West Side Integrated Resources Management Plan

San Luis & Delta-Mendota Water Authority

DRAFT

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Acronyms and Abbreviations

AF	acre-feet
(b)(2)	Section 3406(b)(2) of the CVPIA that dedicates CVP water for fish and wildlife purposes
CAC	County Agricultural Commissioner
CALFED	CALFED Bay-Delta Program
CALSIM	A monthly hydrologic and water delivery model of the CVP and SWP systems
CEQA	California Environmental Quality Act
Cfs	cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act of 1992
CVP Water Year	March 1 through end of February
Delta (or Bay-Delta)	San Francisco Bay/Sacramento-San Joaquin Delta
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
EIR	State Environmental Impact Report
EIS	Federal Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EWA	Environmental Water Account
Interior	U.S. Department of Interior
ID	Irrigation District
M&I	Municipal and Industrial
MAF	million acre-feet
MGD	million gallons per day
NEPA	National Environmental Policy Act
NOD	North-of-Delta
PEIS	Programmatic Environmental Impact Statement

RCD	Resource Conservation District
Reclamation	U.S. Bureau of Reclamation
ROD	CALFED Programmatic EIR/EIS Record of Decision
SCVWD	Santa Clara Valley Water District
SLDMWA	San Luis and Delta-Mendota Water Authority
SOD	South-of-Delta
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
WD	Water District
WQCP	Water Quality Control Plan

Executive Summary

Key Findings

- Since 1989, CVP water supply allocations have decreased significantly for west side CVP contractors.
- Groundwater supplies in the region are declining due to a long-term overdraft condition caused by over-pumping.
- Under average conditions, agricultural water users currently can expect a water supply gap of approximately 1.1 million acre-feet (MAF) per year, while M&I users have a small gap of approximately 8,600 acre-feet (AF).
- The average gap for agricultural users projected for the year 2025 is 832,000 AF. The M&I gap increases, on average, to approximately 104,000 AF by 2025.
- Under current levels of development, the projected agricultural water supply gap is 1.7 MAF under critically dry conditions. The gap is anticipated to be 1.4 MAF by the year 2025.
- The implementation of innovative water supply and demand management measures, in step with the CALFED Program, will help to close the water supply gap for all water users in the west side region, increasing economic output by $500 for every acre foot and creating more than seven jobs for every 1,000 AF.

Introduction

The San Luis and Delta Mendota Water Authority developed the draft West Side Integrated Resources Plan (Plan) as a means of improving the region's stewardship of its water resources. Consistent with the CALFED Bay-Delta Program, the Plan recommends innovative measures to reshape the regions water demand, to retire drainage-impacted farmland, to conserve surface supplies, and improve drainage control and water quality.

The Plan documents changes in agricultural and municipal and industrial (M&I) water use in the San Joaquin Valley and San Francisco Bay area by contractors who rely upon the Central Valley Project (CVP) for all or a portion of their water supplies. It also chronicles state and federal regulatory actions that have contributed to the decline of CVP allocations to the west side of the San Joaquin Valley. This report compares current and anticipated land and water use in the period 2025. Economic activity in the region associated with CVP water supply is also presented.

Numerous projects – some conceptual and others currently being implemented – are identified to help meet water supply needs by improving local supplies and reducing dependence on imported water to the fullest extent feasible. By working collaboratively the region has embraced and is contemplating a variety of integrated water management strategies, including a comprehensive sustainable drainage management program.

Water Use and Supply

Water use in the CVP west side region is dependent upon land use, which is characterized as agricultural or M&I. Agricultural water use occurs on approximately 850,000 irrigated acres on the west side. The current M&I water supply provides a portion of the water supply needs for 1.9 million people in Santa Clara and San Benito Counties as well as the San Joaquin Valley.

The west side water supply is comprised of CVP water, groundwater, and local surface water. Since 1989, CVP water supply allocations have decreased significantly for west side CVP contractors. Current water supply modeling efforts have shown that this decline is primarily attributable to implementation of the following laws and regulations:

- State Water Resources Control Board water quality standards for the Bay-Delta; Decision-1485 and Decision-1641.
- State and Federal Endangered Species Act provisions.
- Central Valley Project Improvement Act (P.L. 102-575) implementation.

Prior to passage of the Central Valley Project Improvement Act (CVPIA), west side agricultural contractors could expect approximately 85 percent of their CVP contracted supply during an average water year. Today, the long-term average allocation has been reduced to less than 60 percent. The current M&I long-term average supply allocation has been reduced from 95 percent (before CVPIA) to 87 percent under current conditions.

In addition to reduced CVP supply allocations, groundwater supplies in the region are declining due to a long-term overdraft condition caused by over-pumping. To protect the long-term sustainability of this resource, groundwater pumping has been significantly reduced, especially when compared to historic use. This, however, has further reduced available water supplies in the region.

Water Supply Gap Analysis

A gap analysis compares the total potential west side water use against total CVP allocations, groundwater and local supplies. The difference between the potential use of water and available supplies is "the gap." This analysis compares the current level of development to the projected level of development in the year 2025. Hydrologic conditions in the analysis include the long-term average condition and a critical dry period.

The potential agricultural water use is based on irrigated acreage (1999 and 2025 forecast), average crop consumptive use, average effective precipitation, leaching requirement, cultural practices, conveyance losses and on-farm water use efficiency, which is projected to improve to 85 percent by 2025. M&I potential water use is based on recent use and projections of population growth for 2025. Water conservation projects expected to be in place by 2025 are accounted for in the future demand.

CVP supply reliability was determined with recent water systems modeling. The groundwater supply available for the analysis is based on levels equal to the safe yield of the local aquifers to prevent further decline. Contractors provided local surface water supply estimates.

The results of the water supply analysis are presented in terms of the potential use for water, available supplies and the resulting gap for each group under the current level of development. Under average conditions, agricultural water users currently can expect a water supply gap of approximately 1.1 million acre-feet (MAF) per year, while M&I users have a small gap of approximately 8,600 acre-feet (AF).

For the 2025 level of development, agricultural water use declines by nearly 300,000 AF due to a small reduction in acreage and a significant increase in on-farm efficiency. The average gap for agricultural users projected for the year 2025 is 832,000 AF. M&I users are expected to experience the largest growth, particularly in the South Bay region. The M&I gap increases, on average, to approximately 104,000 AF.

The water supply gap (or shortage) for agricultural water users is shown in Exhibit 1 for the current level of development and the 2025 level of development. The increase in the water supply gap is much greater under critical dry conditions. Under current levels of development, the projected agricultural water supply gap is 1.7 MAF under critically dry conditions. The gap is anticipated to be 1.4 MAF by the year 2025.

EXHIBIT 1

West Side Water Supply Gap Summary

(AF annually)

	Water Shortage at Current Level of Development [1]		Water Shortage at 2025 Level of Development	
	Average [2]	Critical [3]	Average [2]	Critical [3]
Agricultural	1,110,000	1,733,000	832,000	1,454,000

[1] Current Level of Development is year 1999.
[2] CVP supplies for average hydrologic conditions are 59 percent for Ag.
[3] CVP supplies assumed for critical hydrologic conditions are 25 percent for Ag.

Economic Activity Associated with CVP Water Use

The west side includes two distinct economic regions – agricultural and urban. The agricultural region of the Central Valley includes approximately a dozen communities, highly dependent on irrigated agriculture and a CVP water supply. The urbanized region of the South Bay includes areas of national economic importance including the Silicon Valley, yet it receives a smaller share of its water from the CVP.

Agricultural production using CVP west side water accounts for approximately $2 billion of total agricultural output (including on-farm and indirect activities). CVP M&I water helps support approximately $16.5 billion of economic activity.

The implementation of innovative water supply and demand management measures, in step with the CALFED Program, will help to close the water supply gap for all water users in the west side region, increasing economic output by $500 for every acre foot and creating more than seven jobs for every 1,000 AF.

Reshaping the Demand for Water: Potential West Side Management Projects and Strategies

Numerous west side water management projects have been reviewed for their potential to reduce demand, increase water efficiencies, and enhance environmental protection and restoration.

To adequately address the gap presented in Exhibit 1, irrigation demands must be reduced and available water supplies must be better utilized. Exhibit 2 provides a brief summary of specific projects that are under active consideration or are being implemented and their estimated implementation costs.

EXHIBIT 2

Water Supply and Demand Management Projects on the West Side

Summary of Proposed Projects and Studies

Project/Sponsor	Description	Project Cost
West Stanislaus Flood Control Project/USACE, Gregory D. Showalter	Flood reduction plan and improving conveyance of Crestimba, Salado and Del Puerto Creeks. Detention basins are proposed for Del Puerto Creek for water supply, power and recreation. Cost for additional design.	$1,000,000
Arroyo Pasajero Flood Control and Recharge/DWR DPLA/SJD	Capture of floodwater in the Arroyo Pasajero could have water supply benefits. Could move floodwaters into the California Aqueduct to be stored on the Tulare Lake bed or recharge facilities.	$12,000,000
Surface Water Storage Project	Construct storage basin on retired lands acquired by Westlands Water District.	$12,000,000
Marshall Drain Project	Construct regulating reservoir to regulate surface drain discharges and allow for tail water reuse.	$1,000,000
Groundwater Banking	Construct groundwater banking facilities on the west side.	$9,500,000
Irrigation Water Use Efficiency	Demand management, or water use efficiency, is an integral part of this plan. A high level of water use efficiency is included in the water supply gap analysis.	$10,000,000
Interconnect Mendota Pool/CCID Canal to DMC/Long-term Strategy	Use of available Outside Canal capacity and use of pump and conveyance facilities to lift water into the DMC for DMC users or San Luis reservoir.	$1,500,000

EXHIBIT 2

Water Supply and Demand Management Projects on the West Side

Summary of Proposed Projects and Studies

Land Retirement	Retire up to 200,000 acres of land from irrigated agricultural production to reduce demand and mitigate need for drainage service not provided by the federal government as specified in CVP water supply contract.	$500,000,000
Drainage Service	Expand the Grassland Drainage Project to eliminate flows to the San Joaquin River	$98,000,000

Enhanced management, economic development and resource strategies also have been identified to balance water supply and demand in the San Joaquin Valley. Those programs and strategies include:

- **Retiring Farmland in Westlands Water District for Multiple Benefit**

  Westlands Water District is actively pursuing land retirement as a means to address a chronic shortage of CVP water supplies and long standing drainage issues. The District's goal is to eventually reduce the total number of acres irrigated with CVP water supplies from 570,000 acres to 370,000 acres - a total reduction of up to 200,000 acres. This will ensure that the remaining lands will have adequate water supplies to promote the long-term viability of nearby communities and the $1 billion in annual agricultural production generated in Westlands.

- **I-5 Business Corridor Economic Development**

  This project contemplates the use of lands along the proposed Highway 180 alignment to support commercial and industrial activities. Retired lands could be made available to local communities impacted by land retirement and reduced water supplies resulting from the CVPIA's implementation. Beneficiaries from this project would include the City of Mendota, the I-5 Business Corridor Group, County of Fresno and Westlands Water District.

- **Dry Land Farming**

  Farmlands that have been removed from irrigation are currently being leased to local farmers as dry land farming opportunities. Typically, lessees will plant a winter or spring grain on the land, which will be harvested or used for livestock grazing. Retired lands can be dry land farmed with grains and other crops to provide food and habitat for wildlife. Beneficiaries include farmers, wildlife and the local economy.

- **Wildlife Corridors**

  Discussions between water districts and Reclamation, the California Department of Fish and Game and U.S. Fish and Wildlife Service have focused on plans to restore some of the retired lands for wildlife purposes. State and federal agencies are interested in restoring an east-west and north-south corridor to allow species to migrate to different lands and different areas of the district. In addition to using dedicated retired lands for a wildlife corridor, Westlands would also work with landowners that farm permanent crops – lands that could also be used for a corridor. Beneficiaries could include Reclamation, the Bureau of Land Management, Fish and Wildlife Service and Department of Fish and Game.

- **Upland Habitat Development**

  Discussions also are occurring with state and federal agencies and conservation interests, regarding the potential to restore retired lands for upland habitat purposes. Under one scenario, some of the retired lands could be restored to upland habitat similar to Reclamation's demonstration project for animal and plant species. Beneficiaries include state and federal wildlife agencies and various conservation interests.

- **Groundwater Banking**

  There is some potential for groundwater storage in the upslope areas or western portion of the west side region. Westlands, with assistance from DWR, has investigated groundwater storage potential in the Arroyo Pasajero fan, in the Cantua Creek area and other locations within the boundaries of the water district. Westlands was granted $72,000 from AB303 funds to investigate conjunctive use potential. The District has completed a Proposition 13 grant application for $9.5 Million to construct a groundwater conjunctive use project on the Arroyo Pasajero fan that has an estimated 50,000 acre-foot annual capacity.

- **Drainage Management**

  Land retirement is a key component of regional drainage plans. By retiring drainage-impacted land on a voluntary basis, the need for future drainage service on these lands will be reduced. The retired lands will no longer be irrigated with surface supplies and will thereby reduce the impacts of deep percolation.

  However, drainage management measures will continue to be necessary as farming takes place on lands that are not retired.

  The Grassland Drainage Area covers approximately 97,000 acres of irrigated farmland on the east side of the San Joaquin Valley. The area is highly productive, producing an estimated $113 million annually in agricultural crop market value, with an additional estimated $126 million for the local and regional economies, for a total estimated annual economic value of $239 million. The Grassland Drainage Area farmers have implemented several activities to reduce the discharge of subsurface drainage waters to the San Joaquin River. These activities include: 1) the Grassland Bypass Project; 2) the San Joaquin River Water Quality Improvement Project; 3) formation of a regional drainage entity; 4) distributing newsletters and other farmer-oriented education series; 5) a monitoring program; 6) the use of State Revolving Fund loans for improved irrigation systems; 7) utilizing and installing drainage recycling systems to mix subsurface drainage water with irrigation supplies under strict limits; 8) tiered water pricing; and 9) tradable loads programs.

- **Grassland Bypass Water Quality Improvement Project**

  The entities within the Grasslands Drainage Area have implemented the Grassland Drainage Project. An innovative program designed to improve water quality in historic drainage channels is now used to deliver water to wetland areas. The project consolidates subsurface drainage flows on a regional basis and utilizes a portion of the federal San Luis Drain to convey the flows around the habitat areas to the San Joaquin River downstream of the Merced River confluence.

  The benefits of the Grassland Bypass Project are well documented. In water year 2001, drainage volume was reduced by 47 percent, selenium load was reduced 56 percent, salt load reduced by 28 percent and boron load reduced by 41 percent compared to the pre-project conditions in water year 1996.

- **San Joaquin River Water Quality Improvement Project**

  The San Joaquin River Water Quality Improvement Project (SJRIP) is a major project undertaken by Grassland Drainage Area entities. The project, covered under the 2001 EIR/EIS, used Proposition 13 funds to purchase and improve 4,000 acres of land within the Grassland Drainage Area for the purpose of drain water treatment and disposal. The initial (phase 1) projects of the SJRIP were implemented in the winter of 2001. This phase included the planting of salt tolerant crops and construction of distribution facilities that allowed for 1,821 acres to be irrigated with drainage water and/or blended water. As a result, 1,025 pounds of selenium, 14,500 tons of salt and 62,000 pounds of boron were retained and not discharged to the Grassland Bypass Project and to the San Joaquin River. The project will ultimately allow for planting and irrigation of the entire 4,000 acres with drainage water. Future phases call for acquisition of additional acreage, installation of subsurface drainage systems and implementation of treatment and salt disposal components.

- **Groundwater Management Pilot Project**

  In 2002, the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), in cooperation with Reclamation, implemented a pilot project to study the feasibility of using groundwater pumping to mitigate drainage impacts. The project involved pumping two wells above the Corcoran Clay but below the shallow groundwater. Although this water supply does contain elevated levels of salt, it contains no selenium. This water supply is diverted into surface supply canal and put to beneficial use on surrounding lands and refuges. The 2002 project demonstrated significant lowering of the crop root zone water levels by pumping groundwater from within the Sierran sands located above the Corcoran Clay and below shallow selenium laden groundwater. Sierran sands reduce selenium and can eliminate the constituent from groundwater discharges. The project also showed reductions in nearby tile sump outputs.

- **Key Management Practices**

This plan proposes expansion of current drainage management practices into a comprehensive sustainable drainage program. In order to implement a sustainable drainage program, all management practices must be integrated to provide long-term salt balance in the region. While the goal of salt balance is the same for each sub-area, the most efficient suite of management practices for achieving salt balance may vary among sub-areas. Therefore, each sub-area will emphasize different management practices in their drainage program.

As practices are shown to be effective they will be expanded. The process will build upon past research and evolve into a fully developed integrated in-valley drainage control effort. The districts will implement drainage control efforts appropriate for their specific needs. The implementation of the district efforts will be coordinated with Reclamation and integrated into one comprehensive program. The key management practices are: (1) Land Retirement (2) Groundwater Management (3) Source Control (4) Regional Reuse Projects (5) Drain Water Treatment (6) Salt Disposal.

Introduction

The West Side Integrated Resources Management Plan for the west side region of the San Joaquin Valley documents the potential use of water supply, existing supplies that have diminished in recent years and existing and future water demands. The implementation of the Central Valley Project Improvement Act (CVPIA), water quality regulations in the San Francisco Bay/Sacramento-San Joaquin Delta (the Delta or Bay-Delta) and Endangered Species Act (ESA) provisions have significantly reduced CVP water supply reliability to this region.

Documenting potential water supply is necessary to improve the water supply reliability for west side water users. This Plan also examines the economic activity related to the west side water supply. Reestablishing reliability and responsibly managing water use and demand is critical to the region's economy that is supported by CVP water supplies.

The U.S. Bureau of Reclamation is presently drafting a supplemental report to Congress on the Least Cost CVP Yield Increase Plan (Reclamation and U.S. Fish and Wildlife Service, 1995). The supplemental report is a direct response to CVPIA Section 3408(j), which requires the Secretary of the Interior to "...develop and submit to the Congress, a least cost plan to increase, within fifteen years after the date of enactment of this title, the yield of the Central Valley Project by the amount dedicated to fish and wildlife purposes under this title..." The supplemental report presents a refined set of water supply improvement actions to replace the agricultural and M&I CVP yield dedicated by the CVPIA for environmental purposes.

The remainder of Section 1 provides background information on the CVP and the west side. The laws and regulations affecting the region's water supplies are presented by modeling results quantifying current water supply reliability. Section 2 of the report characterizes the land use and economics associated with water needs of west side agricultural and M&I contractors. In Section 3, a water supply gap analysis for west side agricultural and M&I water users is presented to establish the need for water supply improvement on the west side. In Section 4, various water management projects are discussed to help alleviate these shortages. Appendix A provides additional data on agricultural contractors. Finally, Appendix B describes the economic characteristics of the west side region, estimates how much economic activity and value are attributable to west side agricultural and M&I water supplies and describes how much activity and value might be attributable to more supply.

CVP Background

The CVP was conceived, designed and constructed to create greater economic development in California. The first legislation authorizing development of the CVP was passed in 1935 and at least 15 acts of Congress have authorized additional development. Initial project features included Shasta Dam for flood control, navigation and water storage and a canal system to deliver water from Lake Shasta and the Delta to the north San Joaquin Valley.

The Delta-Mendota Canal (DMC) was completed in 1951. Diversion of Trinity River flows to the Central Valley began in 1963. San Luis Dam and Reservoir, owned jointly with the state, were completed in 1967. The San Luis Canal (SLC) was completed in 1968 and the Coalinga Canal, a branch of the San Luis Canal, was completed in 1973. Water delivery facilities providing irrigation service to lands in the San Luis Unit were not completed until the 1980s. The San Felipe Unit, delivering water to Santa Clara and San Benito counties on the California coast, came on line in 1987.

Geographic Scope of the West Side Region for Analysis

The west side region is defined as those irrigated lands and urban lands receiving CVP water from the Delta via the DMC and SLC. The majority of the region falls within the San Joaquin Valley of California's Central Valley, to the west of the San Joaquin River. Included in the west side region, for purposes of this analysis, are the north Central Coast and South Bay areas, both served by the CVP's San Felipe Unit.

The analysis focuses on CVP export contractors who have had their water supplies adversely affected by the CVPIA and other state and federal regulations. The water supply needs of the San Joaquin River Exchange Contractors are not included in this report because their water supplies have not been impacted by the CVPIA or other regulatory actions cited in this Plan. The west side region analyzed in this report is shown in Exhibit 1-1.

The west side region receives water pumped from the Delta by the Tracy Pumping Plant and conveyed via the DMC, by gravity, up to 116 miles to the Mendota Pool in the San Joaquin River. The Tracy Pumping Plant and the canal immediately downstream were designed to carry 4,600 cubic feet per second (cfs), but physical and institutional factors now limit that capacity. Water is delivered to users at numerous turnouts. The O'Neill Pumping Plant, located at mile 70, can pump up to 4,200 cfs to storage in San Luis Reservoir. San Luis Reservoir withdrawals are conveyed south in the SLC or the State Water Project (SWP) California Aqueduct, or west to Santa Clara and San Benito County (the San Felipe Division) via the Pacheco Tunnel and to CVP contractors on the lower DMC and Mendota Pool.

Water Users Included in the West Side Analysis

Lands addressed in this west side water supply analysis are within the Delta Division, the San Luis Unit and the San Felipe Division of the CVP. These lands are served by several varying types of water service contracts and agreements with the Department of Interior, including CVP agricultural and M&I service contracts, CVP exchange contracts, CVP water rights contracts, or, in the case of wetlands, refuge water supply agreements. The west side lands are also served with water from local supplies and local groundwater.

This analysis specifically focuses on agricultural lands and M&I service areas within the San Luis Delta-Mendota Water Authority (SLDMWA). Only part of the area served by the CVP in the San Joaquin Valley is included in the west side analysis. Land served solely by exchange contracts is not included. These lands are excluded because their water supplies were not affected by the CVPIA. Irrigated areas served by the Cross Valley Canal and the Friant Division of the CVP and not within SLDMWA are not included.

Table 1-1 lists the agricultural and M&I water users included in the west side water supply analysis.

TABLE 1-1
CVP West Side Water Supply Analysis
Agricultural, M&I and Wetlands Water Users

AGRICULTURAL	
San Luis Unit	**San Felipe Unit**
Westlands Water District	San Benito County Water District
San Luis Water District	Santa Clara Valley Water District
Panoche Water District	Pajaro Valley Water Management Agency
Pacheco Water District	
Southern DMC	**Northern DMC**
Fresno Slough Water District	Banta-Carbona Irrigation District
James Irrigation District	Centinella Water District
Reclamation District 1606	Del Puerto Water District
Tranquillity Irrigation District	Patterson Irrigation District
Widren Water District	Plain View Water District
Oro Loma Water District	West Side Irrigation District
Mercy Springs Water District	West Stanislaus Irrigation District
Eagle Field Water District	
Laguna Water District	
Broadview Water District	
Coelho Family Trust	

Laws and Regulations Affecting West Side Water Supplies

Bay-Delta Water Quality Standards and D-1485

Beneficial uses of water in and from the Sacramento-San Joaquin Bay-Delta system (the Bay-Delta or Delta) can be adversely affected by decreased water quality. Water quality problems in the Delta are caused by reduced freshwater inflow (which reduces flushing and allows seawater intrusion), by water quality degradation in rivers flowing into the Delta and by contributions of unwanted constituents from land use practices and other activities within the Delta.

In 1978, the State Water Resources Control Board (SWRCB) released Water Rights Decision 1485. The decision set flow and water quality standards for the protection of beneficial uses in and from the Delta and required the SWP and CVP to meet those standards as water rights conditions for the projects. The standards were based on the premise that beneficial uses would be protected at a level equal to the protection received had the CVP and SWP never been in operation and had construction of those two projects never taken place.

In 1986, the California Court of Appeals issued a decision authorizing the SWRCB to modify water right permits to implement Delta water quality standards and to develop the standards to protect fish and wildlife. These standards, however, could not be established solely to protect Delta water users from the impacts of the SWP and CVP. Consequently, in 1987, the SWRCB began a formal proceeding to reconsider the D-1485 standards, establish new standards if needed and develop a program of implementation.

Reclamation and the State of California entered into a Coordinated Operations Agreement (COA) that sets the responsibility of the CVP and SWP for applicable Delta water quality standards. The COA provides the basis for CVP and SWP operations to ensure an equitable share of water supply for each project, while guaranteeing that the systems operate more efficiently during droughts than if they were to operate independently.

Water Quality Control Plan and D-1641

After a great deal of controversy between the U.S. Environmental Protection Agency and the State of California in the early 1990's, the historic Bay-Delta Accord was signed in 1994. The following year, the SWRCB adopted a new Water Quality Control Plan (WQCP) based on the Accord. That standard required even greater amounts of CVP water to meet water quality standards than the amounts previously required.

The sharing of responsibility for meeting water quality standards has not been entirely resolved. The SWRCB issued D-1641 in December 1999. The decision assigned interim responsibility to the CVP and SWP to meet the flow and water quality objectives in the WQCP. The decision also approved certain agreements involving the projects' responsibility towards certain other water right holders for meeting those objectives. Phase 8 of the Bay-Delta water right hearings is intended to address the responsibilities of remaining water-right holders in meeting the objectives in the 1995 WQCP. The projects (CVP and SWP) and the remaining upstream water right holders reached an agreement on Phase 8 in late December 2002 to stay the SWRCB's Phase 8 proceedings.

Endangered Species Act

The ESA is now the single most influential factor in the annual operation of the CVP and has resulted in reduced water supplies and higher costs for both agricultural and municipal and industrial water users. The 1989 listing of the Sacramento winter-run Chinook salmon as a "threatened" species was the first listing to affect the CVP. In 1994, this listing was upgraded to "endangered." Management actions to protect this species has required structural and operational changes to maintain flows and lower water temperatures below Shasta Dam. Because a supply of cold water must be maintained in

Lake Shasta for downstream temperature control, less water is available for agricultural and M&I water supply. Additional ESA listings include the Delta Smelt in1993, Central Valley Steelhead trout in 1998 and the spring run Chinook salmon in 1999.

In order to minimize take of listed species, the CVP and SWP diversions from the Delta at the federal Tracy Pumping Plant (Tracy) and the Banks Pumping Plant (Banks) have been reduced and sometimes curtailed altogether, especially Delta Smelt and winter run Chinook salmon. The 1994 Bay-Delta Accord and the CALFED ROD, discussed below, established principles for water management to minimize the effect of ESA provisions on water supply.

CVPIA Provisions Affecting CVP Water Supply

A number of key CVPIA provisions directly affect water supply availability for agricultural and M&I water users including:

- Up to 800 TAF of supply per year has been dedicated to restoring fish and wildlife, protecting the Bay-Delta and meeting other federal obligations imposed on the CVP subsequent to passage of the Act. The rededication is referred to as "(b)(2) water" after the CVPIA authorizing provision Section 3406(b)(2).
- The re-operation of the Trinity River Division may increase downstream releases to protect and restore the river's fishery.
- Section 3406(d)(1) of the CVPIA requires firm CVP water supplies to be delivered to federal, state and some private wildlife refuges.

Some of the (b)(2) water dedicated by the CVPIA is used for Bay-Delta water quality and ESA purposes. Water required for the WQCP counts as (b)(2) water, but water provided for ESA actions for winter run Chinook salmon, listed before the CVPIA, does not. Upstream (b)(2) actions help spring run Chinook salmon and Steelhead and Delta (b)(2) actions also reduce entrainment (diversion and mortality) of Delta Smelt. Water supply for the wildlife refuges and Trinity River flows also does not count as (b)(2) water.

In February 2002, a federal court agreed with a lawsuit filed by CVP water users that found (b)(2) accounting adjustments made after Interior's *Final Decision on Implementation of Section 3406(b)(2) of the CPVIA* in October 1999 were improper. These adjustments included a WQCP cap, which set a maximum on the amount of water to meet the WQCP that could be counted as (b)(2) water and offset and reset provisions allowed some (b)(2) actions to occur without counting water as (b)(2) water. This court decision directed Interior not to use these adjustments when implementing CVPIA 3406(b)(2). Therefore, (b)(2) is currently implemented based largely on the 1999 Final Decision, but without the WQCP cap and the offset and reset provisions.

Section 3406(b)(23) of the CVPIA requires Interior to complete a flow study and make a recommendation regarding increased flows in the Trinity River to restore fisheries. Increased flow need was developed in the Trinity River Flow Evaluation Study and recommended in the Trinity River Mainstream Fishery Restoration Draft EIS/EIR. Interior recommended increased flows on the Trinity River, reducing the ability of the CVP to deliver water to its contractors. In response, CVP water and power users filed suit in January 2001 and a U.S. District Court issued a preliminary injunction in March 2001. On December 10, 2002, a federal judge gave Interior 120 days to complete an environmental impact statement for a plan to restore water flow on the Trinity River. The final plan may still reduce the ability of CVP to deliver water.

Section 3406(d)(1) of the CVPIA requires firm water supplies to be delivered to federal, state and some private wildlife refuges, as defined in the CVPIA. This supply is referred to as "Firm Level 2" as outlined in the Refuge Water Supply Report and the San Joaquin Basin Action Plan and is greater than the amount of CVP water previously delivered to the refuges (Reclamation, 1989; Reclamation and California Department of Fish and Game, 1989). Historically, most of the refuges received irrigation tail water for much of their supply, but the CVPIA requires water sources of suitable quality and at a level of reliability greater than that for agricultural contractors. Because CVP water has been supplied to the refuges to meet Level 2 requirements, the ability of the CVP to deliver water to its agricultural and M&I contractors has declined.

The CVPIA also includes several provisions to increase agricultural and M&I water costs. Important provisions include restoration fees, tiered water pricing, conservation requirements and additional water acquisition for wildlife refuges for Level 4 requirements [CVPIA 3406(d)(2)].

CVP Water Supply Analysis Under Current Conditions

An analysis of CVP water supplies available to the west side has been developed using CALSIM, a hydrologic and water supply model developed by the California Department of Water Resources (DWR) and Reclamation to simulate the operation of the SWP and CVP. The monthly time step model includes highly detailed logic describing the operation of the CVP, use of (b)(2) water, hydrologic conditions and other factors affecting water delivery.

The purpose of this analysis is to determine the effects of the previously described regulatory actions on the CVP's water supply delivery performance and reliability. The results of the impact analysis for west side agricultural and M&I contractors' CVP supply are summarized in Table 1-2. Local surface water and groundwater supplies are not included in this table. These sources of water are components of the overall west side water supply and are presented in the water supply gap analysis in Section 3.

TABLE 1-2
CALSIM Model Results
CVP Delivery Under Current Conditions (Annual, March – February)

	West Side CVP Agricultural	
	TAF	**% of Contract**
CVP Contract Totals	**1840**	

TABLE 1-2
CALSIM Model Results
CVP Delivery Under Current Conditions (Annual, March – February)

	West Side CVP Agricultural	
Average of all years 1922-1994	1,084	59%
Critical Period 1928-1934	463	25%
Critical Period 1986-1992	497	27%
All Critical and Dry Years	665	36%

Note: "Critical" year and "Dry" year classifications refer to the Sacramento Valley Water Year Classification, defined in SWRCB D-1641.

West Side Water User Characterization

Water use in the CVP west side region is dependent upon land use, characterized as agricultural and M&I for purposes of this analysis. Presently, agricultural water use occurs on about 850,000 irrigated acres in the region. Today, the M&I water supply provides a portion of the water needs for 1.9 million people in Santa Clara and San Benito Counties as well as the San Joaquin Valley. While the focus of this water supply analysis is on west side water use, it is important to note lands outside of the west side region are supported by activity associated with land and water use within the west side. For example, there are areas in Fresno County that are not in the CVP west side region that experience significant economic activity due to regional agricultural activity generated by CVP water supplies.

Agricultural Water Users

Agricultural water contractors on the west side are listed in Table 2-1 and shown on the map in Exhibit 2-1. Most of the irrigated land included in this water supply analysis is located in the west side of the San Joaquin Valley. Cotton accounts for about 33 percent of the irrigated acreage in the west side region. Tomatoes and miscellaneous vegetable and seed crops account for another 30 percent of acreage. A table of the crop mix by district is provided in the Appendix, Table A-3.

The San Felipe Division of the CVP, within the South Bay and Central Coast of California, serves the remainder of the irrigated acreage. In 1999, 51,086 irrigated acres in San Benito and Santa Clara counties were harvested. Detailed crop mix data is not available for irrigated lands in San Benito County. Crops in the region include vegetables, fruits, nuts, vineyards, forage and field crops. Details on acreage by crop type for the remaining contractors are shown in the Appendix in Table A-3.

TABLE 2-1
Land Use Data for the CVP West Side of the San Joaquin Valley
Agricultural Contractors

Agricultural Contractors	1999 Harvested Acres
Westlands Water District	545,847
San Luis Water District	42,932
Panoche Water District	36,197
Pacheco Water District	4,070
Fresno Slough Water District	1,027
James Irrigation District	23,665
Reclamation District 1606	120
Tranquillity Irrigation District	9,366

TABLE 2-1
Land Use Data for the CVP West Side of the San Joaquin Valley
Agricultural Contractors

Agricultural Contractors	1999 Harvested Acres
Widren Water District	423
Oro Loma Water District	1,003
Mercy Springs Water District (partial)	1,580
Eagle Field Water District	1,242
Laguna Water District	393
Broadview Water District	8,960
Coelho Family Trust	1,008
Banta-Carbona Irrigation District	14,461
Centinella Water District	460
Del Puerto Water District	38,422
Patterson Irrigation District	14,706
Plain View Water District	4,523
West Side Irrigation District	6,243
West Stanislaus Irrigation District	26,493
San Benito County Water District	25,317
Santa Clara Valley Water District	37,757
Pajaro Valley Water Management Agency	2782
Total	**848,997**

Source: Reclamation 1999 Water Needs Analysis.

Water Supply Gap Analysis

The Water Supply Gap Analysis estimates water supply, potential water use and shortages ("the gap") under present and 2025 conditions. Potential water use is based on expected land use, application rates, population and existing economic factors and assumes that supply does not limit potential use. Potential water use does not consider any change in demand caused by future economic factors. The agricultural and M&I gap analyses are based on Reclamation's *Water Needs Analysis* and public water user planning documents.

Agricultural Gap

The gap analysis was completed for potential agricultural water use at 1999 and 2025 levels of development. The total water supply available for agricultural use comprises CVP water, groundwater and other local supplies. The gap is the difference between potential water use and supplies under a range of CVP water supply allocations. The analysis does not consider willingness or ability to pay for supplies to eliminate the water supply gap. The analysis requires data for four determinants of agricultural water use and supply.

- The amount of irrigated acreage and types of crops served.
- Potential use for agricultural water.
- The amount of non-CVP water supplies available to serve the acreage.
- The amount of CVP water supply.

Data and Water Requirements

Irrigated acreage data for 1999 was obtained from irrigation district records. The data is actually harvested acreage, including acres harvested more than once (multiple-cropped acres) in 1999. For example, if an acre of lettuce is harvested in the spring and the same acre is replanted to grains and harvested in the fall, two irrigated acres are counted. Therefore, the amount of harvested acres typically exceeds the amount of land irrigated to produce those harvests.

The 1999 harvested acreage data did not include acreage that was not harvested because of a water shortage in 1999. The shortage was attributed to a 30 percent below CVP agricultural service contract allocation. The west side districts estimated 49,709 acres were fallowed in 1999. This acreage was added into the total 1999 acreage to obtain an estimate of potential irrigated acreage if water supply had not been a limiting factor.

Irrigated pasture is not actually harvested but is included as irrigated acreage in the analysis. However, the 1999 harvested acreage data did not include other irrigated acreage that was not harvested. This acreage is primarily immature, non-bearing fruit trees and vines that did not produce a crop in that year. West side water users estimated an additional 30,000 acres for this irrigated land in 1999.

The acreage data also allowed for 14,000 acres of land retired under the Westlands WD land retirement program. The acreage was not included in the 1999 total. Acreage totals are shown by water district in the Appendix in Table A-1 for Service Contractors and Table A-2 for Water Rights Settlement Contractors. Acreage totals by district and crop type are shown in Table A-3.

Stoddard and Associates (1999) developed an acreage forecast for 2025 for the Water Needs Analysis (Reclamation 2000). The analysis measures all acreage that would be irrigated if water were available. Therefore, an adjustment for fallowed or un-harvested irrigated acreage was not required. The acreage forecast totals are shown in Table A-1 and A-2 of the Appendix.

The agricultural potential water use calculation is demonstrated in Table 3-2. Potential use is based on irrigated acreage and water use per irrigated acre. Water use per irrigated acre includes crop consumptive use (or crop evapotranspiration), water required for leaching salts from the root zone and additional water for cultural practices such as cooling and frost control. On-farm potential use accounts for conveyance losses and on-farm irrigation efficiency.

TABLE 3-2
Irrigated Acreage and Water Potential Use in AF, 1999 and 2025 Conditions

	1999	2025
Irrigated Acres [1]	928,706	915,016
Crop Consumptive Use (Evapotranspiration, ET), AF/acre	x 2.25	x 2.25
Total ET, AF	2,089,589	2,058,786
Effective Precipitation (EP) @ 0.3 AF/acre	- 278,612	- 274,505
Leaching Requirement (LR) @ 0.108 AF/acre	+ 100,300	+ 98,822
Cultural Practices (CP)	+ 55,000	+ 55,000
Total Crop Water Need *(ET-EP+LR+CP)*	1,966,277	1,938,103
On-Farm Efficiency	÷ 77%	÷ 85%
Delivery Potential Use	2,553,606	2,280,121
Conveyance Losses @ 3.5% of Delivery Potential use	+ 89,376	+ 79,804
Total Agricultural Water Potential Use	**= 2,642,983**	**= 2,359,925**

[1] In 1999 49,709 acres were fallowed and 30,000 acres of irrigated land were not harvested (928,706 = 848,997 + 49,709 + 30,000).

Crop consumptive use accounts for most of the need for water. The *Water Needs Analysis* identified an average of 2.2 AF per acre of consumptive use was required. Stoddard and Associates estimated an average of 2.3 AF per acre. The gap analysis used an average of the two findings of 2.25 AF per acre. The analysis assumes a leaching requirement of 0.108 feet per acre and additional water for cultural practices of 55,000 AF in 1999 and 2025. Total farm agricultural delivery requirement excludes effective precipitation estimated to average 0.3 feet per acre and farm delivery requirements include a current on-farm irrigation efficiency of 77 percent, increasing to 85 percent in 2025.

Total water needed at the district level includes in-district conveyance losses of 3.5 percent. Accounting for these losses, total need at the district level is estimated to be about 2.64 MAF in 1999 and 2.36 MAF in 2025.

The CVP water supply contract amount for each west side agricultural water district is shown in the Appendix in Tables A-1 and A-2. Other supplies include groundwater and local surface water. West side districts provided data on local supplies. Annual groundwater supplies for agricultural use on the west side are assumed to equal average annual aquifer recharge, thus preventing long-term decline of groundwater levels. The safe groundwater yield estimates were included in the *Water Needs Analysis*. The amounts of local water supply and safe groundwater yield for each west side agricultural contractor is shown in the Appendix in tables A-1 and A-2.

Municipal Use of Agricultural Service Contract Water

CVP agricultural water supplies are provided under either water rights contracts (non-project supplies) or agricultural service contracts (project supplies). Some contractors have only one type, but some have both types of contracts. Within the west side, there is also municipal use of CVP agricultural service contract water. This municipal use of agricultural water is subject to shortage provisions equal to CVP M&I service contracts, but is nonetheless included in the agricultural gap analysis to maintain a grouping of all CVP agricultural contract water. Municipal use of CVP agricultural water is shown in Table 3-3.

TABLE 3-3
Municipal Use of CVP Agricultural Water Contracts Included in Agricultural Gap Analysis
Recent CVP Delivery and Projected 2025 Use (AF)

Contractor	CVP Delivered Recently	2025 Projected Use
Broadview WD	23[a]	20
Del Puerto WD	12	12
Dept Veterans Affairs	33	450
Pacheco WD – SLU	12	80
Panoche WD – DMC & SLU	52	100
Plain View WD	657	420
San Luis WD – DMC & SLU	616	580
State of CA	6	10
Westlands WD	4,765	11,000
Total (included in Agricultural Gap Analysis)	**6,176**	**12,672**

[a] Data source for Broadview WD was their Conservation Plan.

TABLE 3-3
Municipal Use of CVP Agricultural Water Contracts Included in Agricultural Gap Analysis
Recent CVP Delivery and Projected 2025 Use (AF)

Contractor	CVP Delivered Recently	2025 Projected Use

All other data obtained from Reclamation's *CVP 2001 M&I Water Rates*.

Summary of Agricultural Gap Analysis

The results of the agricultural gap analysis are shown in Table 3-4. The municipal gap is calculated separately from the agricultural service contract water that still serves agricultural uses.

Results are presented as what the water supply gap would be given a range of different water supply scenarios. Recent CALSIM simulations estimate contractors will receive on average 59 percent of their CVP contract amount and 25 percent to 27 percent during an extended critical dry period. For the critical dry condition, 25 percent is used for this analysis. However, the minimum supply allocation in a single critical dry year could be as low as 0 percent. The total 1999 gap in average years is 1,110 TAF. In critical dry years the gap increases to 1,733 TAF. In 2025, the average gap is 832 TAF and 1,454 TAF in critical dry years. While there is less irrigated acreage predicted for 2025, the main reason for the decrease in the agricultural water supply gap is the assumption that agricultural water users will increase on-farm efficiency to 85 percent.

TABLE 3-4
Summary of CVP Agricultural Water Supply Gap at Various CVP Allocations, TAF
1999 and 2025 Conditions

	100% Allocation		59% Allocation [1]		25% Allocation [1]	
	1999	2025	1999	2025	1999	2025
Surface Water	190	190	190	190	190	190
Groundwater	244	244	244	244	244	244
CVP [2]	1,835	1,829	1,100	1,096	479	478
Total Supply	**2,269**	**2,263**	**1,534**	**1,530**	**913**	**912**
Potential Use [3]	**2,643**	**2,360**	**2,643**	**2,360**	**2,643**	**2,360**
Agricultural Gap	374	97	1,109	830	1,730	1,448
Gap from the Municipal Use of Agricultural Water [4]	0	0	1	2	3	6
Total Agricultural Contract Gap	**374**	**97**	**1,110**	**832**	**1,733**	**1,454**

TABLE 3-4
Summary of CVP Agricultural Water Supply Gap at Various CVP Allocations, TAF
1999 and 2025 Conditions

	100% Allocation	59% Allocation [1]	25% Allocation [1]

[1] CALSIM simulations estimate that contractors will receive about 59 percent allocation on a long-term average and 25 percent to 27 percent during a multi-year critical dry period.
[2] Included in the total CVP supply is water from West Side Water Rights Settlement Contracts totaling 40,813 AF as shown in Table A-2. This water is assumed to be reduced 25 percent when agricultural service contracts are reduced 55 percent or more.
[3] Calculation shown in Table 3-2.
[4] The gap resulting from the municipal use of agricultural water is calculated separately because shortage provisions are equal to M&I service contracts.

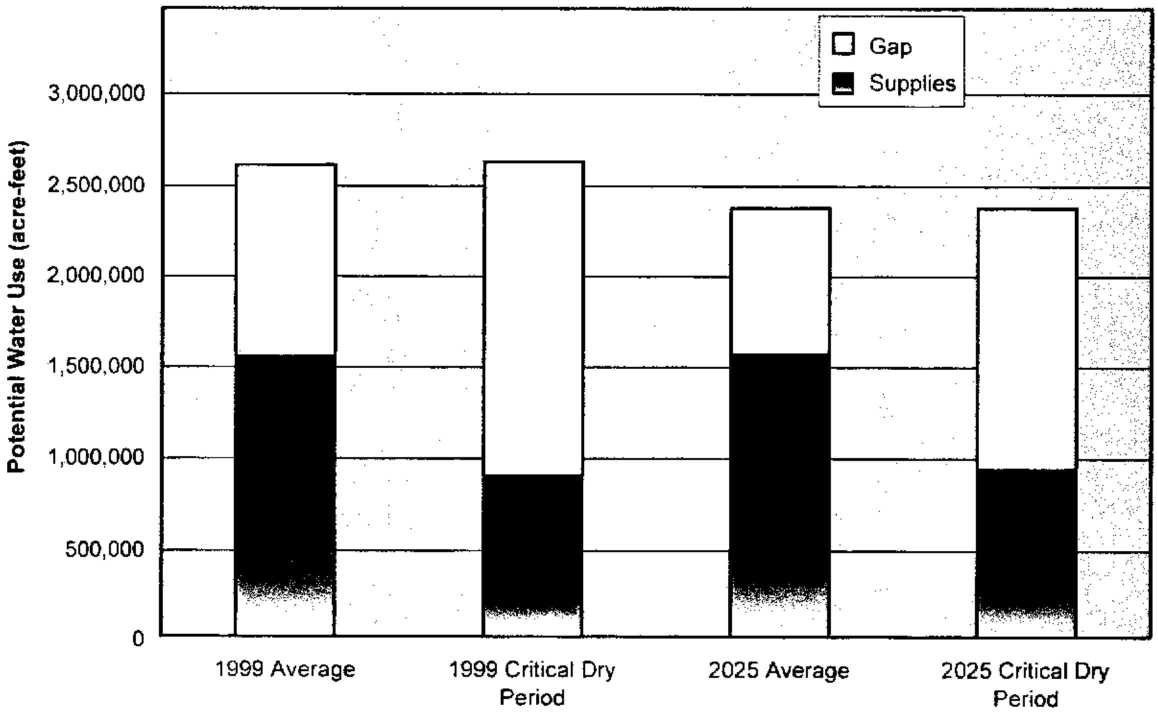

Figure 3-1
Potential Agricultural Water Use, Available Supply, Water Supply Gap

Economic Activity Associated with West Side Water Supply

To understand how the west side economy might respond to more CVP water supply, information was compiled in this appendix describing the west side economy and economic impact associated with CVP water use in the region. The appendix was formulated to address the following questions:

1. What are the economic characteristics of the west side region related to CVP water use?
2. How much economic activity and value are attributable to west side CVP agricultural and M&I water supplies?
3. How much economic activity and value might be attributable to more CVP supply?

This appendix focuses on the economic impact associated with agricultural and M&I water use. No attempt was made to quantify the economic impact associated with water supply for refuges and wildlife areas. While it is acknowledged there would be an economic impact with more water supplies, most other analyses have described these benefits in qualitative terms.

Economic Characteristics of the West Side Region

The west side analysis region includes two distinct economies and each is affected by CVP water supply differently. The South Bay and Central Coast portion of the west side region includes the most southern part of the San Francisco Bay urban area and some less urban areas in San Benito and Santa Clara counties. Most CVP water use in this region is for M&I purposes and the CVP water supply is a small but important share of all water use in the region.

The west San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the region to provide an alternative economic base. This region is predominately affected by use of CVP agricultural supplies. Smaller amounts are used for M&I purposes and refuge water supply. Most water use is for agriculture and the CVP provides a large share of all water use in the region. The total amount of CVP water use in the San Joaquin Valley is roughly ten times the amount of use in the South Bay and Central Coast. The amount of CVP refuge water use alone is more than all CVP water use in the South Bay and Central Coast.

West San Joaquin Valley

The west San Joaquin Valley includes parts of Fresno, Kings, Merced, San Joaquin and Stanislaus counties. Depending on water supply conditions, about 800,000 acres are partially or solely irrigated with CVP water. Agricultural water use is described in

Section 3 and Table A-3 in the Appendix shows crop mix by district. Other economic base industries include travel on the Interstate-5 corridor, some petroleum and tourism. Wetlands benefit the local economies by attracting hunters and bird-watchers.

M&I water use, which is a small share of total water use in the region, occurs in about a dozen locations. M&I water use is described in more detail in Section 3. The largest M&I use areas with their January 2002 populations are the cities of Tracy (65,643), Avenal (14,827), Coalinga (14,827) and Huron (6,919). Tracy has recently grown at a rapid pace, becoming a suburb for commuters to the Bay Area. Total population of the west side Central Valley region in 2000, based on population data by census tract, was about 209,000 persons as shown in Table B-1. The 2002 population data from California Department of Finance suggest that the regional population could now be close to 250,000 persons.

The other towns within or adjacent to the west side have highly agricultural economies. These towns include San Joaquin, Tranquillity, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing and Patterson. All of these communities are strongly affected by CVP agricultural water use. Some of them rely on agricultural water from the CVP for M&I use and some are experiencing dramatic rates of growth and urbanization. The municipal use of CVP agricultural water is forecasted to increase from approximately 6,200 AF to 12,700 AF by 2025.

The region has high unemployment and low per capita incomes relative to the State as a whole. Regional per capita income in the five counties was less than $20,000 annually in 1997 (U.S. Department of Commerce [USDC], Bureau of Economic Analysis, 1997).

TABLE B-1
2000 Population of West San Joaquin Valley

County	Population
Fresno	53,197
Kings	14,751
Merced	45,584
San Joaquin	69,802
Stanislaus	25,769
Total	**209,103**

Source: USDC, Bureau of the Census, 2001. 2000 Census of Population.

South Bay and Central Coast

The portion of the analysis not within the Central Valley includes Santa Clara County and San Benito County. M&I water use is a large share of all water use in the region. Santa Clara Valley Water District serves most of the urbanized land in the region. M&I water use is described in detail in Section 3. Santa Clara Valley is world-renowned as the home of "Silicon Valley." Major cities in Santa Clara and San Benito counties and their 2002 populations are San Jose (917,971), Sunnyvale (132,825), Santa Clara (104,306), Palo Alto (60,487), Milpitas (63,768), Cupertino (52,235) and Saratoga (30,444). Regional population in 2002, including San Benito County, was 1.78 million (California Department of Finance, 2002).

In 1997, per capita personal incomes averaging $37,300 per capita were among the highest in the nation. The cost of living in the region is also among the highest in the nation. A significant portion of the workers in Santa Clara County commute from locations as far north as San Francisco, as far south as Monterey and as far east as Los Banos. With recent declines in the high-tech industries, per capita incomes and other measures of living standards have also declined since 1997.

The south portion of Santa Clara County and San Benito County are more agricultural. CVP agricultural water is directly or indirectly used for irrigation of about 50,000 acres. Important towns in San Benito County include Hollister (36,338), Morgan Hill and Gilroy.

Economic Activity and Value from West Side CVP Agricultural and M&I Water Supplies

This section addresses the question of how much economic activity and value can be attributed to west side agriculture and CVP water supplies. The amount and value of agricultural production, employment and income produced with CVP agricultural water supplies is estimated and reported. Also, the amount of forward-linked activity (sales of products that require farm products) and backward-linked economic activity (sales to farms), that are related to irrigated acreage that uses CVP supplies is reported. An estimate of economic activity related to CVP M&I supplies is also provided.

For agriculture, the amount and value of irrigated production resulting from CVP water supplies is reported. However, it is not correct to attribute t agricultural production to water supply alone because agricultural production would also be lost if any critical factor of production such as soils, labor, capital, or management skill was eliminated. . There is some ability to acquire and use alternative water supplies, so some of the production would continue even without CVP supplies. On the other hand, agricultural users have limited ability and willingness to pay for alternative supplies.

The same types of concerns apply for CVP M&I water supplies. Industrial and commercial production require water supplies and residential living requires water supply, but M&I water users have ability and willingness to substitute other supplies for

CVP water. This is especially true in the South Bay where CVP water is not a large share of all water use and water supply infrastructure has been developed to allow for substitution among supplies if there is conveyance capacity available.

This west side economic analysis encountered data limitations. Many data sources are available for counties, but the west side region defined in this report includes not one entire county and parts of five counties. For west side M&I water use, data on the economic conditions in the individual urban service areas, being small towns and cities, are not available. For the South Bay and Central Coast, the portion of Santa Clara County that is served with CVP water cannot be readily identified. Therefore, this economic analysis must rely on estimates of shares of agricultural production value and population to interpolate from county data sources.

Economic Activity and Value of West Side Agriculture from CVP Water Supply

Table B-2 shows acreage and value data from County Agricultural Commissioners (CAC) for each county within the west side, an estimate of the amount and share of the irrigated land that is within the west side and an estimate of value of production of agricultural commodities from the west side. For Fresno County, the west side economic values are based on west side crop mix and CAC value per acre for each crop type. The inclusion of additional detail is justified by the large share of west side acreage in Fresno County.

The total value of irrigated production from the west side in 1999 was about $1.41 billion. Of the $1.42 billion, about $174 million represents production in the South Bay and Central Coast region. Other farm products such as livestock, dairy and apiary (honeybee) production included, total farm value was $2.1 billion. Value of crop production was $1,697 per irrigated acre. Value of crops, livestock and all other farm products per irrigated acre was $2,518.

Listed below are some points for consideration with respect to the value of west side agriculture.

1. About 28 percent of available water supply in 1999 was not CVP agricultural service contract water. (From the agricultural gap analysis in Section 3, a 70 percent contract allocation in 1999 would have provided 1.256 out of 1.737 MAF of supplies.)

2. The agriculture product results with livestock and dairy double-counts some value in that some of the irrigated product is used to produce the livestock and dairy.

3. Some of the livestock and dairy production uses feed from outside of the west side, so this production should not be "attributed" to west side irrigation.

TABLE B-2
Estimated Value of Farm Production from Irrigated Land in the West Side Analysis, from Total County Data, 1999

	Total County Data	West Side Estimates

County	County Harvested Acres	County Value of Harvested Product (Million $)	County Value of Other Ag Product (Million $)	County Total Agriculture Product (Million $)	1999 West Side Harvested Acres [1]	West Side Share of County Acreage	West Side Value of Harvested Product (Million $)	West Side Total Agriculture Product (Million $)
Fresno	1,265,444	2,596	964	3,560	601,616	47.5%	1,049	1,438
Kings	582,070	431	442	873	54,585	9.4%	40	82
Merced	589,062	642	892	1,534	43,935	7.5%	48	114
San Joaquin	588,100	952	400	1,353	29,877	5.1%	48	69
Stanislaus	454,538	482	728	1,210	53,128	11.7%	56	141
San Benito	57,029	132	48	180	25,317	44.4%	59	80
Santa Clara	24,963	115	61	176	25,769	100.0%	115	176
Total	**3,561,206**	**5,351**	**3,535**	**8,886**	**834,227**		**1,416**	**2,101**

[1] 834,227 acres equals 848,997 (from Table 2-1) less acreage for which no cropping data are available (11,988 acres in SCVWD + 2,782 acres available for irrigation by SCVWD, Pajaro Valley WMA or Westlands WD).

Next, the amount of on-farm employment, wages and salaries and total farm income are estimated. This estimate was completed for only Fresno County because west side irrigated acreage accounts for a relatively large share (47.5 percent) of Fresno County acreage. For the other counties, west side acreage is a small share of the county total and it is more likely that west side acreage shares could misrepresent west side economic shares. Also, about 74 percent (1,049/1,416) of west side value of production is in Fresno County. Relationships between value of production and the other on-farm measures from the Fresno County analysis will be used to extrapolate to the remaining 26 percent of the west side.

IMPLAN is an economic database and modeling tool that provides estimates of agricultural income and employment by county. With estimates of west side crop value share by crop type, the IMPLAN data can be used to estimate the share of Fresno County agricultural income and employment attributable to west side agriculture.

Table B-3 shows the CAC data on total value of agricultural production for Fresno County broken down by Standard Industrial Classification (SIC) groupings, estimated value of crop production for west side acreage in Fresno County and the resulting west side share of Fresno County value of production. From Table B-2, 40.39 percent of Fresno County agricultural value (1,438/3,560) was attributed to the west side. This estimate is used in Table B-3 to estimate west side shares of IMPLAN dairy and all other livestock/poultry.

These shares are then used to estimate the west side share of the IMPLAN agricultural value of output, employment, employee compensation (wages and salaries) and proprietor's and property income. The IMPLAN county value of output estimates is less than the CAC numbers, possibly because IMPLAN does not double count value of production of products resold within the county. On-farm value of output, measured by the IMPLAN conventions, is $1.16 billion. Total on-farm employment attributable to the West Side in Fresno County is 11,119 persons and total farm income attributable to the west side is about $439 million (146 + 161 + 132).

From Table B-2, the Fresno County west side accounts for about 74 percent of the total west side region, so the total economic effects of the west side should be about 35 percent [(1/.74) – 1] larger than the Fresno County west side alone. Assuming this share, total economic effects of west side agriculture are shown in the last row of Table B-3.

TABLE B-3
Economic Value by Crop Type for Fresno County, West Side Share of Fresno County and West Side On-farm Employment and Agricultural Income, Million $ unless noted

				West Side Share of IMPLAN Estimates					
Farm Sectors	**Fresno Output Value from CAC**	**Estimated West Side Value**	**West Side Shares of County, %**	**Value of Output**	**Employ-ment, jobs**	**Employee Compen-sation**	**Pro-prietor's Income**	**Other Property Income**	**Total Farm Income**
Cotton	331.6	256.1	77.3%	174	1,210	20	23	21	70
Fruits	1,051.8	53.6	5.1%	61	842	12	3	4	20
Nuts	136.3	74.5	54.6%	65	746	13	7	7	29
Vegetables	902.4	569.2	63.1%	564	4,592	87	75	80	254
Hay and Pasture	70.7	13.3	18.8%	7	306	0	2	1	4
Greenhouse, Nursery & Forest	32.8		0.0%	0	0	0	0	0	0
All Other Crops	110.0	82.6	75.1%	37	1,428	1	9	9	21
Dairy	222.8	90.0	40.4%	94	534	6	23	4	34
All Other Livestock, Poultry	740.8	299.2	40.4%	165	1,568	9	21	7	39
Total Fresno Co.	3,559	1,438		1,167	11,227	147	162	133	470
Total West Side	**8,886**	**2,088**	**23.5%**	**1,575**	**15,156**	**198**	**219**	**180**	**634**

The economic activity caused by agriculture is much more than the farm output, income and employment alone. The estimates in Table B-2 and B-3 do not account for all economic activity created in marketing, transporting and processing west side products. These forward linked economic activities occur after the product leaves the farm.

IMPLAN data for some industries that include some forward processing activities are provided in Table B-4.

The IMPLAN data for some forward linked processing sectors suggest that there is additional and substantial economic value created in forward processing industries. However, some of these forward processing values might be enabled by raw farm products imported from out-of-county and some of the forward processing industries may be located in Fresno county for reasons other than the availability of raw products. On the other hand, forward-linked value of output in some marketing and transportation industries is not included in Table B-4. Without the pertinent information about product movements and import patterns, it would not be appropriate to quantify a share of the forward processing value to attribute to Fresno County or west side agriculture.

TABLE B-4
Economic Value in Agricultural Forward Processing Sectors, Fresno County, Million $ unless noted

IMPLAN Forward Processing Sectors	IMPLAN Value of Output	Employ-ment, jobs	Employee Compen-sation	Pro-prietor's Income	Other Property Income	Total Value Added
Meat Packing and Processing	682.6	4,100	107	4	20	136
Dairy Products	192.4	521	21	1	10	33
Canned Fruits and Vegs	314.3	1,498	50	1	47	100
Frozen and Dehydrated Product	500.9	2,797	89	2	62	157
Wine, Brandy and Soft Drinks	326.5	994	45	1	34	113
All Other Food Processing	516.1	2,129	70	2	59	136
Total	**2,533**	**12,039**	**383**	**12**	**231**	**676**

Finally, the additional economic activity created in backward linked industries should be included. Backward-linked economic activities occur before the product leaves the farm. The sales of backward-linked industries are the sales of farm inputs to farms, plus the additional sales generated by trade with farm input providers. This economic activity can be estimated using IMPLAN economic multipliers for Fresno County with the estimated west side production values from Table B-3. Results are provided in Table B-5. Estimates for the entire west side in the last row are calculated as the Fresno County numbers multiplied by 1.35. This accounts for the share of the west side in other counties.

TABLE B-5
Economic Multipliers and Total Economic Impacts of West Side Farm Production Through Backward Economic Linkages

Crop	IMPLAN Multipliers, Dollars per Dollar of Direct Output Unless Noted			West Side Value of Output	West Side Total Impacts With Backward Linkages, Million $ Unless Noted		
	Total Output	Employee Compens.	Employment (Jobs/Mil$)		Total Value of Output	Employee Comp	Employment (Jobs)
Dairy Farm Products	1.52	0.22	15.3	94	142	21	1,434
Poultry And Eggs	1.53	0.21	16.1	58	89	12	931
Ranch Fed Cattle	1.63	0.19	26.5	26	42	5	680
Range Fed Cattle	1.83	0.21	32.6	31	57	6	1,010
Cattle Feedlots	1.63	0.19	14.9	44	72	8	659
Sheep, Lambs And Goats	1.63	0.19	99.1	1	1	0	75
Misc. Livestock and Meat Products	1.51	0.24	45.6	4	6	1	187
Cotton	1.72	0.32	20.3	174	299	56	3,534
Food Grains	1.67	0.19	32.0	6	11	1	206
Feed Grains	1.55	0.17	23.7	2	3	0	53
Hay And Pasture	1.56	0.18	54.9	7	11	1	402
Grass Seed	1.48	0.15	81.2	14	20	2	1,112
Fruits	1.78	0.44	29.2	61	108	27	1,778
Tree Nuts	1.74	0.43	25.6	65	114	28	1,673
Vegetables	1.76	0.38	24.2	564	992	215	13,625
Sugar Crops	1.59	0.18	24.8	14	22	2	338
Miscellaneous Crops	1.82	0.31	46.9	0	0	0	11
Oil Bearing Crops	1.56	0.22	27.3	0	1	0	13
Total				1,167	1,993	389	27,752
Total West Side				**1,575**	**2,691**	**525**	**37,465**

The direct and indirect effects of west side agriculture in Fresno County in 1999 were about $1.99 billion of output, $389 million of employee compensation and about 27,752 jobs. The direct and indirect effects of all west side agriculture in 1999 were about $2.69 billion of output, $525 million of employee compensation and about 37,465 jobs. These impacts include the direct, on-farm effects, but not the forward linkage effects.

In summary, Fresno County west side agriculture directly contributed about $1.44 billion to the Fresno County economy in 1999 of which $1.05 billion was crop value. Direct agricultural employment was about 11,227 jobs paying $147 million in employee compensation and $162 million in proprietor's incomes and $133 million in other property income were earned. Through backward economic linkages, an additional $0.826 billion in output (1.993-1.167) and $242 million in employee compensation (389-147) were generated. Additional proprietor's and property incomes were generated, but the share of these incomes paid to Fresno County residents is unclear.

A total of 27,752 jobs were created by Fresno County west side agriculture. In addition, the west side was responsible for an unknown share of 12,000 jobs in forward processing in Fresno County. Additional value of output from marketing, transportation and forward processing in other counties has not been counted.

Assuming that the Fresno county west side accounts for 74 percent of total west side economic value, the annual economic contribution of west side agriculture is listed below.

- Direct crop value: $1.42 billion
- Direct crop value, IMPLAN counting conventions: $1.25 billion
- Total on-farm value: $2.1 billion
- Total on-farm value, IMPLAN counting conventions: $1.575 billion
- Direct employment: 15,156 persons
- Direct wages and salaries: $198 million
- Direct wages and salaries, proprietor's and property incomes: $634 million

Total annual economic impacts of west side agriculture including both on-farm and backward linkages are summarized below. All forward linkage effects are not included.

- Total on-farm and indirect value of output effects: $2.69 billion
- Total on-farm and indirect wages and salaries: $525 million
- Total on-farm and indirect employment: 37,465

Economic Activity and Value from CVP M&I Water Supplies

This section estimates the baseline amount of economic activity that is related to CVP M&I contract supplies. Issues involving the relationship between water supply and economic activity and data problems involving the distribution of CVP water supply within counties cannot be resolved. A simple approach is used that, at best, provides an indicator for economic activity related to CVP supply.

Economic data for counties from the Regional Economic Information System are measures of economic activity that could be affected by CVP M&I water use. These data are adjusted according to the product of (1) the share of county population living in the

CVP service area and (2) the share of water supplies in the service area that are CVP contract supplies. Table B-6 shows results.

TABLE B-6
Level of Economic Activity Associated with CVP M&I Water Supplies Based on County Economic Data, Share of County
Population in CVP Service Area and Share of Service Area Supplies that are CVP

	Percent Shares of County Population, CVP Supply Share and Economic Activity Share			Shares of Population and Economic Activity Associated with CVP M&I Supplies		
Urban Area	**Service Area Share of County Population**	**CVP Share of Service Area M&I Supplies**	**CVP Economic Activity Share**	**Mil $ Personal Income**	**Popu-lation**	**Employ-ment**
Avenal, Kings Co.	11.4%	100.0%	11.4%	$190	14,751	5,449
Tracy, San Joaquin Co.	12.4%	61.0%	7.6%	$820	42,595	17,644
Coalinga, Fresno Co.	1.7%	100.0%	1.7%	$239	13,247	6,478
Huron, Fresno Co.	1.6%	100.0%	1.6%	$236	13,105	6,408
San Benito County	99.5%	6.9%	6.9%	$62	3,197	1,327
Santa Clara County	100.0%	24.3%	24.3%	$14,914	393,961	286,660
Total				**$16,461**	**480,855**	**323,967**

CVP M&I contract supplies are associated with about $16.5 billion of personal income, 481,000 persons living in CVP service areas and 324,000 full and part-time jobs.

The M&I water supplies appear to be associated with much more income and employment than the agricultural water supplies. However, the dependency of economic activity on CVP M&I water is not as strong as the dependency of agricultural economic activity on CVP agricultural supplies. When CVP supplies are short, CVP M&I users are willing and able to pay for substitute supplies. The willingness and ability of agricultural users to pay is substantially less, so more of the associated economic activity will actually be lost.

Economic Activity and Value Attributable to More CVP Supply

The last question to consider is the economic impacts of incremental changes in CVP water supply. This issue has been studied extensively within several economic studies as part of environmental documentation for implementation of the CVPIA.

For west side agriculture, the effects of an increase in water supplies are:

- Decreased use and costs for alternative supplies, including groundwater and water transfers.
- Decreased costs for conservation, including capital and labor costs.
- Crop switching to crops that use more water per acre.

- To the extent that it is not economical to reduce use of alternative supplies, reduce conservation, or switch crops, then less land is idled and agricultural production is increased.
- All of these actions increase farm profits, which increase local spending on investment and discretionary items. To the extent that agricultural production is increased, regional economic spending is increased through farm spending and forward economic linkages.

The CVPIA PEIS conducted detailed economic modeling of these types of economic effects. It is possible to use these results to infer the economic effects of west side water supply increases. If CVPIA agricultural effects could be reversed, water supply increases and reduced water costs would result in $161 million of output, $74 million of personal income and 2,370 jobs in the San Joaquin Valley. Changes in output, employment and income per AF of water supply are shown in Table B-7. These impacts include effects from eliminating CVPIA restoration payments.

TABLE B-7
Regional Economic Effects of PEIS Alternative 1, per AF of Supply

	Output $/AF		Employment per 1000 AF		Income $/AF	
	Direct	Total	Direct	Total	Direct	Total
Output Effect	$147.50	$333.44	1.5	4.7	$36.88	$136.25
Total Effect	$244.06	$502.81	3.0	7.4	$90.31	$232.50

For west side M&I water users, the effects of an increase in water supplies are summarized below.

- Decreased use and costs for alternative supplies, including groundwater, water transfers and capital and O&M costs of local or statewide water development.
- Decreased costs for conservation improvements, including capital and labor costs.
- Decreased costs of shortage in some dry years. These costs include net revenue losses for M&I water providers and consumer surplus losses for water customers. For industrial and commercial users, these consumer losses are lost net revenues from reduced production or increased costs.
- Regional economic spending increases because decreased water costs increase the discretionary incomes of M&I water users.

Results from the PEIS can be used to infer that, with CVPIA implementation effects reversed, employment would be increased in the Bay Area by 100 persons and in the

San Joaquin Valley, by 100 persons. Value of output in these regions would increase by $13.4 million and income would increase by $7.6 million. These impacts include effects from eliminating CVPIA restoration payments and decreased conservation and metering costs.

Reshaping Regional Demand

Additional Irrigation Water Use Efficiency

Demand management, or water use efficiency, is an integral element of this Plan. A high level of water use efficiency is included in the water supply gap analysis and additional urban water use efficiency is included in the baseline conditions.

Reclamation actively promotes water use efficiency in the region and other federal programs provide funding for conservation efforts. Authorization for conservation expenditures by Reclamation is provided in the CVPIA, the Reclamation Reform Act and Title XVI of P.L. 102-575 (Reclamation Wastewater and Groundwater Studies). CVPIA restoration funds are also being used for water conservation activities. The 1996 Federal Agricultural Improvement and Reform Act authorizes continuing USDA spending for irrigation improvements and related actions primarily through the Environmental Quality Incentives Program (EQIP). Proposition 13 funding also has been utilized within the Delta Mendota Service areas to provide revolving loans to farmers for improving irrigation efficiency. A higher level of conservation has been achieved because of these funds.

The west side San Joaquin Valley region possesses unique characteristics that enable increased benefits through irrigation water conservation. The SJVDP recommended irrigation conservation as one method of reducing drainage and drainage disposal costs. The recommendation was made because some applied irrigation water is not consumed and becomes unusable contaminated drainage requiring costly disposal and may it impair environmental values. Increased conservation offers multiple benefits, including reduced groundwater pumping and/or Delta exports, improved water quality and better crop and irrigation management.

Some parts of the west side region have already attained a high level of conservation, utilizing drip irrigation water application systems with on-demand scheduling. Nevertheless, additional conservation is planned throughout the region. Improvements will be relatively expensive, requiring intensive management, widespread use of subsurface drip irrigation and reuse of degraded tail water. The use of irrigation technology to reduce evaporation losses appears promising, but the costs and benefits remain too uncertain to recommend funding for a large-scale program for purposes of water supply improvement.

The analysis assumes a regional average of 85 percent on-farm efficiency will be achieved by 2025. The improvement will result in applied water savings of almost 300,000 AF and the volume of drainage water will be reduced by a similar amount.

Westlands Land Retirement: Retiring Farmlands for Multiple Benefit

Westlands Water District encompasses more than 570,000 irrigated acres of diversified crops on some of the most productive soil in the world. Yet Westlands is actively pursuing land retirement as a means to address a chronic shortage of CVP water supplies and long standing drainage issues. The District's goal is to eventually reduce the total number of acres irrigated with CVP water supplies from 570,000 acres to 370,000 acres - a total reduction of up to 200,000 acres. This will ensure that the remaining lands will have adequate water supplies to promote the long-term viability of nearby communities and the $1 billion in annual agricultural production generated in Westlands.

While much of the land within Westland is extraordinarily productive, it is also affected by drainage and salinity problems. This affected area includes approximately 270,000 acres. In 1999, Westlands initiated a process to purchase 14,000 acres of land with shallow groundwater problems. The land was also located in the area identified by Reclamation as needing drainage service. In addition, 1,443 acres have been retired under Reclamation's Land Retirement Demonstration Project. As the lands were purchased, the water supply historically applied to those lands was reallocated to remaining lands in the District. The district developed an agricultural lease program for these lands, enabling lessees to dry land farm these retired lands and maintain it to district specifications. Reclamation has been using its land for habitat restoration.

In 2002, Westlands approved an agreement to settle a portion of *Sagouspe, et al., v. Westlands Water District, et al.*, concerning how the district will allocate CVP water to the Area I Lands and Area II Lands after December 31, 2007, or after a long-term renewal contract becomes effective. Such a contract is currently being negotiated with Reclamation. The agreement is the product of lengthy negotiations between Area I and Area II representatives. Under the settlement, the District will acquire additional lands and the water appurtenant to those lands will be allocated to other lands in the district.

The proposed plan shows acquisition of 100,175 acres through the issuance of debt and another 5,600 acres acquired using district cash reserves, for a total of 105,775 acres. This total includes the 13,978 acres previously taken out of agricultural production and lands to be acquired through the settlement of other litigation. These lands will be temporarily fallowed and managed by the district.

Land Retirement Economic Report

An Economic Impact Report has been completed that identifies the short-term and long-term impacts associated with land retirement. The report concludes that land retirement provides the greatest long-term benefits for west side agriculture and the communities dependent upon this sector for their survival. The overall benefit to all CVP contractors is also recognized since the drain on water supplies would be reduced and drainage service would finally be mitigated. The report is available at ( )

Land Retirement and Drainage

Land retirement is a key component of the regional drainage plan. By retiring drainage-impacted land on a voluntary basis, the need for future drainage service on these lands will be reduced. The retired lands will no longer be irrigated with surface supplies and will thereby reduce the impacts of deep percolation. To the fullest extent possible, groundwater pumping will continue throughout the areas where land retirement occurs. Modeling shows a significant drain water source reduction from such a combination. The land will become available for other uses such as regional drainage reuse projects, commercial and industrial use, flood control, surface water storage where appropriate and wildlife habitat. Each project will be strategically located to maximize the benefits to the region. For example, drainage reuse projects will be located to maximize their ability to mitigate past drainage impacts and eliminate future regional impacts from land that remains in production. Each land use choice will be coordinated into an overall program designed to maintain a viable environment and economy.

The water supply from this land will remain within the region so long as appropriate drainage mitigation programs are effectively implemented consistent with the plan. Specific measurable criteria will be developed to document drainage management measures that are effective at mitigating any past, present and future drainage impacts that result from irrigation within the region.

Westlands Land Retirement Plan

Under the present land retirement scenario, up to 200,000 acres of drainage-impacted land will be purchased from individual landowners, removing the land from irrigated agricultural production. Title to these lands would be retained by Westlands and/or a nonprofit entity that would put the land to beneficial uses such as wildlife habitat, dryland farming, or related economic development activities. These lands will be managed in a manner compatible with continuing agriculture on the remaining farmlands. The District's guiding principles for land retirement includes the following:

- The plan must provide balanced benefits for all affected parties.
- The plan must provide farmers a fair and reasonable price for their land, with values determined as if those lands had drainage services provided.
- The program must be voluntary, involving only willing sellers.
- No harm or loss of water should occur to any other Central Valley Project water user.
- Third-party impacts must be identified and addressed.

Beneficial Uses of the Retired Lands

Westlands, in conjunction with local officials, landowners and state and federal agencies, has begun a preliminary investigation into the potential alternative uses of the retired land, with the objective of administering those lands to achieve broader benefits for the district and the region. The following potential uses for the land have been considered:

- Regional Drainage Reuse and Treatment / Disposal
- I-5 Business Corridor – Economic Development Opportunities
- Panoche/Silver Creek Detention Basin
- Arroyo Pasajero Flood Control Project
- Surface Water Storage
- Dry Land Farming
- Wildlife Corridors
- Upland Habitat Development

Regional Drainage Reuse and Treatment

Westlands anticipates lands adjacent to the retired area will still require drainage service, specifically with regard to treatment and reuse. Retired lands can be used as regional reuse projects to provide drainage for lands remaining in production and to mitigate for past drainage impacts. The facilities would be designed and operated similar to the project identified in Reclamation's *Plan Formulation Report of the San Luis Drainage Feature Reevaluation.* The beneficiaries of this project would include: Westlands, landowners that need drainage service and Reclamation because it will be relieved from providing drainage service – a significant cost to the U.S.

I-5 Business Corridor

This project contemplates the use of lands along the proposed Highway 180 alignment to support commercial and industrial activities. Retired lands could be made available to local communities impacted by land retirement and reduced water supplies resulting from the CVPIA's implementation. Beneficiaries from this project would include the City of Mendota, the I-5 Business Corridor Group, County of Fresno and Westlands.

I-5 Panoche/Silver Creek Detention Basin

This project consists of constructing a detention basin to collect and attenuate flood flows from Panoche/Silver Creek and discharge a constant flow to the Fresno Slough. Historically, flows from Panoche Silver Creek have flowed out from the channel and down to the City of Mendota flooding parts of the city, depositing silt on county and state roadways and damaging adjacent cropland. Westlands expects the Panoche Silver Creek CRMP will also administer this activity. The beneficiaries would include the City of Mendota, County of Fresno, CALTRANS, landowners and the U.S. Army Corps (Corps) of Engineers.

Arroyo Pasajero Flood Control Project

Retired lands could be used to construct a detention basin to collect and attenuate flood flows from the Arroyo Pasajero. The Corps completed a report to construct a 50,000 acre-foot reservoir to attenuate the flows from the creek; however, the cost-benefit ratio did not support construction of the project. As an alternative, DWR is investigating a proposal to divert Arroyo Pasajero flows into the California Aqueduct, to transport the flows downstream and then divert the waters into the Tulare Lake Bed. As a less expensive and easier to implement alternative, Westlands is proposing to divert the Arroyo Pasajero flows onto its retired lands. The beneficiaries of this project would be the City of Huron, County of Fresno, CALTRANS, the Corps, DWR, State Water Contractors and CVP contractors.

Surface Water Storage

The project consists of constructing a series of storage basins on eight sections (5,120 acres) adjacent to laterals 6 and 7 within Township 15 South and Range 15 East. The Project will have an estimated 40,000 to 50,000 acre-feet of storage for rescheduled water, surplus water and water from other sources including refuges, San Joaquin River flood flows and other CVP contractors. In addition to the storage benefit, the project will be near the Mendota Wildlife Area and will provide habitat for migratory birds. Because of this benefit, other partners may be willing to contribute to the project. This project will be designed to prevent impacts to shallow ground water due to seepage.

Dry Land Farming

Westlands is currently leasing some of its retired lands to local farmers as dryland farming opportunities. Typically, lessees will plant a winter or spring grain on the land, which will be harvested or used for livestock grazing. Retired lands can be dry land farmed with grains and other crops to provide food and habitat for wildlife. Beneficiaries include Westlands, wildlife and the local economy.

Wildlife Corridors

Westlands is in discussions with Reclamation, the California Department of Fish and Game and U.S. Fish and Wildlife Service regarding plans to restore some of the retired lands for wildlife purposes. State and federal agencies are interested in restoring an east-west and north-south corridor to allow species to migrate to different lands and different areas of the district. In addition to using dedicated retired lands for a wildlife corridor, Westlands would also work with landowners that farm permanent crops – lands that could also be used for a corridor. Beneficiaries could include Reclamation, the Bureau of Land Management, Fish and Wildlife Service and Department of Fish and Game.

Upland Habitat Development

Westland is also in discussions with state and federal agencies and conservation interests, regarding the potential to restore retired lands for upland habitat purposes. Under one scenario, some of the retired lands could be restored to upland habitat similar to Reclamation's demonstration project for animal and plant species. Beneficiaries include state and federal wildlife agencies and various conservation interests.

Conservation Through Recharge and Flood Control Projects

There are a number of proposed water conservation and flood control projects that offer meaningful water supply benefits for the west side region. These projects are not yet planned for implementation, but actions could be taken as part of an overall plan including a share of CVP system-wide actions. Most of these projects and the resulting water supply they may create, would be developed without substantial financial or technical assistance by Reclamation. At least 50,000 AF of these local supplies could be developed before 2025. These supplies are included in the with-IRP condition.

West Stanislaus Flood Control Project

The project will identify a plan to reduce flood damages in Newman, Patterson and surrounding agricultural lands by improving hydraulic capacity of Crestimba, Salado and Del Puerto Creeks. Multi-purpose detention basins are proposed for Del Puerto Creek to achieve water supply, hydropower and recreational benefits. A Notice of Intent (NOI) and Notice of Preparation (NOP) for an EIS/EIR were issued March 2001. Potential water supply benefits are unknown.

Arroyo Pasajero Flood Control/Recharge

The Arroyo Pasajero River inundates the Huron area during flood events and causes severe damage to Highway 269, to thousands of irrigable acres within Westlands and of most concern, to the California Aqueduct - a main source of irrigation and drinking water for southern California. In 1995, a major flood event washed out a bridge on Interstate 5 resulting in the loss of life and significant damage to the Aqueduct. In 1999, the U.S. Army Corps of Engineers (Corps) released a flood study on the Arroyo Pasajero that proposed the construction of the Gap Dam. The project would resolve the flood threat and provide up to 50,000 AF of storage. Unfortunately, several agencies opposed the project due to concerns over potential wildlife corridor impacts. In addition to the Gap Dam proposal, the Corps included an alternative that proposed the following:

a. Enlargement of the Westside Retention Basin located west of the California Aqueduct and

b. Modification of structures to allow Arroyo Pasajero floodwaters into the California Aqueduct and

c. Construction of a turnout structure near Kettleman City to divert water out of the California aqueduct and finally,

d. Construction of a surface water detention basin on lands within the Tulare lakebed.

Ultimately, the Corps decided the project's cost-to-benefit ratio was not high enough to support Federal funding or further design. DWR has assumed the Corps' role is continuing to develop the project as outlined above. Although this project will protect the aqueduct from major flood events, it fails to address the following: (i) inundation of irrigable lands west of the aqueduct, (ii) shallow groundwater problems resulting from water being stored and percolated west of the aqueduct and (iii) most importantly, still allows flood flows which carry silt, asbestos and other constituents into the aqueduct.

Westlands Alternative

Since the DWR and Corps proposal fails to address all of the major issues involved in the problem, Westlands has developed its own alternative that could prove to be less expensive and more efficient. . Westlands proposal consists of the following project features:

a. Enlargement of the Westside Retention Basin similar to the DWR/Corps proposal and

b. Construction of a siphon under or a flume across the California Aqueduct to prevent flows from entering the aqueduct and

c. Construction of diversion channel to convey water from the California Aqueduct to a detention basin and

d. Construction of an Eastside detention basin on lands that Westlands has acquired or will acquire in the future.

Preliminary Project Design

Both the DWR and Corps proposal and Westlands alternative recommend expansion of the Westside Detention Basin. Westlands' proposal then consists of construction of a siphon under or a flume over the California Aqueduct near the Gale Avenue inlet structure. The inlet structure will remain and only be used for those events that exceed the 100-year design event. The siphon or flume will convey water across the aqueduct and to a flood diversion channel originating on the west side of the aqueduct. The seven mile long channel will be earth lined and vegetated for erosion control since the channel will have approximately 100 feet of elevation fall. The channel will be designed to carry the 100 year flood event assuming a constant flow rate from the Westside Detention basin and will be designed so all flows are subcritical to avoid channel erosion. The channel will terminate at the Eastside Detention basin located on approximately 12 sections, 7,680 acres, see Figure 1. The basin will be constructed using material on site to minimize construction costs. The levees will be constructed along the 210 feet through 240 feet land elevation contours and have a total storage of approximately 45,000 acre-feet. The basin will likely fill from the northeast section and back-fill southwesterly.

Preliminary Project Operations

The project design will allow flood operations to be flexible based on the size of a given flood event. During small flood events, water can be detained in the Westside Detention basin where it will cause no damage. The water can be stored or diverted to the Eastside Detention basin where it can be stored for evaporation or be used to provide water supply to adjacent lands. During large storm events, stream flows will be diverted into the Westside Detention basin where the large peak events will be attenuated. During these events, water will be discharged at a constant rate under/across the aqueduct, into the diversion channel and then to the Eastside detention basin. In addition to the storage that the Eastside Basin will provide, a connection can be made to the Tulare Lake Basin Water Storage District Lateral "A" canal to allow the basin to be drained to the canal where the floodwater can be beneficially used for irrigation. In addition, Westlands could pump the supply from the basin into its distribution system where the water could be beneficially used as well.

Cost Comparison

Westlands expects its proposal to be less expensive than the DWR/Corps proposal. Most importantly, the lands where the proposed Eastside Detention basins would be sited have been acquired by Westlands, thereby minimizing acquisition costs. The costs necessary for the Detention basin would be the construction of levees and outlet structures. In addition, the diversion channel has a significant gradient which will result in a reduced cross section thereby reducing the easements and rights-of-ways to be acquired. Additionally, the channel can be earthen lined and vegetated to reduce the channel cost compared to concrete lining. The only remaining cost is the construction of a siphon under or flume over the California Aqueduct. Until the operation is finalized, the size of the siphon or flume cannot be determined.

The cost that has not been developed between the two proposals is the additional cost for the DWR proposal for desilting the aqueduct and delivery reductions after major flood events. With the Westlands proposal, the aqueduct will remain in service and not be affected by flood flows. However, the DWR proposal will still result in flood flows entering the aqueduct that will require downstream deliveries to be suspended and after a flood event, the aqueduct will have to be cleaned of silt, debris and other constituents.

Surface Water Storage/Wildlife Habitat Enhancement

The project consists of constructing a series of storage basins on eight sections (5,120 acres) adjacent to laterals 6 and 7 within Township 15 South and Range 15 East (see Figure 1). The Project will have an estimated 40,000 to 50,000 acre-feet of storage for rescheduled water, surplus water and water from other sources including refuges, San Joaquin River flood flows and other CVP contractors. Because the project would be situated near the Mendota Wildlife Area and could provide habitat for migratory birds, other partners may be willing to participate in the project.

The Project will use District laterals 6 and 7 to facilitate filling and draining of the basin cells. Lateral 6 has a design capacity of 94 cubic feet per second (cfs), 180 acre-feet per day (AF/D), from the San Luis Canal (SLC). Lateral 7 has a design capacity of 170 cfs, 328 AF/D, from the SLC. Using both facilities, the reservoir can be filled in approximately 90 days. For rescheduled water, the reservoir could be filled from December through February and drained from April through June.

In addition to filling and draining the basin, some water will be lost through evaporation and infiltration/percolation. For percolation, a soil analysis will be completed to determine the volume of water lost through the basin floor. In addition, the soil analysis will specify whether a perimeter drain is needed to prevent flooding on adjacent lands. While this report provides preliminary information about the project, further geologic soils testing and engineering design evaluations will be required to determine the feasibility and cost of the project.

Preliminary Design

Currently, the project will be constructed on eight sections of land with interconnected cells having levees on section lines and/or 5-foot contour intervals. The levees will be approximately 14 feet high above existing ground. If existing road right-of-ways can be abandoned, the levees that exist along the section lines can be removed which would reduce the required earthmoving and compaction. In addition, another alternative will be investigated that will have one large pond on each section; however, this will increase the levee height to 25 feet.

Preliminary Cost Estimate

For the purposes of this report, it has been assumed that Westlands under Sagouspe or a similar acquisition program will acquire the land required for the project footprint. Aside from land expenses the other significant cost will be earth moving, levee construction and compaction. Based on preliminary information, these costs are estimated at $1.50 per cubic yard of compacted soil for construction of the levees (approximately 7 million cubic yards at an estimated cost of $10,500,000). After the completion of surveys and soil testing, the project could be redesigned to reduce the number of interior levees that would decrease the volume of earth to be moved. In addition, the existing soil with its high clay content should be adequate for constructing impervious levees; therefore, the estimate excludes lining the ponds with betonite or a similar lining product. This assumption is reasonable because the County of Fresno used topsoil from an adjacent section to line the bottom of a local landfill site.

The project will be located on 8 sections, however, within each section, there will be storage cells which will require connecting structures and spillways to link the reservoir system. With permits, fees and engineering design figured in with a 10% contingency, the total estimated project cost would be $12,000,000.

Southwest Stanislaus County Regional Drainage Management, Marshall Drain Improvements

This project would modify the Marshall Road drain to reduce silt loading and chemicals in drainage water, while conserving water through a system to recover operational spills and tail water. A 10 to 20 acre desilting and tail water recovery reservoir would be developed next to the drain to allow water to be recycled back through the system. In Phase 2, a master plan would be developed for drainage channels in southwest Stanislaus County. Total increase in reuse would be about 20,600 AF annually.

Groundwater Banking

There is some potential for groundwater storage in the upslope areas or western portion of the west side region. Westlands, with assistance from DWR, has investigated groundwater storage potential in the Arroyo Pasajero fan, in the Cantua Creek area and other locations within the boundaries of the water district. Westlands was granted $72,000 from AB303 funds to investigate conjunctive use potential. The District has completed a Proposition 13 grant application for $9.5 Million to construct a groundwater conjunctive use project on the Arroyo Pasajero fan that has an estimated 50,000 acre-foot annual capacity.

Interconnect Mendota Pool/CCID Canal to DMC

The Outside Canal, owned by Central California Irrigation District (CCID), diverts water from the Mendota Pool on the San Joaquin River. Some of its capacity is not needed by CCID during the non-irrigation season. Pump and conveyance facilities would be developed to lift water from the Outside Canal into the DMC and water could be delivered to DMC users or San Luis Reservoir. Based on 200 cfs of new capacity, average supply is estimated to be 7,000 AF per year.

Drainage/Water Quality Strategies

Drainage on the west side of the San Joaquin Valley has been studied for decades. Enormous investments of time and money have been invested to develop theoretical drainage reduction strategies. Although many strategies are known to be effective, few projects have been implemented despite the fact that state and federal planners have recognized the need for a special drainage plan for over half a century. However, little has been done to actually implement any such plan despite a contractual obligation under the district's 1963 CVP water supply agreement.

Drainage for farmers in and adjacent to the CVP's San Luis Unit service area is critical. Present regulatory requirements for discharge from these lands to the San Joaquin River are nearly impossible to meet. Impending standards threaten to cut off current discharges to the San Joaquin River from the area. Full drainage service must be in place by 2009.

The West Side Regional Drainage Plan (Plan) is intended to 1) identify scientifically sound projects proven to be effective by local, state and federal agencies and private consultants; 2) develop an aggressive implementation plan initially utilizing existing projects documented to be environmentally sound; and 3) curtail discharges to the San Joaquin River in accordance with impending regulatory constraints while maintaining the ability to farm.

This collaborative Plan focuses on the implementation of regional drainage projects in a short timeline. Drainage Service Alternatives are identified by Reclamation in its San Luis Drain Feature Re-Evaluation (SLDFR) Plan Formulation Report, December 2002. Once these regional projects are in place, final disposal projects will be implemented. An in-valley disposal appears to be the preferred alternative when considering cost, time to implement, implementation complexity and environmental concerns. The Drainage Service Area is presented on Exhibit A. Identical to the SLDFR, components include drain water reduction measures, irrigation drainage management, drainage collection and drainage reuse. The plan coordinates all strategies to meet regulatory requirements on time while protecting the environment and sustaining agriculture.

Adaptive management and implementation of drainage projects is essential. An educated landowners' group working cooperatively with local, state and federal agencies and environmental interests is critical for the successful management of the plan. Regional knowledge and cooperation, together with state and federal resources will ensure viable projects.

Drainage on the west side must be addressed on a regional basis. However, local districts and entities within each sub-area have specific needs and resources. The plan for each sub-area must allow for implementation of efficient and effective drainage management while integrating these practices into one comprehensive program. Drainage cannot be effectively managed without equitably addressing each sub-area.

The plan's key management components are: (1) land retirement, (2) groundwater management, (3) source control, (4) regional reuse projects, (5) drain water treatment and (6) salt disposal. Each sub-area will implement a different suite of management practices coordinated to alleviate drainage impacts throughout the region. By implementing management practices in the most effective areas - past, present and future drainage impacts will be mitigated.

As a coordinated drainage program is implemented, regional interests will evaluate the long-term sustainability of the complete solution. The first phase of the plan will be to implement the projects consistent with any ultimate disposal option. The implementation schedule for Phase 1 projects provides the time needed to perfect and implement the in-valley option. If treatment proves ineffective, the plan provides for the necessary immediate drainage relief and time to implement other disposal alternatives.

Reclamation has analyzed the proposed plan to retire up to 200,000 acres of land within the Westlands Water District. The San Luis Drain Feature Re-Evaluation identifies the remaining quality and quantity of drain water disposal required. The Re-Evaluation recalculates the costs of collection, conveyance, reuse, treatment and disposal. Based on this analysis, it is estimated that the land retirement option is 33 percent less expensive than the other drainage service options.

Current Drainage Management Activities

Due to a lack of drainage service provided to the region, interests have worked together to coordinate several drainage management activities independent of the state and federal government's assistance. Significant drainage control efforts are ongoing within the Drainage Service Area, shown in Exhibit B. The efforts have been implemented to respond to the specific needs of the different sub areas. The Drainage Service Area has been subdivided into five sub-areas: 1) the San Luis unit sub-area; 2) the exchange contractors' sub-area; 3) the northern Westlands sub-area; 4) the central Westlands sub-area; and 5) the southern Westlands sub-area.

Grassland Drainage Area

The Grassland Drainage Area is comprised of the San Luis Unit and Exchange Contractors sub-areas. In 1996, the Grassland Drainage Area formed a regional drainage entity under the umbrella of the San Luis & Delta-Mendota Water Authority, to implement the Grassland Bypass Project. Participants include the Broadview Water District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, Panoche Drainage District, Widren Water District and the Camp 13 Drainage District, located in a portion of Central California Irrigation District. The area covers approximately 97,000 acres of irrigated farmland on the east side of the San Joaquin Valley. The area is highly productive, producing an estimated $113 million annually in agricultural crop market value, with an additional estimated $126 million for the local and regional economies, for a total estimated annual economic value of $239 million.

The Grassland Drainage Area farmers have implemented several activities to reduce the discharge of subsurface drainage waters to the San Joaquin River. These activities include: 1) the Grassland Bypass Project; 2) the San Joaquin River Water Quality Improvement Project; 3) formation of a regional drainage entity; 4) distributing newsletters and other farmer-oriented education series; 5) a monitoring program; 6) the use of State Revolving Fund loans for improved irrigation systems; 7) utilizing and installing drainage recycling systems to mix subsurface drainage water with irrigation supplies under strict limits; 8) tiered water pricing; and 9) tradable loads programs.

Grassland Bypass Water Quality Improvement Project

The entities within the Grasslands Drainage Area have implemented the Grassland Drainage Project. An innovative program designed to improve water quality in historic drainage channels is now used to deliver water to wetland areas. Prior to the project, subsurface drainage water was conveyed through these channels to the San Joaquin River and limited the project's ability to deliver habitat supplies. The project consolidates subsurface drainage flows on a regional basis and utilizes a portion of the federal San Luis Drain to convey the flows around the habitat areas to the San Joaquin River downstream of the Merced River confluence.

In 1988, negotiations between the San Luis & Delta-Mendota Water Authority and Reclamation resulted in the use of a portion of the San Luis Drain for the project. Stakeholders included in the process were the U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service, California Department of Fish and Game, the Central Valley Regional Water Quality Control Board, Environmental Defense, Contra Costa County and Contra Costa Water District. In late 1995, environmental documentation for the first five years of the project was completed and an agreement signed. Discharge through the project began in September 1996. In September 2001, the agreement was extended for another eight years and three months to December 2009. An Environmental Impact Report/Environmental Impact Statement (EIR/EIS) was completed and on September 7, 2001, the Central Valley Regional Water Quality Control Board issued new Waste Discharge Requirements for the project. In addition, a Biological Assessment/Biological Opinion was completed and Total Maximum Monthly Load (TMML) reports were submitted to the Regional Board and EPA. The agreement requires continued reductions in selenium discharge until ultimately TMML limits are achieved in 2005 for above normal and wet years and continued progress is made to meet water quality objectives in 2010 for below normal, dry and critical years.

The benefits of the Grassland Bypass Project are well documented. In water year 2001, drainage volume was reduced by 47 percent, selenium load was reduced 56 percent, salt load reduced by 28 percent and boron load reduced by 41 percent compared to the pre-project conditions in water year 1996. In water year 1996, prior to the Grassland Bypass Project, the mean selenium concentration in Salt Slough at Lander Avenue was 16 parts per billion (ppb). Since October 1996, the two ppb water quality objective for Salt Slough has been met in all months except for February 1998 when uncontrollable flood flows were mixed with subsurface drainage water and could not be contained within the Grassland Bypass Project. In that month, the selenium concentration in Salt Slough was four ppb. In water year 1996, the mean selenium concentration at Camp 13 Ditch was 55.9 parts per billion (ppb). In water year 1997, the first year of operation of the Grassland Bypass Project, the mean selenium concentration at Camp 13 Ditch was 2.6 ppb. This value was slightly above the wetland selenium objective of two ppb. In April 1998, specific actions were taken to eliminate any possible subsurface drainage discharges from the Grassland Drainage Area into the Camp 13 Slough and other discharge points. Since that time, there have been no discharges from the Grassland Drainage Area into wetland channels.

San Joaquin River Water Quality Improvement Project

The San Joaquin River Water Quality Improvement Project (SJRIP) is a major project undertaken by Grassland Drainage Area entities. The project, covered under the 2001 EIR/EIS, used Proposition 13 funds to purchase and improve 4,000 acres of land within the Grassland Drainage Area for the purpose of drain water treatment and disposal. The initial (phase 1) projects of the SJRIP were implemented in the winter of 2001. This phase included the planting of salt tolerant crops and construction of distribution facilities that allowed for 1,821 acres to be irrigated with drainage water and/or blended water. As a result, 1,025 pounds of selenium, 14,500 tons of salt and 62,000 pounds of boron were retained and not discharged to the Grassland Bypass Project and to the San Joaquin River. The SJRIP project is the key component for the Grassland Drainage Area to meet future selenium load limits. The project will ultimately allow for planting and irrigation of the entire 4,000 acres with drainage water. Future phases call for acquisition of additional acreage, installation of subsurface drainage systems and implementation of treatment and salt disposal components.

A component of this future phase, the Grassland Integrated Drainage Management Project, is being implemented with Proposition 13 funds. Subsurface drains are being installed in 550 acres within the SJRIP area and irrigation systems are being improved to allow drainage water to be applied to this land and associated crops.

Groundwater Management Pilot Project

In 2002, the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), in cooperation with Reclamation, implemented a pilot project to study the feasibility of using groundwater pumping to mitigate drainage impacts. The project involved pumping two wells above the Corcoran Clay but below the shallow groundwater. Although this water supply does contain elevated levels of salt, it contains no selenium. This water supply is diverted into surface supply canal and put to beneficial use on surrounding lands and refuges. In addition to the water supply being made available, the project also included monitoring of the shallow groundwater levels and discharges of nearby tile sumps. The 2002 project demonstrated significant lowering of the crop root zone water levels by pumping groundwater from within the Sierran sands located above the Corcoran Clay and below shallow selenium laden groundwater. Sierran sands reduce selenium and can eliminate the constituent from groundwater discharges. The project also showed reductions in nearby tile sump outputs.

The pilot project indicates that an expansion of the groundwater management program is a viable component of the long-term drainage plan. Extensive modeling has demonstrated significant drain water source reduction benefits from groundwater pumping. The modeling results demonstrate that a carefully crafted and implemented groundwater management program can in itself result in significant source reduction.

Key Management Practices

This plan proposes the expansion of the current drainage management practices into a comprehensive sustainable drainage program. In order to implement a sustainable drainage program, all management practices must be integrated to provide long-term salt balance in the region. While the goal of salt balance is the same for each sub-area, the most efficient suite of management practices for achieving salt balance may vary among sub-areas. Therefore, each sub-area will emphasize different management practices in their drainage program.

As practices are shown to be effective they will be expanded. The process will build upon past research and evolve into a fully developed integrated in-valley drainage control effort. The districts will implement drainage control efforts appropriate for their specific needs. The implementation of the district efforts will be coordinated with Reclamation and integrated into one comprehensive program. The key management practices are: (1) Land Retirement (2) Groundwater Management (3) Source Control (4) Regional Reuse Projects (5) Drain Water Treatment (6) Salt Disposal. These components are described in greater detail in the following sections.

Ground Water Management

Ground water management will be used to meet several goals of the drainage management program. These goals include: 1) limiting the advance of sub-surface drainage; 2) maintaining groundwater below the crop root levels; 3) mitigating the impacts from the lack of historical drainage service; 4) providing necessary interim drainage management until disposal options are developed; and 5) developing an additional water supply during the life of the project.

Studies conducted by the federal government and others have confirmed that ground water management is a suitable strategy to provide drainage within the region. The studies conclude that extraction of groundwater above the Corcoran clay will lower groundwater levels and reduce drainage water production. Using a groundwater flow model specifically designed for the region (Belitz) the United States geological survey also estimated the beneficial effects from pumping on levels and flows.

The Belitz model demonstrates significant drain water source reduction benefits from groundwater pumping. Figure 1 presents the modeled estimations of drainage discharge reduction from the exchange contractors sub-area. The modeling indicates that groundwater management is a key component of any drainage program. Groundwater pumping is also needed to manage the advance of poor quality northeast groundwater toward the City of Firebaugh and the San Joaquin River. The San Joaquin River Exchange Contractors Water Authority AB3030 groundwater monitoring effort has documented this condition and concluded that groundwater pumping is needed to manage it.

In addition, groundwater pumping is necessary in order to extract the accumulated drainage water from the shallow groundwater. The accumulation is from years of irrigation of croplands without drainage. The resulting imbalance in the water budget within the region has caused the shallow water table to rise. Surface water has been applied at rates that exceed the carrying capacity of the groundwater system resulting in increase groundwater storage in shallow zones. A groundwater-pumping program would be designed to extract the accumulation to pre-CVP levels.

The Groundwater Management Plan will develop a usable water supply during the life of the project. It has been shown that water from well below the root zone and above the Corcoran Clay, while generally high in salinity, does not contain selenium. This selenium-free water can be used to augment water supplies for regional re-use projects, wildlife habitat and traditional farming without creating problems associated with selenium-laden water.

A Groundwater Management Program is currently in the early stages of deployment through a set of studies and pilot projects focused on immediate drainage relief. Program progress is managed through a monitoring analysis and refinement system designed to maximize benefits and direct project component development. It is expected that the program will include the following steps:

1. Identify the acceptable water quality standards for the various water supply needs in the area. As an example, the Grassland Drainage Area (GDA) 4,000-acre experimental salt removal project has an additional need for water supply in the 2500 parts per million (ppm) total dissolved solids (tds) range. Additionally, an investigation is being conducted to determine whether a portion of the well water could be blended with higher quality Delta-Mendota Canal water and used within the Grassland Water District. On the basis of the required standards, identify potential production areas with acceptable groundwater quality through evaluation of existing data, pilot project data and additional samples to be collected for this purpose. The results will provide preliminary groundwater volumes and production area estimates for the future pumping strategy.

2. Modify, update and develop analytical tools. The U.S. Geological Survey groundwater-flow model is the primary tool to analyze the proposed pumping strategy. Necessary updates include a) extension of model boundaries to include all of the area, b) reevaluation of boundary conditions for potential impacts on the pumping assessment and modification as necessary, c) representation of drainage systems in greater detail, d) revise model time-steps to provide seasonal information, review and revise hydraulic conductivity data and e) revise sub-area boundaries. Portions of these work tasks are currently being accomplished and are in various stages of completion.

3. Utilize analytical tools to identify preferred production areas and develop a preliminary pumping strategy. The groundwater-flow model and an optimization program will be used to estimate the mixture of pumping volumes to optimize water quality. The groundwater-flow model will be utilized to determine pumping amounts and locations to minimize drainage water production, possible subsidence effects and maximize management of poor groundwater migration. Solute transport modeling using updated pilot project data will be used to calculate the expected operation life of the pumping strategy.

4. Design and implementation of additional field-scale pilot projects to evaluate the pumping in areas most likely to result in successful drainage and/or water level reductions and yield high quality water. Collect water level, drainage and pumping data. Measurement of pumping volumes will be critical for effective evaluation of the project. Implementation of initial field-scale pilot projects is currently under way with results from the monitoring indicating positive results towards successful drainage management.

5. Incorporate pilot projects results into the model and reevaluate pumping using the new information. Integrate pumping into the overall drainage management strategy.

6. Conduct necessary environmental and additional legal analysis.

7. Fully integrate pumping into the overall drainage management strategy; install necessary wells and integrate these existing wells into the water supply system.

Source Control

Source control is the first line of defense in the battle to control subsurface drainage. Farmers in the region have taken advantage of funding through the State Revolving Fund (SRF) and other sources to implement various irrigation improvements and enhance irrigation practices. These practices include conversion to ¼ mile furrows, sprinkler systems and drip irrigation systems. Experimentation has also proceeded with timing of pre-irrigation and shallow drainage management to reduce deep percolation. These practices and new improvements will continue to be implemented to further reduce the production of subsurface drainage water – an issue that has to be dealt with by other means. It is assumed that SRF loans or other loan/grant sources will be utilized.

In addition to on-farm measures such as improved irrigation practices, there are regional source control measures that would likely be implemented on a regional level by districts or other regional entities. Such measures include: 1) lining of surface water delivery canals to reduce seepage losses that contribute to subsurface drainage; and 2) implementation of uses of drainage water for displacement projects such as replacing fresh water dust control with permanent systems or water trucks using drainage water.

Regional Drainage Reuse

Reuse is the application of subsurface drainage water (either directly or slightly diluted) to salt tolerant crops. The purpose of reuse is to reduce the volume of the subsurface drainage water for ease in treatment. Reuse differs from recycling: whereas recycled water is minimized for maximum yield on salt sensitive crops, reuse is maximized for drainage quantity reduction. Crops used for reuse would include salt tolerant alfalfa, pasture or halophyte crops. These crops would not necessarily be grown for returns on yield but for drainage volume reduction.

Lands used for reuse would have to be managed to maintain adequate salt levels in the fields for the crops grown. This would likely require that subsurface drains be installed under the reuse fields to allow for an adequate leaching fraction to be maintained. It is assumed that approximately four acre-feet per acre could be applied on the reuse crops with a leaching fraction of approximately 27 percent or one acre foot per acre. Subsequently, there is a 73 percent reduction in volume through the reuse projects. The reuse projects are essential to any in-valley or out-of-valley long-term drainage plan.

These projects will be modeled after the San Joaquin River Water Quality Improvement Project (SJRIP) that has already been partially implemented within the Grassland Drainage Area. Within Westlands Water District, portions of the land purchased under the land retirement program, particularly those that are best suited to mitigate past and future drainage impacts, will be used to implement these regional reuse projects. The land will be used to grow salt tolerant crops to utilize water collected by shallow agricultural tile sumps as well as water generated by shallow well pumping. These projects will reuse drain water in order to reduce the volume of drain water and increase the efficiency of treatment. These types of projects have been proven effective and will be integrated into the entire regional approach to maximize drain water use and minimize drainage impacts.

Specific locations will be selected to implement large-scale reuse projects to mitigate regional drainage impacts. These sites will be selected based upon the ease of delivering drain flows to the area, the regional benefits from intercepting drain flows on the property and the availability of the property. Preliminary investigations indicate that, in addition to retired lands within Westlands, portions of Broadview Water District and areas on the northern edge of the Grassland Drainage Area are potential candidates for regional reuse projects.

These projects will reuse drain water in order to minimize flows for more efficient treatment. Drain water will be applied to salt tolerant crops such as pasture and alfalfa. These crops will be marketed, when possible, to reduce costs of the project, however, the primary factor in planting decisions will be drainage reduction not crop production. The agricultural activity will also provide jobs in the region and help maintain retired ground to avoid impacts to surrounding farmland. Subsurface tile lines will be installed on the reuse projects to collect water that percolates from the irrigation. This water will be reused, treated or placed in evaporation ponds.

Drain Water Treatment

Drain water treatment is another essential component of a regional drainage solution. Drainage collected from the regional drainage projects described above will require treatment to further reduce its volume, remove salt and allow for more cost-effective disposal of the residue. This treatment will consist of Reverse Osmosis and other membrane systems, chemical reduction systems as well as flow through wetland systems. Pilot projects exist for all of these treatment systems. The region will expand these pilot programs to find the most effective system to treat the drain water.

It is anticipated that irrigation efficiency, source control, ground water management and regional reuse projects can reduce the amount of drainage water by 82 percent. But in order to eliminate discharge to the San Joaquin River, the remaining water needs to be managed. Pilot treatment plants are being implemented within the Grassland Drainage Area. These investigations include membrane treatment for removal of salt, selenium and boron as well as flow through selenium removal systems. The membrane systems for pretreatment and salt removal are showing water recovery of up to 92 percent and salt removal of up to 98 percent. The system is also demonstrating an ability to accomplish this with reduced power requirements. These pilot projects will continue for the next five years. Selenium treatment systems are showing a high percentage of selenium removal. Investigations are continuing on the removal of selenium through cropping in reuse areas.

These treatment systems will result in improved quality water and concentrated brine. The water will be made available to augment regional water supplies. Some of this water may be of high enough quality for municipal and industrial use. This water will be marketed to help offset the costs of the treatment process. After treatment, the resulting brine solution must be disposed of or utilized.

Salt Disposal

Salt disposal is the final stage of the drainage solution. Initially, the brine solution could be stored in waste containment facilities, including evaporation ponds built on retired land. Ultimately, it may be possible to market some of this product for uses ranging from construction materials to dying textiles. An aggressive investigation into potential markets for reclaimed salts should be implemented. If successful, this investigation could result in the most economical and environmentally favored alternative for salt disposal. If a viable market for reclaimed salt is not developed then, as an alternative, salts could be collected in waste containment facilities and stored indefinitely. Evaporation ponds and solar evaporators will be used to concentrate the brine into sludge or dry crystals for ultimate utilization and disposal. Final disposal could also be made to permitted disposal sites. Recent legislation has acknowledged the need for on site disposal of salt.

While the need for ultimate salt disposal is obvious, the best method for this disposal is unclear. Any final salt disposal option must be economically viable and environmentally sound. In an effort to find the best disposal option, the parties will explore a wide variety of disposal methods. The ultimate disposal option will be selected based on economic, environmental and practical considerations. Determination of the best disposal method will require significant effort by all parties; however, the effort will result in a comprehensive drainage program.

Adaptive Management Approach

The regional drainage management plan will utilize adaptive management techniques to determine the most effective and efficient drainage solutions. Districts in the region will coordinate their activities with input from Reclamation. Each of the districts will participate in a group to manage the regional activities and document the program's progress. The members will work with Reclamation as well as other state and federal agencies to ensure the most effective program possible. This plan establishes a three-phased approach to establishing drainage service. The phased approach will allow the districts to modify their activities according to the most recent developments in drainage control.

The group will analyze specific management efforts and refine them as needed to meet the ultimate goal of sustaining agriculture while addressing regulatory issues. When particular practices are shown to be viable, they will be expanded. When the analysis indicates that other practices are deficient they will be refined or abandoned. This process will serve as a practical test of the drainage reduction concepts developed over the last several decades. Each of the districts supporting this approach has specific resources and expertise that can be used to find long-term in-valley solutions. If, after the region has made a focused effort to reduce drainage impacts through in-valley solutions, these practices do not prove to be the total drainage solution, an out-of-valley solution can be more thoroughly explored. The projects, expertise and knowledge the region develops through this process will greatly benefit regional drainage control in both the short and long term.

Appendix A - West Side Agricultural Contractor Data

A.1 West Side Agricultural Service Contractors Data

TABLE A-1
Acreage and Water Supplies for South-of-Delta Agricultural Water

Agricultural/M&I Contractors	Contract No.	2025 Acres	1999 Acres	Local Surface Supply	Ground Water	Total Project Water Quantity
Service Contractors[1]						
Banta Carbona ID	4305AIR3	15,500	14,461	29,770	230	25,000
Broadview WD	8092IR3	8,163	8,960	0	0	26,980
Centinella WD	W0055IR3	940	460			2,500
Del Puerto WD	922IR5	44,750	38,422	0	3,000	140,198
Eagle Field WD	7754IR3	777	1,242			4,560
Laguna WD	W0266IR3	400	393			800
Mercy Springs WD – partial	3365IR3A	2,223	1,580	0	0	7,040
Santa Clara Valley WD, Pajaro Valley WMA, & Westlands WD	3365IR3B	2,782	2,782	0	0	6,260
Oro Loma WD	7823IR3	767	1,003			4,600
Pacheco WD – DMC & SLU	W0469	3,768	4,070	4,400	0	10,000
Panoche WD – DMC & SLU	7864A	37,361	36,197	0	0	93,900
Plain View WD	785IR5	2,961	4,523	0	0	20,180
San Benito County WC & FCD	W0130	25,700	25,317	0	4,000	35,550
San Luis WD – DMC & SLU	7773A	41,744	42,932	0	5,000	124,500
Santa Clara Valley WD [2]	W0023	38,875	37,757	34,350	35,675	22,500
The West Side ID	W0045IR3	6,399	6,243	24,000	0	7,500
Westlands WD	495A & 106-E	606,100	545,847	0	175,000	1,143,695
West Stanislaus ID	1072IR5	25,600	26,493	45,000	5,000	50,000
Widren WD	8018IR3	835	423	0	0	2,990
Total		**865,645**	**799,105**	**137,520**	**227,905**	**1,728,753**

[1] Data from Stoddard and Associates
[2] Only 23,425 AF of groundwater and 22,271 AF of surface water is available in a Critical Dry year.

A.2 West Side Water Rights Settlement Contractors Data

TABLE A-2
Acreage and Water Supplies for South-of-Delta Agricultural Water Rights Settlement Contractors

Water Rights Settlement Contractors[1]								
Contractor	**Contract No.**	**2025 Acres**	**1999 Acres**	**Local Surface Supply (AF)**	**Ground Water (AF)**	**Project Water (AF)**	**Water Rights (non-Project) (AF)**	**Total Water (AF)**
Coelho Family Trust – Partial	7859A	2,250	1,008			2,080	1,332	3,412
Dudley & Co. (Marchini Farms)	4448A					0	2,280	2,280
Fresno Slough WD	4019A	1,215	1,027			4,000	866	4,866
Hughes MD and M	3537A					70	93	163
James ID	700A	23,000	23,665	9,700	12,000	35,300	9,700	45,000
Patterson ID	3598A1R3	13,466	14,706	23,000	2,000	16,500	6,000	22,500
Recl. District No. 1606	3802A	170	120			228	342	570
Tranquillity ID	701A	9,270	9,366	20,200	2,000	13,800	20,200	34,000
Totals		**49,371**	**49,892**	**52,900**	**16,000**	**71,978**	**40,813**	**112,791**

[1] Agricultural water rights settlement contractors having both a project and non-project supply.

A.3 West Side Crop Mix Data by District

TABLE A-3
West Side Crop Mix by District and by Sub-region, 1999 Acreage

CVP Region Contractor	**Hay and Pasture**	**Field Crops**	**Vegetables**	**Melons**	**Fruits**	**Sugar Beets or Cotton**	**Nuts**	**Sum**
San Luis Unit								
San Luis WD-DMC	2,216	5,306	5,261	4,858	3,855	12,061	9,375	42,932
Pacheco WD-DMC	279	90	1,101	1,240	0	1,360	0	4,070

TABLE A-3
West Side Crop Mix by District and by Sub-region, 1999 Acreage

CVP Region Contractor	Hay and Pasture	Field Crops	Vegetables	Melons	Fruits	Sugar Beets or Cotton	Nuts	Sum
Panoche WD-DMC	3,364	4,161	8,799	4,937	653	13,689	594	36,197
Westlands WD	15,250	91,967	158,809	17,944	17,982	210,752	33,143	545,847
San Luis Sub Total	21,109	101,524	173,970	28,979	22,490	237,862	43,112	629,046
Percent	3%	16%	28%	5%	4%	38%	7%	100%
Southern DMC								
Eagle Field WD	309	250	134	0	0	549	0	1,242
Laguna WD	76	0	0	0	0	317	0	393
Fresno Slough WD	0	688	13	0	0	326	0	1,027
Broadview WD	0	1,862	1,148	795	0	5,155	0	8,960
Widren WD	0	336	0	0	0	87	0	423
Oro Loma WD	0	839	0	0	0	164	0	1,003
Mercy Springs WD	786	374	0	0	0	420	0	1,580
James ID	131	9,329	1,481	140	382	11,433	769	23,665
Coelho Family Trust	0	0	0	0	310	698	0	1,008
Tranquillity ID	118	2,492	581	0	0	6,145	30	9,366
South DMC Sub Total	1,420	16,170	3,357	935	692	25,294	799	48,667
Percent	3%	33%	7%	2%	1%	52%	2%	100%
Northern DMC								
Banta-Carbona ID	1,953	2,969	3,669	366	1,217	302	3,985	14,461
Centinella WD	40	35	0	0	0	0	385	460
Del Puerto WD	3,526	3,754	8,855	1,380	5,398	80	15,429	38,422
Patterson WD	4,870	4,099	2,388	17	2,184	54	1,094	14,706
Plain View Water District	2,990	445	472	122	377	0	117	4,523
West Side ID	3,676	1,006	806	0	20	669	66	6,243
West Stanislaus ID	1,798	5,010	12,368	767	3,183	0	3,367	26,493
North DMC total	18,853	17,318	28,558	2,652	12,379	1,105	24,443	105,308
Percent	18%	16%	27%	3%	12%	1%	23%	100%

TABLE A-3
West Side Crop Mix by District and by Sub-region, 1999 Acreage

CVP Region / Contractor	Hay and Pasture	Field Crops	Vegetables	Melons	Fruits	Sugar Beets or Cotton	Nuts	Sum
San Felipe Unit								
Santa Clara Valley WD	8,100	453	12,052	0	4,639	0	525	25,769
San Benito County WD	0	0	0	0	0	0	0	25,317
San Felipe Sub Total (SCVWD Only)	8,100	453	12,052	0	4,639	0	525	25,769
Percent	31%	2%	47%	0%	18%	0%	2%	100%
Grand Total	49,482	135,465	217,937	32,566	40,200	264,261	68,879	808,790
Percent	6%	17%	27%	4%	5%	33%	9%	100%

Note: The acreage total in Tables A-1 and A-2 for 1999 (799,105 + 48,892 = 848,997), is used to calculate the agricultural potential water use shown in Table 3-2. The acreage in A-3 is 808,790 and does not include 25,317 acres (San Benito County WD), 120 acres (Reclamation District 1606), 11,988 acres (additional Santa Clara Valley WD acres) and 2,782 acres (Santa Clara Valley WD/Pajaro Valley WMA/Westlands WD). These acreages are not included in Table A-3 because crop mix data was not available. 808,790 + 25,317 + 120 + 11,988 + 2,782 = 848,997 acres total in the analysis.