculture/forestry/fisheries, trade, and government. Total industrial output was estimated at $88 billion. Total employee compensation was about $26 billion, and property income was $18 billion.

The population of San Joaquin River Region counties increased from about 1.676 million in 1970 to 2.974 million in 1990, for an annual growth rate of 7.72%. The growth rate slowed between 1990 and 1995. In 1940, agriculture was the largest single employer in the San Joaquin River Region. At that time, agricultural production provided about one-third of total household employment in the region. By 1992, agricultural production provided less than 10% of total wage and salary employment in the area, or about 93,000 jobs. Currently, the largest proportions of wage and salary jobs in the region are in the services, wholesale and retail trades, and government sectors, respectively.

7.10.3.5 OTHER SWP AND CVP SERVICE AREAS

The study area includes service areas receiving SWP water in DWR's South Coast Region, Central Coast Region, and the Antelope Valley and Mojave River Planning Subareas of the South Lahontan Region. The San Felipe service area of the CVP, and the South and North Bay Aqueduct Regions are included in the Bay Region.

The South Coast Region includes the cities of Los Angeles and San Diego. Central Coast SWP contractors are in Santa Barbara and San Luis Obispo Counties. These two counties are served by deliveries through the Coastal Aqueduct of the SWP. Table 7.10-1 shows economic variables estimated for the Other SWP and CVP Service Areas. In 1991, 9.6 million persons were employed. Primary employers were services, trade, manufacturing, and government. Total industrial output was estimated at $705 billion. Total employee compensation was about $247.5 billion, and property income was $153 billion.

The first European use of the Central and South Coast Regions involved Spanish settlement for trade and cattle production. After statehood, the region grew quickly as agriculture, business, and industry took advantage of the region's warm Mediterranean climate. The Los Angeles metropolitan area is now the second largest in the nation. Population increased from about 12.1 million in 1970 to 18.2 million in 1990, for an annual growth rate of 4.4%. The population growth rate slowed between 1990 and 1995.

7.10.4 ASSESSMENT METHODS

The economic sectors most likely to be directly affected by the Program are agriculture, urban water supply, commercial fishing, recreation, construction, and hydropower. Specific economic effects for each sector are addressed in other sections. This section applies the projected economic changes in each sector to assess the general magnitude of direct and indirect effects on regional economies. The primary economic indicators assessed are employment, personal income, and public finance. Public finance involves the collection of income by public entities such as the State, towns and special districts.

In general, the expenditure of Program funds stimulates the economy at the location of the expenditure. The expenditure results in economic multiplier effects as it is respent in the regional economy. A multiplier is a direct expenditure, plus all the respending, divided by the direct expenditure alone. Some of the initial expenditure and respending are paid for goods and services from outside the region. These outside expenditures are called leakage. Leakage reduces the size of economic multipliers.

Expenditures must come from somewhere. Costs must be paid by somebody. The source of the money acquired for the expenditure is affected in opposite ways from the location of the expenditure. If money is merely taken from one region and given to another the net effect on expenditure is zero.

Programs, however, are not just transfers of money between regions. The expenditure also has a result in terms of the physical and economic consequence of the program. The program may build storage facilities or levees, conserve water, or convert farmland, for example, and these actions result in regional economic implications beyond the expenditures alone. If beneficiaries pay for a program and the long-run monetary benefits exceed costs, the beneficiaries realize more money to spend—in net income, disposable income, profits, or rents. This additional spending is an economic stimulus to the region. On the other hand, if the share of costs paid by the region exceeds the benefits, disposable income may be reduced and spending decreased.

In this simple construct, expenditure, employment, income, and public finance always move in the same direction. Employment is merely the physical unit to which employment income is paid. All changes in incomes, net incomes, and sales affect public finance through income, sales, and property taxes. Expenditure and subsequent multiplier effects have beneficial effects on public finance, but the economic consequences of a project may include impacts on costs of public services that must also be accounted for. Changes in net income can influence property values if net income is tied to the property. This is the case with agricultural land. If expected net returns increase or expected costs decrease, land value also is increased or decreased. Changes in land prices affect public finance through property taxes.

Regional economic effects also can occur through price changes and substitution effects. Price changes occur when supply or demand shifts cause prices to be bid up or down. Changes in the availability of land or water may cause prices to change. Land prices can be affected by changes in agricultural net revenues. Some prices—agricultural commodities, for example—are strongly influenced by trade and policy conditions determined outside California. Substitution effects occur when one factor of production is substituted for another. Irrigation technology and labor can be substituted for irrigation water, for example. Price changes and substitution effects can influence patterns of regional economic effects. In general, these market effects will work to reduce economic costs by finding efficient ways to deal with them.

The following assumptions were made for the quantitative portions of this analysis:

- Average gross revenue per acre of affected cropland averages between $500 and $1,500 per year.

- Fifty direct jobs are created per $1 million of agricultural revenue.

- Economic multipliers for jobs and output are on the order of 2 to 3 for each of the regions in the analysis (that is, each job or dollar of output creates 2-3 more jobs or dollars through trade linkages).

- Costs of storage and conveyance facilities are taken from the Storage and Conveyance Component Cost Estimates, dated April 29, 1998.

Most other information about regional impacts is provided in a qualitative fashion. Insufficient information about direct economic effects is available to perform a complete quantitative analysis of impacts by region. For this analysis, the evaluation methodology has identified the overall level of magnitude and direction of potential regional economic impacts, based on the description of Program actions for each alternative and an estimate of the degree to which each Program action or component would affect water and land use in each region.

The programmatic nature of this analysis does not support complete estimation of specific changes in economic values in the local communities within each of the identified study areas. The Program recognizes that impacts on individual counties and communities can be proportionately greater or smaller than the regional impacts are designed to show. These more localized impacts will be assessed when decisions are made about implementation of specific projects.

Regional economic effects are a subset of a broader set of indicators for the well-being of a region. Regional effects such as employment and income often are linked to social effects such as poverty, divorce, crime, suicide, and other mortality. These linkages are not provided here but, in general, it may be inferred that these social effects are related to employment and income.

7.10.5 CRITERIA FOR DETERMINING EFFECTS

Social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic or social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic or social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project.

Levels of effect are identified for employment and income on the basis of potential changes in sectoral employment within each region in comparison to regional employment. A substantial effect on income, output, or employment is defined as more than one-half of 1% of the region's baseline level. Employment changes in small subregions may be a much larger percent of subregional employment. No attempt has been made to isolate effects in smaller subregions or individual communities. Qualitative assessment of effects on public finance is provided.

Employment is related to social well-being. The significance of employment effects on social well-being is discussed in Section 7.3, "Agricultural Social Issues."

7.10.6 NO ACTION ALTERNATIVE

The 2020 condition for regional economics incorporates economic growth but not change in economic structure. It is assumed that the California economy will continue to grow at a rate similar to the forecasted rate of population growth, but the No Action Alternative regional economic structure is assumed to remain the same as existing conditions. This means that economic shares are assumed to remain the same as the economy grows. Based on past trends, it might be assumed that manufacturing, agriculture, and mining would continue to decrease in relative importance while government and services increase. This continued trend is not reflected in this analysis, and 2020 regional economies are larger but otherwise the same as in existing conditions.

The No Action Alternative economic data for each region are provided in Table 7.10-2. These data were obtained from the IMPLAN 1991 database and adjusted for economic growth to 2020 using population forecasts issued by the California Department of Finance.

Table 7.10-2. Regional Economic Levels under the No Action Alternative, 2020, 1992 Dollars

REGION/INDUSTRY	FINAL DEMAND (billion dollars)	TOTAL INDUSTRY OUTPUT (billion dollars)	EMPLOY. COMPENS. INCOME (billion dollars)	PROPERTY INCOME (billion dollars)	TOTAL PLACE OF WORK INCOME (billion dollars)	TOTAL VALUE ADDED (billion dollars)	EMPLOY-MENT (1,000s of jobs)
Delta Region							
Agriculture, forestry, fisheries	0.5	0.7	0.1	0.1	0.2	0.2	14
Mining	0.3	0.3	0.0	0.2	0.2	0.2	0
Construction	1.4	1.6	0.4	0.1	0.6	0.6	16
Manufacturing	3.7	4.5	1.1	0.7	1.8	1.9	26
Transportation, communication, utilities	0.8	1.3	0.4	0.3	0.7	0.7	10
Wholesale, retail trade	1.7	2.1	1.1	0.3	1.3	1.7	50
Finance, insurance, real estate	1.8	2.4	0.5	1.2	1.6	1.9	20
Services	2.4	3.3	1.5	0.6	2.1	2.2	67
Government enterprise, special industry	1.6	1.7	1.4	0.1	1.5	1.5	44
Total	**14.1**	**18.0**	**6.3**	**3.7**	**10.1**	**10.9**	**248**
Population (1,000s)						445	
Bay Region							
Agriculture, forestry, fisheries	1.5	2.0	0.5	0.4	0.9	0.9	37
Mining	4.6	4.7	0.3	1.9	2.3	3.1	6
Construction	18.9	21.5	6.6	2.1	8.6	8.7	210
Manufacturing	84.2	101.8	26.2	18.1	44.4	45.7	558
Transportation, communication, utilities	17.8	26.6	7.5	6.3	13.8	14.7	191
Wholesale, retail trade	29.7	37.1	18.7	5.4	24.1	29.9	799
Finance, insurance, real estate	31.8	43.9	9.0	21.1	30.1	34.9	334
Services	45.0	65.5	29.3	13.1	42.4	43.1	1,237
Government enterprise, special industry	19.3	21.2	17.5	0.7	17.8	17.8	518
Total	**252.9**	**324.3**	**115.6**	**69.2**	**184.4**	**198.9**	**3,891**
Population (1,000s)						6,273	
Sacramento River Region							
Agriculture, forestry, fisheries	3.1	4.5	0.5	1.0	1.6	1.7	97
Mining	1.3	1.4	0.1	0.9	1.0	1.1	3
Construction	14.8	16.4	4.3	1.3	5.6	5.7	176
Manufacturing	16.1	20.4	4.6	3.3	8.0	8.6	138
Transportation, communication, utilities	5.1	9.6	2.6	2.5	5.1	5.5	76
Wholesale, retail trade	13.9	16.5	8.6	2.2	10.8	13.2	445
Finance, insurance, real estate	15.6	20.6	3.7	9.6	13.3	16.4	181
Services	19.5	25.5	11.3	4.8	16.1	16.4	550
Government enterprise, special industry	19.6	21.6	16.0	2.1	18.1	18.1	515
Total	**108.9**	**136.5**	**51.8**	**27.7**	**79.5**	**86.5**	**2,181**
Population (1,000s)						4,123	

Table 7.10-2. Regional Economic Levels under the No Action Alternative, 2020, 1992 Dollars (continued)

REGION/INDUSTRY	FINAL DEMAND (billion dollars)	TOTAL INDUSTRY OUTPUT (billion dollars)	EMPLOY. COMPENS. INCOME (billion dollars)	PROPERTY INCOME (billion dollars)	TOTAL PLACE OF WORK INCOME (billion dollars)	TOTAL VALUE ADDED (billion dollars)	EMPLOY-MENT (1,000s of jobs)
San Joaquin River Region							
Agriculture, forestry, fisheries	19.6	26.9	3.0	5.2	8.2	8.4	533
Mining	8.6	9.4	0.5	5.0	5.5	6.7	11
Construction	15.3	17.9	4.5	1.3	5.9	5.9	192
Manufacturing	34.0	41.3	7.5	5.6	13.2	14.2	240
Transportation, communication, utilities	7.5	12.8	3.4	3.0	6.4	6.9	114
Wholesale, retail trade	14.7	18.9	10.0	2.6	12.6	15.3	513
Finance, insurance, real estate	14.0	19.8	3.2	9.8	13.0	16.0	166
Services	20.3	26.0	11.3	4.7	16.0	16.3	566
Government enterprise, special industry	14.4	15.3	13.1	0.7	13.8	13.8	455
Total	**148.4**	**188.3**	**56.6**	**37.9**	**94.5**	**103.6**	**2,790**
Population (1,000s)						5,911	
Other SWP and CVP Service Areas							
Agriculture, forestry, fisheries	11.2	15.1	2.9	3.1	5.9	6.0	305
Mining	11.0	11.6	0.9	4.2	5.1	7.5	20
Construction	74.0	84.6	23.0	8.1	31.2	31.4	879
Manufacturing	233.3	287.6	73.5	53.8	127.3	130.1	2,106
Transportation, communication, utilities	38.1	71.5	19.4	17.7	37.1	39.6	556
Wholesale, retail trade	105.5	130.4	63.1	18.5	81.6	103.6	3,111
Finance, insurance, real estate	115.8	159.1	28.8	80.0	108.8	127.8	1,221
Services	161.9	234.1	101.7	45.7	147.4	150.3	4,389
Government enterprise, special industry	70.8	78.8	63.2	2.4	65.6	65.6	2,022
Total	**821.7**	**1,072.8**	**376.6**	**233.4**	**609.9**	**661.9**	**14,608**
Population (1,000s)						25,279	

Source:
IMPLAN 1991 database and California Department of Finance 1991 and 2020 population projections. Sacramento River, San Joaquin River, and Bay Regions are reduced for share of population living in the Delta. Shares are 4.1%, 4.1%, and 2.6%, respectively. The Delta Region numbers are the sum of these shares.

The comparison of Program alternatives to existing conditions is the same as the comparison to the No Action Alternative, except that 1995 development conditions are different from the 2020 development conditions in the No Action Alternative. The No Action Alternative conditions require more water supply to meet 2020 demand. DWRSIM results suggest that export supplies can be increased to meet these demands on average, but not in dry periods. This finding implies that local water supplies must be increased, or per capita demands reduced, by 2020. The conclusions regarding project effects on regional economics when compared to existing conditions would be similar to those compared to the No Action Alternative.

7.10.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For regional economics, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, and Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as discussed in Section 7.10.8.

7.10.7.1 DELTA REGION

Ecosystem Restoration Program

Most effects in the Delta Region involve the loss of agricultural land. Some construction expenses would result in positive economic impacts in the Delta, and recreation expenses would increase in response to improved recreation opportunities. Increases in the recreation economy and temporary effects of construction are not expected to fully compensate for losses in the agricultural economy.

The Ecosystem Restoration Program would directly affect land and water resources used for agricultural production in the Delta. Substantial direct losses to farm revenues and employment also would result in adverse indirect effects on local communities and public finance. Ecosystem Restoration Program actions could result in a total regional loss of agricultural revenues of $60-$225 million per year or more, representing about 20% of the regional total. Approximately 3,000-11,000 jobs, or about half of the regional agricultural employment, may be lost through just the direct effects. Total effects across all sectors could amount to losses of approximately $120-$500 million in output and 10,000-20,000 jobs worth about $200-$400 million in personal income. Although these impacts are a small fraction (from 2 to 5%) of the regional economy, they could be very important on a localized basis. The loss of property taxes could result in a negative effect on public finance for county, municipal, and other local jurisdictions.

Possible methods of alleviating these effects could include phasing project elements in order to allow local economies to gradually adjust to new conditions; providing job training and retraining, and supporting actions for economic development loans and grants; providing technical assistance to displaced farmers; supporting actions to alleviate the proposed removal of private lands from tax and assessment roles by, for example, making in-lieu payments to local governments; supporting actions to provide economic development and transitional assistance funds; minimizing or avoiding fallowing, or shifting to crops that require high input and output expenditures; promoting geographically broad-based ecosystem restoration to ensure that no one localized area is involved in a disproportionately large amount of land conversion; limiting the amount of acreage that can be fallowed in a given area; minimizing job loss to the extent possible by relocating facilities and shifting agriculture to new areas; providing job referral and placement services; supporting actions to compensate local governments for increased demand for services resulting from labor displacement; and supporting actions to compensate workers displaced by specific transfers through such actions as augmenting unemployment insurance benefits.

Short-term adverse impacts on recreation could occur as Ecosystem Restoration projects are implemented, but improved recreational opportunities, especially for fishing, are expected to increase Delta recreation in the long run. The increased jobs and spending in the recreational and fisheries sectors are not expected to offset the losses stemming from agricultural land conversion.

Additional mosquito control costs may be caused by increased wetland acreage. The magnitude of the costs and their allocation are currently unknown for this potentially adverse economic impact.

Water Quality Program

Potential regional economic impacts from the Water Quality Program are expected to be low to moderate. Increased emphasis on control of Delta island drainage might require new treatment or drainage rerouting. Improved water quality will benefit the ecosystem, recreational activities, and some Delta municipal and industrial (M&I) water users. The costs associated with any water quality improvement are unknown.

Levee System Integrity Program

Short-term economic benefits would occur in construction and related industries from expenditure of about $1.5 billion for upgrades on about 500 miles of levees. Increased levee system reliability could enhance land values and result in a beneficial impact on public finance. Costs of the program could offset the economic benefits; however, no information on cost allocation is available to calculate a net effect.

Water Use Efficiency Program

The Water Use Efficiency Program could affect rural communities and regional economies that depend on agriculture through several mechanisms:

- Some of the expenditure for irrigation improvements could stimulate the regional economy.
- Cost-effective expenditure on irrigation could increase net returns.
- The Water Use Efficiency program could decrease demand for unskilled farm labor and increase demand for skilled labor.
- Some incidental effects of improved efficiency, such as better water quality or increased crop yields, could benefit agriculture.

Benefits of municipal water use efficiency include:

- The costs of new water supplies avoided plus other costs, such as energy and wastewater costs, avoided by conservation.
- Water reuse benefits, if water reuse is a cost-effective supply.

Costs of improved water use efficiency and water reuse could offset these agricultural and municipal benefits. However, little information on the amount of costs and cost allocation is available to calculate a net effect. It is believed that costs of some of the water reuse proposed by the Program are more per unit than the costs of other new water supplies.

Water Transfer Program

The voluntary transfer of water out of the Delta Region that may occur is not expected to result in any adverse economic effects on the region. Water Transfer Program actions and existing legal requirements placed on water transfers will avoid significant effects from fallowing irrigated land. Water transferred to urban water use in the Delta might reduce water supply costs and result in regional economic benefits.

Watershed Program

The Watershed Program is not expected to result in any substantial impacts in the Delta Region.

Storage

With new storage, water supplies in dry and average years would increase. Dry-year supplies would increase substantially in comparison to a Program alternative without new storage. Total water supplies for all users are estimated to increase from 600 to 800 TAF on average and by over 1 MAF in some critical years. Delta Region water users would obtain only a fraction of the total increase. Any storage facilities constructed in the Delta would cause additional losses of agricultural production and would result in temporary local benefits from construction expenditures.

Program alternatives would increase CVP and SWP available electrical generation capacity and generation if storage facilities are developed; however, the increase in CVP and SWP project energy use associated with the Program would be greater than the increase in power production. Therefore, the amount of power available for sale from the projects would be reduced, the SWP's net energy requirement would increase, and Western and DWR likely would increase their power rates. Increases in Western power rates could cause adverse impacts on Western and its preference power customers. Increased power costs could reduce disposable income and regional spending.

7.10.7.2 BAY REGION

None of the Program elements are expected to produce long-term adverse economic effects on the regional economy of the Bay Region. This finding is primarily due to the size of the Bay Region economy in comparison to Program costs. Public finances are not expected to be substantially adversely affected.

Ecosystem Restoration Program

The Ecosystem Restoration Program would have little effect on the Bay Region, except that (1) some expenditures on the program would be captured by the region, a short term effect; (2) some increases in recreational spending might occur; and (3) the region may pay for some of the program. The amount of cost and cost allocation are currently unknown.

Levee System Integrity Program

Short-term economic benefits would occur in construction and related industries due to the expenditure of about $1.5 billion for upgrades on about 500 miles of levees in the Delta. Some of this expenditure would spill into the Bay Region.

Water Transfer Program

The Water Transfer Program might allow more water to be imported into the Bay Region, augmenting existing supplies, improving reliability, and reducing water supply costs.

Water Quality and Water Use Efficiency Programs

Implementation costs associated with the Water Quality and Water Use Efficiency Programs could result in short-term adverse effects. Over the long term, income generation might increase as a result of increased water supply reliability. Improved water quality could benefit the commercial fishing and recreation industries. Relocation of water supply intakes and construction of water reuse projects could provide new construction income and employment for the region.

Watershed Program

The Watershed Program is not expected to substantially affect land use in the Bay Region. The region may pay for some of the program, but the costs and cost allocation for the Watershed Program are currently unknown.

Storage

Increased storage could increase water supply, reducing costs for other supplies. Based on current allocation patterns, and before considering storage costs, additional water supplies with new storage could save M&I users from $3 million to $13 million per year. Local beneficiaries would pay for the share of water supply they use. The effects on public finance and regional economics from the financing of storage are currently unknown. Some of the expenditure for storage facilities would spill into the region. Regional economic impacts from power production are the same as those described for the Delta Region.

7.10.7.3 SACRAMENTO RIVER REGION

Ecosystem Restoration Program

The Ecosystem Restoration Program would directly affect land and water resources used for agricultural production in the Sacramento River Region. Slight to moderate amounts of farm revenues and employment would be lost, and these direct effects would result in adverse indirect effects on local communities and public finance. Ecosystem Restoration Program actions could result in a total regional loss of agricultural revenues of up to $34 million per year. Possible methods of alleviating these effects were discussed for the Delta Region.

Water Quality Program

Implementation costs associated with the Water Quality Program could result in short-term adverse impacts, but construction expenditures could be beneficial to the local economy. Costs and cost allocation are currently unknown.

Levee System Integrity Program

Economic effects associated with the Levee System Integrity Program in the Sacramento River Region are expected to be negligible. Some spillover of construction expenditure can be expected.

Water Use Efficiency Program

Impacts on regional economics in the Sacramento River Region associated with the Water Use Efficiency Program would be similar to those described for the Delta Region.

Water Transfer Program

The Sacramento River Region may function primarily as a source of water transferred into other regions and therefore primarily would experience adverse effects. Use of temporary land fallowing as a source for water to transfer could result in adverse economic effects, depending on the magnitude, timing, and source of water. These effects would be minimal if appropriate protections are in place. Revenues generated by water transfers could offset some of the loss if the transfer proceeds are spent in the region. Water Transfer Program actions and existing legal requirements placed on water transfers will avoid significant effects from fallowing irrigated land.

Watershed Program

Activities could substantially affect land use in the region. Economic impacts depend on the types of actions and the form of incentives used to obtain the desired results. Subsidies would be generally beneficial to the regional economy.

Storage

Increased storage could increase water supply, reducing costs for other supplies. Local beneficiaries would pay for the share of water supply that they use, but costs of Program supplies are currently unknown.

Agricultural land could be lost by inundation, resulting in a loss of farm revenue of approximately $32 million. With impacts of the Ecosystem Restoration Program, about 1% of the regional agricultural revenues could be affected. Up to 3,300 jobs might be lost, representing less than 1% of all regional jobs. Since agricultural spending and income are a small share of total regional spending and income, the net region-wide effect on personal income, employment, and public finance would be negligible; however, they could be important on a localized basis. Agricultural water users may obtain additional water supplies, which could reduce or eliminate net losses.

Effects of construction expenditure could result in localized beneficial effects. Total expenditures for storage and related facilities could be from $1 to $3 billion dollars. Most of these effects would be short term. Impacts on recreation spending are expected to be positive. Regional economic impacts from power production are the same as those described for the Delta Region. The effects on public finance and regional economics from financing storage are currently unknown.

7.10.7.4 SAN JOAQUIN RIVER REGION

Effects on the San Joaquin River Region should be similar to those described for the Sacramento River Region, except as noted below.

Ecosystem Restoration Program

Ecosystem Restoration Program actions could result in a total regional loss of agricultural revenues of up to $11 million per year. Urban water quality for export users south of the Delta could be affected. Possible methods of alleviating these effects were discussed for the Delta Region.

Water Quality Program

Urban water quality for export users south of the Delta could be affected by Water Quality Program actions. Increased and usable water supplies may enhance economies or benefit the regional economy by lowering treatment costs. Please refer to Section 5.3, "Water Quality," and Section 7.5, "Urban Water Supply Economics," for more information.

Levee System Integrity and Watershed Programs

Economic impacts associated with the Levee System Integrity and Watershed Programs in the San Joaquin River Region are expected to be negligible.

Water Use Efficiency Program

The Water Use Efficiency Program could affect agricultural economies south of the Delta. Economic impacts associated with the Water Use Efficiency Program in the San Joaquin River Region are similar to those described for the Delta.

Water Transfer Program

The Water Transfer Program most likely would result in beneficial economics effects in the San Joaquin River Region. Beneficial effects of transfers are more likely to occur in the San Joaquin Valley, since transfers from this area are more likely to be surplus reservoir water or transfers based on conjunctive use and groundwater banking projects. In addition, this area is likely to be the recipient of water transferred in from the Sacramento River and Delta Regions. As a receiving area, beneficial effects can result from increased water supply reliability for agriculture, beneficially affecting productivity and employment opportunities.

Storage

Implementing the Storage element in the San Joaquin River Region would result in effects similar to those described for the Sacramento River Region, except that more productive agricultural land might be converted for new storage facilities. Total losses in agricultural revenues could be an additional $25 million annually. On a regional basis, these effects are considered small adverse economic effects; however, they may be important on a localized basis. Possible methods of alleviating these effects were discussed for the Delta Region.

Agricultural water users may obtain additional water supplies, which could reduce or eliminate net losses. The San Joaquin River Region stands to gain more than most agricultural regions from new water supplies since the region is relatively water scarce and water is relatively expensive. Expenditure of construction funds also could be beneficial.

7.10.7.5 OTHER SWP AND CVP SERVICE AREAS

The Other SWP and CVP Service Areas would experience a pattern of impacts similar to those described for the Bay Region, except as discussed below.

Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs

The Other SWP and CVP Service Areas could be affected by most programs as a source of finance. Current costs and cost allocation are unknown. Water quality benefits could benefit regional economies by reducing the cost of water treatment. The Water Use Efficiency Program, especially urban water efficiency and water reuse actions, could result in a relatively important effect on this region. Water supply reliability might be increased, but costs of additional conservation and water reuse may be more than other available supplies. Because the region is located relatively distant from the Delta, effects on Delta recreation or the costs of construction would have little effect on this region. Increased water transferred to the region could increase water supplies and decrease the need for other, probably more expensive, sources.

Storage

With new storage, and before considering Program cost shares, M&I water supply cost savings could be $80-$250 million per year. Most water from Program Storage probably would replace other supplies, but any increases in net water supply caused by increases in the amount of water exported to the region could increase regional revenues and jobs. New Program water supplies could improve the quality of water supplies in the region. Savings from reduced treatment costs and end-user costs may be important. The potential adverse effects of financing storage have not been estimated.

7.10.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For regional economics resources, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.10.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

Improvements in conveyance and CVP and SWP wheeling are expected to improve water supply reliability (see Section 5.1.8.4) when compared to the No Action Alternative. Benefits would be partially or completely offset by costs of the improvements. Local beneficiaries would pay for the share of the Program water supply that they use. The effects on public finance and regional economics from financing conveyance and storage are currently unknown.

Delta Region

Improved conveyance could increase water supply, especially in the west Delta, reducing costs for other supplies. Without new storage, the increase in water supply in average years would be about four times the increase in dry years. Improvements in through-Delta water conveyance could improve urban water quality in the western part of the region. Water quality improvements from improved conveyance are expected to be important. Cost savings may involve salinity and DBP precursors. Changes in operations are not anticipated to adversely affect regional economics. Construction expenditures could result in temporary impacts on local economies. Some agricultural land would be lost, reducing agricultural revenues above Ecosystem Restoration Program effects.

Bay Region

Water supply and urban water quality would be improved. Cost savings may involve salinity and DBP precursors. Changes in operations are not anticipated to adversely affect regional economics. Some of the expenditure for construction of conveyance could spill over from the Delta Region into the Bay Region. The effects of financing conveyance on regional economics are currently unknown.

Sacramento River and San Joaquin River Regions

Water supply increases would improve agricultural economics. Water quality improvements would occur for a few small urban water users south of the Delta.

Changes in operations are not anticipated to adversely affect regional economics. Some of the expenditure for construction of conveyance could spill over from the Delta Region into the Sacramento River and San Joaquin Regions. The effects of financing conveyance on regional economics are currently unknown.

Other SWP and CVP Service Areas

New Program water supplies and improved conveyance could improve the quality of water supplies in the region. Reduced concentrations of salinity and DBPs could result in important cost savings and increased disposable income in the region. Any increases in water supply caused by net increases in the amount of water exported to the region could increase regional revenues and jobs. The potential adverse effects of financing the Preferred Program Alternative have not been estimated.

7.10.8.2 ALTERNATIVE 1

All Regions

The patterns of effects for Alternative 1 generally would be identical to those described for the Preferred Program Alternative, except for differences involving Conveyance elements. In comparison to the No Action Alternative, salinity and concentration of bromides in water exports from the south and west Delta would increase. Increased costs for water treatment and end-user costs would adversely affect regional economies in the Bay and South Coast Regions.

With storage, the amounts and costs of other non-Program water supplies would be reduced; but the costs of Program storage would be paid by the beneficiaries. Local, temporary economic effects associated with construction of storage and conveyance facilities would occur.

7.10.8.3 ALTERNATIVE 2

All Regions

The patterns of effects for Alternative 2 would be similar to those described for the Preferred Program Alternative. Export water quality would be improved even more than under the Preferred Program Alternative. The pattern of impacts on agricultural lands in the Delta would be more and somewhat different.

7.10.8.4 ALTERNATIVE 3

Delta Region

The patterns of effects for Alternative 3 would be similar to those described for Alternative 2, except that (1) export water quality at CCFB would be improved even more; (2) export water quality at the CCWD intake and at the Old River at SR 4 would decline in comparison to Alternative 2, but still would be better than under the No Action Alternative; (3) the pattern of impacts on agricultural lands in the Delta would be somewhat different; (4) more loss of agricultural land would occur in the Delta; and (5) water supply increases probably would be less on average. For regional economics, the implications of Alternative 3 include more construction impacts in the Delta, water quality benefits in export regions in terms of reduced treatment costs, and more adverse effects on agricultural economies in the Delta.

Construction of isolated conveyance facilities would generate new economic activity in the Delta region during the construction phase, resulting in moderate beneficial effects on income, employment, and public finance. Total construction expenditures are expected to be from $1-$2 billion above those costs identified for the through-conveyance improvements. Most of these effects would be short term. In the long term, some agricultural land would be lost, reducing agricultural revenues by about $20 million annually above Ecosystem Restoration Program effects. The effects on public finance and regional economics from financing conveyance are currently unknown.

Bay Region

In the Bay Region, construction of isolated conveyance facilities could generate new economic activity, depending on the amount of spillover from the Delta Region. Most of these effects would be short term. Conveyance facilities would improve the quality of water supply for most urban water users. The effects on public finance and regional economics from financing conveyance are currently unknown.

Sacramento River Region

In the Sacramento River Region, effects associated with construction of isolated conveyance facilities would be similar to those described for the Bay Region, except that urban water quality would be unaffected.

San Joaquin River Region

In the San Joaquin River Region, effects associated with construction of isolated conveyance facilities would be similar to those described for the Sacramento River Region, except that the improved quality of export water would be a benefit to some urban water supplies.

Other SWP and CVP Service Areas

Impacts in the Other SWP and CVP Service Areas associated with construction of isolated conveyance facilities would be similar to those described for the Bay Region. Differences include less construction expenditure spillover, potential for substantial urban water quality cost savings because baseline levels of water use and salinity are higher, and a larger share of export water supplies and subsequent repayment.

7.10.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. This programmatic analysis found that the potentially beneficial and adverse effects from implementing any of the Program alternatives when compared to existing conditions are essentially the same effects as those identified in Sections 7.10.7 and 7.10.8, which compare the Program alternatives to the No Action Alternative.

The No Action Alternative assumes 2020 development conditions. In regional economics, 2020 regional economies are larger than the 1995 existing conditions economies. These larger economies require more water or more demand management actions, and existing supplies are stretched more. Without new supplies or more demand management actions, shortages are more frequent and larger, as a proportion of demand, than under existing conditions. Also, the water quality of Delta exports under the No Action

Alternative is expected to be worse in 2020 than under existing conditions. Water quality improvements in 2020 have the potential to be more valuable, in terms of avoided costs, than they are under existing conditions.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional adverse environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative.

The benefits of the Program on regional economics under the Preferred Program Alternative include:

- Increases in recreation-related or construction-based economies.
- Increased land values due to flood protections.
- Reduced cost to some water supplies due to increased storage.
- Some increases in regional revenues and jobs associated with the Storage element.

The potential adverse effect on the Delta Region of converting agricultural lands to other uses remains an unavoidable effect when compared to existing conditions.

7.10.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. For regional economics, the analysis and conclusions regarding the Preferred Program Alternative's contribution to cumulative effects are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term effects. This is partially due to the long-term nature of the Program and the wide range of actions that fall within the scope of the Program's potential future actions. Section 7.10.1 presents in summary form a discussion of the potential long-term regional economic effects. Sections 7.10.7 and 7.10.8 elaborate on long-term effects.

Cumulative effects could involve a number of projects and actions that may add to Program effects in the following areas:

- Agricultural land conversion and loss of agricultural economies
- Construction expenditure impacts
- Changes in costs of water supply
- Changes in recreation spending
- Cost recovery and cost allocation

Several actions would influence agricultural land conversion to other uses. In particular, the Delta Wetlands Project would result in additional loss of land in the Delta by inundation. Other programs that may influence Delta land use include the ISDP and certain provisions of the CVPIA. The CVPIA would not substantially affect irrigated land in the Delta. Cumulative effects on farm revenues and employment from land conversion are adverse, primarily because effects from the Program alone are adverse.

Many proposed projects could involve construction expenditure effects in the Delta and elsewhere. These effects would be beneficial, from the perspective of regional economics, as well as temporary; therefore, a cumulative effect analysis is not required.

The Program and other projects would change water supply and recreation spending—in particular, the CVPIA, Delta Wetlands, American River Watershed, Supplemental Water Supply (EBMUD), and Pardee Reservoir Enlargement Projects. Water losses from the CVPIA would reduce agricultural production in and near CVP agricultural water contractors where CALFED actions are also reducing the amount of irrigated land. Other projects such as Delta Wetlands or Supplemental Water Supply may increase water supply. Other projects may improve conditions for recreation. These changes would result in beneficial effects from the perspective of regional economies.

Program actions could result in adverse effects on regional economics through cost recovery. These effects are not considered adverse either alone or in combination with other new finance, water pricing changes, or new costs. One exception may involve the water pricing provisions of the CVPIA. Increased costs of irrigation water under the CVPIA, combined with increased costs for conservation and water under the Program, could result in an adverse effect on some agricultural economies that depend on the CVP service areas.

Growth-Inducing Effects. No effects are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The Preferred Program Alternative generally would maintain and enhance long-term productivity of regional economics but may cause adverse effects on regional economics resulting from short-term uses of the environment.

The Preferred Program Alternative would require conversion of agricultural land for habitat and storage and conveyance. Some habitat could be lost to accommodate storage and conveyance facilities. No effects are expected through the mechanism of regional economics.

Irreversible and Irretrievable Commitments. Storage and conveyance features could result in the irretrievable commitment of resources such as construction materials, labor, energy resources, and land conversion.

An irreversible and irretrievable commitment of resources may occur if Program water supplies encourage or allow urban economic growth. The Program is not expected to result in significant effects on urban economic growth; therefore, no irreversible and irretrievable commitment of resources are expected in the area of regional economics.

7.10.11 ADVERSE EFFECTS

Potential adverse effects on farm revenues and employment that occur as agricultural lands in the Delta are converted to other uses may not be avoidable. These effects could substantially affect the region, especially small communities that depend on agriculture for their income. Some adverse effects also could be expected in the urbanized areas that surround the Delta: Sacramento, Stockton and Pittsburg/ Antioch. The form of the effects would be reduced employment and income, a reduction in property tax base through land conversion and reduced residential property values, and increased costs for social services and other local services—especially in the short run.

7.11 Cultural Resources

Cultural resources remain undiscovered in the study area, and implementation of the CALFED Bay-Delta Program may adversely affect some of these resources. Sites protected as a result of Program actions would benefit future generations.

7.11 Cultural Resources

7.11.1 SUMMARY

A wealth of cultural resources exist within the CALFED Bay-Delta Program (Program) geographic area. This is especially true of the Delta Region, with its rich ecosystem and history of intense aboriginal occupation. Cultural resources consist of archeological sites, historic sites, and traditional cultural properties associated with the values of Native Americans and other cultural groups. Although many archeological sites have been greatly compromised as a result of agricultural development, remains of these sites can provide insight into the adaptation of early people and reveal information about the context of the early Delta as well. Burials frequently are found at Delta archeological sites. Human remains are a sensitive issue and important to many surviving Native American groups. Archeological and historic properties from other regions provide information about an earlier way of life and express the range of human adaptation through time.

Actions that physically disturb a site, alter its setting, or introduce elements out of character with the site constitute an impact. Any type of physical damage results in a permanent loss of information that reduces the potential contribution of the site to our understanding of the past. Some prehistoric sites are found only in buried contexts. These sites will not be detected until such time as an area is trenched or excavated. Cultural resources eligible for inclusion in the National Register of Historic Places (NRHP) under federal law or considered important under state law may be adversely affected by a wide range of impacts. Cultural resources are fragile, finite, and nonrenewable.

Within the context of the cultural resource discussion, impacts are evaluated as minor, moderate, or major. These terms refer to the potential for an action to affect cultural resources. Small or low-intensity actions have a minor potential to affect cultural resources. Conversely, extensive construction programs hold a major potential to affect cultural resources. For the purposes of CEQA, minor, moderate, or major impacts were assumed to be potentially significant. The actual impact of an action on cultural resources depends on a project-specific survey and inventory of cultural resources at a project site. The March 1998 Cultural Resources Technical Report elaborates on this topic.

Preferred Program Alternative. Implementing the Preferred Program Alternative would adversely affect cultural resources. Projects in the Delta involving minor construction actions generally result in little surface disturbance. These actions usually, but not always, result in only slight impacts on cultural resources. Revegetation projects, improved fish passages, and creating shallow-water habitats are examples of actions involving minor construction activity. As the level of impacts increases, the potential for affecting cultural resources also increases. Setback levees or other dredging actions may constitute a moderate impact. Large-scale impacts may be expected from projects that call for the movement of large quantities of sediment, such as through-Delta conveyance structures.

Regions outside the Delta may experience substantial impacts on cultural resources, depending on the scale of the activity. Depending on the location of the reservoir, water storage facilities may affect many cultural resource sites from construction and flooding.

Cultural resources may benefit as a result of implementing the Preferred Program Alternative. For example, purchasing and placing a cultural resource site into federal ownership provides the protection of federal cultural resource legislation. These laws apply only to resources found on public lands. Similarly, a site would benefit if a Program action prevents the site from being disturbed.

Alternatives 1, 2, and 3. The impacts identified under Alternatives 1, 2, and 3 would be similar to those identified for the Preferred Program Alternative but would vary in magnitude, depending on the Delta facilities associated with the alternative. Alternative 1 would result in the fewest impacts on Delta cultural resources because it includes the fewest in-Delta facilities. Alternative 2 and the Preferred Program Alternative would result in similar impacts on cultural resources. Alternative 3 would have the greatest potential for impacts on cultural resources because of the larger scope of the isolated facility.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Impacts on cultural resources from ground-disturbing activities (1-9,11).

Impacts on cultural resources from new construction, excavation, or fill (1-9,11).

Inundation of cultural resources from flooding (1-11).

Impacts on cultural resources from alteration of existing facilities (1,7,10).

Impacts on cultural resources from construction of new facilities (1-9, 11).

Alteration of the historic setting of a cultural resource (1-11).

Introduction of elements out of character with a cultural resource site (1-11).

Mitigation Strategies

1. Conducting cultural resource inventories.
2. Avoiding sites through project redesign.
3. Mapping sites.
4. Conducting surface collections.
5. Performing test excavations.
6. Probing for potentially buried sites.
7. Preparing reports to document mitigation work.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative (continued)

8. Conducting full-scale excavations of sites slated for destruction as a result of projects.
9. Preparing public interpretive documents.
10. Documenting historic structures by preparing Historic American Engineering Records or Historic American Building Surveys.
11. Conducting ethnographic studies for traditional cultural properties.

No potentially significant unavoidable impacts on cultural resources are associated with the Preferred Program Alternative.

7.11.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to cultural resources.

7.11.3 AFFECTED ENVIRONMENT/ EXISTING CONDITIONS

7.11.3.1 DELTA REGION

The Delta Region is one of the most intensely investigated areas of California because of its high prehistoric population density and proximity to population centers. Although the bulk of sites were recorded prior to 1960, there has been little systematic inventory for cultural resources. Most of the early archeological work in the region focused on prominent prehistoric mounds. Later work has recorded a more diverse, but less impressive range of sites. Documentation of historic sites has largely occurred only in the last 20-30 years.

At least 171 sites in the Delta Region have been listed in the NRHP as individual properties or as districts. Six sites in the region have been listed as California Historical Landmarks, and four are listed as California Points of Historical Interest.

Prehistoric Resources. Types of prehistoric sites that have been recorded in the Delta Region include village sites, temporary camp sites, milling-related activity sites, and lithic scatters (Table 7.11-1). Locations of recorded prehistoric sites in the Delta Region have been entered into a geographic information system (GIS) for the region. This GIS layer reveals that prehistoric sites are not evenly distributed across the Delta Region. Although channel deposits, floodplains, and basins make up approximately 40% of the total acreage in the Delta Region, nearly 80% of prehistoric sites are located within these land forms. In contrast, those land forms identified as mucks, organic soils, fans, basins, and terraces make up 25% of the study area landmass but contain less than 5% of the prehistoric sites. Furthermore, no prehistoric sites have been recorded in peat (> 50% organics) or peaty mucks (25-50% organics). Former tidal wetlands may be sensitive areas for prehistoric resources where they contain sand dunes and mounds that have been occupied in prehistoric times.

Table 7.11-1. Distribution of Prehistoric Site Types by Landform Type in the Delta Region

LANDFORMS (LANDFORM CODE)	AREA (x1,000)	% AREA	PREHISTORIC SITE CODES* 01	02	04	07	16	15	15,09	09	TOTAL SITES	% SITES
Channel deposits (11)	82.1	10.3	11				7	23	14	12	67	34.9
Mucks: Delta/marsh (12)	62.0	7.8							2		2	1.0
Floodplains (14)	59.1	7.4	4				5	3	8	8	28	14.6
Peat and muds (15)	185.9	23.4	1				1	3	9	4	18	9.4
Organic soils (16)	105.2	13.2	1				1	1		1	4	2.1
Basins and basin rims (22)	151.8	19.1	3	3			2	17	17	13	55	28.6
Interfan basins (31)	8.2	1.0									0	0.0
Fans, basins, terraces (32)	36.9	4.6						1			1	0.5
Eolian deposits (33)	14.6	1.8					1			1	2	1.0
Valley fill (34)	38.3	4.8			1		2	1	2		6	3.1
Alluvial fans (35)	9.2	1.1									0	0.0
Low terraces (41)	25.5	3.2					2	1	1		4	2.1
Dissected terraces (51)	4.4	0.5						1			1	0.5
Steep uplands (62)	7.0	0.8				2		1			4	2.1
Mountain slopes (63)	4.5	0.5									0	0.0
Total	**794.7**	**N/A**	**21**	**3**	**1**	**2**	**21**	**52**	**53**	**39**	**192**	**N/A**
Percentage of site types			10.9	1.5	0.5	1.0	10.9	27.1	27.6	20.3	N/A	N/A

Notes:

N/A = Not applicable.

* Prehistoric Site Types: 01 = Unknown; 02 = Lithic scatter; 04 = Bedrock mortar/milling feature; 07 = Architectural feature; 15 = Habitation debris; 16 = Other; 15 and 09 = Habitation debris with burials; 09 = Burials.

The landscape of the Delta Region is radically different today than it was prior to farmland reclamation. Reconstructed watercourses, areas presently and formerly subject to tidal influence, and other features of surface geology were used as a basis for generating a predictive model of prehistoric settlement patterns in the Delta Region. Further mapping of extinct watercourses can help define areas of sensitivity for buried prehistoric sites. Age dating the sediments on which sites are found may be useful in predicting the location of sites from the same chronological period.

Much of the region has a long history of agricultural development. In these areas, intact surface or shallow subsurface deposits are unlikely to exist. Intact surface prehistoric resources are most likely to exist in areas relatively unaffected by development or agriculture, although subsurface deposits may exist below the plow zone or may be capped underneath pavement or structures.

Historic Resources. Potential historic resources in the Delta Region are largely related to agriculture; however, other types of resources also are present, including farmsteads, labor camps, landings for the shipment of agricultural produce, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Forty known historic sites coincide with prehistoric sites. Labor camps generally consist of at least one wooden bunkhouse or boarding house, a dining hall, a cookhouse, a washroom, and associated buildings. Landings, for the most part, are not elaborate, consisting of a few pilings or a dolphin. At least three ferry crossings are present in the study area.

Due to the extensive use of the land in historic times, architectural resources are likely to occur throughout the region. However, much of the region is still used for agricultural purposes, where the ground surface is regularly plowed, raked, or tilled.

Traditional Cultural Properties. A review of the ethnographic literature for the Delta Region has revealed no known traditional properties or sacred sites. Contact with the Native American Heritage Commission and a number of Native American individuals also did not identify any traditional cultural properties in the Delta Region.

Native American Groups. Several Native American groups occupied portions of the Delta Region. The Valley Nisenan occupied the far northeastern portion. The Plains and Bay Miwok originally were found in the eastern and far western portions of the area. The south Delta was occupied by the Northern Valley Yokuts. The north shore of Suisun Bay was settled by the Patwin. These cultures were rapidly reduced by missionization, epidemics, and results of the Gold Rush.

No reservations or rancherias are located in the Delta Region. However, several Native American burial and cremation sites have been discovered in the region, and more are likely to be found. These types of sites are of concern to Native American groups.

7.11.3.2 BAY REGION

Considerable industrial and residential development in the Bay Region has taken a toll on archeological resources. Prehistoric and historic sites have been destroyed by urban development and by industrial construction. Archeological sites remain in areas that have not been fully developed. Subsurface deposits also can be found capped under asphalt and below buildings.

At least 407 sites within the Bay Region have been listed in the NRHP as individual properties or as districts. In addition, 176 sites in the region have been listed as California Historical Landmarks, and 156 are listed as California Points of Historical Interest (see the March 1998 Cultural Resources Technical Report). Many of these are historic buildings located in urban areas. Historic preservation programs, societies, and organizations are active in the Bay Region. The Bay Region includes the Suisun Marsh, which is the largest contiguous tidal wetlands in the state.

Prehistoric Resources. Prehistoric site types recorded in the Bay Region include village sites, temporary camp sites, milling sites, petroglyphs, lithic scatters, quarry sites, shell and ash middens, and burial sites. Permanent settlements were common in the Bay Region in prehistoric times, and prehistoric sites are likely to occur throughout the region. However, substantial commercial and residential development in the region has disturbed or destroyed many sites. Intact deposits are most likely to occur in undeveloped areas.

Historic Resources. Historic site types documented in the Bay Region include railroad grades and associated features, recreational sites, dams and culverts, mining-related sites, early military sites, lighthouses and other navigational aids, vessels both sunken and afloat, refuse deposits, and architectural structures. Due to the extensive use of the land in historic times, historic resources are likely to occur throughout the region. However, extensive development has destroyed or disturbed many sites.

Traditional Cultural Properties. Mount Diablo and Mount Tamalpais are well-known landmarks in the Bay Area that are considered traditional cultural properties because of their religious and ceremonial significance to several Native American groups. Mount Diablo, located approximately 13 miles southeast of Suisun Bay and 22 miles east of San Francisco Bay, plays an important role in Native American religion and is the focal point of the Costanoan creation myth and several Miwok legends. Mount Tamalpais is also a sacred site, located approximately 6 miles northwest of Sausalito. In addition, many sacred sites in the Bay Area are not on mountain tops.

Native American Groups. The primary Native American groups known to have occupied the Bay Region are the Costanoan, Coast Miwok, Wappo, and Patwin. No formal reservations or rancherias are present in the Bay Region; however, a number of Native Americans live in the area. Several Native American burial sites have been discovered in the Bay Region, and more are likely to be found. These types of sites are of concern to Native American groups, who consider these locations sacred. Mount St. Helena is an important sacred place to the Wappo.

7.11.3.3 SACRAMENTO RIVER REGION

Substantial agricultural and urban development of the valley floor has significantly damaged many archeological sites. Prehistoric mounds have been leveled, and sites have been repeatedly tilled and plowed in agricultural fields. Nevertheless, intact archeological deposits may occur in buried contexts, beneath the plow zone, or under asphalt parking lots. The foothill regions of the Sacramento River Region contain undeveloped areas where prehistoric and historic sites may be found.

At least 299 sites in the Sacramento River Region have been listed in the NRHP as individual properties or districts. In addition, 226 sites in the region have been listed as California Historical Landmarks, and 198 are listed as California Points of Historical Interest (see the March 1998 Cultural Resources Technical Report). Many of these properties fall outside areas of potential impact.

Prehistoric Resources. Prehistoric site types that have been recorded in the Sacramento River Region and that are likely to occur in the upper watersheds include village sites, temporary camp sites, milling sites, petroglyphs, lithic scatters, quarry sites, and burial sites. Acorn processing sites are commonly found in the oak woodland. According to a site-density model prepared for the American River Water Resources Investigation, the foothills and granite-based upland areas contain a projected 3.5 and 2.8 sites per square mile, respectively. Habitation sites and bedrock mortar or other milling sites are the most common types found in these areas. Due to intensive occupation of the area in prehistoric times, prehistoric resources are common in the region. However, substantial agricultural development has disturbed or destroyed many sites. Intact sites are most likely to occur in areas that have not been fully developed or farmed, or may remain below plow zones.

Archeological sites are frequently found clustered along the river, particularly where tributary streams enter the main stem. Related primarily to fishing, such sites served as major encampments. Resource procurement camps also occur in the uplands.

Historic Resources. The majority of historic site types recorded in the Sacramento River Region and listed in the NRHP consist of local structures, such as houses, schools, libraries, churches, post offices, hotels, railroad stations or related features, mine sites, and bridges. Additional types of historic sites that have been recorded in the Sacramento River Region and that may be likely to occur in the upper watersheds include mining-related structures or features, railroad grades and associated features, dams and culverts, and refuse deposits. Mining in the Sierra Nevada was widespread in the second half of the nineteenth century, and numerous railroads were established throughout the region to transport timber and other goods. The mining boom brought non-Indians to the northern mountains of the region. Native peoples were driven out, and the landscape was altered. Abundant evidence of this era still remains. In addition, attempts to irrigate the valley and bring potable water to San Francisco created many irrigation features in the region. Historic resources are likely to occur throughout the region.

Traditional Cultural Properties. Traditional cultural properties exist in the study area. Some natural or geologic features are traditionally considered sensitive or sacred. Sutter Buttes is considered by the Konkow and Maidu to be the location where spirits of the dead left for the afterworld. Butte Mountain is a Nisenan ancestral ceremony site. The Nomlaki consider Lassen Butte to be the home of a mythical figure. Marysville Buttes and Mount Shasta are also of mythical importance to the Patwin and Wintu. Burial or cremation sites may exist in the Sacramento River Region. Specific traditional cultural properties along the Trinity River have not been identified for this Programmatic EIS/EIR.

Native American Groups. The primary Native American groups known to have occupied the Sacramento River Region include the Achumawi, Atsugewi, Konkow, Maidu, Nisenan, Nomlaki, Yana, Wintu, and Patwin. The Hoopa and Yurok are known to have occupied the Trinity River area. Twenty-one reservations or rancherias are located in the counties that make up the Sacramento River Region. However, some of these reservations fall outside areas of potential impact. An unknown number of public domain allotments are located in the region.

7.11.3.4 San Joaquin River Region

As in the Sacramento River Region, vast agricultural development in the San Joaquin River Region has destroyed many archeological sites. Remnants of sites still occur in agricultural lands, but they have been highly disturbed.

At least 156 sites in the San Joaquin River Region have been listed in the NRHP as individual properties or districts. In addition, 111 sites in the region have been listed as California Historical Landmarks, and 50 are listed as California Points of Historical Interest (see the March 1998 Cultural Resources Technical Report). Many of these properties fall outside areas of potential impacts.

Prehistoric Resources. Prehistoric site types that occur in the San Joaquin River Region and are likely to occur in the upper watersheds include village sites, temporary camp sites, milling sites, petroglyphs, lithic scatters, quarry sites, and burial sites. Prehistoric sites are most commonly found along the San Joaquin River and its associated sloughs. Buried sites are possible in this region due to the high rate of sedimentation. Substantial agricultural development in the valley has disturbed or destroyed many sites. Prehistoric sites are most likely to exist in areas not fully developed or farmed, or may remain below plow zones.

Historic Resources. Historic site types that have been recorded in the San Joaquin River Region and that are likely to occur in the upper watersheds include mining-related and timber harvesting structures and features, railroad grades and associated features, dams and culverts, roads, refuse deposits, and architectural structures. Agricultural development of the valley has occurred since the Gold Rush era, leading to the establishment of numerous rural communities. These communities may contain sites and structures of historical significance.

Traditional Cultural Properties. Table Mountain is a traditional cultural property because of its importance to the Monache, who believe that mythical beings visited the mountain. Several additional places of mythological importance to the Monache that are located in the San Joaquin River Region also may qualify as traditional cultural properties. Table Mountain near Friant was thought to be visited by mythical beings. Burial or cremation sites also may exist in the San Joaquin River Region.

Native American Groups. The primary Native American groups known to have occupied the San Joaquin River Region include the Foothill Yokuts and Southern Valley Yokuts, Kawaissu, Kitanemuk, Monache (Sierra Mono), and Tubatulabal. Eight reservations or rancherias are located in the counties that make up the San Joaquin River Region, although some of these reservations fall outside areas of potential impact. An unknown number of public domain allotments are present in the region.

7.11.3.5 OTHER SWP AND CVP SERVICE AREAS

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

The majority of the Other SWP and CVP Service Areas has sustained extensive residential, urban, and industrial development, which has destroyed or damaged many archeological sites. Other sites may have been damaged from the limited agricultural development in the areas. Intact cultural deposits are most likely to occur in areas not fully developed or may lie buried beneath structures or plow zones. Some portions of this region, especially in the foothills, have not been substantially developed and may contain intact prehistoric and historic resources. Historically significant architectural resources may exist throughout the region.

Prehistoric Resources. Prehistoric site types include village sites, temporary camp sites, milling sites, petroglyphs, lithic scatters, quarry sites, and burial sites. Permanent settlements were common along the coast in prehistoric times, and interior valleys were traversed on a seasonal basis. Therefore, prehistoric sites are likely to occur in the region. However, substantial development has occurred in urban areas, and many sites have been disturbed or destroyed. Prehistoric sites may exist in areas that have not been fully developed or farmed, may remain buried under plow zones, or may be capped under asphalt or structures.

Historic Resources. Historic site types that have been recorded in the area include mines and mining-related features, railroad grades and associated features, roads, trails, bridges, refuse deposits, and architectural structures. Because the California coast was heavily occupied in historic times, historic resources are likely to occur in the region. However, these areas also are extensively developed.

Traditional Cultural Properties. Few traditional cultural properties have been identified in the region. The Martinez Historical District, located in the Torres-Martinez Indian Reservation in Riverside County (SWP service area), was listed in the NRHP in 1973. This district plays an important role in the history of the Torres-Martinez band of Mission Indians and is therefore considered a traditional cultural property. Other properties of significance to cultural groups may exist in the region.

Native American Groups. The primary Native American groups known to have occupied the region are the Northern Valley Yokuts, Chumash, Cahuilla, Gabrielino, Luiseno, Ipai, Kumeyaay, Tataviam, and Serrano. The region contains approximately 24 Native American reservations or rancherias. Public domain allotments also may exist in the region.

7.11.4 ASSESSMENT METHODS

Impact assessments focus on those properties listed or eligible for listing in the National Register of Historic Places (NRHP), properties known as historic properties, or sites designated as either historic resources or unique archeological resources, as defined either in 36 Code of Federal Regulations (CFR) 800.16(l) for federal actions or in the State CEQA Public Resources Code (PRC) (21084.1 and 21083.2) and the CEQA Guidelines (15064.5[a]). Information concerning the regulatory context for cultural resources is provided below.

Under federal law, Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulation (36 CFR Part 800), require federal agencies to consider the effects of their actions on properties listed or eligible for listing in the NRHP. The regulations state that an undertaking affects a historic property when that undertaking alters those characteristics of the property that qualify it for inclusion in the NRHP. An undertaking is considered to adversely affect a historic property when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include, but are not limited to:

- Physical destruction, damage, or alteration of all or part of the property.
- Isolation of the property or alteration of the character of the property's setting when that character contributes to the property's qualifications for the NRHP.
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or changes that may alter its setting.
- Neglect of a property resulting in its deterioration or destruction.
- Transfer, lease, or sale of a property, without adequate provisions to protect the property's historic integrity.

Under state law, the evaluation of impacts on historic resources (CEQA Guidelines 15064.5) parallels federal law as described above. The CEQA Guidelines state that if a project follows the Secretary of Interior's Standards for the Treatment of Historic Properties, the impacts are considered "mitigated to a level of less than a significant impact" (CEQA 15064.5[b][3]). Additional discussion of CEQA in relationship to historic resources and unique archeological sites is provided in the "Regulatory Context" section below.

Additional assessment methods are provided in the March 1998 Cultural Resources Technical Report.

Regulatory Context. The jurisdiction of applicable state and federal laws to protect archeological and historical sites is contingent on several factors. Federal law applies to all federal lands and to those projects that are sponsored, permitted, approved, or funded by federal agencies. Private entities or state agencies receiving federal funds for projects are required to comply with federal law. State law applies to state agencies, city governments, or private entities implementing CALFED projects on private or state lands.

The NHPA of 1966 and its implementing regulations is the single-most important federal legislation designed to protect historic properties. Archeological, historic, architectural, or traditional cultural properties that are eligible for listing or listed in the NRHP are defined as historic properties. Section 106 of the NHPA and the CFR Title 36 Section 800 define a consultation process with the State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation to ensure that historic properties have been adequately considered in project planning. When impacts on historic properties cannot be avoided, regulations guide the process of mitigation (36 CFR 800). Sites that fail to qualify as historic properties, as concurred to by the SHPO, need not be considered further in project planning.

The California PRC protects historic resources and unique archeological resources, as defined in the PRC (21084.1 and 21083.2) and CEQA Guidelines (15064.5[a]). The CEQA Guidelines (15064.5) address evaluating impacts on historic resources and unique archeological resources. The CEQA Guidelines (15126.4[b][3][A-B]) indicate preferences for mitigating historic resources by emphasizing preservation in place. Mitigation measures are identified for unique archeological resources in PRC (21083.2); financial and time limits are placed on such measures. According to CEQA, unique archeological resources may or may not be defined as historical resources. Compliance with federal standards for the treatment or mitigation of historic properties generally will avoid a significant effect on the resource. Non-unique archeological resources are not considered beyond noting their presence in an Initial Study or EIR, if one is prepared.

Vandalism of cultural resources is addressed in both state and federal law. The PRC (Sec. 5025, 5024.5, 5097.5, 6313) prohibits unauthorized disturbance or removal of archeological or historical resources. The State Penal Code (Section 622.5) applies to objects of historical or archeological interest located on state or private land and, specifically exempting the landowner, provides penalties for damaging such objects. Under federal law, the Archeological Resources Protection Act identifies criminal and civil penalties for illegally excavating, disturbing, or removing artifacts from federal land.

Federal and state laws protect human remains. The Native American Graves Protection and Repatriation Act and its implementing regulations (43 CFR 10) describe procedures for the discovery and repatriation of Native American human remains on federal lands. The applicable state law, the Health and Safety Code (Section 7052), and CEQA Guidelines (15064.4[d]) prohibit the disturbance of human remains except under certain conditions. The CEQA Guidelines also specify procedures, including consultation with the California Native American Heritage Commission, to be followed in the event that Native American graves are found.

Both state and federal law contain provisions for the inadvertent discovery of historic properties, historic resources, or unique archeological resources during project construction (CEQA Guidelines 15064.5[f] and 36 CFR 800.13). In addition to these laws and regulations, local counties and cities may have adopted policies, plans, and ordinances to protect cultural, historic, and archaeological resources within their respective jurisdictions.

7.11.5 SIGNIFICANCE CRITERIA

Impact assessments for cultural resources are based on the type of site; a determination of whether the site is considered a historic property (36 CFR 60.4), historic resource, or unique archeological resource (CEQA Statutes, Section 21083.2[g] and Section 21084.1); the type of impact; and the extent of disturbance from the project. Impacts on prehistoric and historic resources are considered potentially significant if the project could adversely affect historic properties, historic resources, or unique archeological resources.

Potentially significant adverse impacts on cultural resources can be caused by ground-disturbing activities, modification and alteration of historic structures, visual intrusion to a historic setting, and artifact theft. Direct impacts are those that occur during project construction, development, or operation that directly impinge on or destroy cultural resources, such as all activities that entail earthmoving. Ground-disturbing activities may affect the physical integrity of cultural resources, destroying the research potential. Modification or alteration of historic buildings may disturb the architectural integrity that contributes to their NRHP eligibility or importance under CEQA.

Potentially significant adverse impacts also can occur indirectly through the alteration of the character of the site setting and the introduction of visual, audible, or atmospheric elements that change the character of a site or its setting—which may affect the eligibility of the site for inclusion in the NRHP. Additional indirect impacts may result from increased pedestrian activity in an area, which provides opportunities for artifact theft or vandalism of cultural resources.

The acquisition of private land by the federal government could result in a potential beneficial impact since the cultural resources that are present would be subject to federal antiquities legislation.

Additional significance criteria are provided in the March 1998 Cultural Resources Technical Report.

7.11.6 NO ACTION ALTERNATIVE

Several actions, planned or under development, will be implemented under the No Action Alternative. Impacts on cultural resources from these actions in each of the regions are being considered prior to implementation. For example, considerable inventory, excavation, and mitigation of historic and archeological sites have been conducted in support of the Los Vaqueros Reservoir Project. Many other actions listed in Attachment A will not affect cultural resources.

Impacts from individual projects will be evaluated on a project-specific basis using 36 CFR Part 800 as a guide for compliance with Section 106 of the NHPA. Impacts also will be evaluated using the CEQA Guidelines in Section 15064.5.

7.11.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For cultural resources, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as discussed in Section 7.11.8.

The terms "minor," "moderate," and "major" impacts are used in the following sections and are described with respect to CEQA in the "Summary" section. These arbitrary terms attempt to categorize the "potential" that a Program action will affect historic properties, historic resources, or unique archeological resources—based on the type of impact compared to the integrity of the landscape. Minor, moderate, and major impacts are considered to be potentially significant impacts on these resources according to state law. Given the uncertainty of resource locations, archeological sites cannot be identified or located until after site-specific Program actions are proposed and a surface inventory is performed. In some cases, excavations are required to reveal the presence of a buried archeological site. Under federal law, the application of formal archeological data recovery methods formulated in consultation with the SHPO and others will result in a determination either that the action will result in "no historic properties affected," or that the action will result in "adverse effects." If a Program action results in "adverse effects," an MOA will be developed with the SHPO to mitigate the effects.

7.11.7.1 DELTA REGION

Ecosystem Restoration Program

Implementing the Ecosystem Restoration Program could result in minor to moderate impacts on cultural resources. A multitude of minor construction projects are involved in the Ecosystem Restoration Program. Revegetation projects, improved fish passage, eradication of undesirable plant species, and establishment of shallow-water habitat could result in relatively minor adverse impacts on prehistoric and historic sites. Conversely, gravel replacement, new floodways, and levee setbacks may constitute a moderate adverse impact on cultural resources because areas adjacent to waterways potentially have greater prehistoric and historic sensitivity. Creating aquatic and wetlands habitat is projected as a moderate adverse impact.

Water Quality, Water Use Efficiency Programs, Water Transfer, and Watershed Programs

No impacts on cultural resources in the Delta Region are anticipated as a result of the Water Quality, Water Use Efficiency, Water Transfer, or Watershed Program.

Levee System Integrity Program

In the Delta Region, prehistoric and historic sites often are clustered along watercourses. Levee construction activities are viewed as a potential moderate adverse impact due to the extensive earth movement required, combined with the sensitivity associated with the proximity of water sources. Future cultural inventories would be conducted to determine the actual number of sites affected by levee construction activities.

Storage

Several Delta islands may be flooded. Impacts associated with such actions are considered minor. The surface of most Delta islands has long been compromised as a result of extensive agricultural development. Impacts would be proportional to the size of the storage facility. Cultural resources assessments would be required to ensure that historic resources were not damaged as a result of island flooding.

7.11.7.2 BAY REGION

Ecosystem Restoration and Levee System Integrity Programs

The Suisun Marsh is located in the Bay Region. For cultural resources, the only Program actions that would directly affect the marsh are levee improvements under the Levee System Integrity Program and restoration actions under the Ecosystem Restoration Program. Some ecosystem restoration activities may affect cultural resources found at Suisun Marsh. Impacts of the Levee System Integrity Program in the Suisun Marsh are expected to be similar to those described for the Delta Region.

Water Quality, Water Use Efficiency, Water Transfer, and Watershed Programs and Storage

These Program elements would not affect cultural resources in the Bay Region.

7.11.7.3 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Ecosystem Restoration Program

Ecosystem Restoration Program projects include habitat improvement, fish facilities, relocation of water facilities, and upgrade of structures. Potential adverse impacts on cultural resources from these actions include primarily minor and possibly moderate construction activity. Site-specific inventories and evaluations would be needed to fully analyze project-specific adverse impacts.

Water Quality, Water Use Efficiency, and Water Transfer Programs

No impacts on cultural resources in the Sacramento River or San Joaquin River Region are anticipated from these programs.

Watershed Program

Projects that could be included in upper watershed restoration may involve construction, flooding of areas, dredging soil to restore streams or reduce erosion, and revegetation or use of controlled burns for wildfire prevention. Construction activities or the flooding of areas could result in adverse impacts on NRHP-eligible properties, historic resources, or unique archeological resources present in construction areas. Dredging could result in impacts similar to construction-related impacts if NRHP-eligible properties, historic resources, or unique archeological resources are present in the dredged soils or locations for fill deposition. Clearing or replanting of vegetation, if not performed with hand tools, could adversely affect historic properties or important cultural resources located in the areas to be cleared or restored. Other potential impacts on cultural resources include vandalism and looting of artifacts as a result of increased access to locations where cultural resources are present. Impacts from individual projects would need to be evaluated on a project-specific basis. Potential impacts from the above projects may be mitigated, but this depends on the type of resource and consultation with the SHPO and other interested parties.

Storage

Storage elements potentially involve surface water and groundwater storage. Surface storage reservoirs represent significant surface disturbance, with major construction-related adverse impacts and adverse impacts associated with flooding. In general, the larger the land area dedicated for water storage, the greater potential for affecting cultural resources. Groundwater storage could result in similar impacts because the possible inclusion of percolating basins may be needed, but the overall scope of such projects would be less than for a surface storage reservoir.

7.11.7.4 OTHER SWP AND CVP SERVICE AREAS

All Programs

The Program would not result in any direct adverse impacts on cultural resources in the Other SWP and CVP Service Areas. No structures, conveyance facilities, storage projects, or habitat improvements are planned in the region. Although the delivery of water to nonagricultural areas may result in growth above current projections, such growth and development is driven primarily by socioeconomic factors, regardless of increases in the water supply.

7.11.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For cultural resources, the Conveyance element results in environmental consequences that differ among the alternatives, as discussed below. This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur. The terms "minor," "moderate," and "major" are used to describe the potential for impacts in the following sections. The explanation of these terms in Section 7.11.7 also applies to the following discussion.

7.11.8.1 ALL ALTERNATIVES

Under the Preferred Program Alternative and Alternatives 1, 2, and 3, various projects are proposed for increasing flow through the Delta that may affect cultural resources. Construction and flooding along waterways that are potentially archeologically sensitive may result in a moderate level of adverse impacts. Additional adverse impacts involve flooding certain tracts, acquiring land, and relocating certain facilities that may hold historic significance. Generally, Alternative 1 would have the lowest potential for causing adverse impacts due to channel enlargement. The Preferred Program Alternative has more potential for adverse effects than Alternative 1; impacts are similar to those of Alternative 2 and less than those of Alternative 3. Depending on the size of the isolated facility in Alternative 3, the need for channel enlargement under Alternative 3 is generally more than under Alternative 2. Therefore, Alternative 3 potentially would cause more adverse effects than Alternative 2.

Alternative 2 and the Preferred Program Alternative include projects that involve setting back levees, dredging and enlarging channels, or widening portions of Mokelumne River that could result in a potential moderate to major impact on cultural resources, since these environments likely contain prehistoric and historic sites. Earth moving associated with these actions could affect cultural resources. Dredging may reduce the area required for setback levees but may increase the likelihood of encountering possible ship wrecks or other underwater cultural resource features. Disposal of dredged spoils could affect buried and surface archeological sites. As stated above, prehistoric and historic sites often are clustered along watercourses. As an example, levee setbacks along the North Fork of the Mokelumne River may affect six recorded prehistoric sites and two historic sites. Identification of the actual number of sites affected by this levee project, however, depends on future cultural resources inventories of the entire area to be affected. The diversion facility on the Sacramento River or the barrier at Old River constitute minor adverse impacts, although the isolated channel to the Mokelumne River may constitute a moderate impact on cultural resources. If the pilot project is not built, these consequences would not be associated with the Preferred Program Alternative.

Construction of an isolated facility under Alternative 3 potentially could cause major adverse impacts on cultural resources. These adverse impacts are considered major due to the magnitude of the proposal, the presence of potentially significant archeological resources, and the amount of construction disturbance involved. Varying the size of the isolated facility from 5 to 15,000 cfs would result in relatively little difference in the potential impacts on cultural resources.

7.11.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. The analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions are the same impacts as those identified in Sections 7.11.7 and 7.11.8, which compare the Program alternatives to the No Action Alternative. The comparison of Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences that were not identified in the comparison of the Program alternatives to the No Action Alternative.

The following potentially significant impacts were identified for the Preferred Program Alternative:

- Impacts on cultural resources from ground-disturbing activities.
- Impacts on cultural resources from new construction, excavation, or fill.
- Inundation of cultural resources from flooding.
- Impacts on cultural resources from alteration of existing facilities.
- Impacts on cultural resources from construction of new facilities.

- Alteration of the historic setting of a cultural resource.
- Introduction of elements out of character with a cultural resource site.

No potentially significant unavoidable impacts on cultural resources are associated with the Preferred Program Alternative.

7.11.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For cultural resources, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.11.1 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate them. At the programmatic level, the analysis did not identify any impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level. Sections 7.11.7 and 7.11.8 elaborate on long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of all the projects listed in Attachment A that result in ground-disturbing activities, would result in potentially significant adverse cumulative impacts on cultural resources in the Delta, Bay, Sacramento River, and San Joaquin River Regions. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.11.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level.

Mitigation measures for the CALFED Program's potentially significant impacts on cultural resources will be implemented as required according to procedures identified in Section 106 of the NHPA and its implementing regulations. CEQA requires lead agencies to adopt feasible mitigation measures for significant impacts on historic resources and unique archeological resources. Mitigation measures will be developed through a consultation process involving the federal agencies, SHPO, state agencies, and interested members of the public. Mitigation measures also will be required for potentially significant impacts on cultural resources caused by implementation of the Preferred Program Alternative. CEQA Guidelines (15126.4) provide guidance regarding the preference for strategies to mitigate impacts on historic resources. The guidelines indicate that preservation in place is the preferred approach and enumerate other mitigation options. Limits on potential costs of mitigating unique archeological resources are presented in PRC 21083.2.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. Development of alternatives may affect cultural resources; however, mitigation is available to reduce potential impacts to less-than-significant levels. Long-term benefits to cultural resources could result from federal protection of resources found on public land.

Irreversible and Irretrievable Commitments. Cultural resources are fragile, finite, and nonrenewable. Any type of physical damage results in a permanent loss of information. The importance of any given resource is closely related to its structural or depositional integrity. Once a site is disturbed, it may be stabilized and protected from further deterioration, but it cannot be restored to its original condition. Even the application of data recovery techniques involves some loss because data recovery is necessarily selective. Although the construction or development phase of a proposed project may be of relatively short duration, adverse effects on NRHP-eligible or important cultural resources could be long term and permanent. The application of data recovery techniques can recover physical objects and mitigate the loss of data, but the site is nonetheless lost to posterity and future in-situ research.

Cultural resources that are affected during the implementation of any alternative would be lost for posterity. Data recovery techniques ameliorate this loss somewhat. Cultural resources cannot be replaced or reproduced once they are lost, regardless of mitigation activities.

7.11.11 MITIGATION STRATEGIES

Mitigation strategies will be considered during specific planning and development of implementation projects. Specific mitigation measures will be adopted, consistent with Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

A range of actions is possible to mitigate adverse impacts on cultural resources. Specific mitigation strategies depend on the type of cultural resource being affected. Specific types of sites require different forms of mitigation. For example, an archeological site consisting of an isolated feature would require less mitigation than a long-term habitation location that contains burials.

Inventories for cultural resources often consist of formal on-foot transects across the area of potential effect. Historic and prehistoric sites are recorded through the completion of a site record form. When inventories are completed for specific Program elements and resources have been evaluated for NRHP eligibility or significance under CEQA, discussion of mitigation measures begin for affected properties. New 36 CFR 800 regulations require additional input from Native Americans and the public to aid in evaluating resources and to address mitigation procedures. The preferred mitigating action is avoiding the historic property (that is, a resource that is listed in or eligible for listing in the NRHP, or is considered a historic resource or a unique archeological resource under CEQA Guidelines [15064.5] and CEQA Status [210832.2]). This option would save money and preserve the resource for posterity. Routes could be diverted, facilities relocated, or projects redesigned to avoid adversely affecting historic properties. When avoidance is not feasible, mitigation becomes necessary.

Developing and implementing mitigation measures involve a series of steps described in 36 CFR 800. These are, in part, contingent on the specific resource. Data recovery is a common measure undertaken to mitigate adverse impacts on historic properties, historic resources, or unique archeological resources. Data recovery typically includes record keeping, mapping, surface collections, subsurface testing, and possibly excavations. These actions are preceded by research design and a memorandum of agreement (MOA), in compliance with Section 106 of the NHPA. Completing an MOA involves input from various federal and state agencies, as well as potential input from interested members of the public. Mitigation is complete with agency acceptance of a final report. Public reports summarizing the results of mitigation efforts often are used to disperse information gained from data recovery. In addition to data recovery, mitigation may involve other long-term actions, such as fencing, monitoring, or maintaining a historic property.

Prior to mitigating historic resources, CEQA calls for preparation of a data recovery plan in advance of excavation (CEQA Guidelines 15126.4[b][3][4]). The plan is deposited with the California Historical Resources Information Center (Center). If the lead state agency determines that testing or evaluative studies have adequately recovered sufficient scientific information, additional data recovery is not required. The CEQA Guidelines require that such a finding be documented in the EIR and that the studies be deposited at the Center.

Mitigating historic architectural properties is more involved. If a structure is determined eligible for inclusion in the NRHP, an MOA is prepared, as described above. The actual level of documentation for a structure or engineering facility is determined in consultation with the National Park Service, which provides direction for recording the structure to standards found in the Historic American Buildings Survey or the Historic American Engineering Record.

Mitigating impacts on traditional cultural properties is more problematic due to the character and potential sensitivity of the resource. Avoiding impacts through project redesign is preferred. Development of a management plan for the property is one possibility. Conducting intensive ethnographic interviews and research would provide additional documentation, if appropriate. Fencing, project redesign, and limiting the season of use are all options. Mitigation measures should be developed on a case-by-case basis in consultation with the cultural group with which the property is associated.

7.11.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

Implementation of the Program would result in impacts on some cultural resources. The quantity and significance of these impacts is unknown since specific projects have not been determined and a detailed cultural resource inventory and evaluation for specific sites have not been conducted. At a minimum, however, impacts can be assumed to be potentially significant. If impacts on historic properties, historic resources, or unique archeological resources in any region could not be avoided through project design, after appropriate consultation, mitigation would be available to reduce impacts to a less-than-significant level.

7.12 Public Health and Environmental Hazards

Overall, the CALFED Bay-Delta Program would benefit public health; however, some potentially significant adverse impacts may be associated with increased mosquito breeding habitat. The Program also could result in indirect long-term beneficial impacts by reducing public exposure to certain environmental hazards, such as forest fires.

7.12 Public Health and Environmental Hazards

7.12.1 SUMMARY

Reducing the spread of disease and risk of fires, and limiting the exposure of individuals to hazardous materials and waste are societal goals. Controlling and managing these potential hazards improve the overall quality of life in a society. Many every-day activities relate to the category of public health and environmental hazards. For example, improper disposal of garbage, over time, could create a public health concern. Hazardous wastes often are by-products of modern living. For this document, the public health and environmental hazard resource category addresses three issues that are salient to the CALFED Bay-Delta Program (Program): disease transmission by insect vectors, fire hazards, and increased exposure to hazardous materials and waste. Public health and environmental hazard impacts resulting from poor water quality, disinfection by-products, or trihalomethanes are addressed in the water quality impact analysis, Section 5.3.

Preferred Program Alternative. The Preferred Program Alternative would benefit public health by providing better water quality for the ecosystem and for drinking, which also could contribute to reduced opportunities for disease transmission and, in some instances, to reducing mosquito breeding habitat. The Water Quality Program is designed to reduce elevated levels of detrimental chemicals, metals, and pesticides. These reductions will not only benefit water quality but also will reduce public health concerns about consuming fish and shellfish from the Bay-Delta. Public health benefits from the Watershed Program could result from fewer or less intense forest fires which, in turn, would lessen the sediment load in streams and rivers. In addition, the organic materials that run off from fire-scorched areas and contribute to mosquito breeding habitat could be reduced. The Water Use Efficiency Program could benefit public health by reducing the amount of water left standing in an agricultural field and by reducing the amount of surface water pollution.

Beneficial impacts associated with the Levee System Integrity and Storage Programs, and the Conveyance Element could include improved flood control and fire management capabilities. However, these elements could cause potentially significant adverse impacts on public health, including temporary additional ponding that could create mosquito breeding habitat and exposure to hazardous materials or the resuspension of contaminants, such as mercury, during construction. All impacts related to exposure to hazardous materials, temporary ponding, and resuspension of contaminants can be mitigated to a less-than-significant level.

The Ecosystem Restoration, Levee System Integrity, Storage, and Conveyance Elements of the Preferred Program Alternative could result in potentially significant adverse impacts related to disease transmission by insect vectors, primarily by increasing the amount of potential mosquito breeding habitat. The combination of increased mosquito breeding habitat and increased human population independent of CALFED Program actions could result in potentially significant adverse impacts on public health. The Ecosystem Restoration and Levee System Integrity Program elements also could result in a potentially significant adverse impact related to an increase in the levels of methyl mercury released to the Bay-Delta ecosystem. These impacts can be mitigated to a less-than-significant level.

Alternatives 1, 2, and 3. Alternatives 1, 2, and 3 would result in similar benefits and adverse impacts as those described for the Preferred Program Alternative. Alternatives 2 and 3 have greater potential for construction-related impacts on public health and environmental hazards, such as exposing the public to hazardous materials, because their additional conveyance features would require additional construction activities. However, these alternatives have a greater potential for long-term benefits, including improved flow conditions that could improve water quality. Conversely, Alternative 1 and the Preferred Program Alternative could result in fewer short-term impacts but have less potential for overall long-term benefits on public health and environmental hazards.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Short- and long-term increases in mosquito breeding habitat from wetland restoration activities or fluctuating water levels (1,2,3,4,5).

Increased risk of groundwater and surface water contamination from naturally occurring or spilled hazardous materials and from improper handling of hazardous materials (6).

Increased exposure to hazardous materials and waste from construction activities related to storage and conveyance projects (6,7,8,9,11,12).

Increases in water quality degradation, resuspension of contaminates, and exposure to hazardous materials from dredging activities (6,8,9,11,12).

Increases in levels of methyl mercury released to the Bay-Delta ecosystem from wetland restoration and levee rehabilitation activities (10).

Mitigation Strategies

1. Using various mosquito control methods, such as biological agents, chemical agents, and ecological manipulation of mosquito breeding habitat.
2. Supporting actions to establish or find funding for mosquito abatement activities.
3. Removing or disturbing water that remains stagnant for more than 3 days at a construction site.
4. Limiting construction to cool weather, when mosquito production is lowest.
5. Limiting construction to periods of low precipitation to avoid forming pools of standing water.
6. Following established and proper procedures and regulations for removing and disposing of contaminated materials.
7. Increasing monitoring activities to ensure that groundwater pumping equipment is operating to existing standards.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative (continued)

8. Limiting or coordinating construction activities to favorable weather conditions to forestall dispersing hazardous materials.
9. Conducting core sampling and analysis of proposed dredge areas and engineering solutions to avoid or prevent environmental exposure of toxic substances after dredging.
10. Modifying engineering plans to minimize mercury-related problems.
11. Capping exposed toxic sediments with clean clay/silt and protective gravel.
12. Locating constructed shallow-water habitat away from sources of mercury until methods for reducing mercury in water and sediment are implemented.

No potentially significant unavoidable impacts related to public health and environmental hazards are associated with the Preferred Program Alternative.

7.12.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to public health and environmental hazards.

Other issues regarding the effects of Program actions do not involve differences of opinions among experts. One such concern for public health relates to funding mosquito abatement and vector control activities for the projected increases in wetland habitat. Entities responsible for mosquito abatement and vector control are concerned that Program elements could increase mosquito breeding habitat, which could lead to increased need for abatement activities. At the same time, the Program elements involving land conversion could reduce the financial base upon which abatement activities are funded. Mosquito abatement districts (MADs) rely on property taxes for funding; a change in land use could create additional financial demands. The environmental consequences of Program actions on public health and environmental hazards are disclosed in the environmental consequences sections of this document. Strategies are included that can mitigate potentially significant adverse impacts to a less-than-significant level.

7.12.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

7.12.3.1 DELTA AND BAY REGIONS

Disease Transmission. Mosquitos are the primary vectors for disease in these regions. Urban encroachment, a result of population growth in both the Delta and Bay Regions, resulted in more frequent human exposure to mosquitos and the likelihood of mosquito-borne disease transmission. Mosquito breeding habitat and consequent mosquito populations have been affected by land use changes in these regions.

By the early 1900s, most prehistoric Delta and Bay marshes (including the Suisun Marsh) were converted to agricultural land. Although this change in land use could suggest a reduction in mosquito breeding habitat, that has not necessarily been the case. Certain agricultural infrastructure and practices (for example, irrigation ditches and post-harvest flooding in fields to provide habitat for wintering waterfowl and other wildlife) could, and often did, create suitable breeding conditions for mosquitos.

In 1915, the California State Legislature enacted the Mosquito Abatement Act, which allowed local mosquito abatement organizations to form into specific special districts. These special districts had taxation authority to finance abatement programs. By 1973, 64 MADs had been established in California.

Diseases carried by mosquitos are known as arboviruses. At least 18 arboviruses with potential to harm humans are present in California, including western equine encephalomyelitis, St. Louis encephalomyelitis, malaria, and dog heartworm.

In the Delta and Bay Regions, current mosquito control efforts focus on seven mosquito species that could transmit malaria and encephalitis or could cause a substantial nuisance in communities: the floodwater mosquito (*Aedes melanimon*), pasture mosquito (*Aedes nigrormaculis*), encephalitis mosquito (*Culex tarsalis*), western malaria mosquito (*Anopheles freeborni*), pale marsh mosquito (*Aedes dorsalis*), cool-weather mosquito (*Culiseta inornata*), and house mosquito (*Culex pipiens*).

Mosquito Breeding Conditions and Habitat. All mosquito species require standing water to complete their growth cycles. Any body of standing water that remains undisturbed for more than 3 days represents a potential mosquito breeding site. Mosquitos produce year-round on Delta islands, but mosquito production diminishes substantially during cooler weather, typically from late October through April.

Water quality affects the productivity of a potential mosquito breeding site. Typically, water bodies with poor circulation, higher temperatures, and higher organic content produce greater numbers of mosquitos than water bodies with good circulation, lower temperatures, and lower organic content. Irrigation and flooding practices may influence mosquito production associated with a water body. Typically, water bodies with water levels that slowly rise or lower produce greater numbers of mosquitos than water bodies with water levels that are stable or that rapidly fluctuate.

Two general classes of habitats, open water and flooded, provide suitable conditions for mosquito production. Open-water habitats include permanently inundated wetlands, ditches, sloughs, and ponds. Flooded habitats include managed wetlands and agricultural lands that may seasonally retain surface water.

MADs use a combination of abatement procedures to control mosquitos. Each method may have maximum effectiveness under specific habitat conditions or periods of the mosquito life cycle. As a result of concern about the cumulative effects on the environment of past abatement practices, mosquito control has shifted away from applying pesticides, kerosene, and diesel fuel since the late 1970s. Mosquito control methods currently used by MADs include:

- Biological agents, such as mosquitofish, which eat mosquito larvae
- Source reductions, such as draining the water bodies that produce mosquitos
- Pesticides
- Ecological manipulations of mosquito breeding habitat

Other Vectors and Host Populations. Other public health concerns related to animal-vectored disease in California include the transmission of Lyme disease by ticks, bubonic plague by fleas, and rabies by wildlife; however, none of these issues are considered a high risk to public health in the Delta or Bay Regions.

Fire Hazard. Little information is available as to how frequently the Delta and Bay Regions experienced fires prior to European settlement in the 1800s. As more land in both regions were reclaimed for agricultural uses, the possibilities of fires increased because of changes in land use and vegetation, in addition to increased population. As a result of reclamation efforts in swamp lands, there is some limited potential for peat fires in the regions. In the Bay Region, fire suppression policies and large-scale grazing in the forested areas caused material decomposition rates to decline, which contributed to fuel accumulation throughout most of the Bay Region's wildlands.

Several recent fire management measures were adopted by both the state and federal governments. In 1981, the California Department of Forestry and Fire Protection (CDF) initiated its Vegetation Management Program to reduce wildfire damage and enhance resource values by reducing wildland fuel hazards. The Vegetation Management Program encompasses all major ecosystems in the state and a wide range of fuel management techniques. CDF also is implementing a pre-fire management initiative to conduct pre-fire planning in parts of the state for which it has fire suppression responsibility. The goal of the U.S. Forest Service's (USFS's) forest health initiative is to provide periodic fuel management treatment to as much national forestland as possible.

The Bay Region experienced a devastating fire in 1991 in the Oakland-Berkeley Hills. The fire swept through more than 1,500 acres, killing 25 people, destroying almost 3,000 single-family homes, and costing more than $1.5 billion in losses. Severe fires such as the Oakland-Berkeley Hills fire accelerate runoff that can contain greater amounts of soil sediments and increase sedimentation in streams, particularly when riparian vegetation has been burned. Reduced water infiltration through the soil resulting from fires can lead to mudslides.

Hazardous Materials and Waste. In both the Delta and Bay Regions, hazardous waste sites associated with agricultural production activities include storage facilities and agricultural ponds or pits contaminated with fertilizers, pesticides, herbicides, or insecticides. Petroleum products and other materials may be present in the soil and groundwater near leaking underground tanks used to store these materials. Leaking or abandoned pesticide storage containers also may be present on farmland. Water from agricultural fields on which fertilizers and pesticides are applied may drain into ponds, and rinse water from crop duster tanks and other application equipment routinely is dumped into pits. Evaporation can increase chemical concentration in pond water and cause chemicals to be deposited in underlying soil. Surface water percolation can pollute groundwater and expand the area of soil contamination.

Spills and leaking tanks or pipelines from industrial and commercial sites also can be sources of contaminants, such as petroleum hydrocarbons and polychlorinated biphenyls from old electrical transformers. Groundwater pollution in the Bay Region primarily is a result of leaking fuel tanks. Currently, more than 7,500 fuel tanks have leaked in the Bay Region; most groundwater cleanup activities are for fuels leaked from underground storage tanks (USTs). At about 500 other sites, chemicals that usually are toxic industrial solvents have leaked into groundwater. Contamination from gasoline manufacturing plants could include polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons from USTs, as well as cyanide and phenols. Contamination from chlorinated solvents, such as trichloroethylene (TCE) from manufacturing and plating, occurs in San Jose. Contamination from metals and PAHs also could result from railroad operations. Metals such as cadmium, zinc, and mercury are present in inactive and abandoned mines, and in streams in the Delta Region.

A multitude of hazardous chemicals, such as petroleum hydrocarbons and chlorinated solvents, may be present at active and closed military bases and industrial sites. Military bases scheduled for closure in the Bay Region currently are undergoing environmental clean-up activities. The California Environmental Protection Agency (CalEPA) has oversight authority for these clean-up activities. Among the concerns are hazardous materials, such as metals, polychlorinated biphenyl (PCBs), petroleum products, volatile organic compounds (VOCs), asbestos, and unexploded ordnance. Because landfills accepted almost all kinds of waste until the 1980s, any closed landfills may contain hazardous waste. In the study area, naturally occurring elements such as metals may be found at concentrations and amounts that may be considered hazardous.

Illegal drug manufacture and distribution facilities often are located in secluded abandoned structures; these structures can include abandoned barns and other structures present on farmland. Operation of these facilities can result in the improper storage and disposal of hazardous chemicals used during the manufacturing process.

Methyl Mercury. Mercury contamination, particularly the bioaccumulation of toxic methyl mercury in food webs, is a public health problem in the San Francisco Bay-Delta estuary. Mercury has been found throughout this area at elevated concentrations in water, sediment, and organisms. Methyl mercury, an organic form of mercury, has been found in many fresh- and salt-water organisms, including fish and shell fish. Methyl mercury is a potent neurotoxin that can cause nervous system damage in developing fetuses, as well as in children and adults. In 1971, the Department of Health Services issued a health advisory, recommending that pregnant women and children should not consume striped bass taken from the Bay-Delta estuary due to high mercury levels. An additional advisory was issued by the California Office of Environmental Health Hazard Assessment in 1994, when data revealed elevated mercury concentrations in other fish species.

Mercury can be transported through the atmosphere from various emissions, such as power plants, or can enter aquatic systems in runoff from mining operations or runoff from natural geological sources. A number of mercury sources are present in California, including mining, atmospheric, and geological. However, mining related activities are a significant source of mercury in the Bay-Delta. During the past 150 years, large amounts of mercury coming from mines in the California Coast Ranges, as well as residual mercury from gold and silver mining in the Sierra Nevada, have been and continue to be deposited in Bay-Delta sediments. Mercury in sediment may be resuspended through wildlife activities, wave action, dredging and disposal activities, and flooding of lands.

The extensive Sacramento-San Joaquin Delta levee system originated in the 1860s. Many levees likely were constructed in locations that contained considerable mercury deposits. Flooded wetlands have been found to promote methylation, the process that converts inorganic mercury to methyl mercury. Without appropriate attention, the addition of wetlands could increase the amount of methyl mercury in the Bay-Delta ecosystem.

7.12.3.2 Sacramento River and San Joaquin River Regions

Disease Transmission. The existing conditions related to mosquitos and mosquito-borne diseases are similar to those described for the Delta and Bay Regions.

Fire Hazards. Prehistorically, fire was the principal mechanism by which the nutrients contained in forest material were recycled. Since the 1800s, fire suppression policies and large-scale grazing have caused the rate of material decomposition to decline dramatically, and has led to fuel accumulation throughout most of the wildlands of the Sacramento River and San Joaquin River Regions. Fire suppression efforts also have reduced the frequency of wildfires. Due to their infrequency, wildfires now burn at higher intensities and damage larger areas. Wildfires can affect the quantity, quality, and timing of flows from watersheds and are responsible for the most intensive and extensive changes in watershed conditions.

Through vegetation removal, burning organic matter in soil, and creation of impervious soil layers, severe fires accelerate the amount of runoff. This runoff contains greater amounts of soil sediments and increases sedimentation in streams, particularly when riparian vegetation has been burned. With reduced water infiltration through the soil, mudslides can become more prevalent.

Fire suppression and large-conifer logging have resulted in forests dominated by small, shade-tolerant, and fire-sensitive tree species, such as white firs and incense cedars. These species have contributed to the amount of live and dead wood fuels near the forest floor. The presence of these fuels allows fires to climb to the forest canopy, leading to large-scale, severe wildfires. The changes have been greatest in the lower and middle elevations of the Sierra Nevada, the areas where human development has been the most rapid. These two conditions have led to an increase in the amount of people and property that are threatened by fire.

Conifer vegetation is common in the upper watersheds of the Sacramento River and San Joaquin River Regions, and presents a serious wildfire risk. These regions also contain vegetation that makes them susceptible to grass fires and brush fires, which can cause effects similar to, but less intense than, those from forest fires.

Hazardous Materials and Waste. Types of hazardous waste sites in the Sacramento River and San Joaquin River Regions include contaminated agricultural ponds; spills; and leaking tanks or pipelines from industrial sites, railroad operations, commercial sites, and mining. Metals such as cadmium, copper, mercury, and zinc, are present in inactive and abandoned mines in the Sacramento River drainage. The Sulphur Bank Mercury Mine in Clear Lake is listed as an EPA Region IX Superfund Site. Pollution in the San Joaquin River drainage includes pesticides and solvents from heavy industries in Fresno, and includes metals such as cadmium, zinc, and mercury from inactive and abandoned mines. Iron from naturally occurring geologic formations is another source of hazardous materials in the San Joaquin River Region. Landfills and commercial activities, such as dry cleaning, could be sources of contamination in these regions.

Military bases scheduled for closure in the Sacramento River Region currently are undergoing environmental clean-up activities. Among the concerns are hazardous materials such as metals, PCBs, petroleum products, VOCs, TCE, municipal wastes, and solvents. The EPA Region IX Superfund National Priorities List includes Mather AFB, McClellan AFB, and Sacramento Army Depot, all of which are in Sacramento. In the San Joaquin River Region, Castle AFB in Atwater is on the EPA Region IX Superfund National Priorities List. Environmental concerns include TCE, VOCs, and metals. The CalEPA has oversight authority for the environmental clean-up activities on these bases.

7.12.3.3 OTHER SWP AND CVP SERVICE AREAS

Disease Transmission. The existing conditions related to mosquitos and mosquito-borne diseases are similar to those described for the Delta and Bay Regions.

Fire Hazards. The perspective for wildfires is similar to that described for the Sacramento River and San Joaquin River Regions.

Hazardous Materials and Waste. Many of the land uses in the Other SWP and CVP Service Areas are similar to those in the other Program regions. Contamination is possible from agricultural, industrial, commercial, landfill development, and military land uses in the region.

7.12.4 ASSESSMENT METHODS

To identify impacts on public health and environmental hazards resulting from the Program alternatives, changes to the following variables were assessed:

- Amount of mosquito breeding habitat
- Proximity of human populations to mosquito breeding habitat
- Frequency and severity of large-scale wildfires
- Release of hazardous materials or waste

Program actions could affect public health by creating conditions favorable to mosquito breeding, which could cause an increase in mosquito populations. An increase in these populations could increase the possibility of mosquito-human contact. Similarly, decreasing the distance between human and mosquito populations would increase the likelihood of contact. More frequent contact, in turn, would increase the likelihood of disease transmission.

Program actions could increase the exposure of people and the environment to hazardous materials and waste. Hazardous materials include raw materials and products, such as fuels and oils, that are commonly used in commercial activities and during construction activities. Known and unknown sites containing hazardous waste also can be present in a project area. Releases, and subsequent public exposure to, hazardous materials and waste could result from accidental spills, subsurface site disturbance, and flooding in areas where these substances are present.

Program actions that disturb mercury-laden soils or that promote methylation, the process that causes conversion of inorganic mercury to methyl mercury, could increase the levels of methyl mercury released to the Bay-Delta ecosystem.

7.12.5 SIGNIFICANCE CRITERIA

An adverse impact is considered potentially significant if a proposed Program action would create a new public health or environmental hazard, or an increase in any existing hazard. An increase in an existing hazard could include:

- An increase in mosquito breeding habitat
- A decrease in the distance between human and mosquito populations
- An increase in releases or increased exposure to hazardous materials or waste

7.12.6 NO ACTION ALTERNATIVE

At this programmatic level of analysis, the environmental consequences of the No Action Alternative would not substantially differ from existing conditions. Current programs to ameliorate existing disease transmission, fire hazard, hazardous materials problems, and mercury contamination problems would result in some beneficial impacts; but their effectiveness may depend on funding. As habitat restoration and urban development take place next to each other, the potential for increased disease vector (mosquito) and human interaction increases. Continued trends in water quality degradation also could increase mosquito breeding habitat, but successful water quality improvement efforts could negate any potential increase. There is a slight potential for increased fire hazards as population increases; the magnitude of the hazard could depend on the population density. For example, as Bay Area population increases, a fire similar to the Oakland-Berkeley Hills event could be even more devastating. Urbanization also may be a factor in public exposure to hazardous materials and hazardous waste sites.

7.12.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For public health and environmental hazards, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, Watershed, and Storage Program elements are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance Element vary among Program alternatives, as described in Section 7.12.8.

7.12.7.1 DELTA AND BAY REGIONS

Ecosystem Restoration Program

The Ecosystem Restoration Program should result in healthier fish, waterfowl, and wildlife populations, which could indirectly benefit the public health of anglers, hunters, and their families. However, actions associated with the Ecosystem Restoration Program could increase the amount of mosquito breeding habitat. For example, expanding floodplains in the Delta could leave areas of standing shallow water when water levels decline, which would provide excellent mosquito breeding grounds. Converting agricultural land to wetland or other habitat and seasonally flooding agricultural land also could increase standing water. These conditions could increase mosquito breeding habitat, resulting in potentially significant adverse impacts. Increased mosquito breeding grounds could increase the need for abatement activities. At the same time, the Program elements involving land conversion could reduce the financial base upon which abatement activities are funded. MADs rely on property taxes for funding; a change in land use could create additional funding demands. In addition, Program actions such as wetlands restoration in areas that contain or trap mercury deposits could promote methylation, the process that causes the conversion of inorganic mercury to methyl mercury, which could cause an increase in the levels of methyl mercury in the Bay-Delta ecosystem. Mitigation strategies are available to reduce these impacts to a less-than-significant level.

Water Quality and Watershed Programs

The Water Quality and Watershed Programs could benefit public health and potentially reduce environmental hazards. Program actions could reduce surface water pollution, which could decrease health risks from drinking water or contact with contaminated water. Improved surface water quality could benefit waterfowl, fish, and other wildlife that depend on the water. A reduction in surface water pollution could decrease contaminants in fish, which would benefit the health of fish consumers. (For a discussion of impacts related to water quality, please see Section 5.3, "Water Quality.")

A potential indirect benefit of improved water quality could include a decrease in the mosquito population. Decreased amounts of organic material in the water could discourage mosquitos from breeding.

Water Use Efficiency Program

Public health and environmental hazards could benefit from actions associated with improving water use efficiency. Public health could benefit from reduced amounts of irrigation water applied to or left standing on agricultural fields, or modifications in the timing of wetland dewatering—actions that could reduce mosquito breeding habitat.

Agricultural efficiency improvements could reduce the level of contaminants in surface waters. Agricultural drainage water typically contains organic carbons, a major concern for public drinking water quality. Reducing drainage water through efficiency improvements could reduce the organic carbon loading into Delta surface waters. Less organic material in the water could, in turn, discourage mosquito breeding.

Efficiency improvements could increase the long-term operation of pumping equipment for both existing and new groundwater wells. The risk of long-term groundwater contamination from naturally occurring or spilled hazardous materials could increase if groundwater pumps in operation for longer periods were not routinely maintained and inspected. Groundwater pumping operations also could expose people to hazardous materials if established regulations are not properly followed, such as the method of storing gasoline or propane to run the pumps. This could translate into more people exposed to hazardous materials in drinking water, a potentially significant adverse impact. Mitigation is available to reduce this potentially significant impact to a less-than-significant level.

Levee System Integrity Program

The Levee System Integrity Program could result in both beneficial and potentially significant adverse impacts in the Delta and Bay Regions, including the Suisun Marsh, related to public health and environmental hazards. The Levee System Integrity Program would benefit public health and safety by reducing the potential for flooding, thus decreasing potential mosquito breeding habitat. However, some levee reconstruction could create riparian and wetland habitat, and reconstruction activities could result in permanent or temporary (during construction) standing water. The presence of standing water could increase mosquito breeding habitat, as well as the risk of exposure to hazardous materials and waste.

Dredging as a component of the Levee System Integrity Program could result in both beneficial and potentially significant adverse impacts. Dredging may be used to increase channel capacity for flood protection, which could indirectly benefit public health by reducing the likelihood that flooded fields would provide mosquito breeding habitat. (Please see Section 7.8, "Flood Control," for additional discussion about impacts related to flood control.) Potentially significant adverse impacts related to public health and environmental hazards that may be associated with dredging include temporary water quality degradation during dredging (which could contribute to increased mosquito breeding habitat), resuspension of contaminates such as mercury, potential exposure to hazardous materials from placement of contaminated dredged spoils near population centers, and changes to hydrology that could affect the dispersion of hazardous materials. Dredged materials will be analyzed, dredged, and handled in accordance with permit requirements. Permits will incorporate mitigation strategies identified in Section 5.3.11 to prevent release of contaminants of concern.

All potentially significant adverse impacts related to public health and environmental hazards that are associated with Levee System Integrity Program actions can be mitigated to a less-than-significant level.

The Levee System Integrity Program would not directly affect public health and environmental hazards in any Program region other than the Delta and Bay Regions. The Other SWP and CVP Service Areas would experience the indirect benefit of avoided increased salinity in water supplies that otherwise would have resulted from flooding in the Delta. The Levee System Integrity Program is not addressed further in the region-specific discussions that follow.

Water Transfer Program

The Water Transfer Program would result in a negligible effect on public health and environmental hazards. Some water transfers could provide water to wildlife refuges and other natural habitats, which in turn could expand mosquito breeding habitat; however, the potential amount of water transferred to these uses likely would remain small relative to other uses of transfer water.

Storage

Channel widening, island flooding, and fluctuating water levels associated with Storage Program actions could create pockets of standing water that could provide mosquito breeding habitat in the Delta Region. In addition, channel widening and island flooding could disturb sediments contaminated with mercury, which could cause an increase in the levels of mercury in the Bay-Delta ecosystem. Delta island flooding could produce similar methylation processes as those described for the Ecosystem Restoration Program.

Although the proposed action would not decrease fire hazards, additional surface water storage could indirectly enhance fire-fighting capabilities in both the Delta and Bay Regions. These facilities could provide additional water sources available for fighting regional wildfires. This would reduce the transport time for water to wildfire sites, thereby limiting the damage from the fires. This beneficial impact would be most apparent during drought years, when fire hazards increase and the amount of available water decreases.

Construction activities could expose people to hazardous materials and waste, such as PCBs, petroleum products, pesticides, and metals, such as mercury—resulting in potentially significant adverse impacts. Impacts could be caused by exposure to naturally occurring or spilled hazardous materials, or by subsurface disturbance of contaminated sites. Mitigation is available to reduce these potentially significant impacts to a less-than-significant level.

7.12.7.2 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Ecosystem Restoration Program

Impacts associated with the Ecosystem Restoration Program in the Sacramento River and San Joaquin River Regions would be similar to those described for the Delta and Bay Regions. Because only a small amount of wetland habitat would be created in the San Joaquin River Region, the potential for increases in mosquito breeding habitats could be less in that region.

Water Quality Program

Impacts associated with Water Quality Program actions in the Sacramento River and San Joaquin River Regions would be similar to those described for the Delta and Bay Regions. Benefits include reduced exposure to surface water pollutants and reduced organic material—both of which promote mosquito breeding. An additional minor decrease in mosquito breeding habitat could occur if irrigation canals and other facilities are eliminated when agricultural land is retired to reduce drainage problems in the San Joaquin River Region.

Water Use Efficiency and Water Transfer Programs, and Storage

The effects of the Water Use Efficiency and Water Transfer Programs, and the Storage element in the Sacramento River and San Joaquin River Regions, would be similar to those described for the Delta and Bay Regions.

Watershed Program

The Watershed Program could reduce the frequency and severity of wildfires in the Bay-Delta watershed. Forest management activities could reduce the amount of fuel available to fires through a variety of techniques, including controlled burns and removing dead and dying vegetation. Additional potential benefits include increased water yield from restored meadows and reduced organic material in the water.

7.12.7.3 OTHER SWP AND CVP SERVICE AREAS

Ecosystem Restoration and Watershed Programs, and Storage

The Ecosystem Restoration and Watershed Programs and the Storage element would not result in any potentially significant impacts on public health or environmental hazards in the Other SWP and CVP Service Areas.

Water Quality and Water Use Efficiency Programs

The effects of the Water Quality and Water Use Efficiency Programs in the Other SWP and CVP Service Areas would be similar to those described for the Delta and Bay Regions.

7.12.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For public health and environmental hazards, the Conveyance element results in environmental consequences that differ among the alternatives, as described below.

7.12.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

A diversion facility on the Sacramento River and an accompanying conveyance channel, and channel modifications to improve conveyance in the south Delta could result in standing water. The presence of standing water could provide mosquito breeding habitat. Water project operation changes and conveyance features could cause water levels to fluctuate, potentially providing additional mosquito breeding habitat. In addition, Program activities could disturb sediments contaminated with mercury, which could cause an increase in the levels of mercury in the Bay-Delta ecosystem.

Construction activities could expose people to hazardous materials and waste, such as PCBs, petroleum products, pesticides, and metals such as mercury, resulting in potentially significant adverse impacts. Impacts could be caused by exposure to naturally occurring or spilled hazardous materials, or by subsurface disturbance of contaminated sites. Dredging to increase conveyance capacity also could result in potentially significant adverse impacts. Impacts associated with dredging may include temporary water quality degradation (during dredging), resuspension of contaminates such as mercury, increased exposure to hazardous materials from placement of contaminated dredged spoils near population centers, and changes to the hydrology that could affect the dispersion of hazardous materials. Dredged materials will be analyzed, dredged, and handled in accordance with permit requirements. Permits will incorporate mitigation strategies identified in Section 5.3.11 to prevent release of contaminants of concern.

All potentially significant adverse impacts related to public health and environmental hazards that are associated with the Preferred Program Alternative can be mitigated to a less-than-significant level.

7.12.8.2 ALTERNATIVE 1

Conveyance channels and channel modifications to improve conveyance in the south Delta may create additional mosquito breeding habitat and may cause an increase in the levels of mercury in the Bay-Delta ecosystem. Operating fish barriers in the south Delta and changes in project operations could cause water levels to fluctuate, thereby providing additional breeding habitat for mosquitos. These adverse impacts are considered potentially significant.

Although construction activities would result in similar environmental impacts as those described for the Preferred Program Alternative, the magnitude would be less, since less construction is planned under Alternative 1.

7.12.8.3 ALTERNATIVE 2

The environmental impacts on public health and environmental hazards would be the same under Alternative 2 as those described for the Preferred Program Alternative. The primary difference is the degree of potential public exposure to hazardous materials during construction. Since Alternative 2 includes a 10,000-cfs diversion facility near Hood, public exposure to construction-related hazardous materials could be increased as construction would take longer for the larger facility.

7.12.8.4 ALTERNATIVE 3

As with Alternative 2, the additional conveyance facilities proposed under Alternative 3 account for the magnitude of the potential public exposure to hazardous materials during construction. An isolated Delta conveyance facility could result in greater potential public exposure to construction-related hazardous materials. The impact of in-Delta conveyance would depend in part on the channel improvement requirements for a dual-Delta water conveyance system. A smaller isolated facility could require more in-Delta conveyance, and a larger isolated facility could require less. The greater amount and extended time to complete construction would result in greater potential for public exposure to hazardous materials.

7.12.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were the same impacts as those identified in Sections 7.12.7 and 7.12.8, which compare the Program alternatives to the No Action Alternative.

As stated under the "No Action Alternative," conditions under the No Action Alternative related to public health and environmental hazards are expected to remain similar to present conditions. Current trends regarding public health and environmental hazards are unlikely to change substantially.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative.

The following potentially significant impacts related to public health and environmental hazards are associated with the Preferred Program Alternative:

- Short- and long-term increases in mosquito breeding habitat from wetland restoration activities or fluctuating water levels.
- Increased exposure to hazardous materials and waste from construction activities related to storage and conveyance projects.
- Increases in water quality degradation, resuspension of contaminates such as mercury, and exposure to hazardous materials from dredging activities

No potentially significant unavoidable impacts related to public health and environmental hazards are associated with the Preferred Program Alternative.

7.12.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For public health and environmental hazards, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This similarity is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.12.1 lists in summary form the potentially significant adverse long-term impacts and the mitigation strategies that can be used to avoid, reduce, or mitigate these impacts to a less-than-significant level. At the programmatic level, the analysis did not identify any impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level. Sections 7.12.7 and 7.12.8 elaborate on long-term impacts.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on public health and environmental hazards in the Delta, Bay, Sacramento River, and San Joaquin River Regions: American River Water Resource Investigation, American River Watershed Project, other CVPIA actions not yet fully implemented, Delta Wetlands Project, CCWD Multi-Purpose Pipeline Project, ISDP, Montezuma Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento River Flood Control System

Evaluation, Sacramento Water Forum process, EBMUD Supplemental Water Supply Project, Sacramento County municipal and industrial water supply contracts, urbanization, West Delta Water Management Program, and Sacramento River Conservation Area Program. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.12.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. Significant overall long-term benefits related to public health and environmental hazards would result from Program actions. Long-term benefits include reduced mosquito breeding potential from improved water quality, flood control, and water use efficiency; increased fire management capabilities; and increased water supply for fire management. Benefits generally would outweigh the short-term adverse impacts.

Most short-term impacts are related to construction and would cease when construction is complete. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on public heath and environmental hazards. Potentially significant long-term impacts could include creation of increased mosquito breeding habitat near expanding urban areas; and an increase in the levels of mercury in the Bay-Delta ecosystem, which can be mitigated to a less-than-significant level.

Irreversible and Irretrievable Commitments. All Program elements under the Preferred Program Alternative can be considered to cause significant irreversible changes in public health and environmental hazards. Avoidance and mitigation measures can be implemented to lessen adverse effects, but changes will be experienced by future generations. The long-term beneficial irreversible changes include a reduction in mosquito breeding habitat, a reduction in fuels that contribute to forest fires, and improved water supply reliability to help fight forest fires. Long-term adverse irreversible changes include the potential for creating additional mosquito breeding habitat.

7.12.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during specific project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location, and timing.

Potential increases in mosquito populations and exposure to hazardous materials are the two issues for which mitigation strategies were developed. Since fire hazards would not be adversely affected, no change to existing fire management programs is suggested.

The following strategies could be implemented to reduce impacts related to public health and environmental hazards:

- Using various mosquito control methods, such as biological agents, chemical agents, and ecological manipulation of mosquito breeding habitat.

- Supporting actions to establish or find funding for mosquito abatement activities.
- Removing or disturbing water that remains stagnant for more than 3 days at a construction site.
- Limiting construction to cool weather, when mosquito production is lowest.
- Limiting construction to periods of low precipitation to avoid forming pools of standing water.
- Following established and proper procedures and regulations for removing and disposing of contaminated materials.
- Increasing monitoring activities to ensure that groundwater pumping equipment is operating to existing standards.
- Limiting or coordinating construction activities to favorable weather conditions to forestall dispersing hazardous materials.
- Conducting core sampling and analysis of proposed dredge areas and engineering solutions to avoid or prevent environmental exposure of toxic substances after dredging.
- Modifying engineering plans to minimize mercury-related problems.
- Capping exposed toxic sediments with clean clay/silt and protective gravel.
- Locating constructed shallow-water habitat away from sources of mercury until methods for reducing mercury in water and sediment are implemented.

7.12.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

No potentially significant unavoidable impacts related to public health and environmental hazards are associated with the Preferred Program Alternative.

7.13 Visual Resources

The CALFED Bay-Delta Program would result in beneficial and adverse effects on visual resources. Beneficial impacts include visual improvements from restored woodland, riparian, and wetland habitats. Potentially significant unavoidable impacts on visual resources are associated with visually dominant features, such as new levees, embankments, and reservoirs.

7.13 Visual Resources

7.13.1 SUMMARY

Both natural and artificial landscape features contribute to perceived visual images and the aesthetic value of a view. Aesthetic value is influenced by geologic, hydrologic, botanical, wildlife, recreational, and urban features. Visual images and their perceived visual quality can vary significantly by season and even by time of day as weather, light, shadow, and the elements that comprise the viewscape change. Judgments of visual quality must be based on a regional frame of reference. Geographic area also is a factor in evaluating visual qualities.

Individuals respond differently to changes in the physical environment, depending on their experience of that environment prior to changes, the extent and nature of those changes, and the proximity and duration of their views. The aesthetic value of an area is a subjective measure of its visual character and scenic quality.

All Alternatives. Program actions could result in beneficial and adverse impacts on visual resources. Beneficial impacts include visual improvements due to restored woodland, riparian, and wetland habitats. Short-term adverse visual impacts could be associated with construction activities, such as dust, construction staging areas, and glare from night-time lighting. Long-term adverse impacts in the Delta could result from the high visibility of channels, levees, in-channel flow control structures, dams and reservoirs, or other facilities. Some of these potentially significant adverse impacts are unavoidable. In the Delta, Sacramento River, and San Joaquin River Regions, shoreline "rings" around reservoirs caused by fluctuating water levels could cause a potentially significant unavoidable impact on visual resources.

The Conveyance element under Alternative 3 could result in greater visual impacts than the other alternatives because of the isolated conveyance facility.

The following table presents a summary of the potentially significant adverse impacts and mitigation strategies associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact. See the text in this chapter for a more detailed description of impacts and mitigation strategies.

Summary of Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

Introduction of new facilities or presence of constructed linear and obtrusive features (such as levees, dams, and spillways), view obstructions, and a bathtub ring effect caused by fluctuating water levels from drawdown and replenishment of storage reservoirs (1,5,6,7,9,10,11,12,13,14).

Impacts in visually sensitive areas from restoration actions, such as creating borrow pits for gravel replacement and installing fish screens in areas with high visual sensitivity (7,9,14).

Degraded watershed views from such actions as altered timber harvesting practices (3,8,13,14).

Creation of borrow pits or spoils material disposal sites associated with storage, conveyance, and levee projects (8,9,10,11,12,14).

Long-term visual impacts from construction activities extending more than 5 years (2,3,4,5,8,9,14).

Mitigation Strategies

1. Timing changes in flow regimes to minimize "bathtub ring" effects during times of peak recreation use.
2. Minimizing construction activities during the peak-use recreation season.
3. Watering areas where dust is generated, where feasible, particularly along unpaved haul routes and during earth-moving activities, to reduce visual impacts caused by dust.
4. Avoiding unnecessary ground disturbance outside the necessary construction area.
5. Locating and directing exterior lighting at facilities and during construction activities so that it is concealed to the extent practicable when viewed from local roads, nearby communities, and any recreation areas.
6. Siting proposed reservoir(s), if possible, to minimize required cut-and-fill and locating the reservoir on the flattest topographic section of the site to minimize its visibility.
7. Constructing facilities such as pumping-generating plants with earth-tone building materials.
8. Revegetating disturbed areas as soon as possible after construction.
9. Locating visually obtrusive features, such as borrow pits and dredged material disposal sites, outside visually sensitive areas and observation sites.
10. Selecting vegetation type, placement, and density to be compatible with patterns of existing vegetation where revegetation occurs in natural areas.
11. Installing landscape screening, such as grouped plantings of trees and tall shrubs, to screen proposed facilities, such as pumping-generating plants, from nearby sensitive viewers, such as motorists and residents.
12. Using native trees, bushes, shrubs, and groundcover for landscaping, when appropriate, at facilities such as dams and pumping-generating plants, and along new and expanded canals and conveyance channels, in a manner that does not compromise facility safety and access.
13. Creating viewing opportunities of outstanding features (such as Mount Diablo and the Vaca Mountains) through selective vegetation reduction or constructing roadside viewing areas.
14. Recontouring and adding vegetation to areas rated as "poor" in variety class.

Bold indicates a potentially significant unavoidable impact.

7.13.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to visual resources. In addition, no areas of concern are associated with visual resources.

7.13.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

Existing visual resources are described below in terms of variety classes, a ranking system from distinctive visual features (Class A) to minimal visual features (Class C). Refer to Section 7.13.4, "Assessment Methods," for additional information on this method of categorizing visual resources.

7.13.3.1 DELTA REGION

Most of the Delta is devoted to farming. The region is interlaced with a network of waterways and levees designed to protect the Delta's islands and tracts. Reclamation efforts have dramatically changed the Delta landscape since the 1850s, after the federal Swamp and Overflowed Lands Act was passed. Large expanses of wetlands, riparian corridors, and open water were replaced by agricultural lands in low-lying tracts surrounded by levees. As upstream agricultural diversions created greater tidal intrusion of saline water, these agriculture lands were subsequently converted to managed wetland habitat for waterfowl use. By 1930, only a small amount of the natural landscape remained. Levee failures in 1930 resulted in islands flooding throughout the Delta, several of which have not been converted back to agriculture.

By the 1940s, only a few small settlements existed in the Delta. Following World War II, urbanization expanded along the edges of the Delta. From 1946 to 1964, commercial shipping and recreational boating in the Delta increased, followed by marina development. Since 1975, urbanization has continued in the Delta, especially in eastern Contra Costa, San Joaquin, and Sacramento Counties.

Major visual resources in the Delta Region include the SRAs of Franks Tract, Brannon Island, and Windy Cove; Stone Lakes NWR; the Cosumnes-Mokelumne River confluence wildlife preserve; and several private marinas, camping, and fishing sites. SR 160 is a state-designated scenic highway from Antioch to Freeport. Representative Variety Classes A and B resources viewed from the Delta include Mount Diablo in Contra Costa County and the Vaca Range in Napa and Solano Counties.

The main roads from which travelers can view the Delta are SRs 160, 4, and 12. In many sections of SRs 4 and 12, it is impossible to view the Delta waterways, but features such as Mount Diablo can be seen.

7.13.3.2 BAY REGION

Heavy urbanization and industrial uses currently characterize the Bay Region, although some areas remain in open space. Prior to the 1930s, the Bay Area's visual character was dominated by the urban skyline of

San Francisco; the remainder of the region was more rural and less developed. Urbanization and reclamation began changing land use in the Bay Region. Over the last 60 years, the Bay Region has become progressively more urbanized, although open space has been preserved along the major ridgelines that surround San Francisco Bay.

Major visual resources in the Bay Region include:

- San Pablo Bay NWR
- Benicia SRA
- Martinez Shoreline (East Bay Regional Park District [EBRPD])
- Carquinez Strait Shoreline (EBRPD)
- China Camp State Park
- Point Pinole (EBRPD)
- Suisun Marsh
- Grizzly Island WMA

The most visually dominant feature from the east side of the Bay Region is Mount Diablo in southern Contra Costa County and the Diablo Ridge, which frames the southern half of the valley. Rising 3,849 feet above mean sea level (msl), Mount Diablo is also visible throughout the western half of the Sacramento Valley.

The Suisun Marsh is located in the Bay Region. The marsh is the largest contiguous wetlands in California. Much of the marsh was reclaimed during the late nineteenth and early twentieth centuries; for example, reclamation efforts converted about half of Suisun Marsh to agricultural use by 1930.

7.13.3.3 Sacramento River Region

The Sacramento River Region is visually characterized by agricultural uses in the Sacramento Valley, and grasslands and woodlands in the foothills and forests in the upper watersheds. The historical changes in the Sacramento Valley from grasslands, floodplains, and extensive riparian areas to cropland, rice fields, and orchards have reduced visual variety. Prior to the 1940s, the Sacramento Valley was made up of grasslands, scattered oak woodlands, wetlands, vernal pools, and riparian areas. The Sacramento River Region's upper watershed retained its predominately oak woodland, grasslands, forests, and small rural communities despite substantial development along state and federal highways in the foothills and mountain areas. These areas are framed by the forested ridgelines of the Sierra Nevada to the east, the Cascade Range to the north, and the Coast Ranges to the west. Little urbanization in these areas has preserved pristine wildernesses, mountains, and other dramatic landscapes. As a result, areas along I-5, SR 99, SR 70, and other roads generally are Variety Class A.

Important visual resources that could be inventoried as Class A features include the Sacramento, Sutter, and Colusa NWRs; Grey Lodge WMA; and the Colusa-Sacramento River SRA. Other important visual resources in the Sierra foothills include the SRAs at Lake Oroville, Folsom Lake, and Auburn.

Much of the northern and eastern upper watershed of the Sacramento River Region is forest, which blocks views for motorists traveling through these areas. Potential Class A visual features include state and federal park and recreation areas, such as Plumas Eureka State Park, Whiskeytown-Shasta-Trinity NRA, and Lassen Volcanic National Park. The Sutter Buttes, Mount Lassen, and Mount Shasta are prominent mountain features visible from a large portion of the north Central Valley. Mount Lassen, with an elevation 10,457 feet above msl, is a dominant visual feature in the northeastern watershed, visible from throughout the northern Sacramento Valley. SR 70, which traverses Butte and Plumas Counties, is eligible for scenic highway designation. Clear Lake, the largest natural lake in California, is the most distinctive visual feature on the west side of the Sacramento Valley.

Constructing dams and reservoirs substantially changed the visual landscape. Whiskey-town, Shasta, and Black Butte Reservoirs have added visual variety to this region. Viewer sensitivity is high in these areas because of high recreation use and easy public access.

Major urban areas include Sacramento, Redding, Red Bluff, and Chico. A section of SR 36 (in Tehama and Plumas Counties, from SR 89 near Morgan Summit to SR 89 near Deer Creek) is eligible as a state-designated scenic highway. Trinity County is eligible for scenic designation, along with SR 70.

Federally designated wild and scenic rivers include the Middle Fork of the Feather River, the North Fork of the American River, and the Lower American River reach that flows through Sacramento.

7.13.3.4 San Joaquin River Region

Much of the land in the San Joaquin River Region is agricultural (Variety Class C). The valley floor is primarily irrigated agriculture, and cattle graze in many of the mountain meadows in the upper watershed areas. Much of the upper watershed on the east side of the San Joaquin Valley is forested, which limits views for motorists traveling through the area. The watershed areas on the west side of the San Joaquin Valley are a mix of suburban areas surrounded by low-lying agricultural lands. Major urban communities include Modesto, Stockton, Fresno, and Bakersfield.

Historically, this region encompassed both high-elevation forestland and lower-elevation open grasslands, scattered oak woodlands, wetlands, vernal pools, and riparian areas. The San Joaquin River Region is bordered on the east by the Sierra Nevada, on the south by the Tehachapi Mountains, and on the northwest by the Coast Ranges. Yosemite Valley is in the northeast portion of the region. In the south, Tulare Lake at one time occupied close to 800 miles of the valley floor, fed by the Kings, Kaweah, and Tule Rivers. At least one account records when the lake, swollen by flood waters, overflowed natural land barriers and merged with the San Joaquin Delta. In the mid-to-late 1800s, the lake contained excursion paddle-wheelers and a thriving commercial fishery. Waterfowl and wildlife were plentiful on and near the lake. In the years after the Swamp and Overflowed Lands Act of 1852 was enacted, however, reclamation efforts and upstream irrigation projects restricted water flow into the lake until only a lake bed remains today. Prior to the 1940s, developed communities were sparse, and those that existed were concentrated mostly in the Fresno and Modesto areas. Post-war agricultural development and increased urbanization continued the changes to the visual landscape that were started in the nineteenth century, by replacing grasslands with irrigated cropland and reducing what remained of the wetlands, vernal pool, and riparian areas.

The upper watershed areas of the San Joaquin River Region have remained relatively untouched over the last 150 years. The upper watershed is still predominantly oak woodland, grassland, and forest, with some limited rural development. These areas are framed by the forested ridgeline of the Sierra Nevada to the east and the Tehachapi Mountains to the south. Lack of development has preserved the scenic qualities of these areas; however, over the past 30 years, increasingly developed viewscapes have encroached along the major roadways in this region.

Important (Variety Class A or B) visual resources on the valley floor include the San Luis NWR complex, Mendota and Volta NWRs, and the San Luis Reservoir. In the Sierra Nevada, major visual resources include several SRAs and reservoirs such as Camanche, New Don Pedro, and Pine Flat. Lakes in the area include New Hogan, New Melones, McClure, Eastman, Millerton, Kaweah, Success, and Isabella. Other important visual resources include the Colonel Allensworth State Historic Park, Tule Elk State Reserve, and Pixley NWR.

Major (Class A) visual resources in the upper watershed areas of the region include Yosemite National Park and several wilderness areas. The John Muir Wilderness, in the Sierra and Inyo National Forests, encompasses 584,000 acres in the Sierra Nevada and is the largest designated wilderness area in California. Other smaller wilderness areas include Emigrant Wilderness, which covers approximately 117,600 acres adjacent to Yosemite National Park and where elevations range from 6,000 to 12,000 feet above msl.

Major highways with high viewer sensitivity that provide access to Yosemite or Kings Canyon-Sequoia National Parks include SRs 140, 120, 196, and 41. Most of the urbanized areas along I-5 and SR 99 are Variety Class C. State routes eligible for state scenic highway status include SR 33 (in Fresno County, from SR 198 near Coalinga to SR 198 near Oilfields), SR 168 (in Fresno County, from SR 65 near Clovis to Huntington Lake), and SRs 190 and 198 (in Tulare County, from SR 65 in Porterville to the county line). Portions of I-5 and SR 152 (with views of San Luis Reservoir) are designated as scenic highways.

Federally designated wild and scenic rivers include the South Fork of the Merced River, the Middle and South Forks of the Kern River, and the Tuolumne River.

7.13.3.5 Other SWP and CVP Service Areas

The Other SWP and CVP Service Areas region includes two distinct, noncontiguous areas: in the north, are the San Felipe Division's CVP service area and the South Bay SWP service area; to the south, are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

Historically, the southern portion of the region consisted of relatively arid landscape, with topography that ranged from steep, rugged coastal hills and mountains to the fertile plains of the San Fernando Valley. Historical growth was concentrated first along the coast, especially in San Diego and Los Angeles Counties. With water supply development, the inland portions of this area developed into a highly productive agricultural region. Since the 1940s, expanding urban and suburban areas have dominated the landscape.

Much of the region is now urbanized, especially in Los Angeles, Orange, San Diego, San Bernardino, and Riverside Counties. However, major undeveloped areas also provide significant visual resources, including the Los Padres National Forest and Ventura Wilderness, national forestland in the San Gabriel and San Bernardino Mountain Ranges, and the Cleveland National Forest.

The Santa Clara Valley is a flat, gently sloping valley floor that is surrounded by the low, rolling to steep foothills of the Diablo Range to the east and the Santa Cruz Mountains and Gabilan Range to the west. Some coastal areas near Watsonville include tidelands. Historically, this area has been used for agriculture—mostly fruit trees, irrigated crops, and livestock. The first significant European settlement accompanied the founding of the Spanish Mission Santa Clara in 1777. Farming in the area became prevalent after California joined the United States in 1848. By 1880, commercial fruit growing was an established industry. In the post-World War II development, groundwater supplies were depleted, and water from the SWP and CVP was imported through the Pacheco Tunnel from the San Luis Reservoir to Santa Clara and San Benito Counties. Today, CVP water also is supplied to parts of Monterey County.

7.13.4 ASSESSMENT METHODS

The impact assessment process was guided by the Visual Management System (VMS), developed by the USFS. This programmatic-level assessment describes impacts at a broad, regional level and focuses on known sensitive visual resources and landscapes. The analysis uses the following methods:

- Identify visually sensitive areas. Sensitivity was considered highest for views seen by people driving to or from recreational activities, or along routes designated as scenic corridors. Views from relatively moderate to high-use recreation areas also were considered sensitive.

- Consider the distance between the proposed actions or facilities and visually sensitive areas. Only impacts of those project actions that are 3 miles or less from identified visually sensitive areas were assessed. Generally, impacts occurring more than 3 miles away from visually sensitive areas are not readily seen or distinguishable at a level that would be considered sensitive. In some situations, however, depending on the facility and the location-specific topography, the visibility of a proposed facility or Program action might exceed a distance of 3 miles.

- Focus the assessment on components of the Program that could affect the visual environment. The impact analysis focused on the Ecosystem Restoration, Levee System Integrity, Storage, and Conveyance elements. Unless otherwise stated, the impacts of other Program actions are assumed to be neutral or only slightly beneficial.

Variety classes are a key component of the VMS and are used to classify visual features into "distinctive" (Class A), "common" (Class B), and "minimal" (Class C) categories.

7.13.5 SIGNIFICANCE CRITERIA

Two significance criteria were used for this analysis. An impact on a visual resource was considered potentially significant if implementing a Program action would:

- Obstruct or permanently reduce visually important features that are in Variety Classes A and B, and can be viewed from visually sensitive areas.

- Result in long-term (that is, persisting for 5 years or more) adverse visual changes or contrasts to the existing landscape as viewed from areas with high visual sensitivity within 3 miles. The analysis also considered how many viewing sites would be affected.

7.13.6 NO ACTION ALTERNATIVE

Changes and trends in land use and urban development could result in adverse impacts on visual resources under the No Action Alternative. Land now under cultivation or covered in natural vegetation could be urbanized. Most county and city general plans call for parks or green belts, which generally could be considered a beneficial impact associated with urbanization. The No Action Alternative also could result in adverse impacts on visual resources if Delta levees failed. Flooded agricultural land or habitat could be considered a potentially significant adverse visual impact.

Other projects listed in Attachment A could result in beneficial or adverse consequences to visual resources. Projects involving habitat restoration could cause beneficial effects, while projects involving construction of facilities generally would result in negative visual effects.

7.13.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For visual resources, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs, and the Storage element are similar under all Program alternatives, as described below. The environmental consequences of the Conveyance element vary among Program alternatives, as discussed in Section 7.13.8.

7.13.7.1 DELTA REGION

Ecosystem Restoration Program

The visual impacts from the Ecosystem Restoration Program are considered beneficial because restored natural habitats generally are perceived as more scenically diverse and aesthetically pleasing than other land uses. The Ecosystem Restoration Program would convert land in the Delta Region from existing uses to habitat, ecosystem restoration, levee setbacks, and floodways. Most of this acreage is currently agricultural. Short-term visual impacts during construction could include views of bare ground as native or riparian habitat become established or views of dust generated from construction sites. Because these impacts are expected to last less than 5 years, they are not considered potentially significant.

The long-term effects of the Ecosystem Restoration Program would be beneficial, since the program would restore a more natural landscape in an area that is highly developed (Variety Class C). Some areas in the Delta Region could shift from Variety Class B to Variety Class A.

Water Quality and Watershed Programs

The Water Quality and Watershed Programs are not anticipated to cause any visual impacts in the Delta Region.

Levee System Integrity Program

The Levee System Integrity Program would involve levee rehabilitation and habitat creation in the Delta. This program could result in short-term impacts on visual quality during construction caused by vegetation removal, construction staging areas, and night-time glare from construction lights. These effects are expected to diminish, however, when construction ends and as vegetation is reestablished on the levees. Because these visual effects are expected to last less than 5 years, the impacts are not considered potentially significant.

New levees and embankments could visually dominate the surrounding flat, open landscape and could permanently change the visual quality and character of the project area, resulting in a potentially significant unavoidable visual impact.

Water Use Efficiency Program

The Water Use Efficiency Program is not expected to result in any potentially significant visual impacts in the Delta Region. Changes could result from the kinds of plants and materials used in urban landscaping and in the kinds of agricultural crops planted; but these changes would involve substitutions, subtle changes, or beneficial changes to visual aspects that are not considered potentially significant. In some instances, water use efficiency improvements could result in some incidental losses in wetlands and riparian areas that used agricultural return flow. These impacts will be avoided, or mitigation strategies are available to reduce the impacts to a less-than-significant level.

Water Transfer Program

Overall, the Water Transfer Program would result in negligible visual effects. River flows or reservoir elevations could increase or decrease locally, but all such changes are expected to be within historical ranges observed in these water bodies during various water-year types. If land fallowing occurs from temporary water transfers, the changes could improve visual diversity, which some would consider a beneficial visual impact when compared to a crop field. However, long-term or permanent fallowing may be considered by some as an adverse visual impact.

Storage

Any reservoirs built in the Delta Region would inundate areas primarily used for agriculture. Although water bodies generally are considered beneficial visual features, fluctuating water levels from reservoir drawdown and replenishment could cause adverse visual impacts. This"bathtub ring" effect occurs along the shoreline in areas that are alternately inundated and exposed. Vegetation such as emergent marsh grasses that can tolerate periodic flooding and drying may be useful for mitigation; however, the bathtub ring effect along the shoreline cannot always be mitigated through revegetation and screening. New levees and embankments could visually dominate the surrounding flat, open landscape and could permanently change the visual quality and character of the project area. Water diversion and conveyance components of in-Delta water storage facilities could include the presence of constructed linear and obtrusive features (such as inlet structures, pipelines, and siphons) and could obstruct views. These potentially significant long-term impacts on visual resources may be unavoidable.

Facility construction could create temporary or long-term adverse visual impacts, particularly from haul routes, night construction lighting, and construction staging areas. Nearby views of project features under construction could impose temporary visual impacts caused by heavy equipment generating dust and disturbing established topography and vegetation. Proposed construction activities could be particularly noticeable and cause an adverse visual impact for nearby residences at Discovery Bay; recreationists from the Discovery Bay Marina; and motorists on SR 4, a county-designated scenic route. Most of the construction areas for any storage facilities eventually would be inundated but could last more than 5 years, in some cases. Therefore, this impact is considered potentially significant.

7.13.7.2 BAY REGION

Ecosystem Restoration and Levee System Integrity Programs

Ecosystem Restoration and Levee System Integrity actions in the Bay Region, including Suisun Marsh, could result in similar beneficial and adverse visual impacts as those described for the Delta Region. The visual effects of Suisun Marsh levee modifications would be short term; revegetation could begin almost immediately after the levee modifications are completed.

Watershed Program

Watershed Program activities in the Bay Region, such as vegetation and habitat restoration, channel improvements, and erosion control efforts, could result in long-term beneficial visual effects by improving the natural landscape character of rivers and streams in the upper and lower watershed areas. Some short-term construction impacts would occur but are not considered potentially significant.

Water Quality, Water Use Efficiency, and Water Transfer Programs, and Storage

None of these Program elements would result in beneficial or adverse impacts on visual resources in the Bay Region.

7.13.7.3 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

Ecosystem Restoration Program

Ecosystem restoration actions on the whole would result in beneficial visual impacts in the Sacramento River and San Joaquin River Regions since restoration actions would add visual variety to the landscape and possibly could result in an upgrade of variety class. Some actions could result in adverse impacts, such as fencing creeks to protect riparian vegetation. These impacts could be considered potentially significant if they persisted for 5 years or more and occurred in visually sensitive recreation areas.

Ecosystem restoration actions could cause impacts in visually sensitive areas, such as creating borrow pits for gravel replacement and installing fish screens in areas with high visual sensitivity. Because these impacts could be mitigated through revegetation programs and would last less than 5 years, they are considered less than significant.

Water Quality, Water Use Efficiency, and Water Transfer Programs

The effects of these programs in the Sacramento River and San Joaquin River Regions would be similar to those described for the Delta Region. Additionally, if land is fallowed as a result of water transfers, the changes could be similar to those outlined under "Water Transfer Program" for the Delta Region.

Levee System Integrity Program

The Levee System Integrity Program would not affect visual resources in the Sacramento River and San Joaquin River Regions.

Watershed Program

Watershed Program activities, such as vegetation and habitat restoration, channel improvements, and erosion control efforts, could result in long-term beneficial visual effects in the Sacramento River and San Joaquin River Regions. These types of activities could improve the natural landscape character of rivers and streams in the upper and lower watershed areas. Some short-term construction impacts would occur but are considered less than significant.

Altered timber harvesting practices, depending on the methods used, could result in beneficial or adverse visual effects in watersheds. Over the long term, maintaining or enhancing forested areas would preserve the natural landscape and result in a beneficial impact on visual resources. Reduced grazing in some areas could increase the amount of vegetative cover, which in turn could restore the more natural landscape character to grazed areas.

Storage

Short-term adverse impacts on visual quality associated with construction of water storage facilities could include construction grading and removing existing vegetation and habitat. Mitigation is available to lessen the severity of these impacts. Potentially significant long-term adverse visual impacts associated with proposed water storage facilities could include the presence of constructed linear and obtrusive features (such as dams and spillways); view obstructions; fluctuating water levels, creating a bathtub ring effect; and construction activities lasting more than 5 years. These potentially significant long-term impacts on visual resources may be unavoidable.

Previously dry land could be inundated or existing reservoir levels could be increased, causing inundation of new areas around the pre-existing shoreline. Unlike a natural lake, proposed reservoirs would lack naturally evolved shoreline vegetation and trees; it is likely that constructed reservoirs could become a prominent feature in the landscape. Fluctuating water levels due to reservoir filling, drawdown, and replenishment could create or increase the extent of an adverse bathtub ring effect along the shorelines. This effect cannot be mitigated effectively through revegetation or screening.

Proposed construction activities for additional storage facilities could result in temporary or long-term adverse visual impacts. Descriptions of potential visual impacts are given for the Sites/Colusa, Thomes-Newville, and Montgomery Reservoirs as examples of potential impacts on reservoirs.

Sites/Colusa Reservoir. Construction associated with the Sites/Colusa Reservoir Project could be particularly noticeable and cause a temporary or long-term adverse visual impact on nearby residents or motorists on Sites-Lodoga Road, proposed by the county for designation as a scenic route. However, most of the construction area could be screened from public view by intervening topography along Logan Ridge and other adjacent ridgelines. Conveyance facilities associated with the Sites/Colusa Reservoir (such as the Tehama-Colusa Canal Enlargement, Tehama-Colusa Canal Extension, and Chico Landing Intertie) also could result in temporary adverse visual impacts on any nearby residences within one-quarter mile of the construction right-of-way. If construction activities lasted more than 5 years, the visual impact would be considered significant and unavoidable.

Thomes-Newville Reservoir. The proposed Thomes-Newville Reservoir could be situated within three ridgelines that would naturally screen construction activities from the west, north, and east, including nearby residents in the community of Paskenta and recreationists at Black Butte Lake. Constructing the conveyance canals and pumping-generating plants would cause short-term visual impacts that could be more noticeable in the flatter elevations of the project area near I-5.

Montgomery Reservoir. Potential construction activities at the Montgomery Reservoir could be particularly noticeable and cause adverse visual impacts on residences in the nearby community of Snelling. The proposed main dam at Montgomery Reservoir could be visually disruptive, detracting from the natural landscape for nearby residents as well as for new recreation users in the area. If construction activities lasted more than 5 years, the visual impact would be considered significant and unavoidable.

Because of the surrounding topography, visibility of reservoirs at these north-of-Delta storage facilities would be localized to within one-quarter mile of the sites. The project areas currently experience minimal use; however, by introducing potential new recreation users at the reservoirs, the visual changes created by the proposed projects could be considered a potentially significant and unavoidable adverse visual impact.

7.13.7.4 OTHER SWP AND CVP SERVICE AREAS

All Programs

No direct or construction-related visual impacts would occur in the Other SWP and CVP Service Areas from any Program action.

7.13.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

For visual resources, the Conveyance element results in environmental consequences that differ among the alternatives, as described below. This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

7.13.8.1 ALL ALTERNATIVES

Under all alternatives, flow control barriers in the south Delta are expected to be visually obtrusive to boaters using the Delta waterways (especially those originating from Discovery Bay Marina). Viewers from Old and Middle Rivers would be directly affected. When operational, these barriers also could impede boater access to scenic areas. All new intake structures would include fish screens and would be visible from various locations in the Delta. These potentially significant impacts are unavoidable.

Introduction of facilities that are associated with Alternative 2 and the Preferred Program Alternative into visually sensitive areas could result in potentially significant unavoidable adverse impacts.

The isolated facility of Alternative 3 would extend around the Delta periphery, and visual impacts could occur at all significant slough and river crossing sites (such as the Mokelumne River, east side streams, Disappointment Slough, the San Joaquin River, Middle River, Victoria Canal, and Old River). Greater visual impacts could occur on Delta waterways under low-outflow conditions if the isolated facility was used to divert more flow, resulting in lower net outflows. These features of Alternative 3 could result in potentially significant and unavoidable adverse impacts.

7.13.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. The programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were the same impacts as those identified in Sections 7.13.7 and 7.13.8, which compare the Program alternatives to the No Action Alternative.

The analysis indicates beneficial and adverse effects on visual resources when the Program alternatives are compared to existing conditions. The benefits to visual resources would be improvements to visual quality resulting from implementation of the Ecosystem Restoration and Watershed Programs under each of the alternatives compared to existing conditions. Adverse impacts on visual quality would result from Storage and Watershed Program and Conveyance element actions under each of the alternatives compared to existing conditions.

At the programmatic level, the comparison of Program alternatives to existing conditions did not identify any additional potentially significant impacts than were identified in the comparison of Program alternatives to the No Action Alternative.

The following potentially significant impacts on visual resources are associated with the Preferred Program Alternative:

- Visual impacts from construction activities, such as vegetation removal, construction staging areas, night-time glare from construction lights, haul routes, and dust creation.

- **Presence of constructed linear and obtrusive features (such as levees, dams, and spillways), view obstructions, and a bathtub ring effect caused by fluctuating water levels from drawdown and replenishment of storage reservoirs.**

- Impacts in visually sensitive areas from restoration actions, such as creating borrow pits for gravel replacement and installing fish screens in areas of high visual sensitivity.

- Degraded views in watersheds from such actions as altered timber harvesting practices.

- Creation of borrow pits or spoils material disposal sites associated with storage, conveyance, and levee projects.

- **Long-term visual impacts from construction activities extending more than 5 years.**

Bold indicates a potentially significant unavoidable impact.

7.13.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. This section identifies where Program actions could contribute to potentially significant adverse cumulative impacts. In doing so, those potentially significant adverse cumulative impacts for which the Program's contribution could be avoided or mitigated to a less than cumulatively considerable level are identified. If identified in the analysis, this section also presents any potentially significant adverse cumulative impacts that remain unavoidable regardless of efforts to avoid, reduce, or mitigate them. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For visual resources, the analysis and conclusions regarding the significance of the Preferred Program Alternative's contribution to cumulative impacts are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is in part due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. The potentially significant adverse long-term impacts and mitigation strategies that can be used to avoid, reduce, or mitigate these impacts are listed in summary form in Section 7.13.1. At the programmatic level of analysis, the impacts that cannot be avoided, reduced, or mitigated to a less-than-significant level are noted on the list in bold type. The long-term impacts are elaborated on in Sections 7.13.7 and 7.13.8.

The impact of the Preferred Program Alternative, when added to the potential impacts of the following projects, would result in potentially significant adverse cumulative impacts on visual resources in the Delta, Bay, Sacramento River, and San Joaquin River Regions: American River Water Resource Investigation, American River Watershed Project, CVPIA, CCWD Multi-Purpose Pipeline Project; Delta Wetlands Project; ISDP, Montezuma Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento River Flood Control System Evaluation, EBMUD Supplemental Water Supply Project, Sacramento County municipal and industrial water supply contracts, urbanization, and West Delta Water Management Program. At the programmatic level of analysis, the CALFED Program's contribution to cumulative impacts resulting from environmental consequences listed in Section 7.13.1 are expected to be avoided, reduced, or mitigated to a less than cumulatively considerable level—except for the following potentially significant unavoidable impacts. Potentially significant unavoidable impacts could occur from the presence of constructed linear and obtrusive features (such as dams and spillways), view obstructions, and a bathtub ring effect caused by fluctuating water levels from drawdown and replenishment associated with surface storage in the Delta, Sacramento River, and San Joaquin River Regions. One other potentially significant unavoidable impact is long-term visual impacts from construction activities that extend more than 5 years. These potentially significant unavoidable impacts are discussed in Section 7.13.12. For these impacts identified as significant and unavoidable at the programmatic level, this analysis concludes that the impacts also are cumulatively significant and unavoidable. This conclusion is based on currently available information and the high level of uncertainty as to whether this impact can be avoided, mitigated, or reduced to a level that is less than cumulatively considerable.

Growth-Inducing Impacts. Construction of new reservoirs and associated visual enhancement of the area could foster new growth. At this programmatic level of analysis, it is unknown where any increases in population growth or construction of additional housing would take place, or what level of growth might be associated with reservoir construction. When and if they occur, these changes will be subject to local land use decisions by individual cities and counties. Future development at the local level is guided by many considerations. These other factors include the policies in local general plans and zoning ordinance restrictions; the availability of a wide range of community services and infrastructure, such as sewage treatment facilities and transportation infrastructure; the availability of developable land; the types and availability of employment opportunities; and the analysis and conclusions based on an environmental review of proposed projects pursuant to CEQA. These local land use decisions and the environmental impacts associated with these site specific decisions are outside the scope of this Programmatic EIS/EIR, but can and should be considered by the local governments acting on future development proposals.

Short- and Long-Term Relationships. Generally, the Preferred Program Alternative would maintain and enhance visual resources. Improved visual settings would result from Ecosystem Restoration and Watershed Program actions, and generally would outweigh the short-term adverse visual impacts associated with these programs.

Most short-term impacts would be construction related and would cease when construction is complete. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on visual resources.

Potentially significant long-term unavoidable impacts include bathtub ring effects on reservoir shorelines, the presence of constructed linear and obtrusive features, and view obstructions.

Irreversible and Irretrievable Commitments. Features of the Levee System Integrity Program and the Storage and Conveyance elements can be considered to cause potentially significant irreversible changes in visual resources. Avoidance and mitigation measures can be implemented to lessen adverse visual effects, but changes would be experienced by future generations. The long-term beneficial irreversible changes include improvements to visual settings caused by Ecosystem Restoration and Watershed Program actions. Long-term adverse irreversible changes include such impacts as bathtub ring effects along shorelines in reservoirs caused by fluctuating water levels from drawdown and replenishment, the presence of constructed linear and obtrusive features, and view obstructions.

7.13.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during specific project planning and development. Specific mitigation measures will be adopted, consistent with the Program goals and objectives, and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects, because site-specific projects will vary in purpose, location, and timing.

Mitigation strategies involve impact avoidance, impact reduction, site restoration and design, and impact compensation measures. The following strategies could be used to avoid potentially significant adverse visual impacts:

- Timing changes in flow regimes to minimize bathtub ring effects during times of peak recreation use.
- Minimizing construction activities during the peak-use recreation season.
- Avoiding unnecessary ground disturbance outside the necessary construction area.

The following mitigation strategies could be used to reduce the severity of potentially significant impacts:

- Watering areas where dust is generated, where feasible, particularly along unpaved haul routes and during earth-moving activities, to reduce visual impacts caused by dust.

- Locating and directing exterior lighting of facilities and during construction activities so that it is concealed to the extent practicable when viewed from local roads, nearby communities, and any recreation areas.

- Siting the proposed reservoir(s), if possible, to minimize required cut-and-fill and locating the reservoir on the flattest topographic section of the site to minimize its visibility.

- Constructing facilities such as pumping-generating plants with earth-tone building materials.

- Revegetating disturbed areas as soon as possible after construction.

- Locating visually obtrusive features, such as borrow pits and dredged material disposal sites, outside visually sensitive areas and observation sites.

- Selecting vegetation type, placement, and density to be compatible with patterns of existing vegetation where revegetation occurs in natural areas.

- Installing landscape screening, such as grouped planting of trees and tall shrubs, to screen proposed facilities, such as pumping-generating plants, from nearby sensitive viewers, such as motorists and residents.

- Using native trees, bushes, shrubs, and groundcover for landscaping, when appropriate to the visual setting, at facilities such as dams and pumping-generating plants, and along new and expanded canals and conveyance channels, in a manner that does not compromise facility safety and access.

The following mitigation strategies could be used to compensate for visual impacts:

- Creating viewing opportunities of outstanding features (such as Mount Diablo and the Vaca Mountains) through selective vegetation reduction or constructing roadside viewing areas.

- Recontouring and adding vegetation to areas rated as "poor" in variety class.

7.13.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

Potentially significant adverse impacts that cannot be avoided are primarily those associated with Program facilities, since facilities are often difficult or impossible to harmonize with the natural environment. In addition, some facilities, such as reservoirs and conveyance channels, could require more than 5 years to construct. It may not be possible to substantially lessen or mitigate some of these visual impacts from construction at certain sites to a less-than-significant level. For this programmatic analysis, these impacts are considered potentially significant and unavoidable. Visual impacts from fluctuating water levels in storage reservoirs from storage and conveyance components, and the introduction of new levees and embankments that visually dominate the surrounding flat, open landscape also are considered potentially significantly and unavoidable.

7.14 Environmental Justice

The CALFED Bay-Delta Program could result in beneficial or adverse effects on minority or low-income populations. Analysis at the project-specific level is needed to fully determine effects related to environmental justice.

7.14 Environmental Justice

7.14.1 SUMMARY

Environmental justice refers to the fair treatment of people of all races, cultures, and income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Executive Order 12898, signed by President Clinton in 1994, requires federal government agencies to consider the potential for their actions or policies to place disproportionately high adverse human health or environmental effects on minority and low-income populations. This section summarizes baseline demographic data for low-income, minority, and tribal populations used in the environmental justice impact analysis.

An analysis of environmental justice includes identifying low-income and minority populations that could be affected by the CALFED Bay-Delta Program (Program) and assessing whether these populations, if present, would incur disproportionate adverse human health or environmental effects compared to the rest of the population. The best way to evaluate environmental justice effects is at the project-specific level, when specific plans can be analyzed and specific populations identified to determine whether and how a project could disproportionately affect minorities or low-income populations. As specific Program plans are proposed, more detailed environmental justice impact analyses will be conducted.

In the Program study area, people living in predominately rural areas tend to have lower incomes, higher poverty rates, and higher unemployment rates than those living in urban areas. Urban centers offer the greatest employment opportunities for all skill levels, while employment opportunities in rural areas tend to involve industries such as agriculture, logging, and fishing. Urban centers also typically contain the social structure and programs to assist minority and low-income populations. The analysis of potential environmental justice issues focuses on farm workers and agribusiness workers because they are more likely to be directly affected by Program elements than minority and low-income populations in urban areas.

7.14.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy are related to environmental justice.

7.14.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

In the Program study area, people living in predominately rural areas tend to have lower incomes, higher poverty rates, and higher unemployment rates than those living in urban areas. However, San Francisco and Los Angeles counties have high income levels and some of the highest poverty rates in the state. Poverty rates are higher among minority ethnic groups. In all regions except the Sacramento River Region, pockets of prosperity have an "averaging effect" of raising average personal income and lowering average poverty and unemployment rates. Annual per capita income in the study area ranges from $10,000 in the Tulare Lake area (Other SWP and CVP Service Areas) and Yuba County (Sacramento River Region) to $28,000 in Marin County (Bay Region).

Urban centers offer the greatest employment opportunities for all skill levels, while employment opportunities in rural areas tend to involve industries such as agriculture, logging, and fishing. Urban centers also typically contain the social structure and programs to assist minority and low-income populations. The analysis of potential environmental justice issues focuses on farm workers and agribusiness workers because they are more likely to be directly affected by Program elements than minority and low-income populations in urban areas.

By 1983, an estimated 90% of the seasonal farm laborers in California were Mexicans or Chicanos, while nationwide the figure was 60%. Most migrant farm workers are either American citizens or are working in the country legally. The U.S. Department of Labor estimates that about 25% of migrant farm workers are illegal immigrants. Most farm workers earn annual wages of less than $7,500.

Table 7.14-1 presents the percentage of the population below poverty level by Program region.

7.14.3.1 DELTA REGION

In 1996, the population in the Delta Region was 2,362,514. The racial composition in the Delta Region is identical to the composition in the Program study area (Figure 7.14-1). The percentage of the Delta Region population below the poverty level was approximately 11%, which is slightly less than the state percentage of 12%. Approximately 69% of the population was white, 8% was black, and 9% was Asian. Approximately 14% of the population was Hispanic, which was lower than the state percentage of 25%.

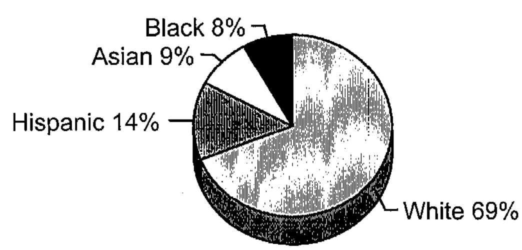


Figure 7.14-1. Racial Composition of the Delta Region

Because farm workers tend to migrate seasonally and live in temporary housing, it is difficult to obtain reliable work force numbers. Based on a 1990 Census of Population and Housing, the farm worker population in the Delta Region included approximately 5,500 farm workers. The actual numbers likely are higher than this figure. Of the farm labor force counted in the census, 77% was Hispanic, 15% white, 7% Asian/Pacific Islander, and less than 1% each was black or American Indian/Eskimo Aleutian.

Table 7.14-1. Percentage of Project Area Population below Poverty Level (by Region)

CENSUS AREA	TOTAL POPULATION	PERCENTAGE OF POPULATION BELOW POVERTY LEVEL
Delta Region	1,572,342	11
Sacramento River Region	5,037,527	9
San Joaquin River Region	1,530,179	13
Other SWP and CVP Service Areas	17,307,700	13
State of California	29,760,021	12

Source:
U.S. Bureau of Census, from **http://venus.census.gov/cdrom/lookup/CMD=LIST/DB=C90STF3A/.**

7.14.3.2 BAY REGION

In 1996, population in the Bay Region was 5,498,964. Approximately 61% of the population was white, 8% was black, and 15% was Asian (Figure 7.14-2). Approximately 16% of the population was Hispanic, which is lower than the state percentage of 25%. The economic base in this area is industrial and agricultural. Major urban areas include San Francisco, Oakland, and San Jose. Rural communities include Napa County. The percentage of the Bay Region population below the poverty level was approximately 9%, which is less than the state percentage of 12%.

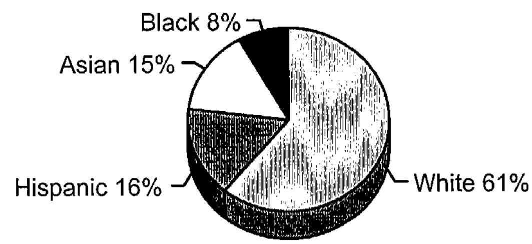


Figure 7.14-2. Racial Composition of the Bay Region

For the same reasons outlined for the Delta Region, farm worker populations are likely to be under reported. In the 1990 Census of Population and Housing, the farm worker population in the Bay Region was approximately 12,200. Of the farm labor force counted in the census, 82% was Hispanic, 14% white, 2% Asian/Pacific Islander, and less than 1% each was black or American Indian/Eskimo Aleutian.

7.14.3.3 SACRAMENTO RIVER REGION

The Sacramento River Region population in 1996 was 1,666,650. Approximately 82% of the population was white, 4% was black, and 5% was Asian (Figure 7.14-3). Approximately 10% of the population was Hispanic, which is lower than the state percentage of 25%. The percentage of the Sacramento River Region population below the poverty level was approximately 13%, which is slightly higher than the state percentage of 12%.

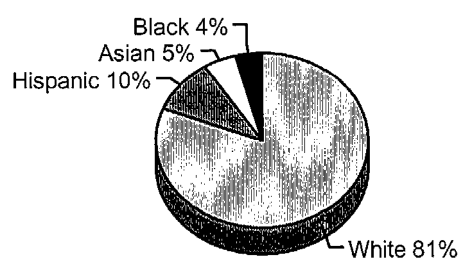


Figure 7.14-3. Racial Composition of the Sacramento River Region

For the same reasons outlined for the Delta Region, farm worker populations are likely to be under reported. In the 1990 Census of Population and Housing, the farm worker population in the Sacramento River Region was approximately 11,600. Of the farm labor force counted in the census, 59% was Hispanic, 31% white, 8% Asian/Pacific Islander, and less than 1% each was black or American Indian/Eskimo Aleutian.

7.14.3.4 San Joaquin River Region

The 1996 San Joaquin River Region population was 3,004,222. Approximately 62% of the population was white, 4% was black, and 6% was Asian (Figure 7.14-4). Approximately 30% of the population was Hispanic, which is higher than the state percentage of 25%. The percentage of the San Joaquin River Region population below the poverty level was approximately 18%, which is higher than the state percentage of 12%.

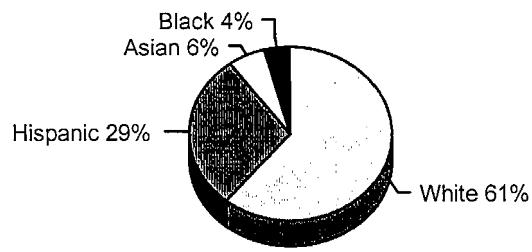


Figure 7.14-4. Racial Composition of the San Joaquin River Region

For the same reasons outlined for the Delta Region, farm worker populations are likely to be under reported. In the 1990 Census of Population and Housing, the farm worker population in the San Joaquin River Region was approximately 74,200. Of the farm labor force counted in the census, 84% was Hispanic, 12% white, 4% Asian/Pacific Islander, and less than 1% each was black or American Indian/Eskimo Aleutian.

7.14.3.5 Other SWP and CVP Service Areas

Two distinct, noncontiguous areas are included in the Other SWP and CVP Service Areas: in the north are the San Felipe Division's CVP and the South Bay SWP service areas; and to the south are the SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

The 1996 population in the Other SWP and CVP Service Areas was 19,159,450. Approximately 52% of the population was white, 9% was black, and 9% was Asian (Figure 7.14-5). Approximately 30% of the population was Hispanic, which is higher than the state percentage of 25%. The economic base in this region is industrial and agricultural. Major urban areas include San Jose, Los Angeles, and San Diego. Rural communities include Watsonville, Hollister, and Gilroy. The percentage of the population in this region below the poverty level was approximately 13%, which is slightly higher than the state percentage of 12%.

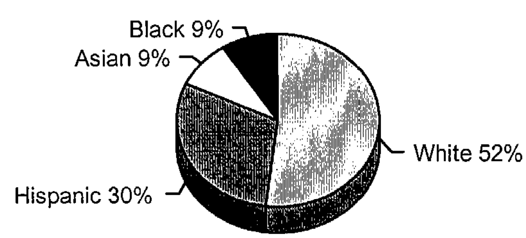


Figure 7.14-5. Racial Composition of the Other SWP and CVP Service Areas

For the same reasons outlined for the Delta Region, farm worker populations are likely to be under reported. In the 1990 Census of Population and Housing, the farm worker population in Other SWP and CVP Service Areas was about 45,000. Of the farm labor force counted in the census, 87% was Hispanic, 10% white, 2% Asian/Pacific Islander, and less than 1% each was black or American Indian/Eskimo Aleutian.

7.14.4 ASSESSMENT METHODS

Program actions were evaluated to determine whether any minority or economic group could be disproportionately affected by an environmental or human health hazard. The "Final Guidance for Incorporating Environmental Justice Concerns in EPA NEPA Compliance Analyses" was used to help formulate the Program's environmental justice impact analysis. In this document, a minority population may be present if the minority population percentage of the affected area is "meaningfully greater" than the minority population percentage in the general population or other "appropriate unit of geographic analysis."

The U.S. Census Bureau poverty thresholds were used to identify low-income populations. According to the thresholds, a single person with income below $8,480 is considered low income. For a family of four, the threshold is $16,588.

The Final Guidance for Incorporating Environmental Justice Concerns establishes an analytical method of delineating both potential effects and the potentially affected population through a screening process. The following screening questions are used:

- Does the potentially affected community include minority or low-income populations or tribal resources?

- Are significant adverse environmental or human health effects likely to fall disproportionately on minority or low-income populations or tribal resources?

Demographic data on race, low-income populations, and tribal resources are provided in Section 7.14.3 to establish the baseline information required for the screening level analysis. Affected populations were considered to be minority when the minority population percentage was meaningfully greater than the minority population percentage of similar geographic areas. Project-specific environmental justice analysis should further serve to identify potentially affected low-income or minority populations, or tribal resources.

7.14.5 CRITERIA FOR DETERMINING EFFECTS

The Program will consider the following factors when determining whether adverse human health effects are disproportionately high:

- Whether the health effects, which may be measured in risks and rates, are above the generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death.

- Whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group.

- Whether health effects occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

The Program will consider the following factors when determining whether adverse environmental effects are disproportionately high:

- Whether there is or will be an impact on the natural or physical environment that adversely affects a minority or low-income population.

- Whether environmental effects are significant and may result in an adverse effect on minority and low-income populations that appreciably exceeds or is likely to appreciably exceed the effect on the general population or other appropriate comparison group.

- Whether the environmental effects occur or would occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Environmental justice issues are considered pursuant to Federal Executive Order 12898. Although these issues sometimes may overlap with environmental impacts and their effects on socioeconomic concerns, environmental justice issues are not treated as separate environmental impacts under CEQA.

7.14.6 NO ACTION ALTERNATIVE

California's population will continue to grow and is projected to reach more than 45 million by 2020. The trend for in-migration from other states, a significant contributor to California's population growth, also is likely to continue. Since 1990, the population segments experiencing the greatest growth are Hispanic and Asian/Pacific Islander. About 12% of the state's population is considered to be living in poverty. Under the No Action Alternative, existing minority and low-income population trends are expected to continue.

The regional economic structure is expected to remain similar to existing conditions. Service and high-tech industries should continue their fast growth rate; heavy manufacturing, mining, and agriculture sectors likely will experience slight declines. Overall baseline levels of production likely will continue to grow during the next 20 years at a rate similar to the forecasted population growth.

The number of agricultural jobs may increase in some areas due to projected changes in crop production to higher value and more labor-intensive crops. This change could affect farm workers and agribusiness workers, although agricultural employment would remain seasonal. Improvements in harvesting and irrigation technologies could eliminate or change farm labor needs. Changes to population, crop production, and technology could result in a decrease in opportunities or duration of employment. This decrease could create an increased need for social services to provide food, health care, and housing for those facing economic hardship.

7.14.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

7.14.7.1 ALL REGIONS

Mitigation strategies that address potentially significant adverse impacts on human health and the environment that also may disproportionately affect minority and low-income populations are identified and listed under the appropriate resource categories in Chapters 5 and 7.

Ecosystem Restoration Program

The Ecosystem Restoration Program could benefit minority or low-income populations in the short term by providing restoration-related employment opportunities, and in the long term by providing restored fishing and hunting habitat. Agricultural land conversion could reduce the number of jobs for farm workers and agribusiness workers. This reduction could result in potential adverse socioeconomic effects that are disproportionately high for minorities and low-income communities, depending on the number of jobs lost and the extent of the mitigation efforts. Those laborers with limited job or English language skills who also lack basic education levels could experience more difficulty finding new employment than laborers with better skills. Existing social services or structures could be affected by an increased demand for their programs. This program could include other direct socioeconomic effects that are disproportionately high for minority and low-income communities (such as moving people from potential restoration areas) or indirect effects (such as reducing the accessibility of groundwater supplies). Groundwater effects could disproportionately affect rural minority and low-income populations that rely on well water. Possible strategies that could be used to lessen these effects include providing skill training and employment relocation, providing project jobs in positions where skills can be transferred or where minimal retraining is required, providing housing relocation, and developing systems to ensure adequate water supply.

The Ecosystem Restoration Program could result in a negligible effect on urban land uses but could require relocating major utility infrastructure, such as power poles. Since utility infrastructure relocation likely would occur on less economically viable land, where low-income people and minorities are more likely to reside, utility relocations could disproportionately affect these populations. These relocations could result in adverse effects related to environmental justice, depending on their location. Possible methods that could be used to alleviate these effects include avoiding utility relocation whenever possible or providing project jobs during relocation.

Water Quality Program

The Water Quality Program could result in reduced production costs and create higher crop yields and greater crop selection flexibility in the long term, which could benefit farm workers. In the San Joaquin River Region, retirement of lands with water quality problems could adversely affect agricultural jobs in the region. These lands are forecast for retirement under the No Action Alternative; however, it is likely that the lands would be retired sooner under the Program than under the No Action Alternative. The loss of these irrigated lands would result in an adverse social effect from loss of jobs associated with retired land.

Levee System Integrity Program

In the long term, the Levee System Integrity Program could benefit minority and low-income populations (only in the Delta Region) by providing a certain level of protection from flooding. Flood protection could reduce the risk of death and economic devastation. In the short-term, however, the program could result in potential adverse effects on minority and low-income populations. Farmland retirement could affect local economies and social well-being because of changes in employment and income. These changes could disproportionately affect minority and low-income populations, including migrant agricultural workers. Some low-income houses on or near the levees could be displaced under the Suisun Marsh component of the Levee System Integrity Program.

The Levee System Integrity Program also could displace existing recreation facilities, reducing recreation opportunities and recreation-related jobs. The loss of recreation-related jobs could disproportionately affect employment of minority and low-income populations. Possible methods that could be used to alleviate these effects include providing skill training and employment relocation, providing project jobs in positions where skills can be transferred or where minimal retraining is required, providing housing relocation, and developing systems to ensure adequate water supply.

Water Use Efficiency Program

During the 1982-87 drought, many jobs were lost as a result of reduced crop acreage or landscaping in urban communities. To the extent that the Water Use Efficiency Program could improve water supply reliability, employment in these areas could be maintained. Some jobs could be created as a result of this program element, for example, installing new irrigation technology or low-flow plumbing. In all likelihood, however, these new jobs would require skilled labor. Although the Water Use Efficiency Program could increase crop yields for farmers, the program also could result in job losses for farm workers because improved irrigation technology could require fewer laborers. The loss of farm worker jobs could disproportionately affect minority and low-income populations, including migrant agricultural workers. Possible methods of alleviating this effect could include providing skill training and employment relocation assistance.

Water Transfer Program

Water transfers could reduce agricultural production at the source of the transferred water and could increase production in the regions receiving the water. Changes in employment and income could affect local economies and social well-being. Possible methods of alleviating this effect could include providing skill training and employment relocation assistance. The actions described in the Water Transfer Program, in conjunction with existing legal requirements placed on water transfers, are expected to protect against potential adverse socioeconomic effects due to water transfers (see Chapter 4 in the Water Transfer Program Plan).

Watershed Program

Watershed Program efforts could result in beneficial effects on minority and low-income populations. For example, surface soil and channel erosion efforts could enhance stream geomorphology by reducing sediment, which in turn could increase fishing opportunities. Increased fishing opportunities could benefit minority and low-income populations that rely on fishing for subsistence.

Storage

Minority and low-income populations, including migrant agricultural workers, could benefit from or be adversely affected by the storage components of the Preferred Program Alternative. The additional water supply could result in additional agricultural land development, greater farm investments, and shifts to higher value crops. These changes could benefit minority and low-income farm workers as a result of more employment opportunities. Some land uses could shift between regions, which could require minority or low-income populations to relocate. For example, agricultural acreage could be taken out of production in the Delta Region, but the Bay Region could experience an increase in productive agricultural acreage. Effects would depend on water yield and opportunities, and on agricultural shifts within or among other regions.

Constructing surface storage facilities could provide entry-level employment opportunities, which could benefit minority or low-income workers. Some additional employment opportunities could be developed as construction-related support industries, such as restaurants, are opened. If a surface storage facility results in new recreational opportunities, a permanent service industry base could develop. Constructing storage and conveyance facilities could remove marginal agricultural land from production, permanently close or relocate recreation facilities, and displace some home sites. Possible methods of alleviating this effect could include providing skill training, employment relocation assistance, and housing relocation assistance.

7.14.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

Effects on environmental justice are discussed below only for the Delta Region. Conveyance facilities would not be modified in the other Program regions; therefore, no impacts on environmental justice are associated with the Conveyance element in the other Program regions.

7.14.8.1 PREFERRED PROGRAM ALTERNATIVE

This section includes a description of the consequences of a diversion facility on the Sacramento River. If the diversion facility is not built, these consequences would not occur.

The Preferred Program Alternative would lead to substantial physical changes to Delta conveyance systems with the construction of a diversion facility on the Sacramento River and an associated conveyance channel; channel improvements and conveyance modifications, including dredging; and the installation of fish screens and flow barriers. Some agricultural land would be converted to project use for conveyance system construction. This conversion could result in a potential adverse effect on employment opportunities for minority or low-income farm workers. Possible methods that could be used to alleviate these effects include providing skill training and employment relocation, providing project jobs in positions where skills can be transferred or where minimal retraining is required, providing housing relocation, and developing systems to ensure adequate water supply.

7.14.8.2 ALTERNATIVE 1

Effects under Alternative 1 would be less than those described for the Preferred Program Alternative. Agricultural land would not be converted for a diversion facility on the Sacramento River or widening of the Mokelumne under Alternative 1, which could result in less potential for adverse effects on minority or low-income farm workers.

7.14.8.3 ALTERNATIVE 2

Under Alternative 2, the effects would be similar to those described for the Preferred Program Alternative if a diversion facility is built on the Sacramento River, although the magnitude may be greater given the difference in size of the diversion facility.

7.14.8.4 ALTERNATIVE 3

Under Alternative 3, the amount of direct, short-term, adverse effects is potentially greater than for all other Program alternatives because the amount of construction would be greater, as would the amount of agricultural land converted to project purposes.

7.14.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of the Preferred Program Alternative and Alternatives 1, 2, and 3 to existing conditions. This programmatic analysis found that the potentially beneficial and adverse effects from implementing any of the Program alternatives when compared to existing conditions were the same effects as those identified in Sections 7.14.7 and 7.14.8, which compare the Program alternatives to the No Action Alternative.

At the programmatic level, the comparison of the Program alternatives to existing conditions did not identify any additional significant environmental consequences than were identified in the comparison of Program alternatives to the No Action Alternative.

The potentially beneficial impacts associated with the Preferred Program Alternative include increased water supply and water quality, and enhanced flood control and protection.

The following potentially adverse effects are associated with the Preferred Program Alternative:

- Reducing the number of recreation-related and farm worker jobs.
- Removing people from potential restoration areas.

- Reducing accessibility to groundwater supplies.
- Moving major utility infrastructure onto land in low-income areas.
- Displacing low-income homes on or near levees.

7.14.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Effects. The CALFED Program involves the approval of a program to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The Program is a general description of a range of actions that will be further refined, considered, and analyzed for site-specific environmental consequences as part of second- and third-tier environmental documents prior to making a decision to carry out these later actions. The Programmatic EIS/EIR presents a general overview of cumulative effects. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For environmental justice, the analysis and conclusions regarding the Preferred Program Alternative's contribution to cumulative effects are essentially the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is partially due to the long-term nature of the Program and the wide range of actions that falls within the scope of the Program's potential future actions. Section 7.14.1 presents in summary form a discussion of the potential long-term environmental justice effects. Sections 7.14.7 and 7.14.8 elaborate on long-term effects.

For all regions, both beneficial and adverse effects on minority and low-income populations actions could result from the projects listed in Attachment A. Beneficial effects associated with these projects include increased water supply and water quality, as well as some flood control and protection. Most adverse effects, both short term and long term, are related to constructing permanent storage or conveyance facilities and the potential loss of agricultural employment and some homes. Actions under the Preferred Program Alternative could be coordinated with present and proposed projects, thereby reducing the extent of the cumulative effects. As specific implementation projects are evaluated, more detailed environmental justice analyses will be conducted.

Growth-Inducing Effects. No effects are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. The storage and conveyance features in the Preferred Program Alternative with the potential for short-term environmental justice effects primarily are related to construction activities. Short-term potentially adverse effects could include displacement of agricultural workers and fewer opportunities for hunting and fishing.

Overall, benefits to long-term productivity generally outweigh the short-term potentially adverse effects. Long-term beneficial effects could include increases in agricultural- or recreation-related employment, and improved opportunities for hunting and fishing to supplement diet.

Irreversible and Irretrievable Commitments. All Program elements that alter land use in any region could be considered to cause irreversible changes in the environmental justice resource category. Avoidance and actions to alleviate these effects could be implemented to lessen adverse effects, but changes will be experienced by future generations. The long-term beneficial irreversible changes include the potential for recreation-related or highly skilled agricultural job opportunities, as well as overall improvement in water quality and the surrounding environment. Long-term adverse irreversible changes include potential job losses due to land conversion caused by development of the Preferred Program Alternative, including reduced agricultural land from levee construction or inundation from surface storage facilities.

In addition to land conversion, storage and conveyance features could result in the irretrievable commitment of such resources as construction materials, labor, and energy resources.

7.14.11 ADVERSE EFFECTS

No substantial adverse effects related to environmental justice are associated with the Preferred Program Alternative at the programmatic level. Analysis at the project-specific level is needed to fully determine effects.

Neither CEQA nor NEPA treats environmental justice effects as environmental impacts separately from physical environmental effects. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect when using the same criteria for other physical changes from the project. Economic and social effects of a project also may be used to assess the significance of a physical effect. Under NEPA, economic and social effects must be addressed if they are inter-related to the natural or physical environmental effects of a project. Consequently, this programmatic document discusses environmental justice issues but, consistent with state and federal law, does not treat adverse social and economic effects as significant environmental impacts for the purposes of CEQA and NEPA.

7.15 Indian Trust Assets

Potential effects on Indian trust assets cannot be determined at a programmatic level of analysis; however, adverse impacts are not anticipated. Project-specific evaluations will disclose impacts on Indian trust assets and provide mitigation as needed. Ecosystem Restoration Program actions may benefit trust assets associated with water and fishing rights.

7.15 Indian Trust Assets

7.15.1 SUMMARY

Indian trust assets are legal interests in assets held in trust by the federal government for Indian tribes or Indian individuals. Assets can be real property, physical assets, or intangible property rights. Indian trust assets cannot be sold, leased, or otherwise encumbered without approval of the federal government. A trust relationship is established through a congressional act or executive order, as well as through provisions identified in historical treaties.

The land associated with a reservation, rancheria, or public domain allotment could be examples of an Indian trust asset. The resources located within reservations, including trees, minerals, oil and gas, and others, also are considered trust assets. Water rights, as well as hunting and fishing rights, may be Indian trust assets.

The Federal Government holds and maintains trust relationships with federally recognized Indian tribes. The Department of Interior manual directs agencies to fulfill their "legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and tribal members" (U.S. Department of Interior, Department Manual, Part 512). The manual stipulates that, whenever plans or actions are identified that may affect tribal trust resources, consultation will take place on a government-to-government basis.

The potential effects of the CALFED Bay-Delta Program (Program) on Indian trust assets are unknown and will be determined when specific projects are evaluated. Specific implementation projects for the Program have not yet been identified; but at the programmatic level, impacts on Indian trust assets appear unlikely. Ecosystem restoration actions may benefit trust assets associated with water or fishing rights. As specific implementation projects are evaluated, adverse or beneficial impacts on Indian trust assets will be assessed through a process of government-to-government consultation. Decisions regarding mitigation measures to offset potential impacts will be arrived at through this consultation process.

7.15.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that reflect differing opinions among technical experts. The opinions of technical experts can differ, depending on which assumptions or methodology they use. According to this definition, no areas of controversy relate to Indian trust assets. In addition, no areas of concern are associated with Indian trust assets.

7.15.3 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

7.15.3.1 DELTA AND BAY REGIONS

No reservations or rancherias are located in the Delta or Bay Region. It is unlikely that any public domain allotments are located in the Delta Region, but some public domain allotments may be located in the Bay Region.

7.15.3.2 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

The Sacramento River Region includes approximately 26 reservations and rancherias, and an unknown number of public domain allotments. Approximately 11 reservations or rancherias are located in the San Joaquin River Region. The number of public domain allotments is unknown. Each Indian reservation, rancheria, and allotment represents an Indian trust asset unless it has been specifically dropped from trust status. Table 7.15-1 lists the Indian lands in the CALFED study area.

7.15.3.3 OTHER SWP AND CVP SERVICE AREAS

A number of Indian reservations, rancherias, and allotments are found in the Other SWP and CVP Service Areas. The region holds approximately 24 Indian reservations or rancherias. An unknown number of Public domain allotments also are found in this region. Table 7.15-1 lists Indian lands in the CALFED study area.

7.15.4 ASSESSMENT METHODS

Identifying specific Indian trust assets is the first action to determine whether an undertaking will affect trust assets. Project planners will examine areas of potential effect for possible conflict with Indian lands and Indian trust assets. The nature of the trust asset will be determined in consultation with the specific Indian tribe, Bureau of Indian Affairs, and possibly the U.S. Department of the Interior Solicitor, and through examining government documents. In addition to an identification of Indian lands, research will be needed to assess actions that may affect tribal water, fishing, or related rights that may or may not be quantified.

The primary potential impact on Indian trust assets stems from those actions, activities, or projects that would affect Indian lands. Construction activities associated with the implementation of Program elements or alternatives may affect individual reservations or rancherias. Indian land located along rivers or in the vicinity of upland reservoir sites may be affected. Development of storage facilities may affect Indian Trust Assets due to the size of such projects, but this likelihood is remote. Before any federal action at the site-specific level, government-to-government consultation would be required with affected tribes.

Table 7.15-1. Indian Lands in the CALFED Study Area

PRIMARY TRIBE	COMMON NAME	OFFICIAL NAME	TYPE
Sacramento River Region			
Cachil DeHe Band of Wintun Indians	Colusa (Cachil DeHe)	Colusa	Rancheria
Elem Indian Colony of Pomo Indians	Sulphur Bank (El-Em)	Sulphur Bank	Rancheria
Maidu Indians	Auburn	Auburn	Rancheria
	Enterprise	Enterprise	Rancheria
	Greenville	Greenville	Rancheria
	Mooretown	Mooretown	Rancheria
Pit River Indians	Alturas	Alturas	Rancheria
Pit River Tribe	Big Bend	Big Bend	Rancheria
	Likely	Likely	Rancheria
	Lookout	Lookout	Rancheria
	Montgomery Creek	Montgomery Creek	Rancheria
	Roaring Creek	Roaring Creek	Rancheria
	XL Ranch	XL Ranch	Reservation
Pomo Indians	Big Valley	Big Valley	Rancheria
	Cloverdale	Cloverdale	Rancheria
	Hopland	Hopland	Rancheria
	Middletown	Middletown	Rancheria
	Robinson	Robinson	Rancheria
	Scotts Valley	Scotts Valley	Rancheria
Shingle Springs Band of Miwok Indians	Shingle Springs	Shingle Springs	Rancheria
Tyme Maidu Indians	Berry Creek	Berry Creek	Rancheria
Upper Lake Band of Pomo Indians	Upper Lake	Upper Lake	Rancheria
Wintun Indians	Redding	Redding	Rancheria
	Cortina	Cortina	Rancheria
	Rumsey	Rumsey	Rancheria
Wintun-Wailaki Indians	Grindstone Creek	Grindstone	Rancheria
San Joaquin River Region			
Chukchansi Indians	Picayune	Picayune	Rancheria
Jackson Band of Me-Wuk	Jackson	Jackson	Rancheria
Me-Wuk Indians	Chicken Ranch	Chicken Ranch	Rancheria
	Sheep Ranch	Sheep Ranch	Rancheria
Mono Indians	Cold Springs	Cold Springs	Rancheria
	North Fork	Northfork	Rancheria
Santa Rosa Indian Community	Santa Rosa	Santa Rosa	Rancheria
Tule River Indian Tribe	Tule River	Tule River	Reservation
Tuolumne Band of Me-Wuk	Tuolumne	Tuolumne	Rancheria
Western Mono Indians	Big Sandy	Big Sandy	Rancheria
Yokut	Table Mountain	Table Mountain	Rancheria
Other CVP and SWP Service Areas			
Agua Caliente Band of Cahuilla Indians	Agua Caliente	Agua Caliente	Reservation
Augustine Band of Cahuilla Mission	Augustine	Augustine	Reservation
Cabazon Band of Cahuilla Mission	Cabazon	Cabazon	Reservation
Diegueno	Jamul Indian Village	Jamul Indian Village	Village
Morongo Band of Cahuilla Mission	Morongo	Morongo	Reservation
Pala Band of Luiseno Mission Indians	Pala	Pala	Reservation
Pauma Band of Luiseno Mission Indians	Pauma-Yuima	Pauma and Yuima	Reservation
San Manual Band of Sorrano Mission	San Manuel	San Manuel	Reservation
San Pasqual Band of Diegueno Mission	San Pasqual	San Pasqual	Reservation
Santa Rosa Band of Cahuilla Mission	Santa Rosa	Santa Rosa	Reservation
Santa Ynez Band of Chumash Mission	Santa Ynez	Santa Ynez	Reservation
Torres-Martinez Desert Cahuilla Indians	Torres-Martinez	Torres-Martinez	Reservation
Twenty-Nine Palms Band of Luiseno	Twenty-Nine Palms	Twenty-Nine Palms	Reservation

Note: Lists derived from large-scale maps and may not include all Indian lands affected by CALFED Program actions. As specific implementation projects are evaluated, adverse or beneficial impacts on Indian trust assets will be assessed through a process of government-to-government consultation.

7.15.5 SIGNIFICANCE CRITERIA

An impact is considered potentially significant if implementation of a Program action would adversely affect water rights, water quality, or other rights associated with specific Indian trust assets.

7.15.6 NO ACTION ALTERNATIVE

A wide range of actions could result from the No Action Alternative projects listed in Attachment A. Some of these actions may affect Indian trust assets. Construction activities may affect lands located along rivers or in the vicinity of upland reservoir sites, water rights, water quality, or other rights associated with specific Indian trust assets. The potential effects on Indian trust assets will be evaluated as specific implementation projects are evaluated. Adverse effects on Indian trust assets will be identified and mitigation will be provided, as needed.

7.15.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

Presently, no effects have been identified for any alternative under the Conveyance element that would adversely affect Indian trust assets. Possible conflicts will be evaluated when specific projects are developed. Adverse effects will be disclosed and mitigation provided, as needed.

7.15.7.1 DELTA AND BAY REGIONS

All Programs

No reservations or rancherias are located in the Delta or Bay Region.

Although some public domain allotments with Indian trust protection may be located in the Bay Region, it is unlikely that the location of proposed projects would conflict with these allotments. It is also unlikely that any Program actions would affect Indian trust assets in these regions; however, an examination of records held by the Bureau of Indian Affairs needs to be completed when projects to implement the Preferred Program Alternative are analyzed in order to determine the potential for impacts.

Changes in project operations would not cause construction-related ground disturbance or affect water levels to the extent of causing impacts on Indian trust assets in any region.

7.15.7.2 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

All Programs

The potential effect of CALFED Program actions on reservations and rancherias is largely unknown. The potential conflict between Indian trust assets, including public domain allotments, and Program actions needs to be determined on a project-specific basis. Some Program actions, particularly those involved with ecosystem restoration, may benefit trust assets associated with water or fishing rights. Storage projects have a limited potential to affect Indian trust assets due to the size of larger reservoirs.

7.15.7.3 OTHER SWP AND CVP SERVICE AREAS

All Programs

It is unlikely that any Indian trust assets would be affected by Program actions since no structures, conveyance facilities, storage projects, or habitat improvement projects are planned for the Other SWP and CVP Service Areas.

7.15.8 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

This section presents the comparison of existing conditions to the Preferred Program Alternative and Alternatives 1, 2, and 3. This programmatic analysis indicates that Indian trust assets must be evaluated on a project-specific basis in accordance with legal requirements. Therefore, the comparison of the Program alternatives to existing conditions is the same as the comparison of Program alternatives to the No Action Alternative.

7.15.9 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. A wide range of actions could result from the projects listed in Attachment A, and some of these actions may affect Indian trust assets. Such impacts range from implementation of the American River Water Resource Investigation to the EBMUD Supplemental Water Supply Project. The potential impacts on Indian trust assets remain unknown and will be determined when specific projects are evaluated. Specific implementation projects for the Program have not yet been identified; but at the programmatic level, impacts on Indian trust assets appear unlikely. As specific implementation projects are evaluated, adverse impacts on Indian trust assets will be disclosed and mitigation provided, as needed.

Growth-Inducing Impacts. No impacts are anticipated. See the "Growth-Inducing Impacts" discussion in Chapter 4 and the discussion of growth-inducing impacts in Section 5.1.10.

Short- and Long-Term Relationships. None of the Program elements appear to directly affect Indian trust assets. The potential effects on Indian trust assets remain unknown and will be evaluated as specific projects are evaluated.

Irreversible and Irretrievable Commitments. The potential effects on Indian trust assets remain unknown and will be evaluated as specific projects are evaluated.

7.15.10 MITIGATION STRATEGIES

The first strategy in mitigating a potentially significant adverse impact on an Indian trust asset is avoiding or minimizing the impact. If avoidance is not possible, any form of mitigation must be developed in consultation with the Indian tribe or individual who possesses the trust asset. Specific mitigation depends on the type of Indian trust asset and the nature of the impact. Agreements between federal action agencies and Indian trust owners may require approval from Congress or the Bureau of Indian Affairs. Projects proposed to carry out the Preferred Program Alternative will be analyzed for impacts on Indian trust assets; and mitigation measures will be implemented, should potentially significant adverse impacts be identified.

7.15.11 ADVERSE EFFECTS

No substantial effects on Indian trust assets have been identified from implementing the Preferred Program Alternative. Project-specific analysis is needed to determine potential effects.