Demand Management
(including Irrigated Agricultural and Urban Demand)

Technical Appendix #3
to the
~~Administrative~~ Final
Least-Cost CVP Yield Increase Plan

U.S. Department of the Interior
Bureau of Reclamation, Mid-Pacific Region
Fish and Wildlife Service

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Acknowledgment

The purpose of this report is to relate the data sources, assumptions, methods, and results of the demand management study. The results presented herein are based on information from several sources including published studies and research and the results of other projects.

By far the most widely used data source for this study has been the California Water Plan Update, Draft Bulletin 160-93 (DWR, 1993) and its backup information. The information found in this document and its supporting files is an invaluable resource to the State of California.

Much of the data used in these analyses is of a more specific nature than can be found in Bulletin 160-93. The staff of the DWR's State office and Northern, Central, San Joaquin, and Southern District Offices have demonstrated a high degree of cooperation and professional courtesy by supplying requested information in a timely manner. This quality of interaction sets the stage for future successful ventures.

The authors of this report wish to extend our gratitude to our colleagues at DWR. Thank you.

Executive Summary

Agricultural Demand Management

The potential to reduce existing agricultural water demands to develop water supplies for other uses was assessed by estimating the demand that would exist under various structural and nonstructural demand management options. That analysis was conducted for 32 geographic regions of the State that were recognized by the California Department of Water Resources (DWR) for water supply planning (Figure ES-1A).

The framework for the analysis is represented by a matrix that associates various demand management options with specific elements of demand (Figure ES-1). Demand elements included consumptive use (evapotranspiration of applied water); conveyance losses (onfarm evaporation and conveyance consumption); and associated losses (deep percolation and on-farm ditch seepage, uncollected on-farm tailwater, conveyance seepage, canal spillage, and gate leakage). Associated losses were separated into their recoverable and irretrievable components based on flows to salt sinks reported by DWR.

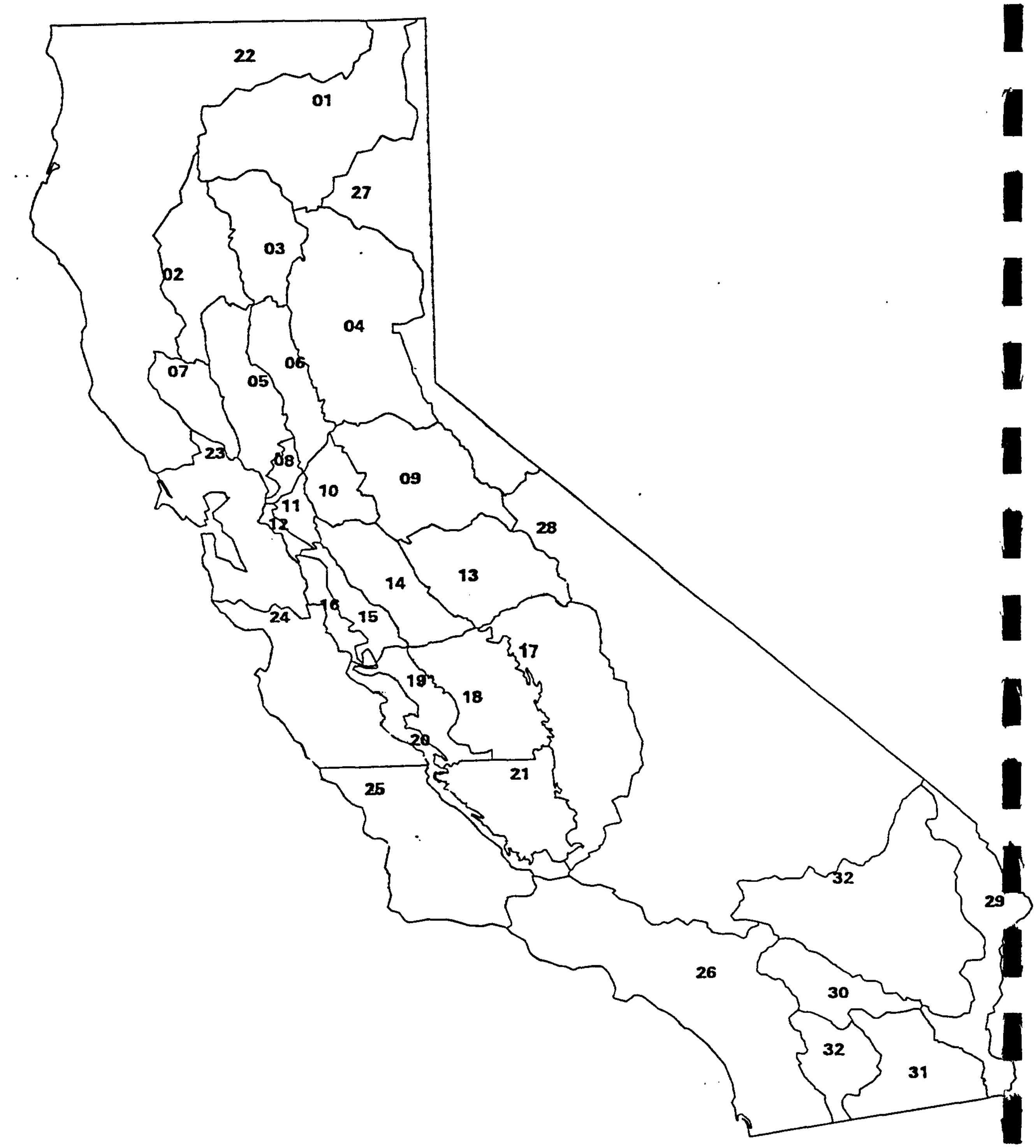
Options considered included those that target on-farm elements (modified cropping, improved irrigation performance, and drainwater reclamation) and district elements (canal lining and piping, spill reduction, and non-leak gates). These options represent combinations of management practices (both conventional and emerging).

Demand management potentials were computed by comparing the magnitudes of the existing demand elements to the magnitudes of demand elements that would exist under maximum employment of options. Data sources for the analyses included the use of 1990 normalized crop data as well as other data from the DWR Draft California Water Plan (Bulletin 160-93) and supporting information. Several inference relationships, and assumptions were also used.

The potential to reduce conveyance losses and irretrievable losses of principal importance to this study because such reduction would actually produce water for commitment to other uses. In contrast, reduction of recoverable losses would deplete supplies currently used by or available to downstream uses; therefore recoverable losses are considered ineligible as yield increase options.

The results of the analysis are summarized in Figure ES-2, which show the distribution of eligible and ineligible losses across five broad regional categories. This illustrates that the sum of irretrievable and conveyance losses is relatively small. Statewide, the potential to reduce conveyance and irretrievable losses is 2.9 million acre-feet.

A sensitivity analysis showed that the results are highly sensitive to several assumptions used in the analysis, indicating the need for careful use of the results and more detailed study.



Features:

Reporting Region boundry

14 Reporting Region number

Scale 1:5500000

Figure ES-1A.

Agricultural Demand Management Reporting Regions

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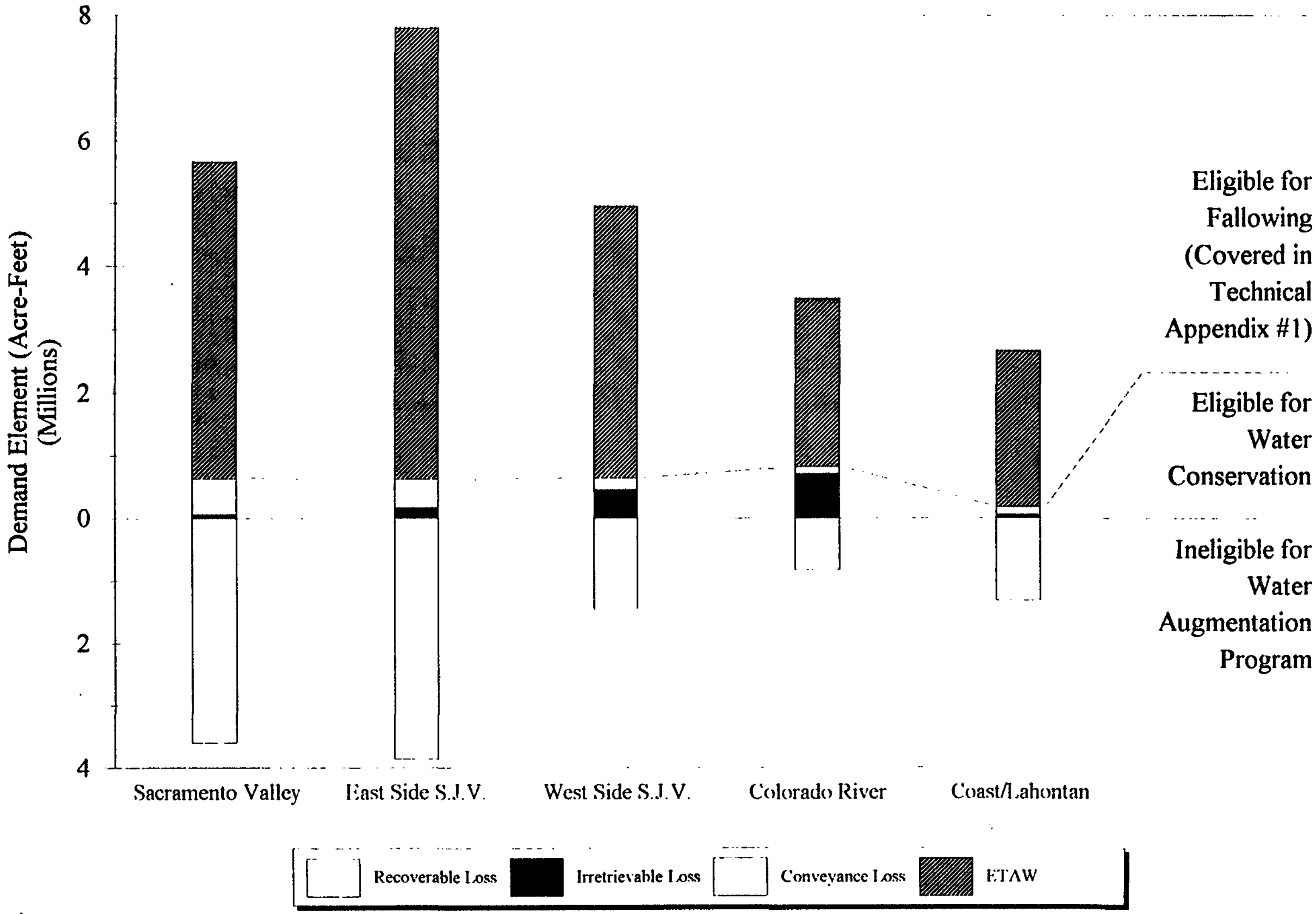
Figure ES-1

Demand Management Elements and Options

	Demand Option						
	Targeting On-Farm Elements			Targeting District Elements			
	Consumptive Use Reduction	Conservation and Reuse of Losses		Conservation of Losses			
Demand Element	Modified Cropping	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining and Piping	Spill Reduction	Non-Leak Gates	Riparian Vegetation Removal
Conveyance Loss of Applied Water							
On-Farm Evaporation	x	x					
Conveyance Consumption	x			x			x
Associated Losses of Applied Water							
On-Farm Tailwater	x	x	x				
On-Farm Deep Percolation and Seepage	x	x	x				
Conveyance Seepage	x		x	x			
Canal Spillage	x	x	x		x		
Gate Leakage	x		x			x	
Typical Implementation Level							
On-Farm	x	x					
District	x	x	x	x	x	x	x

Figure ES-2
Demand Elements Eligible for Water Augmentation Program



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Urban Demand Management

Urban water conservation programs effectively reduce both short- and long-term water demands in many urban areas throughout the State. These demands consist of five sectors: residential, commercial, governmental, industrial, and miscellaneous. Current use for these sectors averages 7.7 million acre-feet annually (1990) with estimates of over 11 million acre-feet by the year 2010, assuming no implementation of post-1990 conservation measures.

Based on these assumptions, 1.8 million acre-feet of water is potential saved annually because of projected urban water conservation measures. This is about a 16 percent reduction in the 2010 urban demands without post-1990 conservation measures. This estimate does not, however, include a cost/benefit analysis and may decrease when cost is included. Almost 80 percent of the savings results from water savings in the residential sector alone. This conserved water, however, only extends the secured supplies of the urban sectors and may not necessarily be available for other needs. For example, the nonconserving volume determined for 2010 could extend the conserved supply such to meet demands in 2020.

A more detailed analysis of conservation potential was completed for the Sacramento River, San Joaquin River, and Tulare Lake Hydrologic Regions (HR) that make up the Central Valley. This analysis identified more urbanized parts of the valley that may provide water from urban water conservation savings to possibly meet local, in-basin demands. Results appear in Table ES-1.

Table ES-1
2010 Calculated Water Conservation Savings for
Central Valley by Planning Study Area

Planning Study Areas	Residential Indoor (1000 af)	Residential Outdoor (1000 af)	Commercial (1000 af)	Governmental (1000 af)	Industrial (1000 af)	Miscellaneous (1000 af)	Total (1000 af)
SACRAMENTO RIVER REGION							
Shasta-Pit	1.0	0.1	0.1	0.1	0.3	0.1	**1.7**
Northwest Valley	4.2	2.5	0.4	0.5	1.7	0.7	**10.0**
Northeast Valley	5.9	1.6	0.5	0.6	2.1	0.8	**11.5**
Southeast	5.6	6.3	0.7	0.8	2.8	1.1	**17.3**
Central Basin West	5.7	5.3	0.7	0.8	2.7	1.0	**16.2**
Central Basin East	32.2	37.8	4.2	4.6	16.3	6.3	**101.4**
Southwest	0.8	0.7	0.1	0.0	0.3	0.1	**2.0**
Delta Service Area	1.3	3.1	0.2	0.3	0.9	0.3	**6.1**
Total	**56.7**	**57.4**	**6.9**	**7.7**	**27.1**	**10.4**	**166.2**
SAN JOAQUIN RIVER REGION							
Sierra Foothills	5.3	0.6	0.2	0.4	2.2	0.4	**9.1**
Eastern Valley Floor	6.7	4.0	0.3	0.5	3.5	0.7	**15.7**
Delta Service Area	4.8	1.3	0.2	0.3	2.2	0.4	**9.2**
Western Uplands	4.3	4.8	0.2	0.4	2.7	0.5	**12.9**
East Side Uplands	0.9	0.8	0.0	0.1	0.5	0.1	**2.4**
Valley East Side	24.7	29.0	1.2	2.4	15.7	3.1	**76.1**
Valley West Side	1.6	1.3	0.1	0.1	0.9	0.2	**4.2**
West Side Uplands	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**48.3**	**41.8**	**2.2**	**4.2**	**27.7**	**5.4**	**129.6**
TULARE LAKE REGION							
Uplands	1.9	0.2	0.1	0.1	0.8	0.2	**3.3**
Kings-Kaweah-Tule	33.7	20.2	1.4	2.7	17.5	3.4	**78.9**
San Luis West Side	1.0	0.3	0.0	0.1	0.5	0.1	**2.0**
Western Uplands	0.2	0.2	0.0	0.0	0.1	0.0	**0.5**
Kern Valley Floor	16.5	15.5	0.8	1.5	9.7	1.9	**45.9**
Total	**53.3**	**36.4**	**2.3**	**4.4**	**28.6**	**5.6**	**130.6**

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Section 1

The *Least-Cost CVP Yield Increase Plan* is a report to Congress describing possible actions to increase the yield of the Central Valley Project (CVP). The CVP is the largest water storage and delivery system in California.

Title 34 of Public Law 102-575 --"The Central Valley Project Improvement Act" (CVPIA)-- dedicates 800,000 acre feet annually of CVP yield for fish, wildlife, and habitat restoration purposes. This yield was previously available to CVP contractors and these contractors may be adversely affected by its reallocation. In order to minimize adverse effects, if any, upon CVP contractors CVPIA required preparation of a *Least-Cost CVP Yield Increase Plan*

The *Least-Cost CVP Yield Increase Plan* was developed with consideration of all reasonable options, including supply increase and demand reduction. In addition the perspectives and viewpoints of various individuals and agencies affected by CVPIA were incorporated into the planning process.

Hundreds of yield increase options were identified within the general categories of land fallowing, conservation, modified operations, conjunctive use, water reuse, surface storage and conveyance, and other supply options. These options were characterized with regard to their annual cost, yield, environmental effects, social effects, time required for implementation, and associated institutional issues.

The identification process and characterization of yield increase options presented and discussed in the *Least-Cost CVP Yield Increase Plan* as well as investigation of social and environmental effects are detailed in a series of technical appendices. The following draft technical appendices have been prepared:

Title	Appendix No.
- Economic Models	1
- Modified Operations	2
- Demand Management	3
- Conjunctive Use	4
- Urban Wastewater Reuse	5
- Surface Storage and Conveyance	6
- Weather Modification, Snowpack Management, Desalination and Water Importation	7
- Basin Models for Yield Increase Analysis	8
- Environmental Effects of Yield Increase Options	9
- Socioeconomic Effects	10

The purpose of this technical appendix is to present the methodology for identification and characterization of demand management options.

Section 2

Introduction

This appendix documents the approach to the task of identifying potential areas where, through the use of demand management, water savings can be obtained and thus allow water to become available for other needs. Demand management, as used within this report, refers to the implementation of structural and non-structural measures to potentially reduce demands.

Demand management options include those that reduce the demand on water supplies by reducing or reclaiming water losses through such actions as urban and agricultural conservation, and agricultural drainage reclamation. For purposes of this report, urban and agricultural demand management opportunities are addressed separately. Options identified are described in terms of their physical components and the potential quantity of water obtainable through implementation.

During this identification and quantification process, benefits or impacts related to environmental and social aspects of a particular option are not considered. This phase stresses identifying augmentation water, through demand management, that may be obtained from willing sellers (no determination of willingness has been made, however).

2.1 - Data Sources

Estimates of potential quantities associated with demand management activities are based upon extrapolation of data used in the development of the California Department of Water Resources' Draft California Water Plan (Bulletin 160-93). Estimates for agricultural water management options are based on projected savings in conveyance loss (i.e., water lost in delivery by natural processes) and irretrievable losses associated with the delivery and application of water (i.e., water that flows to degraded bodies of water). Estimates of urban conservation are based on projected decreases in per capita water use.

2.2 - Study Area

Assuming that economics is not a factor in the feasibility of a particular option, as used during the identification portion of this category, the study area is theoretically unbounded. However, practicality limits the size and extent of the study area to the state of California. Within the State, there are approximately 8 million acres of irrigated farmland and 30 million people. All water for urban and agricultural uses within the State originates within its boundaries except for that imported from the Colorado River and a small percentage from the Klamath River (originating in Oregon). Figure 2-1 shows the study area along with hydraulic linkages among various streams and service areas.

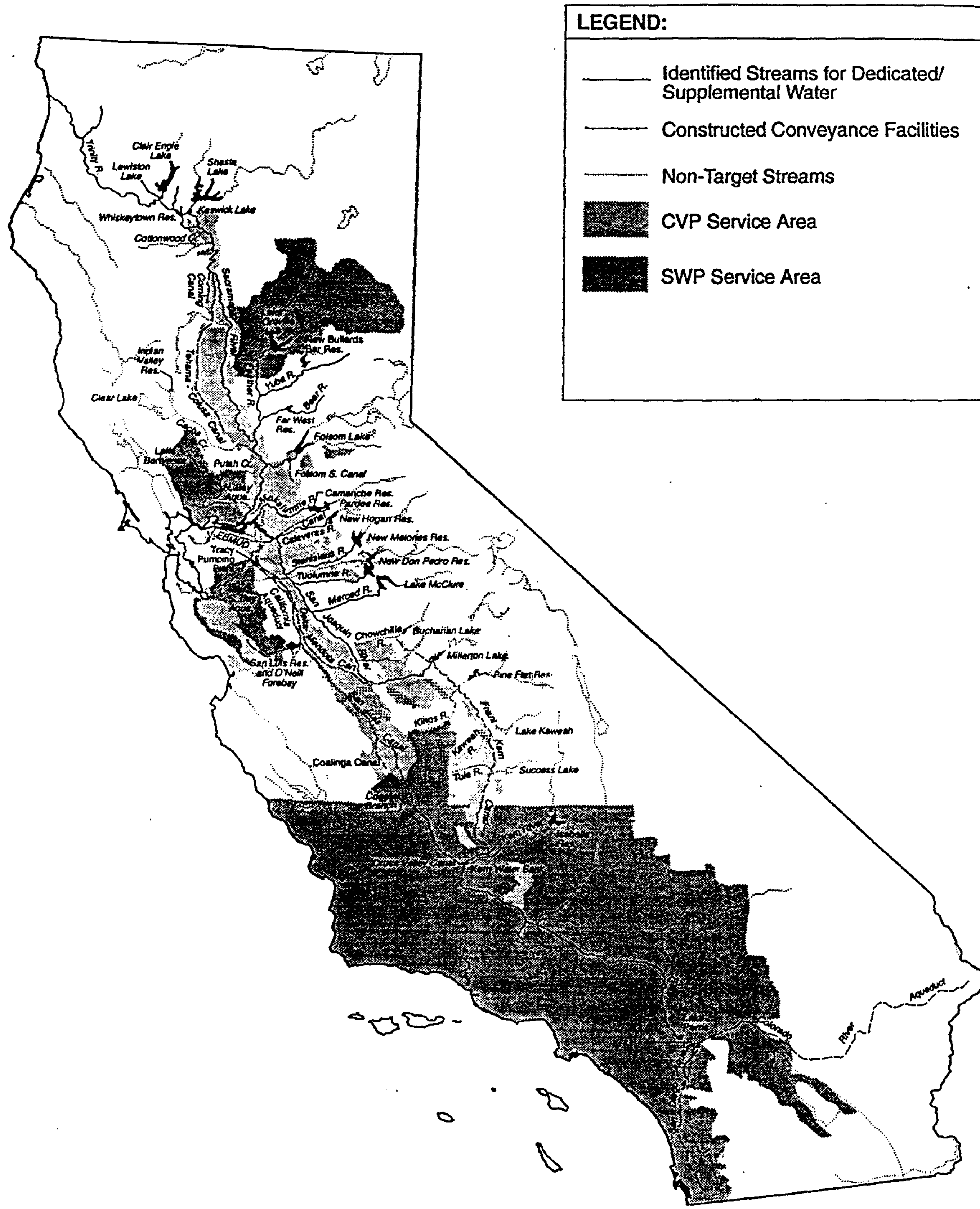

Figure 2-1 Study Area Criterion 1

Section 3

Agricultural Demand Management

The potential may exist to develop transferable water supplies through management of agricultural irrigation demands. Irrigation demand elements include consumptive use of applied water and losses. Terms used to describe the use of water and losses incurred during delivery and application of water to agriculture are defined in the following manner:

Consumptive use of applied water is water that is water that is consumed during agricultural, municipal, and industrial activities.

Conveyance loss is water that is lost during storage and delivery by natural processes (i.e., reservoir and conveyance evaporation and stream/canal riparian vegetation consumption). Seepage associated with the conveyance has been excluded from this term and is instead included as part of the losses described below.

Associated loss is water that is lost as the result of inefficiencies in delivery and application that is not part of the aforementioned "conveyance loss" (i.e., deep percolation and surface runoff of applied water, conveyance system seepage, canal spillage, and gate leakage). There are two subsets of these associated losses:

Recoverable loss is water that returns to the hydrologic system in a useable form. This water may return to supply sources by percolating deep into the soil to recharge groundwater basins or by running off into rivers and streams; or it may be used after its initial application by an immediate downstream user or to sustain a downstream habitat.

Irretrievable loss is water that becomes unusable. Examples include percolation or surface runoff to poor-quality perched groundwater, salt sinks, or water that is high in undesirable constituents. It is currently infeasible or to costly to recover this water for use.

3.1 - Characteristics of Demand

A wide array of structural and non-structural management practices exist that have the potential to reduce these irrigation demand components. These practices can be grouped into demand options that can then be aligned with demand elements to facilitate analysis of potential savings. Figure 3-1 provides a detailed breakdown of these elements and aligns them with demand management options.

Figure 3-1

Demand Management Elements and Options

Demand Element	Demand Option						
	Targeting On-Farm Elements			Targeting District Elements			
	Consumptive Use Reduction	Conservation and Reuse of Losses		Conservation of Losses			
	Modified Cropping	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining and Piping	Spill Reduction	Non-Leak Gates	Riparian Vegetation Removal
Conveyance Loss of Applied Water							
On-Farm Evaporation	x	x					
Conveyance Consumption	x			x			x
Associated Losses of Applied Water							
On-Farm Tailwater	x	x	x				
On-Farm Deep Percolation and Seepage	x	x	x				
Conveyance Seepage	x		x	x			
Canal Spillage	x	x	x		x		
Gate Leakage	x		x			x	
Typical Implementation Level							
On-Farm	x	x					
District	x	x	x	x	x	x	x

3.1.1 - Demand Elements

Demand elements are destinations of agricultural water. Consumptive use and conveyance loss elements represent water that vaporizes and re-enters the hydrologic cycle. Associated loss elements generally flow to surface or groundwater bodies.

Evapotranspiration of Applied Water. Consumptive use of applied water, or evapotranspiration (ET), is the combined processes by which water is transferred from the earth's surface to the atmosphere, including evaporation of liquid water from soil and plant surfaces plus transpiration of liquid water through plant tissues. Evapotranspiration of Applied Water (ETAW) represents the portion of ET that is supplied through irrigation and does not include that supplied by precipitation, shallow groundwater, or other sources.

Conveyance Losses. On-farm evaporation and conveyance consumption are considered conveyance loss elements. On-farm evaporation includes those evaporation losses that occur on the field that are not part of ET such as evaporation from head ditches, reservoirs, and other on-farm water bodies. Conveyance consumption represents consumptive uses of water along supply channels and reservoirs including evaporation from water surfaces and ET of riparian and bank vegetation. (Seepage has been included under *associated losses*)

Associated Losses of Applied Water. Demand elements that flow to surface or groundwater bodies include the following:

- On-farm tailwater
- On-farm deep percolation and ditch seepage
- Conveyance seepage
- Canal spillage
- Gate leakage

On-farm tailwater is uncollected irrigation runoff that leaves the farm as surface water and can flow to either surface or groundwater bodies.

Deep percolation includes two components: the portion resulting from non-uniformity of irrigation and the portion resulting from leaching requirements (LR) for maintaining soil productivity. On-farm and ditch seepage includes seepage from head ditches, reservoirs, and other on-farm structures. These losses flow directly to groundwater bodies.

Conveyance seepage originates from water supplier channels and reservoirs whose seepage flows directly to groundwater bodies. Canal spillage includes discharges from district wasteways and channel end points and can flow to either surface or groundwater bodies.

Gate leakage is water that leaks through the last gate or check structure of a water supply channel. The location of the last gate can vary along a channel with daily demands. Gate leakage is typically small and, as such, usually seeps through channel bottoms and into groundwater bodies.

3.1.2 - Demand Management Options

The number of agricultural demand management options is practically unlimited because of the wide variability in how farms and water purveyors use different irrigation systems, conservation measures, and management practices. Rather than attempt to list all such practices individually, options were identified that combine groups of practices. These options were chosen to allow the future selection of individual practices. Grouping individual practices is also logical because many of them are linked and are commonly used together.

Although some options affect many elements, each option targets either on-farm or district elements. Some options that target on-farm elements could be implemented at the on-farm level by the grower or through district participation or both. All options that target district elements would likely be implemented at the district level (Figure 3-1).

In developing these options, individual practices were reviewed as discussed within PL 102-575 (the CVPIA), USBR Water Conservation Guidelines, DWR Bulletin 160-93, AB 3616 materials, and various other sources.

Improved Irrigation Performance. Practices that can potentially reduce on-farm irrigation losses are grouped into the improved irrigation performance option. These practices include, but are not limited to:

- Irrigation management improvements
- Irrigation system selection
- Irrigation delivery flexibility
- On-farm ditch lining and piping
- Farm delivery measurement and reporting

Irrigation management improvements include using irrigation scheduling, improved irrigation system maintenance, and educating irrigators. Irrigation scheduling avoids overirrigation by more closely matching irrigation frequency to crop demand or soil moisture depletion. System maintenance can also reduce losses. For example, replacing mismatched or worn sprinkler nozzles could improve uniformity. Other improvements can best be realized by educating irrigators on the importance of water management. For example, using surge irrigation often requires training irrigators to operate specific equipment.

Irrigation system selection includes switching to more uniform irrigation methods or better performing hardware. For example, switching from furrows on undulating terrain to drip could improve irrigation uniformity.

Delivery flexibility by districts increases the ability to deliver water to growers at a frequency, rate, and duration that allows use by growers of improved management and methods. Practices that can improve flexibility include improved canal control structures (including automation), enlarged channels, constructing lateral interceptors and regulating reservoirs, and improved delivery system maintenance.

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Measuring water deliveries to farms can help improve irrigation performance by providing management information to growers. This information can help growers to evaluate their irrigations and to facilitate irrigation scheduling. Also, measurement is a prerequisite for implementing water pricing programs aimed at creating incentives to conserve irrigation losses. Information on water delivery quantities can also help increase awareness of conservation issues and encourage a conservation ethic among growers.

The aim of these practices from a demand management perspective is to reduce applied water by improving uniformity, timing, or conveyance. Many of these practices are interdependent. For example, irrigation scheduling cannot be used effectively with an inflexible delivery system. This option is further complicated because practices can be implemented at different levels. Some practices (such as irrigation system and management improvements) would be implemented on farm while most flexibility practices would be implemented at the district level.

Drainwater Reclamation. Subsurface drainwater could be reclaimed primarily in areas with perched saline water tables such as those present on the west side of the San Joaquin Valley. Reclamation practices could include reverse osmosis, distillation, or other energy- and technology-intensive procedures. Although primarily targeting on-farm losses, this option would probably be implemented at the district or other more regional level.

Canal and Reservoir Lining and Piping. Canal and reservoir seepage and consumptive use by riparian vegetation could be reduced by lining these facilities with concrete or other impermeable material or by replacing them with pipes.

Spillage Reduction. Operational spills could be reduced by many of the practices that affect delivery flexibility such as improved canal control structures (including automation), enlarged channels, constructing lateral interceptors and regulating reservoirs, and improved delivery system management.

Non-Leak Gates. Non-leak gates close completely and, thus, reduce or eliminate leakage of terminus canal check structures. Non-leak gates can be installed within some types of existing check structures.

Riparian Vegetation Removal. Consumptive use by riparian vegetation from streams and other delivery channels that occurs during conveyance (conveyance consumption) can be reduced by removing the existing riparian vegetation (e.g., trees, shrubs, willows).

3.2 - Determining Option Potential

The potential of each demand management option is equal to its capability to reduce applied water demand by reducing water losses.

The primary data source used in computing demand management potentials was Draft Bulletin 160-93 and its supporting documentation (DWR, 1993). Crop water use data were based on DWR's normalized 1990 conditions. This source provides complete and consistent coverage of California with respect to groundwater and surface water supplies, applied water (AW), and ETAW (Figure 3-2).

Inference relationships and assumptions were used in most cases to separate Bulletin 160 data into unique demand elements necessary for this analysis (Figure 3-2). An inference model uses relationships between known parameters to extrapolate other data. For example, on-farm losses (evaporation, deep percolation, and tailwater) for all of California were inferred from on-farm loss relationships that have previously been developed for the west side of the San Joaquin Valley.

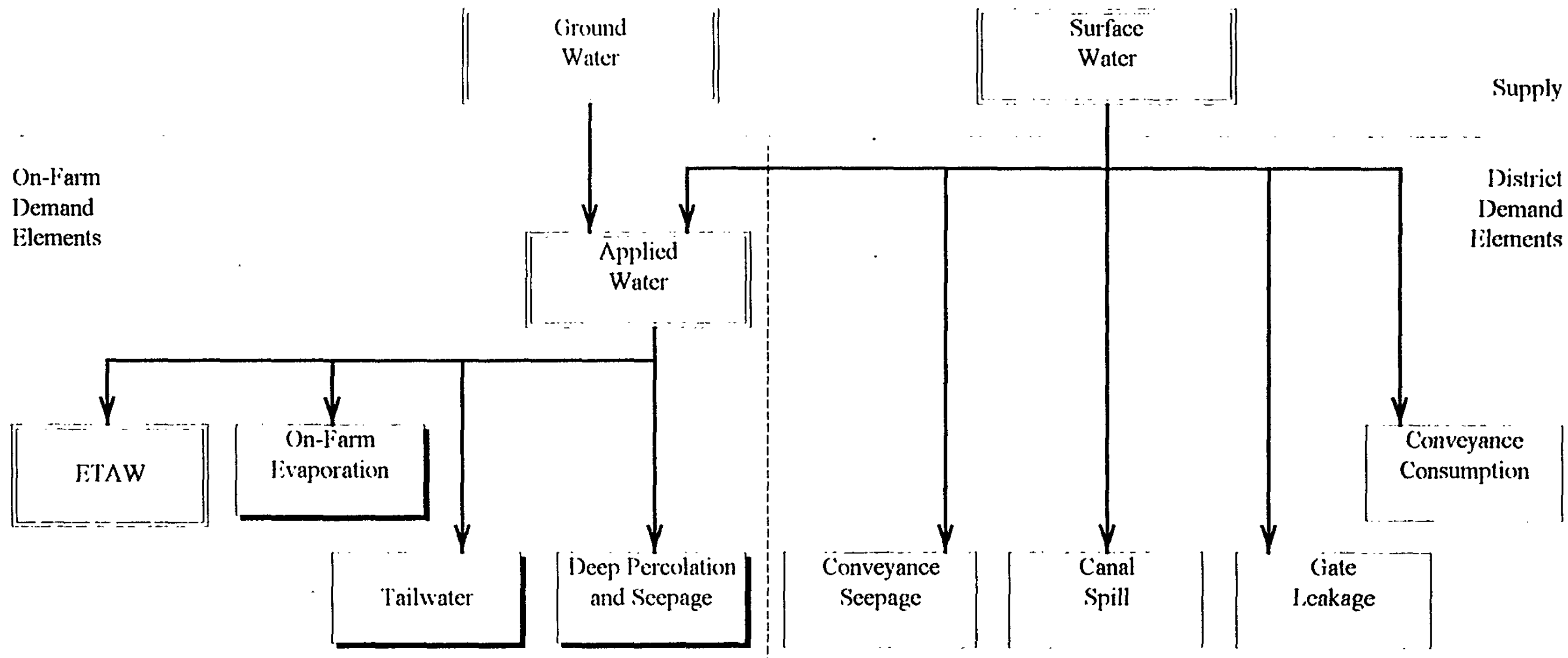
Assumptions were used where insufficient information was available to create reliable inference. For example, limited information was available on district demand elements (conveyance consumption and seepage, canal spill, and gate leakage). These elements were quantified by assuming that they were proportional to surface water supply values.

3.2.1 - Recoverability And Eligibility Of Demand Elements

With the exception of a negligible amount of water required for plant metabolic processes (about 1 percent of the water taken up by plants), agricultural AW can be accounted for by the demand elements presented in Figure 3-2. The "consumptive" elements (ETAW, on-farm evaporation, and conveyance consumption) are lost to the atmosphere and can only be recovered through the hydrologic process. Thus, these elements are not considered humanly recoverable.

The associated loss elements (tailwater, deep percolation, conveyance seepage, canal spill, and gate leakage) flow to either surface or groundwater bodies and may be recoverable. In theory, all associated losses are recoverable for beneficial uses. In practice, however, losses that flow to very deep aquifers or excessively degraded water bodies may not be recoverable because of prohibitively expensive energy requirements. Determining recoverability varies with location and time and other factors.

DWR's estimates of irretrievable losses presented in Bulletin 160-93 was used for this analysis. DWR's determinations are based exclusively on water quality considerations, which assumes that all losses flowing to usable water bodies can be economically recovered. Principal water bodies that DWR generally regards as irretrievable include saline, perched groundwater underlying irrigated land on the west side of the San Joaquin Valley, the Salton Sea, which receives drainage from the Coachella and Imperial Valleys, and the ocean.



Key (Primary Data Source)

DWR (B-160) | Inference | Assumption

Figure 3-2

Demand Element Data Sources

Since irrigation demand consists of consumptive use and associated losses, the following formula can be used.

$$\text{Demand} = \text{ETAW} + L_C + L_{NC}$$

where:

ETAW = consumptive use
L_C = conveyance losses
L_{NC} = associated losses

In addition, associated losses (L_{NC}) can be separated into recoverable and irretrievable potions as follows:

$$L_{NC} = L_I + L_R$$

where

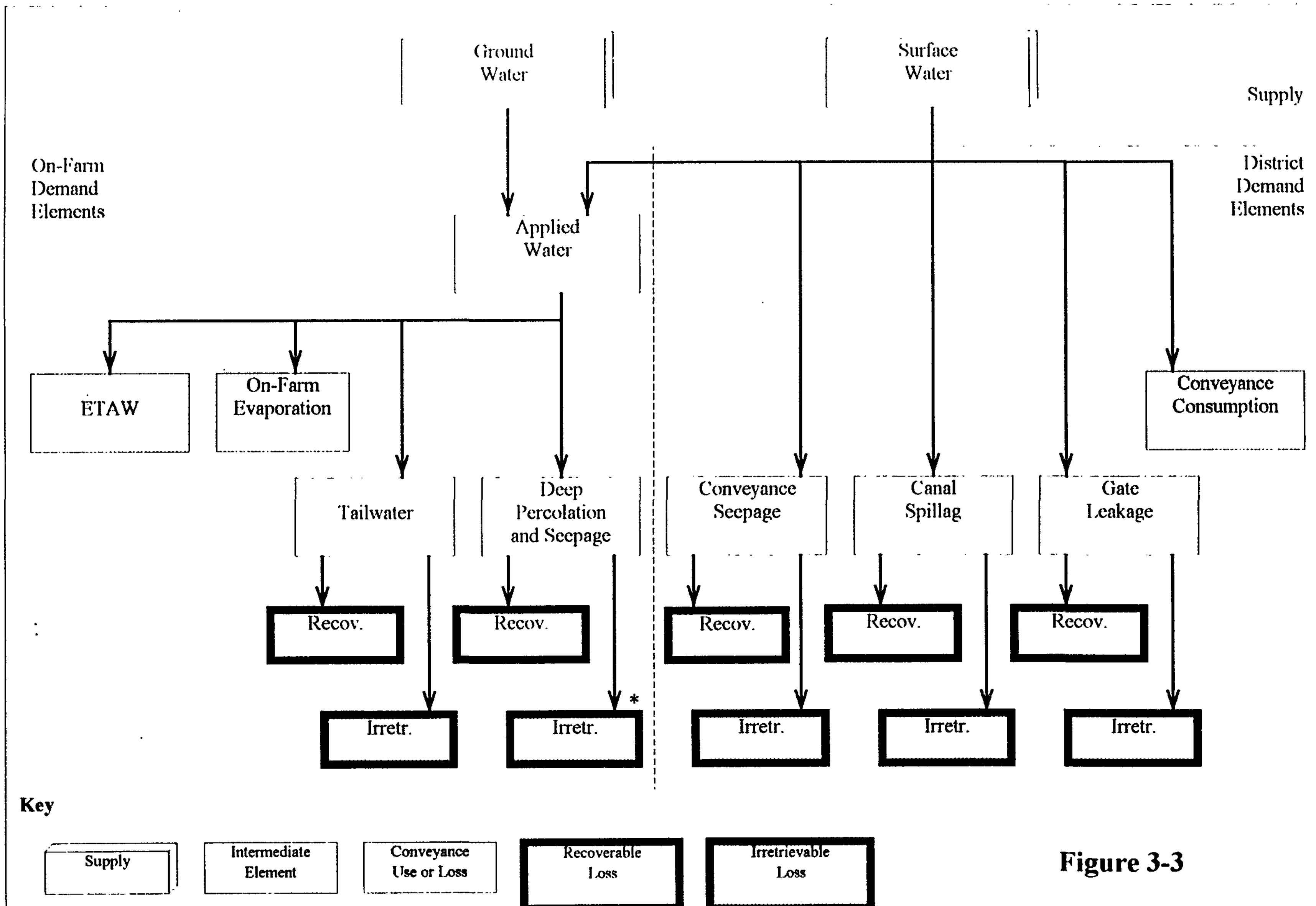
L_I = irretrievable losses
L_R = recoverable losses

Figure 3-3 illustrates demand element destinations.

Demand elements having yield increase potential include conveyance losses and irretrievable losses because they are truly lost (from the current hydrologic cycle), and yield is conserved when these losses are reduced. Recoverable losses, on the other hand, constitute useable supplies to the downstream users. To reduce these losses would deplete such supplies with no net gain in the total water supply (Table 3-1).

The portion of deep percolation that is required for leaching salts requires special consideration. By definition, the leaching requirement (LR) contains salts that have been concentrated to levels at the threshold of causing yield reductions. Thus, this quantity of water is considered degraded and irretrievable. The LR can be conserved only through cessation of irrigation (that is, land fallowing) or drainwater reclamation, however, because leaching is required for sustained crop production. It cannot be reduced through improved irrigation performance.

Recoverable losses are not considered to have yield increase potential because their conservation does not expand the total water supply. Conserving recoverable losses may provide other energy- or water quality-related benefits, however. This is because recoverable losses may be degraded (by picking up leached salts, nutrients, or other chemicals) or lose potential energy (by flowing downward to the water table).



* Irrecoverable portion of deep percolation includes leaching requirement

Figure 3-3

Demand Element Destinations

Table 3-1 Characteristics of Agricultural Demand Elements			
Demand Element	**Definition**	**Geographic Applicability**	**Other Restrictions**
L_C	Conveyance loss of applied irrigation water to canal, ditch, and tailwater reservoir evaporation, bank vegetation use and spray losses.	Throughout study area	None
L_I	Irretrievable loss of applied irrigation water either flowing to degraded water bodies or being discharged at levels unusable for irrigation.	Applicable only where losses flow into unusable water body such as the Ocean, the Salton Sea, or degraded groundwater and cannot economically be recovered for reuse.	When deep percolation is targeted for conservation, only the portion in excess of the leaching requirement is eligible. However, the portion required for leaching can be eligible for transfer through reduction of consumptive use.
L_R	Recoverable loss of applied irrigation water to useable water bodies.	Throughout study area	Reduction of such losses does not expand available water supply, but may provide dry year, energy, and water quality benefits.

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It has been argued that some uses of recoverable losses are not consistent with existing water rights and conservation would produce yield. While this may be true, it is clearly not within the scope of this effort to make such a determination. However, they are computed and presented here for those who may be interested in these or other issues.

3.2.2 - Reporting Regions

For these analyses, California was divided into 32 reporting regions based on groups of DWR's Planning Subareas (PSA) and Hydrologic Regions (HR) (Figure 3-4). In areas with significant irrigated agriculture (such as the San Joaquin Valley), the smaller PSAs were used. Conversely, in areas with little irrigation (such as east of the Sierra), the larger HRs were used (Table 3-2). Maintaining a resolution consistent with DWR allowed use of Bulletin 160 and its supporting data.

3.2.3 - Quantifying On-farm Demand Elements

Values of AW and ETAW were extracted from Bulletin 160-93, from which total on-farm losses were computed for each region as follows:

Sum of on-farm losses = AW-ETAW

It was necessary to divide on-farm losses into evaporation, tailwater, and deep percolation elements. To accomplish this, an inference relationship was developed using irrigation performance fractions that were developed for various irrigation methods and management levels in the San Joaquin valley (Going, et al, 1990, Young and Hatchett, 1994).

On-Farm Evaporation. Weighted average values of the evaporation fraction (el) were computed for each region using an assumed typical distribution of irrigation methods and management levels by crop and the cropping patterns from Bulletin 160-93.

On-farm evaporation was computed for each region and crop as follows:

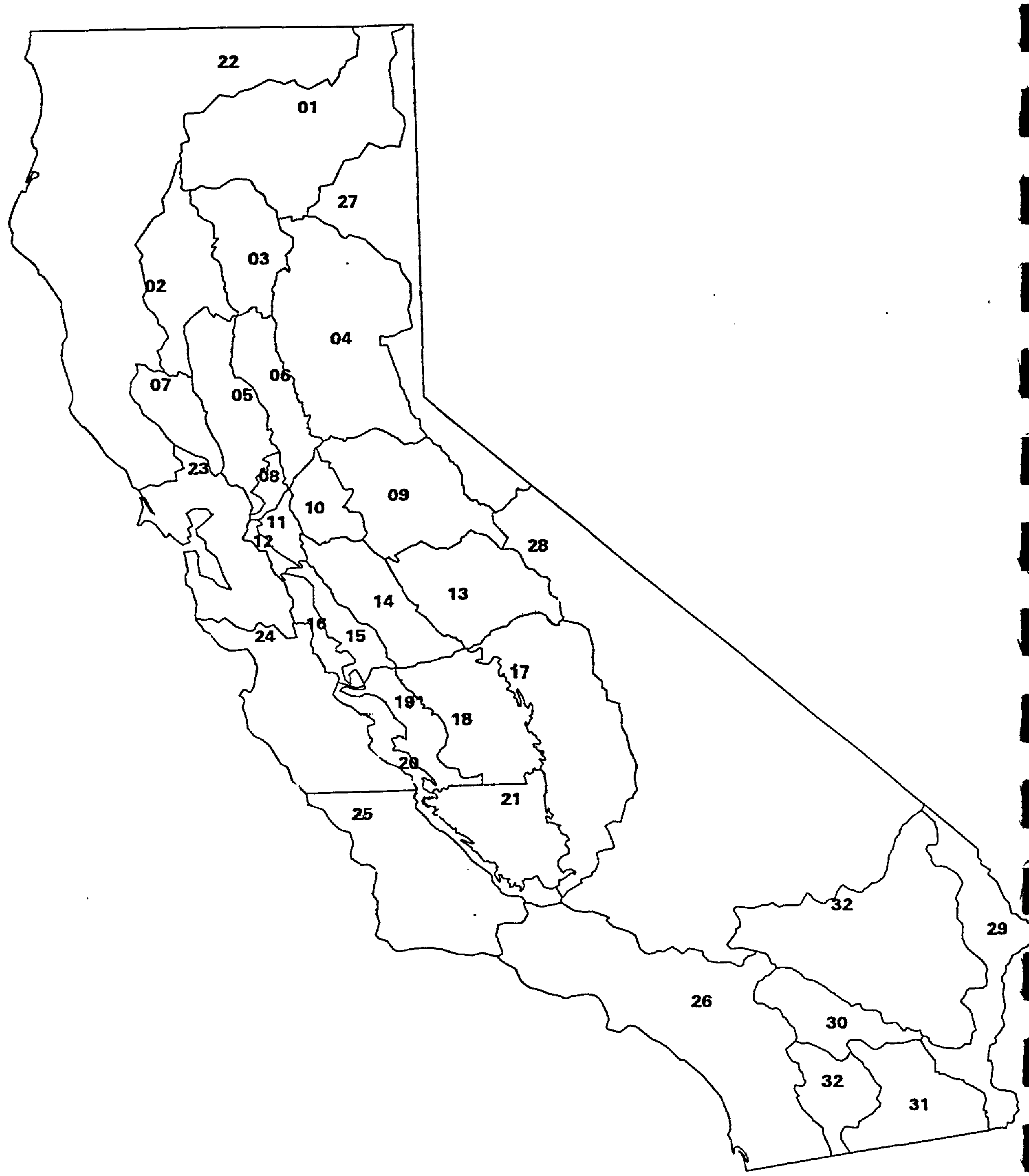
Evaporation = el * AW

Deep Percolation and Seepage. Values of the deep percolation fraction (dp) were computed for each region from the following regression relationship ($R^2 = 0.826$):

$$dp = (-0.75 * bu) + 77.51$$

where

bu = beneficial use fraction = ETAW / AW
Deep percolation = dp * AW



Features:

Reporting Region boundry

14 Reporting Region number

Figure 3-4

Agricultural Demand Management Reporting Regions

Scale 1:5500000

Table 3-2
Reporting Regions Used for
Irrigated Agricultural Demand Managment

Number	Hydrologic Region	PSA or Group of PSAs	Name as Used for Reporting
1	Sacramento River	Shasta Lake - Pit River	SR - Shasta
2		Northwest Valley	SR - N.W. Valley
3		Northeast Valley	SR - N.E. Valley
4		Southeast	SR - S.E.
5		Central Basin West	SR - Central W.
6		Central Basin East	SR - Central E.
7		Southwest	SR - S.W.
8		Delta Service Area	SR - Delta
9	San Joaquin River	Sierra Foothills	SJ - Sierra
10		Eastern Valley Floor	SJ - E. Valley Floor
11		Delta Service Area	SJ - Delta
12		Western Uplands	SJ - W. Uplands
13		East Side Uplands	SJ - E. Uplands
14		Valley East Side	SJ - Valley E. Side
15		Valley West Side	SJ - Valley W. Side
16		West Side Uplands	SJ - W. Side Uplands
17	Tulare Lake	Uplands	TL - Uplands
18		Kings-Kaweah-Tule Rivers	TL - Kings-Kaweah-Tule Rivers
19		San Luis West Side	TL - San Luis W. Side
20		Western Uplands	TL - W. Uplands
21		Kern Valley Floor	TL - Kern Valley Floor
22	North Coast	Upper Klamath, Lower Klamath Smith, Coastal, Russian River	NC - all
23	San Francisco Bay	North Bay, South Bay	SF - all
24	Central Coast	Northern	CC - Northern
25		Southern	CC - Southern
26	South Coast	Santa Clara, Metro LA, Santa Ana, San Diego	SC - all
27	North Lahontan	Lassen Group, Alpine Group	NL - all
28	South Lahontan	Mono-Owens Area, Death Valley, Indian Wells Area, Antelope Valley, Mojave River	SL - all
29	Colorado River	Colorado River	CR - Colorado River
30		Coachella	CR - Coachella
31		Imperial Valley	CR - Imperial Valley
32		Borrego, Twenty-nine Palms-Lanfair, Chuckwalla	CR - Other

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Tailwater. Uncollected runoff was computed for each region from its runoff fraction (ur) as follows :

$$ur = 1 - bu - el - dp$$

and

$$\text{Uncollected runoff} = ur * AW$$

Table 3-3 presents weighted average performance fractions for each region.

3.2.4 - Quantifying District Demand Elements

District demand elements (conveyance consumption and seepage, canal spill, and gate leakage) were primarily estimated from assumption.

Conveyance Consumption and Seepage. Values of conveyance consumption were given by DWR for 7 of the 32 reporting regions. These values represent water usage by riparian and bank vegetation. Table 3-4 presents these values as a percentage of the region's surface water supply. For the remaining regions, the conveyance consumption loss percentage was assumed based on perceived local conditions (Table 3-4).

Values of conveyance seepage were given by DWR for 21 of the 32 reporting regions. Table 3-4 presents seepage values as a percentage of regional surface water supply. The given seepage percentage for four of these regions (SJ-valley E. Side, SJ-Valley W. Side, TL-Kings-Kaweah-Tule Rivers, and TL-Kern Valley Floor) were adjusted based on judgment and familiarity with those regions. Seepage loss percentage values were assumed for the remaining regions.

Canal Spill and Gate Leakage. Canal spill and gate leakage were computed from assumed fractions of regional surface water supply. Combined spill and leakage fractions were assumed to range from 0.03 to 0.08 (Table 3-5). It was assumed that spill would account for 80 percent of the combined spill and gate leakage. Table 3-5 presents resulting spill and gate leakage expressed as fractions of regional surface water supply.

3.2.5 - Determining Recoverable and Irretrievable Portions

Estimates of existing associated losses were divided into their recoverable and irretrievable components by comparing them to DWR's regional values of losses to salt sinks. If the sum of the region's potential irretrievable losses was less than the region's salt sink flow, then all eligible losses were assumed to fit the "irretrievable" category. Potential irretrievable losses were considered to be those that have the opportunity to flow to salt sinks including deep percolation, conveyance seepage, gate leakage, and some portion of tailwater and spill. The portion of tailwater and spill that is a potential irretrievable loss is assumed to be 100 percent in areas that drain to the Salton Sea and 20 percent elsewhere (Table 3-6).

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Table 3-3 Weighted Average On-Farm Performance Fractions				
Region	bu (beneficial use fraction)	el (evaporation loss fraction)	dp (deep percolation fraction)	ur (uncollected runoff fraction)
SR-Shasta	0.706	0.021	0.244	0.029
SR-N.W. Valley	0.710	0.021	0.242	0.027
SR-N.E. Valley	0.731	0.020	0.225	0.023
SR-S.E.	0.674	0.021	0.269	0.037
SR-Central W.	0.623	0.032	0.307	0.038
SR-Central E.	0.613	0.037	0.315	0.035
SR-S.W.	0.719	0.023	0.235	0.023
SR-Delta	0.673	0.017	0.269	0.041
SJ-Sierra	0.675	0.021	0.268	0.037
SJ-E. Valley Floor	0.655	0.020	0.283	0.042
SJ-Delta	0.678	0.017	0.265	0.039
SJ-W. Uplands	0.678	0.020	0.265	0.037
SJ-E. Uplands	0.618	0.020	0.311	0.051
SJ-Valley E. Side	0.700	0.020	0.249	0.031
SJ-Valley W. Side	0.679	0.018	0.265	0.038
SJ-W. Side Uplands	n/a	n/a	n/a	n/a
TL-Uplands	0.658	0.021	0.281	0.041
TL-Kings-Kaweah-Tule Rivers	0.732	0.018	0.225	0.025
TL-San Luis W. Side	0.780	0.015	0.189	0.016
TL-W. Uplands	n/a	n/a	n/a	n/a
TL-Kern Valley Floor	0.744	0.017	0.216	0.023
NC-all	0.689	0.019	0.257	0.035
SF-all	0.769	0.020	0.197	0.014
CC-Northern	0.670	0.017	0.272	0.041
CC-Southern	0.534	0.019	0.374	0.074
South Coast HR	0.743	0.019	0.217	0.021
North Lahontan HR	0.669	0.022	0.273	0.037
South Lahontan HR	0.770	0.020	0.197	0.013
CR-Colorado River	0.621	0.018	0.309	0.053
CR-Coachella	0.660	0.019	0.279	0.042
CR-Imperial Valley	0.760	0.018	0.204	0.018
CR-Other	0.741	0.018	0.219	0.022

Table 3-4

Conveyance Loss Assumptions

Region	Conveyance Consumption as Percent of Surface Supply		Conveyance Seepage as Percent of Surface Supply	
	Reported	Used	Reported	Used
SR-Shasta	6.7	6.7	8.5	8.5
SR-N.W. Valley	12.1	12.1	23.9	23.9
SR-N.E. Valley	13.5	13.5	19.7	19.7
SR-S.E.	5.5	5.5	16.9	16.9
SR-Central W.	6.0	6.0	8.3	8.3
SR-Central E.	9.6	9.6	9.8	9.8
SR-S.W.	8.6	8.6	18.7	18.7
SR-Delta	---	10.0	15.0	15.0
SJ-Sierra	---	5.0	45.3	45.3
SJ-E. Valley Floor	---	6.0	11.6	11.6
SJ-Delta	---	5.0	2.5	2.5
SJ-W. Uplands	---	5.0	14.1	14.1
SJ-E. Uplands	---	5.0	0.0	0.0
SJ-Valley E. Side	---	6.0	0.7	5.0
SJ-Valley W. Side	---	6.0	5.0	10.0
SJ-W. Side Uplands	---	0.0	---	---
TL-Uplands	---	5.0	0.0	0.0
TL-Kings-Kaweah-Tule Rivers	---	4.0	0.5	20.0
TL-San Luis W. Side	---	1.0	2.0	2.0
TL-W. Uplands	---	0.0	---	---
TL-Kern Valley Floor	---	1.0	0.9	2.0
NC-all	---	5.0	---	10.0
SF-all	---	5.0	---	2.0
CC-Northern	---	5.0	---	10.0
CC-Southern	---	5.0	---	10.0
SC-all	---	2.0	---	2.0
NL-all	---	5.0	---	10.0
SL-all	---	5.0	---	10.0
CR-Colorado River	---	2.0	---	10.0
CR-Coachella	---	3.0	13.5	10.0
CR-Imperial Valley	---	2.0	10.7	8.0
CR-Other	---	2.0	---	10.0

Table 3-5

Spill and Non-Leak Gate Assumptions

Region	Assumed Fraction (spill and leak combined)	Spill Fraction	Gate Fraction
SR-Shasta	0.08	0.064	0.016
SR-N.W. Valley	0.06	0.048	0.012
SR-N.E. Valley	0.06	0.048	0.012
SR-S.E.	0.06	0.048	0.012
SR-Central W.	0.08	0.064	0.016
SR-Central E.	0.08	0.064	0.016
SR-S.W.	0.06	0.048	0.012
SR-Delta	0.03	0.024	0.006
SJ-Sierra	0.06	0.048	0.012
SJ-E. Valley Floor	0.08	0.064	0.016
SJ-Delta	0.03	0.024	0.006
SJ-W. Uplands	0.08	0.064	0.016
SJ-E. Uplands	0.08	0.064	0.016
SJ-Valley E. Side	0.08	0.064	0.016
SJ-Valley W. Side	0.08	0.064	0.016
SJ-W. Side Uplands	0.08	0.064	0.016
TL-Uplands	0.08	0.064	0.016
TL-Kings-Kaweah-Tule Rivers	0.06	0.048	0.012
TL-San Luis W. Side	0.03	0.024	0.006
TL-W. Uplands	0.06	0.048	0.012
TL-Kern Valley Floor	0.03	0.024	0.006
NC-all	0.08	0.064	0.016
SF-all	0.06	0.048	0.012
CC-Northern	0.06	0.048	0.012
CC-Southern	0.06	0.048	0.012
SC-all	0.03	0.024	0.006
NL-all	0.06	0.048	0.012
SL-all	0.06	0.048	0.012
CR-Colorado River	0.06	0.048	0.012
CR-Coachella	0.03	0.024	0.006
CR-Imperial Valley	0.03	0.024	0.006
CR-Other	0.06	0.048	0.012

Table 3-6

Assumed Percentage of Surface Losses that Flow to Groundwater or Salt Sinks

Region	Assumed Percentage
SR-Shasta	20
SR-N.W. Valley	20
SR-N.E. Valley	20
SR-S.E.	20
SR-Central W.	20
SR-Central E.	20
SR-S.W.	20
SR-Delta	20
SJ-Sierra	20
SJ-E. Valley Floor	20
SJ-Delta	20
SJ-W. Uplands	20
SJ-E. Uplands	20
SJ-Valley E. Side	20
SJ-Valley W. Side	20
SJ-W. Side Uplands	20
TL-Uplands	20
TL-Kings-Kaweah-Tule Rivers	20
TL-San Luis W. Side	20
TL-W. Uplands	20
TL-Kern Valley Floor	20
NC-all	20
SF-all	20
CC-Northern	20
CC-Southern	20
SC-all	20
NL-all	20
SL-all	20
CR-Colorado River	20
CR-Coachella	100
CR-Imperial Valley	100
CR-Other	20

If the sum of potential irretrievable losses were greater than the reported salt sink flow, then only proportionate shares of the losses were considered to be eligible. Figure 3-5 illustrates how the sum of eligible losses (minus the leaching requirement) was adjusted to equal the salt sink flow (minus the leaching requirement). Remaining losses were assumed to be recoverable and not providing yield increase potential (i.e., loss is already used for another purpose downstream).

The leaching requirement for each region was computed assuming a typical irrigation water salinity and target soil extract salinity for no yield decline on corn (Table 3-7). Corn was chosen as a representative crop because it is moderately salt sensitive.

Because individual irretrievable losses are computed from the *sum of* potential irretrievable losses (and these losses are greater than the salt sink flow in many regions), their individual values are interrelated. For example, using this computational method, if an option under analysis tended to reduce canal seepage, then the analysis would typically indicate that the option tends to increase other irretrievable losses (such that the sum of total losses is always the same).

3.2.6 - Quantifying Potentials of Demand Management Options

Irrigation Performance. The irrigation performance option has a direct effect on the on-farm demand elements (on-farm evaporation, deep percolation, and tailwater). Values of these elements were computed assuming the highest practical irrigation performance (combining irrigation systems, management, and delivery flexibility; average resulting bu fractions were about 0.9). The irretrievable portions of these and other elements were computed from high efficiency elements. The potential reduction of each element was computed as the difference between the existing condition and high efficiency values.

Drainwater Reclamation. The yield increase potential of drainwater reclamation was computed as the sum of existing irretrievable losses if the leaching requirement was less than other existing irretrievable losses. This method assumes that drainwater reclamation can be used to collect all losses to salt sinks in a drainage effected area. If the leaching requirement was greater than or equal to other irretrievable losses, then potential was assumed to be zero because the region was assumed to be primarily not affected by perched water and, thus, collecting subsurface drainage would not be feasible.

Canal Lining and Piping, Spill Reduction, and Non-Leak Gates. The potential for these options was assumed to be 90 percent of their corresponding existing demand element. For example, the potential for non-leak gates was assumed to be 90 percent of existing gate leakage. This assumption is based on the observation that even well constructed canals, control structures, and gates will leak or spill.

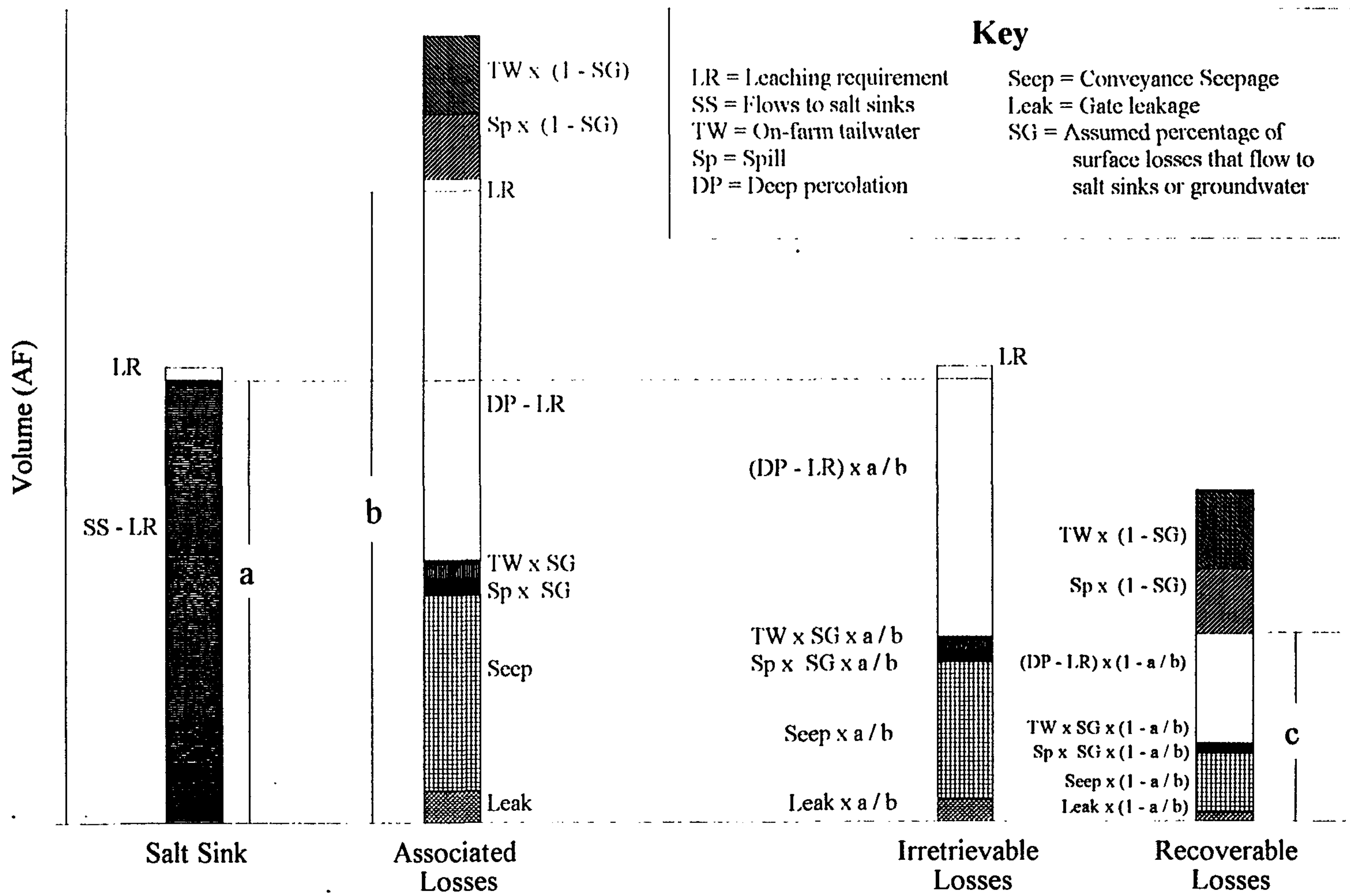


Figure 3-5
Relationship Between Flows to Salt Sinks, Recoverable and Irretrievable Losses

Note: Associated losses = Irretrievable losses + Recoverable losses
(and similarly: b = a + c)

Table 3-7

Assumed Average Regional Leaching Fractions

Region	Assumed Average Irrigation Water Salininty (ppm)	Resulting Leaching Fraction
SR-Shasta	50	0.01
SR-N.W. Valley	50	0.01
SR-N.E. Valley	50	0.01
SR-S.E.	50	0.01
SR-Central W.	50	0.01
SR-Central E.	50	0.01
SR-S.W.	50	0.01
SR-Delta	150	0.03
SJ-Sierra	50	0.01
SJ-E. Valley Floor	50	0.01
SJ-Delta	150	0.03
SJ-W. Uplands	50	0.01
SJ-E. Uplands	50	0.01
SJ-Valley E. Side	50	0.01
SJ-Valley W. Side	300	0.06
SJ-W. Side Uplands	50	0.01
TL-Uplands	50	0.01
TL-Kings-Kaweah-Tule Rivers	50	0.01
TL-San Luis W. Side	300	0.06
TL-W. Uplands	50	0.01
TL-Kern Valley Floor	150	0.03
NC-all	50	0.01
SF-all	50	0.01
CC-Northern	50	0.01
CC-Southern	50	0.01
SC-all	150	0.03
NL-all	50	0.01
SL-all	50	0.01
CR-Colorado River	600	0.12
CR-Coachella	600	0.12
CR-Imperial Valley	600	0.12
CR-Other	600	0.12

3.3 - Results

Statewide potential. Table 3-8 (see first column) shows that the *existing* annual demand for irrigation water in California is approximately 35.6 million acre-feet (MAF) of which 21.6 MAF is consumed by crop ETAW. Of the remaining quantity, *existing* statewide conveyance losses comprise about 1.5 MAF, recoverable losses comprise 11.1 MAF, and irretrievable losses comprise about 1.4 MAF. However, only portions of these quantities are felt to have actual yield increase potential.

The eligible potential of options includes: 0.7 MAF through irrigation performance (reductions in on-farm evaporation and irretrievable losses), 1.2 MAF through drainwater reclamation, 1.3 MAF for canal lining and removal of riparian and bank vegetation (reductions in consumptive loss and irretrievable conveyance seepage). Less than 50 thousand acre-feet (TAF) is available from the combination of district level measures such as spill reduction and installation of non-leak gates.

Regional Potential. Figure 3-6 illustrates the magnitude of existing demand elements for five combinations of regions. These regional combinations group areas with similar irrigation and drainage characteristics. In all five zones, recoverable losses comprise the largest element, however, these are also not seen as having yield increase potential. In the Sacramento Valley and East side of the San Joaquin Valley, recoverable losses are greater than other regions. This reflects the high existing level of reuse of agricultural losses through groundwater pumping and the capture and reuse of surface losses. This figure also graphically portrays the minimal quantity of water available through demand management that could actually increase the water available for other uses.

The large proportion of conveyance losses to irretrievable losses in the Sacramento and East Side San Joaquin valleys is due to the abundance of riparian and bank vegetation lining many of the streams and channels used to convey water to agricultural users. Most conveyance loss conservation could be accomplished through canal lining and piping and through the removal of the riparian and bank vegetation lining the streams and channels. Irrigation performance improvements could achieve only limited conservation of conveyance losses. Conversely, irrecoverable losses in the Sacramento Valley and the East side of the San Joaquin Valley represent a small portion compared to the drainage-affected Westside and Colorado River regions where irretrievable type losses are more prevalent.

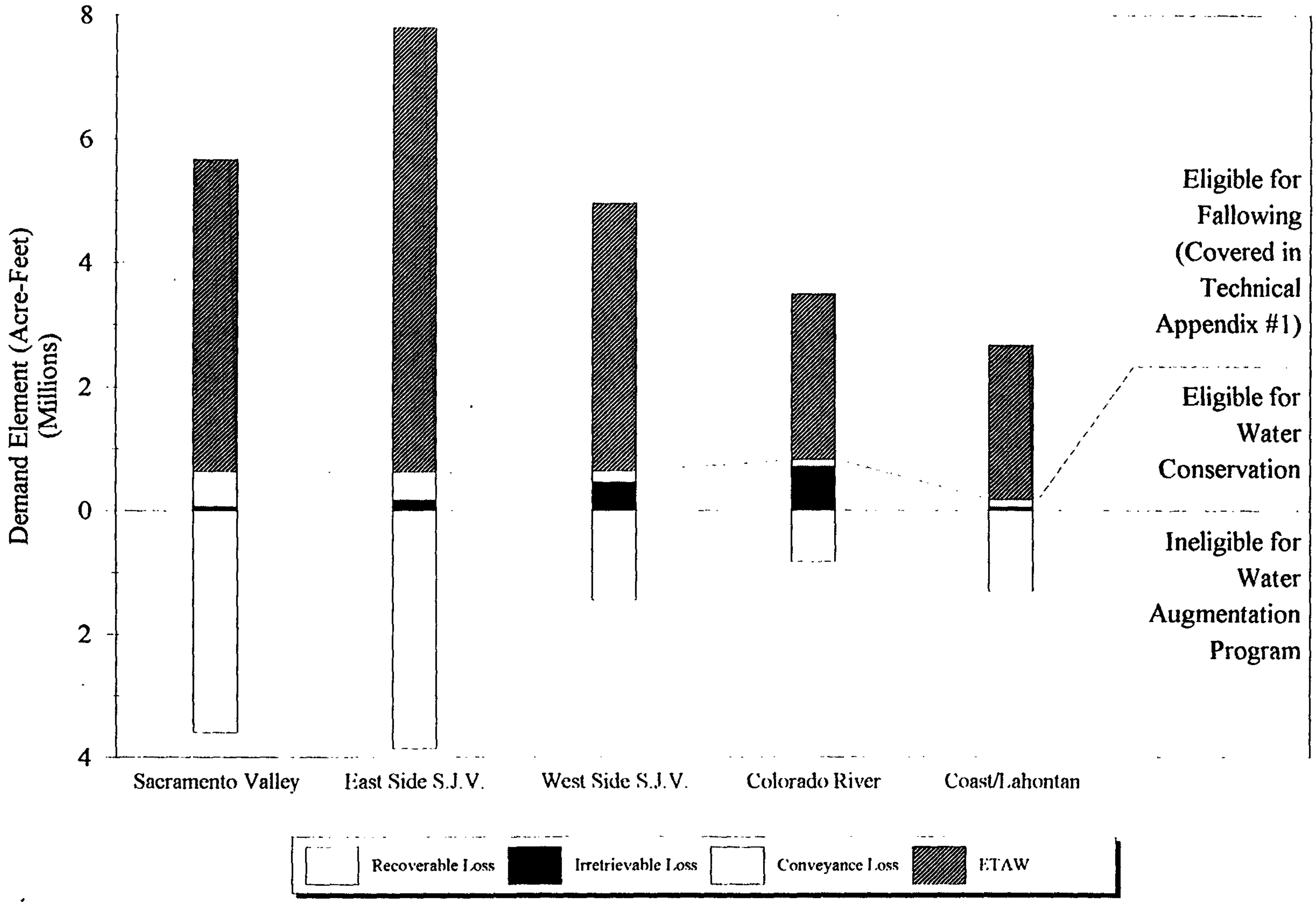
Irrigation performance improvements could conserve approximately 400 TAF statewide. Most of this potential exists in the drainage-affected Westside (about 162 TAF) and Colorado River (about 200 TAF) regions.

The conservation potential of spill reduction and non-leak gates is also greatest in the drainage-affected regions. Spill reduction and non-leak gates on the West Side could conserve approximately 5.5 and 6.8 TAF, respectively. Because Colorado River region surface losses flow to the Salton Sea, the conservation potential for spill reduction there is proportionally greater (about 27.5 TAF).

Table 3-8 Potential of Demand Management Options: Statewide* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Conveyance Loss						
On-Farm Evap.	663,900	498,900	---	---	---	---
Conveyance	1,052,700	---	---	1,052,700	---	---
Sub-total	1,716,600	498,900	0	1,052,700	0	0
Recoverable Loss						
On-farm TW	922,200	654,700	---	---	---	---
On-farm DP & seep.	6,739,500	5,144,800	---	---	---	---
Convey. seep.	1,950,700	---	---	1,755,630	---	---
Canal spillage	1,001,900	---	---	---	901,710	---
Gate Leakage	242,900	---	---	---	---	218,610
Sub-total	10,857,200	5,799,500	0	1,755,630	901,710	218,610
Irrecoverable Loss						
Leaching Req'mt	690,600	---	UNSPECIFIED	---	---	---
On-farm TW	31,300	24,000	UNSPECIFIED	---	---	---
On-farm DP & seep.	415,500	381,500	UNSPECIFIED	---	---	---
Convey. seep.	227,400	---	UNSPECIFIED	204,660	---	---
Canal spillage	38,500	---	UNSPECIFIED	---	34,650	---
Gate Leakage	17,200	---	UNSPECIFIED	---	---	15,480
Sub-total	1,420,500	405,500	1,420,500	204,660	34,650	15,480
Total	13,994,300	6,703,900	1,420,500	3,012,990	936,360	234,090

* Refer to Table 3-2.

Figure 3-6
Demand Elements Eligible for Water Augmentation Program



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Tables 3-9a through 3-9e provide combined regional summaries of water management potentials by option (Appendix A contains potentials for all 32 regions).

3.3.1 - Realignment of Central Valley Results

As stated in the introduction, demand management options represent only one of several types of yield increase options being analyzed under the Water Augmentation Program. The goal of the Program is develop a least-cost plan that looks at *all* types of available options. In order to appropriately analyze agricultural demand management options with those of other categories (e.g., conjunctive use and modified operations), some of the results needed to be reorganized into slightly different regions.

The realignment only applies to the results for options within the Central Valley (originally presented based on PSAs). The new regions are a slight variation of the original PSAs. In some cases the region remains exactly the same, in others, slight adjustments to include some neighboring lands or exclude portions of its otherwise included land area had to be made. The result is 11 regions that characterize the agricultural growing areas of the Central Valley (Figure 3-7). Table 3-10 shows the relationship between the new 11 regions and the original Central Valley PSAs. Results for the remaining 32 original regions are unchanged.

3.4 - Sensitivity Analysis

Results reported depend on inference relationships and assumptions, many of which are based on limited region-specific information. Thus, an analysis was conducted to test the sensitivity of the results to uncertainty in these assumptions:

- On-farm evaporation fraction (el)
- Deep percolation fraction (dp)
- Conveyance seepage percentage
- Conveyance consumption percentage
- Spill percentage
- Gate leakage percentage
- Leaching requirement (LR)
- Percent of surface losses that are eligible to flow to groundwater or salt sinks (SG)
- Conservable portion of existing conveyance seepage
- Conservable portion of existing spill
- Conservable portion of existing gate leakage

Each of these parameters was varied above and below its original or base value while holding all other parameters constant. Results of the analysis were not sensitive to most parameters (Appendix B). Computed quantities of either conveyance or irretrievable losses were sensitive, however, to the on-farm evaporation fraction, conveyance seepage percentage, conveyance consumption percentage, and leaching fraction.

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Table 3-9a
Potential of Demand Management Options: Sacramento Valley* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Conveyance Loss						
On-Farm Evap.	242,400	141,700	---	---	---	---
Conveyance	433,100	---	---	433,100	---	---
Sub-total	675,500	141,700	0	433,100	0	0
Recoverable Loss						
On-farm TW	275,700	71,400	---	---	---	---
On-farm DP & seep.	2,255,700	1,606,500	---	---	---	---
Convey. seep.	584,800	---	---	526,320	---	---
Canal spillage	310,900	---	---	---	279,810	---
Gate Leakage	77,700	---	---	---	---	69,930
Sub-total	3,504,800	1,677,900	0	526,320	279,810	69,930
Irrecoverable Loss						
Leaching Req'mt	56,400	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	56,400	0	0	0	0	0
Total	4,236,700	1,819,600	0	959,420	279,810	69,930

* Includes reporting regions 1, 2, 3, 4, 5, 6, 7, and 8 (Table 3-2).

Table 3-9b Potential of Demand Management Options: San Joaquin Valley - East Side* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	**Existing Condition**	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Conveyance Loss						
On-Farm Evap.	186,800	162,900	---	---	---	---
Conveyance	339,100	---	---	339,100	---	---
Sub-total	525,900	162,900	0	339,100	0	0
Recoverable Loss						
On-farm TW	298,700	271,200	---	---	---	---
On-farm DP & seep.	2,297,900	1,692,300	---	---	---	---
Convey. seep.	769,400	---	---	692,460	---	---
Canal spillage	356,900	---	---	---	321,210	---
Gate Leakage	87,900	---	---	---	---	79,110
Sub-total	3,810,800	1,963,500	0	692,460	321,210	79,110
Irrecoverable Loss						
Leaching Req'mt	81,700	---	UNSPECIFIED	---	---	---
On-farm TW	1,200	1,100	UNSPECIFIED	---	---	---
On-farm DP & seep.	49,800	35,400	UNSPECIFIED	---	---	---
Convey. seep.	24,300	---	UNSPECIFIED	21,870	---	---
Canal spillage	1,400	---	UNSPECIFIED	---	1,260	---
Gate Leakage	1,700	---	UNSPECIFIED	---	---	1,530
Sub-total	160,100	36,500	160,100	21,870	1,260	1,530
Total	4,496,800	2,162,900	160,100	1,053,430	322,470	80,640

* Includes reporting regions 9, 10, 11, 13, 14, 17, and 18 (Table 3-2).

Table 3-9c Potential of Demand Management Options: San Joaquin Valley - West Side* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	**Existing Condition**	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Conveyance Loss						
On-Farm Evap.	97,100	87,200	---	---	---	---
Conveyance	128,000	---	---	128,000	---	---
Sub-total	225,100	87,200	0	128,000	0	0
Recoverable Loss						
On-farm TW	139,500	128,000	---	---	---	---
On-farm DP & seep.	887,200	702,500	---	---	---	---
Convey. seep.	193,900	---	---	174,510	---	---
Canal spillage	178,600	---	---	---	160,740	---
Gate Leakage	38,600	---	---	---	---	34,740
Sub-total	1,437,800	830,500	0	174,510	160,740	34,740
Irrecoverable Loss						
Leaching Req'mt	197,100	---	UNSPECIFIED	---	---	---
On-farm TW	5,100	4,700	UNSPECIFIED	---	---	---
On-farm DP & seep.	200,500	156,800	UNSPECIFIED	---	---	---
Convey. seep.	32,900	---	UNSPECIFIED	29,610	---	---
Canal spillage	6,100	---	UNSPECIFIED	---	5,490	---
Gate Leakage	7,600	---	UNSPECIFIED	---	---	6,840
Sub-total	449,300	161,500	449,300	29,610	5,490	6,840
Total	2,112,200	1,079,200	449,300	332,120	166,230	41,580

* Includes reporting regions 12, 15, 16, 19, 20, and 21 (Table 3-2).

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Table 3-9d
Potential of Demand Management Options: Colorado River Region* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Conveyance Loss						
On-Farm Evap.	68,100	51,000	---	---	---	---
Conveyance	70,300	---	---	70,300	---	---
Sub-total	138,400	51,000	0	70,300	0	0
Recoverable Loss						
On-farm TW	78,200	67,900	---	---	---	---
On-farm DP & seep.	396,400	440,200	---	---	---	---
Convey. seep.	253,800	---	---	228,420	---	---
Canal spillage	65,100	---	---	---	58,590	---
Gate Leakage	16,300	---	---	---	---	14,670
Sub-total	809,800	508,100	0	228,420	58,590	14,670
Irrecoverable Loss						
Leaching Req'mt	319,800	---	UNSPECIFIED	---	---	---
On-farm TW	24,600	17,800	UNSPECIFIED	---	---	---
On-farm DP & seep.	152,700	179,300	UNSPECIFIED	---	---	---
Convey. seep.	169,500	---	UNSPECIFIED	152,550	---	---
Canal spillage	31,000	---	UNSPECIFIED	---	27,900	---
Gate Leakage	7,700	---	UNSPECIFIED	---	---	6,930
Sub-total	705,300	197,100	705,300	152,550	27,900	6,930
Total	1,653,500	756,200	705,300	451,270	86,490	21,600

* Includes reporting regions 29, 30, 31, and 32 (Table 3-2).

Table 3-9e Potential of Demand Management Options: Coast and Lahontan* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	**Existing Condition**	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Conveyance Loss						
On-Farm Evap.	69,500	56,100	---	---	---	---
Conveyance	82,200	---	---	82,200	---	---
Sub-total	151,700	56,100	0	82,200	0	0
Recoverable Loss						
On-farm TW	130,100	116,100	---	---	---	---
On-farm DP & seep.	902,300	703,200	---	---	---	---
Convey. seep.	148,800	---	---	133,920	---	---
Canal spillage	90,400	---	---	---	81,360	---
Gate Leakage	22,500	---	---	---	---	20,250
Sub-total	1,294,100	819,300	0	133,920	81,360	20,250
Irrecoverable Loss						
Leaching Req'mt	35,700	---	UNSPECIFIED	---	---	---
On-farm TW	400	400	UNSPECIFIED	---	---	---
On-farm DP & seep.	12,400	10,100	UNSPECIFIED	---	---	---
Convey. seep.	700	---	UNSPECIFIED	630	---	---
Canal spillage	100	---	UNSPECIFIED	---	90	---
Gate Leakage	100	---	UNSPECIFIED	---	---	90
Sub-total	49,400	10,500	49,400	630	90	90
Total	1,495,200	885,900	49,400	216,750	81,450	20,340

* Includes reporting regions 22, 23, 24, 25, 26, 27, and 28 (Table 3-2).

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Table 3-10
Realignment of Reporting Regions for Central Valley Results

New Central Valley Region	Original Reporting Region(s) Included (see Table 3-2)
1	SR - N.W. Valley SR - N.E. Valley (portion)
2	SR - Central W. (portion) SR - Central E. (portion)
3	SR - Central E. (portion)
4	SR - Central W. (portion) SR - Delta SJ - Delta
5	SR - Central E. (portion) SJ - E. Valley Floor
6	SJ - Valley W. Side
7	SJ - Valley E. Side (portion)
8	SJ - Valley E. Side (portion)
9	TL - San Luis W. Side
10	TL - Kings, Kaweah, Tule Rivers
11	TL - Kern Valley Floor

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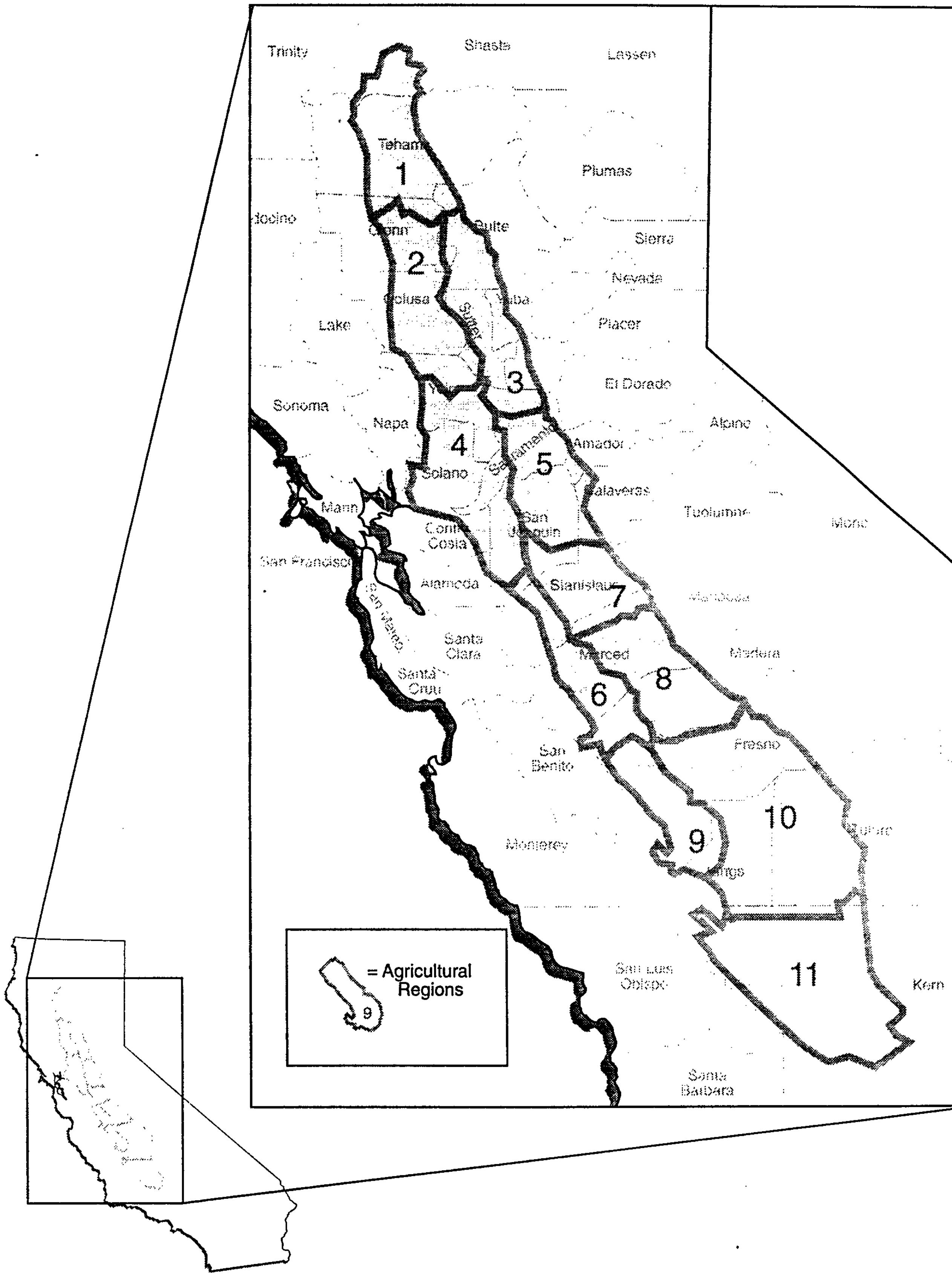

Figure 3-7
Central Valley Agricultural Regions

On-farm Evaporation Fraction. The base distribution of irrigation method and management level was varied to extreme values. Resulting weighted average values of el ranged from a low of 1 percent of AW to a high of 2.5 percent. These values were used to test the sensitivity of this parameter. At the base value, potential statewide conveyance losses for irrigation performance were approximately 0.3 MAF. Low and high el values cause conveyance losses for these options to shift down and up by about 0.2 MAF (i.e., 0.1 MAF to 0.5 MAF).

Conveyance Seepage Percentage. Assumed values of conveyance seepage percentage were adjusted downward and upward by 50 percent of their base value (resulting in values of 50 and 150 percent of base). Resulting statewide irretrievable no loss potential for canal lining varies proportionally to the seepage by about 0.1 MAF. Irretrievable loss potential for some of the other options varies inversely to seepage. Of those that vary inversely, the potential for irrigation performance is the most sensitive (varies by about 60 TAF).

Conveyance Consumption Percentage. This parameter had the greatest sensitivity. It was varied from 50 to 150 percent of its base value. Statewide conveyance loss conservation potential varied from approximately 0.5 MAF to 1.55 MAF (base potential was approximately 1.1 MAF).

Leaching Requirement. As a result of changing the leaching requirement to 50 percent of its base assumption, the statewide conveyance loss conservation potential decreased for drainwater reclamation options, but increased for other options. Inverse results were obtained with 150 percent of the LR. At the lower LR irrigation performance potential increases by about 0.1 MAF. Other options are affected to a lesser magnitude.

Section 4

Urban Demand Management

Urban water conservation programs effectively reduce both short- and long-term water demands in many urban areas throughout the State. DWR estimates that long-term (permanent) urban water conservation programs will eventually result in overall water savings of 10 to 15 percent. Long-term conservation and short-term drought management are interrelated, sometimes relying on the same techniques to reduce water use. Short-term drought management relies more extensively on temporary habitat changes. It normally focuses on reducing discretionary uses of water such as flushing toilets after every use and irrigating turf to maintain a green landscape. Theoretically, if extensive long-term conservation is implemented, then the potential for short-term drought management is lessened because some waste or "slack" has been eliminated. Short-term management during drought conditions includes both voluntary and mandatory regulations. DWR generally considers that savings up to 15 percent are achievable through voluntary measures while mandatory programs are necessary to achieve higher levels. Some legislation regarding statewide urban water conservation is discussed in the following sections.

State Legislation. The State Urban Water Management Planning Act of 1983 requires the 300 medium- and large-sized urban water agencies to prepare and adopt plans for efficient water use. The first plans were due in 1985 and are updated every five years. Over 95 percent of the affected agencies have submitted plans.

During the 1988 Bay-Delta Hearings, the State Water Resources Control Board received a wide variety of opinions on the appropriate levels of urban water conservation. State agencies, urban water agencies, and environmental groups evaluated the information and developed a list of "Best Management Practices" (BMP). BMPs are conservation measures that meet either of the two following criteria:

An established and generally accepted practice among water suppliers that results in more efficient use or conservation of water.

A practice for which sufficient data are available from existing water conservation projects to indicate that significant conservation or conservation-related benefits can be achieved. The practice should be technically and economically reasonable, environmentally and socially acceptable, and reasonable for most water suppliers to carry out.

Table 4-1 shows the 16 BMPs that satisfied the criteria. Other potential BMPs are included at the end of the table. Some BMPs have quantified water use savings as shown on Table 4-2.

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Table 4-1

Best Management Practices in the Memorandum of Understanding Regarding Urban Water Conservation

BMP	Description
1. Residential Water Audits	The top 20 percent of single- and multifamily home water users (on gallons per account per day basis) are offered a free audit that includes indoor water conservation measures and development of an irrigation schedule.
2a. Enforce New Plumbing Code	The new ultra low flush toilet (1.6 gallons/flush) is mandated in all new construction, residential and nonresidential, as of January 1, 1992. Low flow shower heads have been required since 1980.
2b. Prohibit Sale of Non-Ultra Flush Toilets	Included in the Energy Policy Act of 1992 is a provision to prohibit the sale of 3.5 or more gallons/flush toilets as of January 1, 1994.
2c. Plumbing Retrofit	Retrofit kits containing low flow shower heads and toilet tank retrofit devices would be distributed to all homes.
3. Distribution Water Audits, Leak Detection and Repair	Water distribution system would be audited every three years; leak detection and repair if cost-effective.
4. Metering	Meters would be required on all connections with billing by volume of use. (4a.) Existing customers would be retrofitted with meters over a 5-year period. (4b.) Meters would be installed by customers at the time of construction of new connections.
5. Large Landscape Water Audits and Incentives	Audits to increase the irrigation efficiency of landscapes containing more than three acres of turf would be conducted according to methods developed by the DWR.
6. Landscape Water Conservation Requirements	All cities and counties could develop and apply a landscaping ordinance, as required by AB325.
7. Public Information	Water districts would create and staff a public information program to promote water conservation. The program would include speaker bureaus, media, advertising, bill inserts, and other promotional methods.
8. School Education	Water districts would provide educational materials and instructional assistance on water conservation to school districts.

Table 4-1 (Continued)	
BMP	**Description**
9. Commercial and Industrial Conservation	The top 10 percent of water users in this class would be contacted and offered a free audit and incentives sufficient to achieve customer implementation of audit findings.
10. New Commercial and Industrial Water Use Review	New applications for commercial/industrial water service would be reviewed and recommendations for improving water use efficiency would be made during the building permit process.
11. Conservation Pricing	Nonconservation pricing would be eliminated in favor of conservation-oriented water rates. This could involve uniform pricing, inclining block rates, seasonal rates, excess-use charges during peak demand periods, marginal-cost pricing, or lifeline rates.
12. Landscape Water Conservation for Single-Family Homes	Single-family homeowners would be provided with guidelines, incentives, and possibly an ordinance requiring water-conserving landscaping for new homes or at the time of relandscaping.
13. Water Waste Prohibition	An ordinance prohibiting water waste (gutter flooding, nonrecycling fountains, car washes, cooling system effluent, and self-regenerating water softeners) should be adopted and enforced.
14. Water Conservation Coordinator	A utility staff person should be designated as a water conservation coordinator responsible for preparing a water conservation plan, managing its implementation, and evaluating the results.
15. Financial Incentives	Financial incentives would be offered by water agencies to their customers to achieve conservation.
16. Ultra Low Flush Toilet Replacement	Water agencies would implement a toilet program offering rebates to customers who replace their high-water-use toilets with 1.6 gallon/flush models. Approximately 25 percent of high water use toilets would be replaced.

Table 4-2
Water Conservation Unit Savings

Conservation Measures	Area of Application	Rate Reduction
Existing Codes and Standards (BMPs 2a, 2b, 6)		
1992 Plumbing Code on New Construction (ULF toilets)	All new residential and nonresidential	9 gpcd (a)
Prohibition on Sale of Non-ULF Toilets	1.5% per year of pre-1992 res. and nonres.	9 gpcd (a)
Non-Residential Landscape Codes	Post 1992 nonres. landscape, excl. rec.	15% of outdoor use
Residential Audit and Retrofit (BMPs 1, 2c, 12)		
Residential Auditing and Retrofit	3% per year pre-1980 residential	9.0 gpcd (b) + 5% of outdoor use
Residential Auditing and Retrofit	3% per year of 1980-1992 residential	3.4 gpcd (b) + 5% of outdoor use
Residential Landscape Conservation		NQ
Distribution System (BMPs 3a, 3b)		
Distribution Audit (1 every 3 year, AWWA standard)	Entire dist. system and unauthorized uses	NQ
Leak Detection and Repair (if audit shows cost effect)	entire distribution system	0% of total production (c)
Metering (BMPs 4, 11)		
New Comm., Industrial, Parks, R of Ws, and Public	All new nonresidential	10% of indoor and 20% of outdoor
New Residential	All new residential	10% of indoor and 20% of outdoor
Existing Comm., Industrial, Parks, R of Ws, and Public	All existing nonresidential	10% of indoor and 20% of outdoor
Retrofit Existing Residential	All existing residential	10% of indoor and 20% of outdoor
Conservation Pricing	All metered customers	(d)
Non Residential Audits (BMPs 5, 9)		
Nonresidential Landscape Audits	Pre-1992 nonres landscape	15% of outdoor use
Commercial and Industrial Indoor Audits	All commercial/industrial	10% of indoor
Education (BMPs 7, 8, 14)		
Public Information	All customers	NQ
School Education	All customers	NQ
Water Conservation Coordinator	All customers	NQ
Water Use Review and Waste Prohibition (BMPs 10, 13)		
New Commercial and Industrial Water Use Review	New commercial and industrial	NQ
Water Waste Prohibition	All customers	NQ
Financial Incentives (BMP 15)		
Not Yet Determined		NQ
ULF Toilet Replacement (BMP 16)		
ULF Toilet Replacement (at change of ownership)	1.5% per year of pre-1992 res. and nonres.	9 gpcd (a)

Notes:
NQ = Not quantified at this time
(a) 9 gpcd is the weighted average based on number of homes between pre-1980 residential savings (16 gpcd) and 1980-1992 residential savings (8 gpcd)
(b) Assuming an average annual residential demand of 3.0 ac-ft/ac:
  9.0 gpcd is equivalent to 13% of residential indoor use
  3.4 gpcd is equivalent to 5% of residential indoor use
(c) Total water system losses are estimated to remain at 7.5% of total production through the year 2030
(d) Rate reduction is reflected when meters are installed

The BMPs have been incorporated into a Memorandum of Understanding (MOU) "Regarding Urban Water Conservation in California". By December 1992, over 180 water agencies and other interested parties had signed the MOU. The MOU commits those agencies to implement the BMPs by 2001. Implementation of the BMPs is overseen by the California Urban Water Conservation Council, which was established by the MOU.

4.1 - Approach

This analysis was completed at the HR level of detail for the entire state (see Figure 4-1). This designation is consistent with that developed by DWR for reporting water-use-related data. Population and water demand data for 1990 and 2010, presented on Table 4-3, are based on data presented in DWR Bulletin 160-93. The 2010 demand estimates presented in DWR Bulletin 160-93 include a 7 to 10 percent reduction due to implementation of the BMPs. However, for this analysis the initial 2010 total demand was developed without affects of post-1990 conservation. Table 4-4 presents the urban demand for 2010, which was calculated using the 1990 per capita demand and the 2010 population.

California' s population is expected to increase by 41 percent from 29.9 million in 1990 to 42.4 million in 2010. Annual urban water demand without further conservation is expected to increase about 43 percent during the same period from 7.7 million acre-feet to 11.2 million acre-feet.

4.2 - Characteristics of Demand

Urban water demand consists of five sectors: residential, commercial, governmental, industrial, and miscellaneous. Each sector makes up a percentage of urban water demand for a given HR. Percentages vary between HRs depending on many factors including, but not limited to, population, industry, and climate. Table 4-4 shows the 1990 percentage of urban water use by sector for each HR. Table 4-5 applies these percentages to estimate 2010 water demands by sector.

Residential. In 1990, residential water demand varied from 28 to 59 percent of the total urban water demand in individual HRs and averaged about 54 percent statewide. The greatest potential for urban water conservation is in the residential sector. Residential water demand averaged about 120 gallons per capita day in California with indoor water use accounting for 80 gallons per capita day. Outdoor demand varies significantly depending on climate and population density, and can account for up to 60 percent of total residential water demand.

Commercial. In 1990, commercial water demand varied from 4 to 23 percent of total urban water demand in individual HRs and averaged about 17 percent statewide. Commercial water demand averaged over the statewide population is about 40 gallons per capita day.

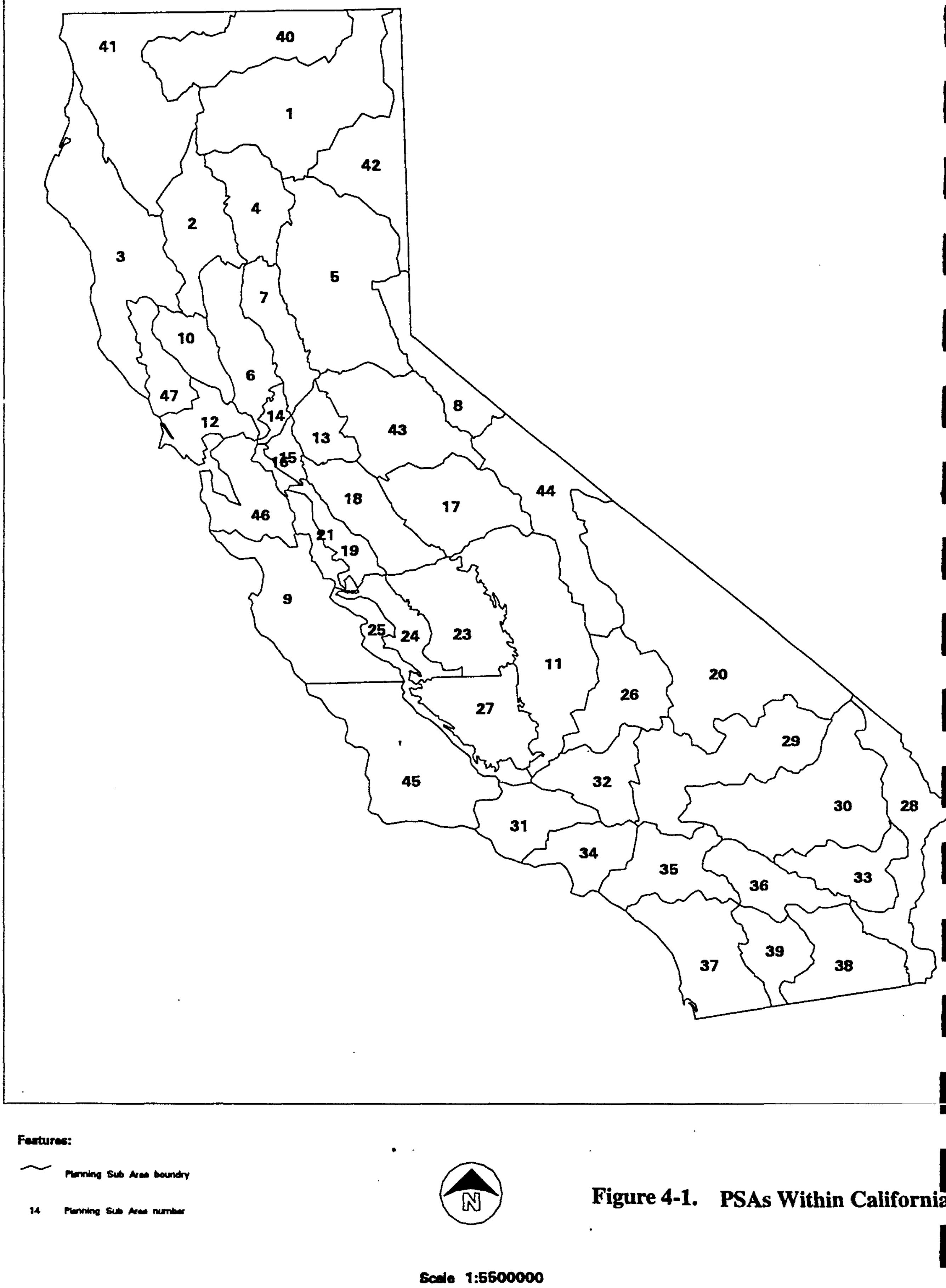

Figure 4-1. PSAs Within California

Table 4-3

1990 and 2010 Urban Water Demand (1)

Hydrologic Study Area	1990 Population(2) (1000's)	2010 Population(2) (1000's)	1990 Urban Demand (1000's af)	2010 Adjusted Urban Demand (3) (1000's af)	1990 and 2010 Per Capita Urban Demand (gpcd)
North Coast	572	789	168	232	260
San Francisco Bay	5,484	6,611	1,184	1,429	190
Central Coast	1,293	1,761	273	371	190
South Coast	16,293	22,098	3,851	5,221	210
Sacramento River	2,209	3,469	745	1,170	300
San Joaquin River	1,430	2,555	495	885	310
Tulare Lake	1,554	2,772	523	930	300
North Lahontan	78	107	37	52	420
South Lahontan	599	1,429	187	443	280
Colorado River	463	818	301	530	580
Total	**29,975**	**42,409**	**7,764**	**11,263**	**230**

(1) Source: DWR Draft California Water Plan Update, Bulletin 160-93.
(2) Population data based on DOF Report 93 P-1.
(3) 2010 Adjusted Urban Demand calculated using 1990 per capita demand mutiplied by the 2010 population. This does not include affects of conservation measures.

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Table 4-4

1990 Percentage of Urban Water Use by Sector (1)

Hydrologic Study Area	Per Capita 1990 Urban Demand(2) (gpcd)	Residential	Commercial	Governement	Industrial	Miscellaneous	Comments
North Coast	260	28%	8%	6%	44%	14%	Above average industrial water use from wood and pulp processing plants.
San Francisco Bay	190	54%	21%	7%	10%	8%	Recent reductions in per capita water use due to conservation efforts in 1987-1992 drought.
Central Coast	190	42%	13%	4%	31%	10%	Urban water demand relatively stable because of few water intensive industries and balance between single family and multi-family units.
South Coast	210	59%	19%	11%	31%	9%	Redevelopment of urban areas from single family units to multi-family units decreases household water use.
Sacramento River	300	39%	10%	6%	7%	9%	High industrial use includes food and wood processing.
San Joaquin River	310	41%	4%	8%	41%	6%	High industrial use includes food
Tulare Lake	300	38%	7%	3%	43%	9%	High industrial use due to food processing and petroleum refining and production.
North Lahontan	420	43%	19%	14%	9%	15%	High per capita water use includes heavy tourist demands in Tahoe Basin.
South Lahontan	280	55%	19%	11%	5%	10%	Limited industrial use, most of urban demand from residential sector.
Colorado River	580	58%	23%	3%	2%	14%	Recreation and resort facilities increase per capita demand to highest levels in state.
Total	**230**	**54%**	**17%**	**9%**	**10%**	**10%**	

(1) Source: DWR Draft California Water Plan Update, Bulletin 160-93

(2) Based on Table 17

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Table 4-5 Projected 2010 Urban Water Demand (1)							
	Residential						Total
Hydrologic Study Area	Indoor (1000 af)	Outdoor (1000 af)	Commercial (1000 af)	Government (1000 af)	Industrial (1000 af)	Miscellaneous (1000 af)	Demand (1000 af)
North Coast	62	3	19	14	102	32	232
San Francisco Bay	593	179	300	100	143	114	1429
Central Coast	138	18	48	15	115	37	371
South Coast	1979	1102	992	313	365	470	5221
Sacramento River	311	145	117	129	363	105	1170
San Joaquin River	229	134	35	71	363	53	885
Tulare Lake	248	105	65	27	401	84	930
North Lahontan	10	12	10	7	5	8	52
South Lahontan	127	117	84	49	22	44	443
Colorado River	73	234	122	16	11	74	530
Total	**3,770**	**2,049**	**1,792**	**741**	**1,890**	**1,021**	**11,263**

(1) Based onTables 17 and 18.

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Governmental. In 1990, governmental water demand varied from 3 to 14 percent of total urban water demand in individual HRs and averaged 10 percent statewide. This value averaged over the statewide population is about 23 gallons per capita day.

Industrial. In 1990, industrial water demand varied from 2 to 44 percent of total urban water demand in individual HRs and averaged 9 percent statewide. This value averaged over the statewide population is about 21 gallons per capita day.

Industrial water demand decreased significantly in the 1980s as many industries implemented water conservation programs to reduce the costs of producing goods and services. Two motivating factors are responsible for reducing industrial water consumption. First, by becoming more water efficient industries can extend their water supplies, especially during prolonged droughts, and reduce the risk of production cutbacks due to deficient water supplies. Second, more efficient water use reduces expensive wastewater treatment costs.

Miscellaneous. Miscellaneous water is essentially the losses that occur during water deliveries, fire water, and unmetered municipal uses. In 1990, these demands varied from 6 to 15 percent of total urban water demand in individual HRs and averaged 10 percent statewide. This value averaged over the statewide population is about 23 gallons per capita day.

4.3 - Determining Option Potential

Water conservation measures for each urban sector are addressed in sections of the MOU's BMPs as shown in Table 4-1. Table 4-2 identifies unit water savings associated with those BMPs. Two components are used to estimate potential water savings through implementation of urban water conservation measures. First, savings are estimated by assigning conservation values to each of the five sectors of urban water demand. Second, a compliance rating is used to represent the percentage of a given sector that will participate in implementing conservation measures. The compliance rating varies by urban sector and by HR to account for different existing levels of conservation already in place. For example, many industries implemented conservation measures before 1990 to improve cost effectiveness and extend limited water supplies. Only industries that have not yet implemented BMPs will achieve water savings. Thus, future compliance rates for industrial conservation are assumed to be less than 100 percent. Several different water conservation analyses were conducted to incorporate a range of compliance rates. Table 4-6 shows compliance and conservation rates used in this analysis. The following sections describe water conservation savings and compliance rates for each urban sector. Compliance rates used in this first analysis step do not consider cost-benefits implications.

Table 4-6 Assumed Compliance Rates (%)						
	Residential					
Hydrologic Study Area	Indoor	Outdoor	Commercial	Government	Industrial	Miscellaneous
North Coast	75%	75%	50%	50%	50%	100%
San Francisco Bay	50%	50%	50%	50%	50%	100%
Central Coast	75%	75%	50%	50%	50%	100%
South Coast	75%	75%	50%	50%	50%	100%
Sacramento River	75%	75%	50%	50%	50%	100%
San Joaquin River	75%	75%	50%	50%	50%	100%
Tulare Lake	75%	75%	50%	50%	50%	100%
North Lahontan	75%	75%	50%	50%	50%	100%
South Lahontan	75%	75%	50%	50%	50%	100%
Colorado River	75%	75%	50%	50%	50%	100%

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4.3.1 Residential Water Conservation

Total residential water conservation varies throughout the state based on the balance between single- and multi-family units, extent of ornamental landscaping, average income, and climate. For this analysis, the compliance rate for both indoor and outdoor water conservation is assumed to range from 50 to 75 percent, as shown in Table 4-6.

Indoor Water Conservation. Much indoor water use occurs in the bathroom, so this is a source of significant water savings. Before 1980, toilets typically used 5 to 7 gallons per flush. After 1980, low-flush toilets used 3.5 gallons per flush. As of January 1, 1992 all new construction of residential and nonresidential structures is required to use the new ultra-low flush toilet (1.6 gallons/flush). Also, renovation of many houses built before 1980 will require replacement of high volume toilets with ultra-low flow toilets. Additional water savings is possible by replacing 5- to 8-gallons-per-minute shower heads with low-flow shower heads and flow restrictors, which use 1.3 to 2.1 gallons per minute.

Some of these improvements are made during change of ownership of households. Other conservation activities result from water district-sponsored events such as toilet replacement programs or district-provided plumbing retrofit kits.

Water-using appliances are also becoming more efficient. Assuming the average life of a dishwasher or washing machine is 15 years, older, less water-efficient models will continually be replaced by more efficient models. Besides water savings, reduced hot water use saves on energy costs.

The Draft DWR Bulletin 160-93 assumes that in 1990 indoor water use averaged about 80 gallons per capita day. This is consistent with the American Water Works Association (AWWA, 1987) estimate of 77.3 gallons per capita day for a nonconserving household. The same publication estimates that a conserving household would average about 60 gallons per capita day. This 25 percent savings includes using ultra-low flush toilets, low-flow shower heads, and more efficient water-using appliances such as dishwashers and washing machines. For this analysis, 25 percent savings to indoor use will be applied for those residences that are assumed to comply with the conservation BMPs (that is, 50 to 75 percent of the homes will have a 25 percent reduction in indoor use compared to 1990 levels).

Outdoor Water Conservation. Xeriscaping has become more common in California as the state struggled through the recent drought. Xeriscaping includes using more water-efficient sprinklers and low-water-using landscaping to reduce outdoor demand. Many water districts provide examples of xeriscaping, and some have initiated programs to reduce the amount of turf and other high-water-using landscapes. As of January 1993, water-efficient landscaping became law under the Water Conservation in Landscaping Act of 1990.

For this analysis, outdoor water conservation assumes total xeriscaping of all areas. AWWA sites studies that show xeriscaping can reduce outdoor water demand by up to 50 to 60 percent. For this analysis, a 50 percent reduction is applied to all residential outdoor water demand for the percentage of households in compliance.

4.3.2 Commercial Water Conservation

Existing commercial water users face many of the same issues as the residential users. Some have already implemented water conservation measures such as retrofitting existing plumbing with low-flow fixtures. Water demand will be further reduced by requiring new commercial water users to improve water use efficiency. The MOU quantifies potential savings from commercial water users at 12 percent of existing demand. This value includes both indoor and outdoor water use. For this analysis, the 12 percent savings was used.

Because some commercial water users implemented water conservation measures before 1990, the compliance rate for each HR was assumed to be 50 percent.

4.3.3 Governmental Water Conservation

Existing governmental water users have been faced with many of the same issues as the commercial sector and some also implemented water conservation measures. The MOU quantifies potential savings from governmental water users at 12 percent of existing demand. For this analysis, the 12 percent savings was used. Because some governmental water users implemented water conservation measures before 1990, the compliance rate for each HR was assumed to be 50 percent.

4.3.4 Industrial Water Conservation

The industrial sector initiated significant water conserving measures during the recent drought, including xeriscaping, recycling water, installing ultra-low flush toilets, and repairing leaks. The MOU quantifies potential savings from industrial water users at 15 percent of existing demand. This value includes both indoor and outdoor water demand. For this analysis, the 15 percent savings was used. Because some industrial water users implemented water conservation measures before 1990, the compliance rate for each HR was assumed to be 50 percent.

4.3.5 Miscellaneous Water Conservation

Historically, water districts have had leak detection and repair programs. Increased demands and limited water supplies have focused new attention on this sector for potential savings. In response, many districts developed more rigorous leak detection and repair programs to reduces these losses. The MOU quantifies potential savings from miscellaneous water users at 10 percent of existing demand. For this analysis, the 10 percent savings was used. All miscellaneous water users can reduce the amount of water lost to leaks, so the compliance rate for each HR was assumed to be 100 percent.

4.3.6 Exclusion of Water Meters in Conservation Potential

Using water meters to monitor demands applies to all categories of water use. The primary purpose for installing water meters is to provide an economic incentive to conserve water (by demonstrating exactly how much water is used by a particular customer). Meters themselves

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do not conserve water. The remaining BMPs listed in Table 3-1 were also developed to reduce urban water demand. If conserving BMPs are in place and water use is reduced, installing meters will not result in further reduction of water demand. Thus, additional savings from installing water meters was not included in this analysis. This exclusion will help eliminate the possibility of "double-counting" actual potential conservation quantities.

4.4 - Results

As California's population grows, so will the demand for water by urban users. Many water users may implement water conservation measures to extend limited water supplies to postpone or reduce costs of developing additional water supplies. This analysis assumes that in the year 2010, water supplies will be developed to provide the 11 million acre-feet of urban water demand without implementing any post-1990 conservation measures.

Based on these assumptions, there is a potential savings of 1.8 million acre-feet of water resulting from projected urban water conservation measures. This is about a 16 percent reduction in the 2010 urban demand without post-1990 urban water conservation measures. Table 4-7 summarizes savings from each HR for each sector of urban water demand. Almost 80 percent of the savings results from water savings in the residential sector. This conserved water only extends the secured supplies of the urban sectors, however, and may not necessarily be available for other needs. For example, the non-conserving volume determined for 2010 could extend the conserved supply such that it meets demands in 2020.

A more detailed analysis was completed for the potential conservation savings for the Sacramento River, San Joaquin River, and the Tulare Lake HRs that make up the Central Valley. This was done to identify more urbanized parts of the valley that may provide water from urban water conservation savings to meet local demands. Table 4-8 summarizes potential savings from urban water conservation at the PSA level for the Central Valley. In the Sacramento River HR, 60 percent of the potential savings is available from the Central Basin East PSA, which includes the City of Sacramento. In the San Joaquin River HR, almost 60 percent of the potential savings is available from the Valley East Side PSA, which includes Modesto and Merced. In the Tulare Lake HR, 60 percent of the potential savings is from the Kings-Kaweah-Tule PSA, which includes the City of Fresno. Also in the Tulare Lake HR, the Kern Valley Floor PSA, which includes the City of Bakersfield, accounts for 35 percent of the potential savings for the HR.

Table 4-7

2010 Calculated Water Conservation

Hydrologic Study Area	Residential Indoor (1000 af)	Residential Outdoor (1000 af)	Commercial (1000 af)	Government (1000 af)	Industrial (1000 af)	Miscellaneous (1000 af)	Total Savings (1000 af)	Total Savings (%)
North Coast	12	1	1	1	8	3	26	11%
San Francisco Bay	74	44	18	6	11	11	165	12%
Central Coast	21	6	2	1	7	3	41	11%
South Coast	370	416	60	19	27	47	939	18%
Sacramento River	57	57	7	8	27	10	166	14%
San Joaquin River	48	41	2	4	28	5	129	15%
Tulare Lake	53	36	2	4	29	6	130	14%
North Lahontan	2	5	1	0	0	1	8	15%
South Lahontan	24	44	5	3	2	5	82	19%
Colorado River	13	89	7	1	1	7	119	22%
TOTAL	**674**	**739**	**105**	**47**	**140**	**99**	**1,803**	**16%**

Table 4-8
2010 Calculated Water Conservation Savings for Central Valley by Planning Study Area

Planning Study Areas	Residential Indoor (1000 af)	Residential Outdoor (1000 af)	Commercial (1000 af)	Governmental (1000 af)	Industrial (1000 af)	Miscellaneous (1000 af)	Total (1000 af)
SACRAMENTO RIVER REGION							
Shasta-Pit	1.0	0.1	0.1	0.1	0.3	0.1	**1.7**
Northwest Valley	4.2	2.5	0.4	0.5	1.7	0.7	**10.0**
Northeast Valley	5.9	1.6	0.5	0.6	2.1	0.8	**11.5**
Southeast	5.6	6.3	0.7	0.8	2.8	1.1	**17.3**
Central Basin West	5.7	5.3	0.7	0.8	2.7	1.0	**16.2**
Central Basin East	32.2	37.8	4.2	4.6	16.3	6.3	**101.4**
Southwest	0.8	0.7	0.1	0.0	0.3	0.1	**2.0**
Delta Service Area	1.3	3.1	0.2	0.3	0.9	0.3	**6.1**
Total	**56.7**	**57.4**	**6.9**	**7.7**	**27.1**	**10.4**	**166.2**
SAN JOAQUIN RIVER REGION							
Sierra Foothills	5.3	0.6	0.2	0.4	2.2	0.4	**9.1**
Eastern Valley Floor	6.7	4.0	0.3	0.5	3.5	0.7	**15.7**
Delta Service Area	4.8	1.3	0.2	0.3	2.2	0.4	**9.2**
Western Uplands	4.3	4.8	0.2	0.4	2.7	0.5	**12.9**
East Side Uplands	0.9	0.8	0.0	0.1	0.5	0.1	**2.4**
Valley East Side	24.7	29.0	1.2	2.4	15.7	3.1	**76.1**
Valley West Side	1.6	1.3	0.1	0.1	0.9	0.2	**4.2**
West Side Uplands	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**48.3**	**41.8**	**2.2**	**4.2**	**27.7**	**5.4**	**129.6**
TULARE LAKE REGION							
Uplands	1.9	0.2	0.1	0.1	0.8	0.2	**3.3**
Kings-Kaweah-Tule	33.7	20.2	1.4	2.7	17.5	3.4	**78.9**
San Luis West Side	1.0	0.3	0.0	0.1	0.5	0.1	**2.0**
Western Uplands	0.2	0.2	0.0	0.0	0.1	0.0	**0.5**
Kern Valley Floor	16.5	15.5	0.8	1.5	9.7	1.9	**45.9**
Total	**53.3**	**36.4**	**2.3**	**4.4**	**28.6**	**5.6**	**130.6**

4.4.1 - Realignment of Central Valley Results

As was done for agricultural options (see Section 3.3.1), results for conservation potential within cities in the Central Valley was realigned to match a new set of 11 regions (Figure 3-7, Table 3-10). This was completed to allow for appropriate comparison of urban conservation potential with other options identified under the Water Augmentation Program. It is important to remember that urban conservation potential only exists within distinct urban areas in the region and not throughout the region.

Potential has also been identified for 6 particular geographic areas. These areas have been separated out because of their ability to import surface water from the Delta. If conservation measures were implemented, the water could be available in the Delta for augmentation purposes. However, only a portion of the potential designated for a particular HSA is applicable. For example, of the approximately 120 TAF of residential conservation potential in the San Francisco HSA (Table 4-7), only an estimated 30 TAF of conservation is related to imported water sources. These can be attributed to diversions on the Contra Costa Canal, and South and North Bay Aqueducts. Table 4-9 shows the yield increase potential related to conservation of residential water use realigned under regions and particular geographic areas.

Table 4-9
Realigned Results

Activity	Annual Yield (1,000 AF)	Activity	Annual Yield (1,000 AF)
Region 1		**Region 2**	
Residential (in/outdoor)	15	Residential (in/outdoor)	15
Region 3		**Region 4**	
Residential (in/outdoor)	50	Residential (in/outdoor)	20
Region 5		**Region 6**	
Residential (in/outdoor)	30	Residential (in/outdoor)	5
Region 7		**Region 8**	
Residential (in/outdoor)	25	Residential (in/outdoor)	25
Region 9		**Region 10**	
Residential (in/outdoor)	- none identified -	Residential (in/outdoor)	55
Region 11		**North Bay Aqueduct**	
Residential (in/outdoor)	30	Residential (in/outdoor)	10
Contra Costa W.D.		**South Bay Aqueduct**	
Residential (in/outdoor)	10	Residential (in/outdoor)	10
San Felipe Division		**Central Coast**	
Residential (in/outdoor)	10	Residential (in/outdoor)	15
Southern California			
Residential (in/outdoor)	415		

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Section 5

Cost Characterization

Cost estimates have been made for the selected agricultural and urban demand management options identified in the preceding sections.

5.1 - Agricultural Demand Management

As determined in Section 3, potential exists for demand management through implementation of on-farm or district water conservation targeting irretrievable losses, drainage reclamation, and reduction in conveyance losses (namely canal seepage and riparian vegetation consumption).

5.1.1 - Agricultural Water Management

Agricultural water management is the term used to describe the on-farm and related district level improvements that will reduce on-farm evaporation and irretrievable losses. This term includes the options identified as improved irrigation performance, canal lining, spill reduction, and non-leak gates.

Total agricultural water conservation potential was computed for regions in California based on the quantity of eligible losses. Following is a description of the analysis used to estimate the conservation potential for the following cost ranges:

- Less than $100/AF
- $100/AF to $200/AF
- $200/AF to $500/AF
- Greater than $500/AF

Only conservation potential in PSA's with greater than 5,000 AF of either conveyance or irretrievable losses was distributed into the cost ranges. Identified values of recoverable losses within PSA's or HR's were not distributed within the cost range.

Input Costs. On-farm irrigation system costs were adapted from Young, et al. (1994) and were given in the units of dollars per acre per year by irrigation method and management level. Water costs were adapted from the Central Valley Production Model (Hatchett, 1994) and were given in the units of dollars per acre-foot by region. Irrigation district costs were not included in the economic analysis, but were included as part of the sensitivity analysis.

Computation of Eligible Losses. A spreadsheet model was developed that used the cropping data for each region to compute the losses for each cost range. The basis for the computations is the cost and performance relationships presented originally by Gohring, et al

(1989) in which costs and applied water destinations are presented for low, medium and high irrigation management levels and various crops.

The existing eligible losses for each crop and region were computed from supporting data from the Draft California Water Plan (DWR, 1994).

Marginal Cost Curve. For each region and crop, the cost and eligible losses were computed for the appropriate array of irrigation methods and management levels. Figure 5-1 shows these values plotted for tree and vine crops in the San Luis region. The label prefixes represent the irrigation system type (Gohring, 1988). The label extensions represent the management level.

The lowest cost point in the array defines the beginning of the marginal cost curve. The remaining points along the marginal cost curve are those above and to the left of the least cost point and define the leading edge of the array (Figure 5-1).

Marginal Cost Curve Derivative. To estimate the cost of reducing eligible losses, a numerical derivative was taken of each marginal cost curve (Figure 5-2). The loss reduction (conservation) potential for each cost range was determined from a numerical solution of the derivative at different unit costs. For example, the conservation potential between $200/AF and $500/AF is L(200) - L(500). In some cases (e.g., Le < L(100) as shown in Figure 5-2), the existing losses are less than the losses computed at a particular unit cost. This indicates that on average, the farms in this region have already invested more than $100/AF into irrigation performance and there is no conservation potential below that cost.

The conservation potential above $500/AF is L(500) - Lmin. Lmin is the minimum practical eligible loss given current technologies. The conservation potential for each region and cost range is computed as the sum of the potentials for each crop group (Table 5-1).

Table 5-1
Agricultural Conservation Potential (Acre-Feet/Year)

Region	Cost Range ($/AF) Less than 100	100 to 200	200 to 500	Over 500	Total
Valley East Side	0	0	0	57,300	57,300
Valley West Side	0	1,000	2,600	48,600	52,200
Kings, etc.	0	0	4,700	106,500	111,200
San Luis	0	14,300	21,600	43,100	79,000
Kern Valley Floor	0	0	26,500	75,500	102,000
Coachella Valley	0	1,100	12,800	6,000	19,900
Imperial Valley	2,500	77,200	31,600	62,900	174,200
Total	2,500	93,600	99,800	399,900	595,800

Figure 5-1
Cost vs. Consumptive and Degraded Loss and Marginal Cost Curve
(Region: TL - San Luis; Crop: Trees/Vines)

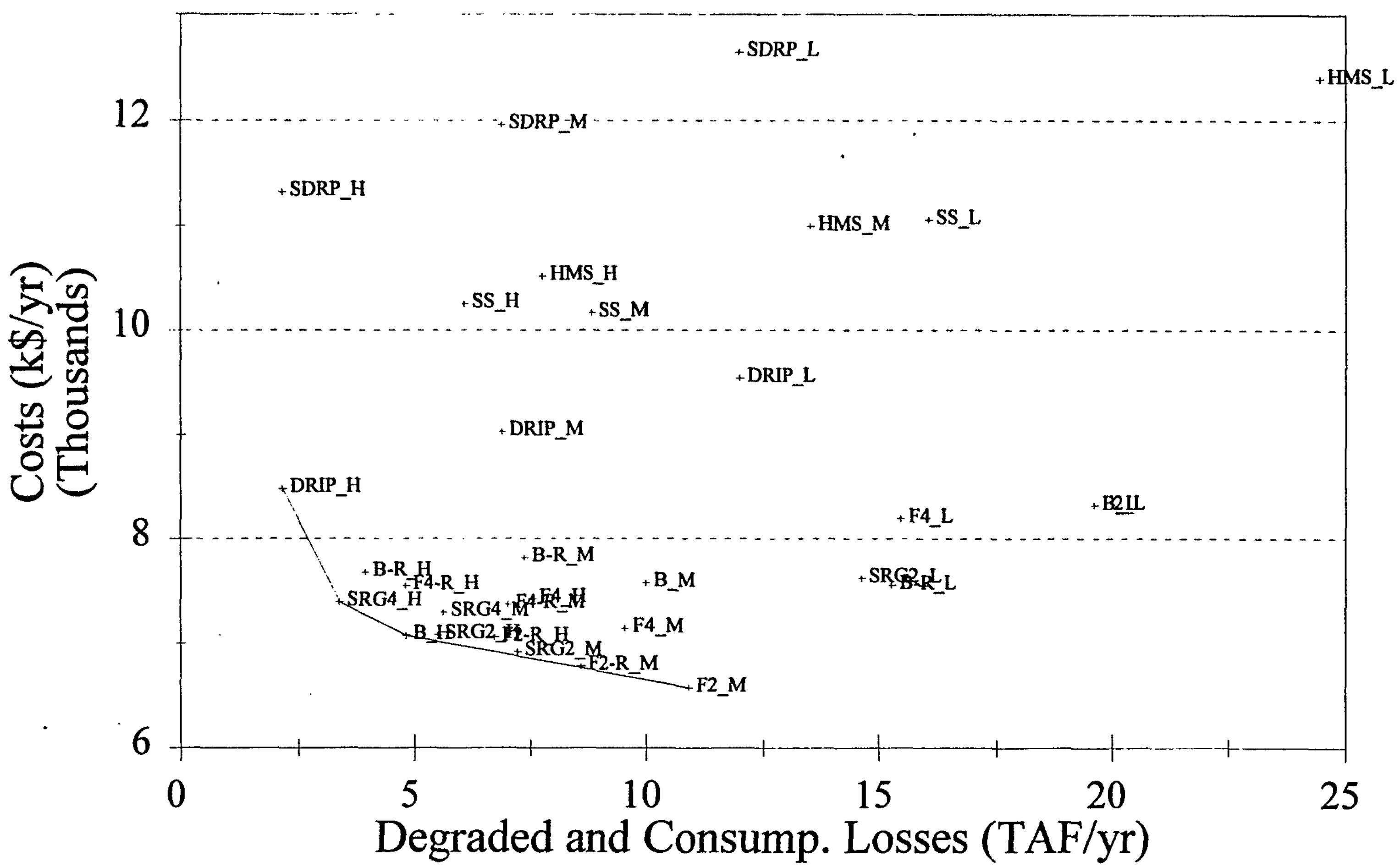

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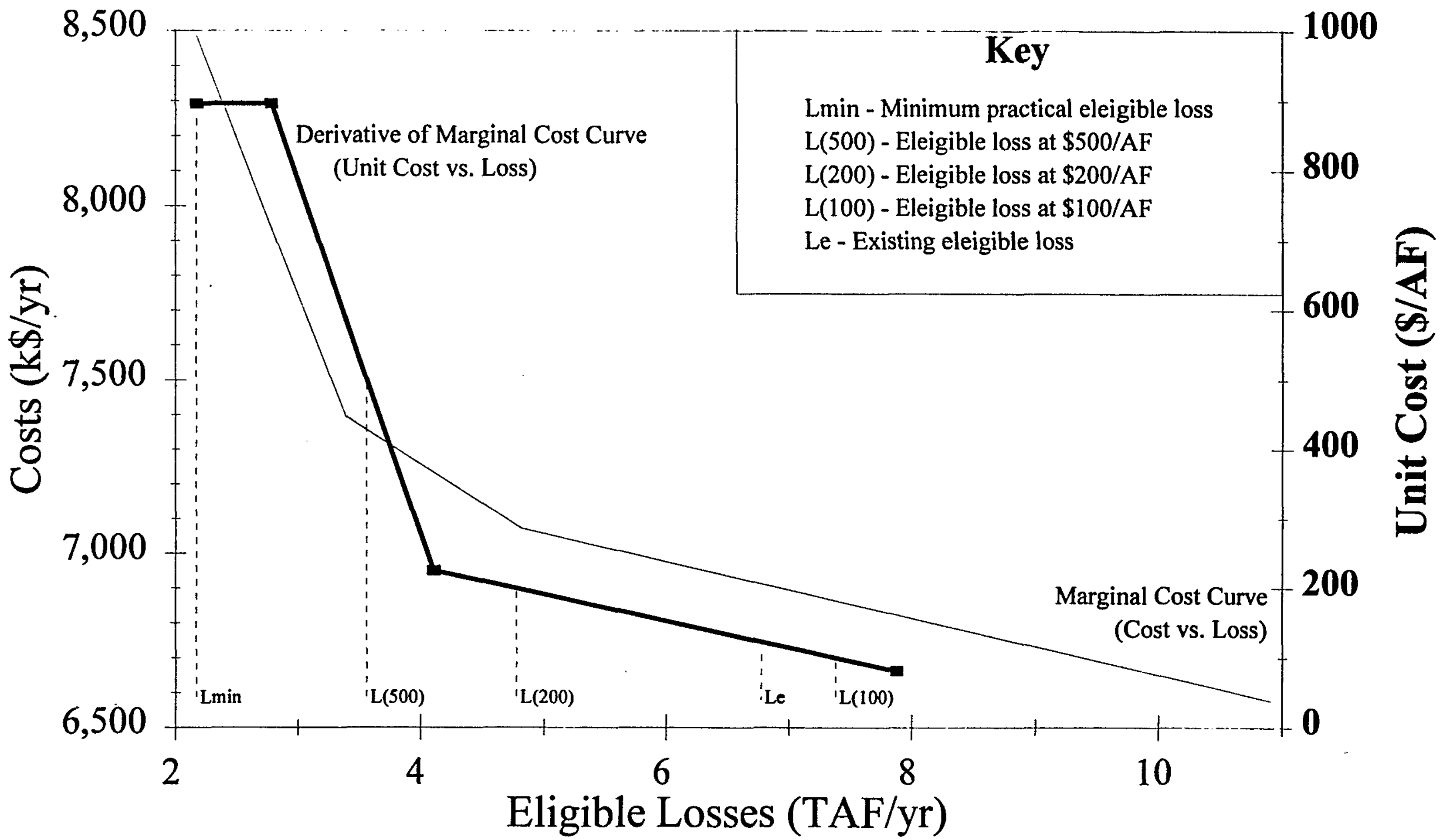
Figure 5-2
Marginal Cost Curve and Derivative
(Region: TL - San Luis; Crop: Trees/Vines)



Sensitivity Analysis. An analysis was conducted to determine the sensitivity of the above cost potentials to the inclusion of irrigation district costs. The sensitivity analysis was conducted on the Kern Valley Floor region because this region has a combination of both drainage affected and well-drained land. The analysis included four tiers of district-level conservation costs (Table 5-2).

The kinds of improvements that would be funded by these district-level costs include canal automation, improved operations, improved delivery gates, canal rehabilitation, etc. These type of activities would tend to enable on-farm water conservation by increasing the flexibility and reliability of the irrigation water supplies.

Table 5-2
District-Level Conservation Costs Used in Sensitivity Analysis
($/Acre/Year)

	On-Farm Irrigation Management Level		
Analysis Case	**Low**	**Medium**	**High**
Base	0	0	0
1	0	5	10
2	0	10	20
3	0	15	30
4	0	20	40

These rough costs were estimated from anecdotal information from the Merced and Imperial Irrigation District water conservation programs. The Merced project was estimated to contain flexibility improvement costs of approximately $25 per acre per year (of the total estimated project cost of $50 million, flexibility-related costs were about $25 million in capital costs for 100,000 acres). The flexibility portion of the Imperial project was estimated to cost approximately $15 per acre per year (Of the total estimated project cost of $120 million, flexibility-related costs were about $75 million in capital costs for 500,000 acres).

The mid-range between these costs is represented by the high management level costs of Case 2. Low management costs were assumed to be zero and medium management costs to be the average of the low and high costs.

The conservation potentials for each unit cost range were found to be relatively insensitive to district-level costs below $30 per acre (Case 3). The slight increase in potential within the $100 to $200 per acre-foot range is due to the introduction of a district-level costs at the medium and high levels. Without any district-level costs, the losses at $200 per acre-foot (for the base condition) are greater than the existing losses, resulting in no conservation potential. With the introduction of medium and high costs, the losses at $200 per acre are shifted slightly below the existing losses, creating a slight potential.

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Table 5-3 Results of Sensitivity Analysis: Conservation Potential for the Kern Valley Floor Region (Acre-Feet/Year)					
	Cost Range ($/AF)				
Analysis Case	Less than 100	100 to 200	200 to 500	Over 500	Total
Base	0	0	26,500	75,200	101,700
1	0	600	28,100	73,000	101,700
2	0	100	25,100	76,500	101,700
3	0	0	12,100	89,600	101,700
4	0	0	4,800	96,900	101,700

The relative insensitivity of the conservation potential below the $30 per acre per year district cost was considered sufficient evidence of the validity of the economic computations given the scope of this study.

5.1.2 - Agricultural Drainage Reclamation

Drainwater reclamation costs were estimated using those given by CH2M HILL (1986) for the San Joaquin Valley Drainage Program (Table 5-4). Construction costs were updated to 1994 levels with the Construction Cost Index (???, 19??) 1994:1985 ratio of 1.29. Treatment (primarily energy related) and disposal costs were updated using the Consumer Price Index 1994:1985 ratio of 1.29 (149.5 / 108.7).

Table 5-4 Summary of Drainwater Reclamation Costs			
Item	1985 Cost ($/kgal)[1]	1985 to 1994 Cost Ratio	1985 Cost ($/kgal)
Construction	0.65	1.290[2]	0.84
Desalting	2.70	1.375[3]	3.71
Disposal	1.70	1.375[3]	2.34
Total			6.89 ($ 2,245 / AF)

Notes:
[1] From CH2M HILL (1986)
[2] ??? (19??)
[3] U.S. Department of Labor (1994)

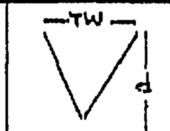
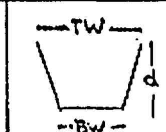
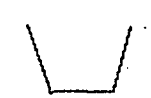
5.1.3 - Canal Lining

Canal lining costs were developed by estimating canal cross-sections and seepage rates for five typical canals sizes and three different soil types. Table 5-5 shows the values used in estimating seepage quantities and lining or piping costs. This report did not attempt to determine the type and quantity of canals present in the various regions that would correspond to the values shown for canal lining. Therefore, the "medium district canal" was chosen as a representative lining project and an average between the medium and heavy soil seepage was assumed (most lining does not make sense on sandy soils because of the recharge benefit of these soil types to the groundwater). Based on this assumption, canal lining would cost approximately $160/af

5.2 - Urban Demand Management

As determined in Section 4, potential exists for reductions in the per capita use of residential indoor and outdoor needs. Activities listed in Table 4-1 would need to be implemented in order to achieve the potential quantities identified. According to DWR's Draft California Water Plan (Bulletin 160-93), urban conservation costs range from $315 to $390. These values included capital and operation and maintenance costs discounted over a 50 year period at 6 percent. The $315 corresponds to residential water audit programs and the $390 corresponds to ultra low flush toilet replacement programs (see Table 4-1). The DWR values were originally from a 1988 report and were updated in Bulletin 160-93 to reflect current conditions.

Table 5-5
Cost and Performance of Canal Lining and Piping

			Pre-Project					Post-Project				
			Typical Characteristics		Seepage (cfs/mile) Soil Type				Typical Characteristics			
Level	Description	Typical Q (cfs)	Shape	Geometry	Light	Medium	Heavy	Leakage (cfs/mile)	Shape	Geometry	Capital Costs ($/mi)	Annual O&M Costs ($/mi/yr)
1	Small Lateral	15		TW: 7.40 d: 1.85 s: 0.0017	0.7	0.4	0.1	0.0		Dia: 2.6 s: 0.0017	811,800	-2500
2	Typical Lateral	50		TW: 12.40 BW: 4.00 d: 2.10 s: 0.0017	1.2	0.7	0.2	0.0		TW: 9.85 BW: 2.00 d: 1.96 s: 0.0017	117,900	-2500
3	Medium District Main	150		TW: 21.20 BW: 6.00 d: 3.80 s: 0.0008	2.1	1.2	0.3	0.1		TW: 17.26 BW: 4.00 d: 3.32 s: 0.0008	204,000	-2500
4	Large District Main	1,500		TW: 69.00 BW: 25.00 d: 11.00 s: 0.0002	6.7	3.8	0.8	0.2		TW: 53.56 BW: 14.00 d: 9.89 s: 0.0002	1,070,800	-2500
5	Regional Distribution Canal	5,000		TW: 132.00 BW: 80.00 d: 13.00 s: 0.0002	12.9	7.3	1.6	0.3		TW: 91.46 BW: 40.00 d: 12.87 s: 0.0002	2,532,700	-2500

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Attachment

Potential of Demand Management Options: SR-Shasta* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	9,100	5,800	---	---	---	---
Conveyance	20,300	---	---	20,300	---	---
Sub-total	29,400	5,800	0	20,300	0	0
Recoverable Loss						
On-farm TW	12,600	8,700	---	---	---	---
On-farm DP & seep.	104,400	78,500	---	---	---	---
Convey. seep.	25,900	---	---	23,310	---	---
Canal spillage	19,500	---	---	---	17,550	---
Gate Leakage	4,900	---	---	---	---	4,410
Sub-total	167,300	87,200	0	23,310	17,550	4,410
Irrecoverable Loss						
Leaching Req'mt	3,100	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	3,100	0	0	0	0	0
Total	199,800	93,000	0	43,610	17,550	4,410

* Refer to Table 3-2.

Potential of Demand Management Options: SR-N.W. Valley* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	10,100	7,600	---	---	---	---
Conveyance	33,600	---	---	33,600	---	---
Sub-total	43,700	7,600	0	33,600	0	0
Recoverable Loss						
On-farm TW	12,800	9,600	---	---	---	---
On-farm DP & seep.	110,700	81,100	---	---	---	---
Convey. seep.	66,500	---	---	59,850	---	---
Canal spillage	13,400	---	---	---	12,060	---
Gate Leakage	3,300	---	---	---	---	2,970
Sub-total	206,700	90,700	0	59,850	12,060	2,970
Irrecoverable Loss						
Leaching Req'mt	3,400	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	3,400	0	0	0	0	0
Total	253,800	98,300	0	93,450	12,060	2,970

* Refer to Table 3-2.

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Potential of Demand Management Options: SR-N.E. Valley* (Acre-Feet / Year)						
Demand Element	**Demand Management Options**					
	Existing Condition	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	6,200	5,400	---	---	---	---
Conveyance	17,900	---	---	17,900	---	---
Sub-total	24,100	5,400	0	17,900	0	0
Recoverable Loss						
On-farm TW	7,000	6,200	---	---	---	---
On-farm DP & seep.	66,700	47,400	---	---	---	---
Convey. seep.	26,200	---	---	23,580	---	---
Canal spillage	6,400	---	---	---	5,760	---
Gate Leakage	1,600	---	---	---	---	1,440
Sub-total	107,900	53,600	0	23,580	5,760	1,440
Irrecoverable Loss						
Leaching Req'mt	2,200	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	2,200	0	0	0	0	0
Total	134,200	59,000	0	41,480	5,760	1,440

* Refer to Table 3-2.

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Potential of Demand Management Options: SR-S.E.* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	**Existing Condition**	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	7,400	5,100	---	---	---	---
Conveyance	18,700	---	---	18,700	---	---
Sub-total	26,100	5,100	0	18,700	0	0
Recoverable Loss						
On-farm TW	13,100	10,700	---	---	---	---
On-farm DP & seep.	93,700	73,900	---	---	---	---
Convey. seep.	57,800	---	---	52,020	---	---
Canal spillage	16,400	---	---	---	14,760	---
Gate Leakage	4,100	---	---	---	---	3,690
Sub-total	185,100	84,600	0	52,020	14,760	3,690
Irrecoverable Loss						
Leaching Req'mt	2,400	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	2,400	0	0	0	0	0
Total	213,600	89,700	0	70,720	14,760	3,690

* Refer to Table 3-2.

Potential of Demand Management Options: SR-Central W.* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	91,600	52,300	---	---	---	---
Conveyance	107,100	---	---	107,100	---	---
Sub-total	198,700	52,300	0	107,100	0	0
Recoverable Loss						
On-farm TW	106,800	18,000	---	---	---	---
On-farm DP & seep.	851,500	604,700	---	---	---	---
Convey. seep.	147,100	---	---	132,390	---	---
Canal spillage	113,900	---	---	---	102,510	---
Gate Leakage	28,500	---	---	---	---	25,650
Sub-total	1,247,800	622,700	0	132,390	102,510	25,650
Irrecoverable Loss						
Leaching Req'mt	17,600	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	17,600	0	0	0	0	0
Total	1,464,100	675,000	0	239,490	102,510	25,650

* Refer to Table 3-2.

Potential of Demand Management Options: SR-Central E.* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	108,500	58,000	---	---	---	---
Conveyance	195,900	---	---	195,900	---	---
Sub-total	304,400	58,000	0	195,900	0	0
Recoverable Loss						
On-farm TW	102,800	0	---	---	---	---
On-farm DP & seep.	897,200	615,200	---	---	---	---
Convey. seep.	200,200	---	---	180,180	---	---
Canal spillage	131,100	---	---	---	117,990	---
Gate Leakage	32,800	---	---	---	---	29,520
Sub-total	1,364,100	615,200	0	180,180	117,990	29,520
Irrecoverable Loss						
Leaching Req'mt	17,800	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	17,800	0	0	0	0	0
Total	1,686,300	673,200	0	376,080	117,990	29,520

* Refer to Table 3-2.

Potential of Demand Management Options: SR-S.W.* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	**Existing Condition**	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	1,700	1,300	---	---	---	---
Conveyance	2,200	---	---	2,200	---	---
Sub-total	3,900	1,300	0	2,200	0	0
Recoverable Loss						
On-farm TW	1,700	1,100	---	---	---	---
On-farm DP & seep.	16,800	11,800	---	---	---	---
Convey. seep.	4,800	---	---	4,320	---	---
Canal spillage	1,200	---	---	---	1,080	---
Gate Leakage	300	---	---	---	---	270
Sub-total	24,800	12,900	0	4,320	1,080	270
Irrecoverable Loss						
Leaching Req'mt	500	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	500	0	0	0	0	0
Total	29,200	14,200	0	6,520	1,080	270

* Refer to Table 3-2.

Potential of Demand Management Options: SR-Delta* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	7,700	6,300	---	---	---	---
Conveyance	37,500	---	---	37,500	---	---
Sub-total	45,200	6,300	0	37,500	0	0
Recoverable Loss						
On-farm TW	18,800	17,200	---	---	---	---
On-farm DP & seep.	114,700	93,900	---	---	---	---
Convey. seep.	56,300	---	---	50,670	---	---
Canal spillage	9,000	---	---	---	8,100	---
Gate Leakage	2,200	---	---	---	---	1,980
Sub-total	201,000	111,100	0	50,670	8,100	1,980
Irrecoverable Loss						
Leaching Req'mt	9,300	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	9,300	0	0	0	0	0
Total	255,500	117,400	0	88,170	8,100	1,980

* Refer to Table 3-2.

D—045877

Potential of Demand Management Options: SJ-Sierra* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	400	300	---	---	---	---
Conveyance	1,200	---	---	1,200	---	---
Sub-total	1,600	300	0	1,200	0	0
Recoverable Loss						
On-farm TW	700	600	---	---	---	---
On-farm DP & seep.	5,200	4,100	---	---	---	---
Convey. seep.	10,600	---	---	9,540	---	---
Canal spillage	1,100	---	---	---	990	---
Gate Leakage	300	---	---	---	---	270
Sub-total	17,900	4,700	0	9,540	990	270
Irrecoverable Loss						
Leaching Req'mt	100	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	100	0	0	0	0	0
Total	19,600	5,000	0	10,740	990	270

* Refer to Table 3-2.

Potential of Demand Management Options: SJ-E. Valley Floor* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	18,000	15,200	---	---	---	---
Conveyance	11,800	---	---	11,800	---	---
Sub-total	29,800	15,200	0	11,800	0	0
Recoverable Loss						
On-farm TW	37,300	33,100	---	---	---	---
On-farm DP & seep.	245,800	193,100	---	---	---	---
Convey. seep.	22,800	---	---	20,520	---	---
Canal spillage	12,600	---	---	---	11,340	---
Gate Leakage	3,200	---	---	---	---	2,880
Sub-total	321,700	226,200	0	20,520	11,340	2,880
Irrecoverable Loss						
Leaching Req'mt	5,800	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	5,800	0	0	0	0	0
Total	357,300	241,400	0	32,320	11,340	2,880

* Refer to Table 3-2.

Potential of Demand Management Options: SJ-Delta* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	12,500	10,600	---	---	---	---
Conveyance	33,400	---	---	33,400	---	---
Sub-total	45,900	10,600	0	33,400	0	0
Recoverable Loss						
On-farm TW	29,100	27,100	---	---	---	---
On-farm DP & seep.	181,000	147,900	---	---	---	---
Convey. seep.	17,000	---	---	15,300	---	---
Canal spillage	16,000	---	---	---	14,400	---
Gate Leakage	4,000	---	---	---	---	3,600
Sub-total	247,100	175,000	0	15,300	14,400	3,600
Irrecoverable Loss						
Leaching Req'mt	15,000	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	15,000	0	0	0	0	0
Total	308,000	185,600	0	48,700	14,400	3,600

* Refer to Table 3-2.

Potential of Demand Management Options: SJ-W. Uplands* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	800	700	---	---	---	---
Conveyance	2,000	---	---	2,000	---	---
Sub-total	2,800	700	0	2,000	0	0
Recoverable Loss						
On-farm TW	1,500	1,300	---	---	---	---
On-farm DP & seep.	10,400	8,000	---	---	---	---
Convey. seep.	5,500	---	---	4,950	---	---
Canal spillage	2,500	---	---	---	2,250	---
Gate Leakage	600	---	---	---	---	540
Sub-total	20,500	9,300	0	4,950	2,250	540
Irrecoverable Loss						
Leaching Req'mt	300	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	300	0	0	0	0	0
Total	23,600	10,000	0	6,950	2,250	540

* Refer to Table 3-2.

Potential of Demand Management Options: SJ-E. Uplands* (Acre-Feet / Year)						
Demand Element	**Demand Management Options**					
	Existing Condition	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	100	100	---	---	---	---
Conveyance	600	---	---	600	---	---
Sub-total	700	100	0	600	0	0
Recoverable Loss						
On-farm TW	300	300	---	---	---	---
On-farm DP & seep.	2,100	1,700	---	---	---	---
Convey. seep.	0	---	---	0	---	---
Canal spillage	800	---	---	---	720	---
Gate Leakage	200	---	---	---	---	180
Sub-total	3,400	2,000	0	0	720	180
Irrecoverable Loss						
Leaching Req'mt	0	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	0	0	0	0	0	0
Total	4,100	2,100	0	600	720	180

* Refer to Table 3-2.

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Potential of Demand Management Options: SJ-Valley E. Side* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	63,000	53,100	---	---	---	---
Conveyance	171,100	---	---	171,100	---	---
Sub-total	234,100	53,100	0	171,100	0	0
Recoverable Loss						
On-farm TW	99,900	87,900	---	---	---	---
On-farm DP & seep.	768,800	573,100	---	---	---	---
Convey. seep.	141,600	---	---	127,440	---	---
Canal spillage	182,200	---	---	---	163,980	---
Gate Leakage	45,300	---	---	---	---	40,770
Sub-total	1,237,800	661,000	0	127,440	163,980	40,770
Irrecoverable Loss						
Leaching Req'mt	22,300	---	UNSPECIFIED	---	---	---
On-farm TW	100	100	UNSPECIFIED	---	---	---
On-farm DP & seep.	5,100	3,800	UNSPECIFIED	---	---	---
Convey. seep.	900	---	UNSPECIFIED	810	---	---
Canal spillage	200	---	UNSPECIFIED	---	180	---
Gate Leakage	300	---	UNSPECIFIED	---	---	270
Sub-total	28,900	3,900	28,900	810	180	270
Total	1,500,800	718,000	28,900	299,350	164,160	41,040

* Refer to Table 3-2.

D—045883

Potential of Demand Management Options: SJ-Valley W. Side* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	25,400	21,400	---	---	---	---
Conveyance	90,200	---	---	90,200	---	---
Sub-total	115,600	21,400	0	90,200	0	0
Recoverable Loss						
On-farm TW	52,600	47,000	---	---	---	---
On-farm DP & seep.	281,300	246,700	---	---	---	---
Convey. seep.	133,800	---	---	120,420	---	---
Canal spillage	94,100	---	---	---	84,690	---
Gate Leakage	21,400	---	---	---	---	19,260
Sub-total	583,200	293,700	0	120,420	84,690	19,260
Irrecoverable Loss						
Leaching Req'mt	57,600	---	UNSPECIFIED	---	---	---
On-farm TW	1,200	1,100	UNSPECIFIED	---	---	---
On-farm DP & seep.	34,900	30,600	UNSPECIFIED	---	---	---
Convey. seep.	16,600	---	UNSPECIFIED	14,940	---	---
Canal spillage	2,100	---	UNSPECIFIED	---	1,890	---
Gate Leakage	2,700	---	UNSPECIFIED	---	---	2,430
Sub-total	115,100	31,700	115,100	14,940	1,890	2,430
Total	813,900	346,800	115,100	225,560	86,580	21,690

* Refer to Table 3-2.

Potential of Demand Management Options: SJ-W. Side Uplands* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	0	0	---	---	---	---
Conveyance	0	---	---	0	---	---
Sub-total	0	0	0	0	0	0
Recoverable Loss						
On-farm TW	0	0	---	---	---	---
On-farm DP & seep.	0	0	---	---	---	---
Convey. seep.	0	---	---	0	---	---
Canal spillage	0	---	---	---	0	---
Gate Leakage	0	---	---	---	---	0
Sub-total	0	0	0	0	0	0
Irrecoverable Loss						
Leaching Req'mt	0	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	0	0	0	0	0	0
Total	0	0	0	0	0	0

* Refer to Table 3-2.

Potential of Demand Management Options: TL-Uplands* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	600	500	---	---	---	---
Conveyance	900	---	---	900	---	---
Sub-total	1,500	500	0	900	0	0
Recoverable Loss						
On-farm TW	1,200	1,000	---	---	---	---
On-farm DP & seep.	7,300	5,800	---	---	---	---
Convey. seep.	0	---	---	0	---	---
Canal spillage	1,100	---	---	---	990	---
Gate Leakage	300	---	---	---	---	270
Sub-total	9,900	6,800	0	0	990	270
Irrecoverable Loss						
Leaching Req'mt	200	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	700	600	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	900	600	900	0	0	0
Total	12,300	7,900	900	900	990	270

* Refer to Table 3-2.

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Potential of Demand Management Options: TL-Kings-Kaweah-Tule Rivers* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	92,200	83,200	---	---	---	---
Conveyance	120,100	---	---	120,100	---	---
Sub-total	212,300	83,200	0	120,100	0	0
Recoverable Loss						
On-farm TW	130,100	121,100	---	---	---	---
On-farm DP & seep.	1,087,700	766,600	---	---	---	---
Convey. seep.	577,400	---	---	519,660	---	---
Canal spillage	143,100	---	---	---	128,790	---
Gate Leakage	34,600	---	---	---	---	31,140
Sub-total	1,972,900	887,700	0	519,660	128,790	31,140
Irrecoverable Loss						
Leaching Req'mt	38,100	---	UNSPECIFIED	---	---	---
On-farm TW	1,000	900	UNSPECIFIED	---	---	---
On-farm DP & seep.	44,000	31,000	UNSPECIFIED	---	---	---
Convey. seep.	23,400	---	UNSPECIFIED	21,060	---	---
Canal spillage	1,100	---	UNSPECIFIED	---	990	---
Gate Leakage	1,400	---	UNSPECIFIED	---	---	1,260
Sub-total	109,000	31,900	109,000	21,060	990	1,260
Total	2,294,200	1,002,800	109,000	660,820	129,780	32,400

* Refer to Table 3-2.

D—045887

Potential of Demand Management Options: TL-San Luis W. Side* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	24,700	23,000	---	---	---	---
Conveyance	14,300	---	---	14,300	---	---
Sub-total	39,000	23,000	0	14,300	0	0
Recoverable Loss						
On-farm TW	26,000	24,500	---	---	---	---
On-farm DP & seep.	161,900	127,400	---	---	---	---
Convey. seep.	18,800	---	---	16,920	---	---
Canal spillage	32,100	---	---	---	28,890	---
Gate Leakage	5,800	---	---	---	---	5,220
Sub-total	244,600	151,900	0	16,920	28,890	5,220
Irrecoverable Loss						
Leaching Req'mt	79,400	---	UNSPECIFIED	---	---	---
On-farm TW	1,800	1,700	UNSPECIFIED	---	---	---
On-farm DP & seep.	78,600	61,900	UNSPECIFIED	---	---	---
Convey. seep.	9,200	---	UNSPECIFIED	8,280	---	---
Canal spillage	2,200	---	UNSPECIFIED	---	1,980	---
Gate Leakage	2,800	---	UNSPECIFIED	---	---	2,520
Sub-total	174,000	63,600	174,000	8,280	1,980	2,520
Total	457,600	238,500	174,000	39,500	30,870	7,740

* Refer to Table 3-2.

D—045888

Potential of Demand Management Options: TL-W. Uplands* (Acre-Feet / Year)						
Demand Element	**Demand Management Options**					
	Existing Condition	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	0	0	---	---	---	---
Conveyance	0	---	---	0	---	---
Sub-total	0	0	0	0	0	0
Recoverable Loss						
On-farm TW	0	0	---	---	---	---
On-farm DP & seep.	0	0	---	---	---	---
Convey. seep.	0	---	---	0	---	---
Canal spillage	0	---	---	---	0	---
Gate Leakage	0	---	---	---	---	0
Sub-total	0	0	0	0	0	0
Irrecoverable Loss						
Leaching Req'mt	0	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	0	0	0	0	0	0
Total	0	0	0	0	0	0

* Refer to Table 3-2.

Potential of Demand Management Options: TL-Kern Valley Floor* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	46,200	42,100	---	---	---	---
Conveyance	21,500	---	---	21,500	---	---
Sub-total	67,700	42,100	0	21,500	0	0
Recoverable Loss						
On-farm TW	59,400	55,200	---	---	---	---
On-farm DP & seep.	433,600	320,400	---	---	---	---
Convey. seep.	35,800	---	---	32,220	---	---
Canal spillage	49,800	---	---	---	44,820	---
Gate Leakage	10,700	---	---	---	---	9,630
Sub-total	589,300	375,600	0	32,220	44,820	9,630
Irrecoverable Loss						
Leaching Req'mt	59,800	---	UNSPECIFIED	---	---	---
On-farm TW	2,100	1,900	UNSPECIFIED	---	---	---
On-farm DP & seep.	87,000	64,300	UNSPECIFIED	---	---	---
Convey. seep.	7,200	---	UNSPECIFIED	6,480	---	---
Canal spillage	1,700	---	UNSPECIFIED	---	1,530	---
Gate Leakage	2,200	---	UNSPECIFIED	---	---	1,980
Sub-total	160,000	66,200	160,000	6,480	1,530	1,980
Total	817,000	483,900	160,000	60,200	46,350	11,610

* Refer to Table 3-2.

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Potential of Demand Management Options: NC-all* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	15,600	10,600	---	---	---	---
Conveyance	28,900	---	---	28,900	---	---
Sub-total	44,500	10,600	0	28,900	0	0
Recoverable Loss						
On-farm TW	29,500	24,500	---	---	---	---
On-farm DP & seep.	210,300	163,200	---	---	---	---
Convey. seep.	57,800	---	---	52,020	---	---
Canal spillage	37,000	---	---	---	33,300	---
Gate Leakage	9,200	---	---	---	---	8,280
Sub-total	343,800	187,700	0	52,020	33,300	8,280
Irrecoverable Loss						
Leaching Req'mt	5,800	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	5,800	0	0	0	0	0
Total	394,100	198,300	0	80,920	33,300	8,280

* Refer to Table 3-2.

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Potential of Demand Management Options: SF-all* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	1,800	1,700	---	---	---	---
Conveyance	3,300	---	---	3,300	---	---
Sub-total	5,100	1,700	0	3,300	0	0
Recoverable Loss						
On-farm TW	1,300	1,200	---	---	---	---
On-farm DP & seep.	17,400	11,200	---	---	---	---
Convey. seep.	1,300	---	---	1,170	---	---
Canal spillage	3,200	---	---	---	2,880	---
Gate Leakage	800	---	---	---	---	720
Sub-total	24,000	12,400	0	1,170	2,880	720
Irrecoverable Loss						
Leaching Req'mt	700	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	700	0	0	0	0	0
Total	29,800	14,100	0	4,470	2,880	720

* Refer to Table 3-2.

Potential of Demand Management Options: CC-Northern* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	12,200	11,700	---	---	---	---
Conveyance	5,600	---	---	5,600	---	---
Sub-total	17,800	11,700	0	5,600	0	0
Recoverable Loss						
On-farm TW	28,800	28,400	---	---	---	---
On-farm DP & seep.	179,500	139,100	---	---	---	---
Convey. seep.	10,800	---	---	9,720	---	---
Canal spillage	5,300	---	---	---	4,770	---
Gate Leakage	1,300	---	---	---	---	1,170
Sub-total	225,700	167,500	0	9,720	4,770	1,170
Irrecoverable Loss						
Leaching Req'mt	4,700	---	UNSPECIFIED	---	---	---
On-farm TW	200	200	UNSPECIFIED	---	---	---
On-farm DP & seep.	7,300	5,700	UNSPECIFIED	---	---	---
Convey. seep.	400	---	UNSPECIFIED	360	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	100	---	UNSPECIFIED	---	---	90
Sub-total	12,700	5,900	12,700	360	0	90
Total	256,200	185,100	12,700	15,680	4,770	1,260

* Refer to Table 3-2.

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Potential of Demand Management Options: CC-Southern* (Acre-Feet / Year)						
Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	8,100	7,300	---	---	---	---
Conveyance	4,100	---	---	4,100	---	---
Sub-total	12,200	7,300	0	4,100	0	0
Recoverable Loss						
On-farm TW	31,700	30,900	---	---	---	---
On-farm DP & seep.	154,800	135,400	---	---	---	---
Convey. seep.	7,900	---	---	7,110	---	---
Canal spillage	3,900	---	---	---	3,510	---
Gate Leakage	1,000	---	---	---	---	900
Sub-total	199,300	166,300	0	7,110	3,510	900
Irrecoverable Loss						
Leaching Req'mt	2,300	---	UNSPECIFIED	---	---	---
On-farm TW	200	200	UNSPECIFIED	---	---	---
On-farm DP & seep.	5,100	4,400	UNSPECIFIED	---	---	---
Convey. seep.	300	---	UNSPECIFIED	270	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	7,900	4,600	7,900	270	0	0
Total	219,400	178,200	7,900	11,480	3,510	900

* Refer to Table 3-2.

Potential of Demand Management Options: SC-all* (Acre-Feet / Year)

Demand Element	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
	Demand Management Options					
Consumptive Loss						
On-Farm Evap.	14,200	13,300	---	---	---	---
Conveyance	9,700	---	---	9,700	---	---
Sub-total	23,900	13,300	0	9,700	0	0
Recoverable Loss						
On-farm TW	15,200	14,300	---	---	---	---
On-farm DP & seep.	141,500	104,600	---	---	---	---
Convey. seep.	9,700	---	---	8,730	---	---
Canal spillage	11,600	---	---	---	10,440	---
Gate Leakage	2,900	---	---	---	---	2,610
Sub-total	180,900	118,900	0	8,730	10,440	2,610
Irrecoverable Loss						
Leaching Req'mt	16,200	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	16,200	0	0	0	0	0
Total	221,000	132,200	0	18,430	10,440	2,610

* Refer to Table 3-2.

Potential of Demand Management Options: NL-all* (Acre-Feet / Year)						
Demand Element	**Demand Management Options**					
	Existing Condition	**Improved Irrigation Performance**	**Drainwater Reclamation**	**Canal Lining/Piping**	**Spill Reduction**	**Non-Leak Gates**
Consumptive Loss						
On-Farm Evap.	11,300	7,400	---	---	---	---
Conveyance	19,300	---	---	19,300	---	---
Sub-total	30,600	7,400	0	19,300	0	0
Recoverable Loss						
On-farm TW	19,400	14,800	---	---	---	---
On-farm DP & seep.	138,800	109,500	---	---	---	---
Convey. seep.	38,600	---	---	34,740	---	---
Canal spillage	18,500	---	---	---	16,650	---
Gate Leakage	4,600	---	---	---	---	4,140
Sub-total	219,900	124,300	0	34,740	16,650	4,140
Irrecoverable Loss						
Leaching Req'mt	3,500	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	3,500	0	0	0	0	0
Total	254,000	131,700	0	54,040	16,650	4,140

* Refer to Table 3-2.

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Potential of Demand Management Options: SL-all* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	6,500	4,200	---	---	---	---
Conveyance	11,400	---	---	11,400	---	---
Sub-total	17,900	4,200	0	11,400	0	0
Recoverable Loss						
On-farm TW	4,200	1,900	---	---	---	---
On-farm DP & seep.	59,900	40,300	---	---	---	---
Convey. seep.	22,700	---	---	20,430	---	---
Canal spillage	10,900	---	---	---	9,810	---
Gate Leakage	2,700	---	---	---	---	2,430
Sub-total	100,400	42,200	0	20,430	9,810	2,430
Irrecoverable Loss						
Leaching Req'mt	2,400	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	2,400	0	0	0	0	0
Total	120,700	46,400	0	31,830	9,810	2,430

* Refer to Table 3-2.

Potential of Demand Management Options: CR-Colorado River* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	14,200	10,900	---	---	---	---
Conveyance	12,100	---	---	12,100	---	---
Sub-total	26,300	10,900	0	12,100	0	0
Recoverable Loss						
On-farm TW	41,200	37,900	---	---	---	---
On-farm DP & seep.	183,800	196,900	---	---	---	---
Convey. seep.	60,400	---	---	54,360	---	---
Canal spillage	29,000	---	---	---	26,100	---
Gate Leakage	7,200	---	---	---	---	6,480
Sub-total	321,600	234,800	0	54,360	26,100	6,480
Irrecoverable Loss						
Leaching Req'mt	58,500	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	58,500	0	0	0	0	0
Total	406,400	245,700	0	66,460	26,100	6,480

* Refer to Table 3-2.

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Potential of Demand Management Options: CR-Coachella* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	7,600	7,300	---	---	---	---
Conveyance	8,900	---	---	8,900	---	---
Sub-total	16,500	7,300	0	8,900	0	0
Recoverable Loss						
On-farm TW	13,800	13,500	---	---	---	---
On-farm DP & seep.	66,200	70,800	---	---	---	---
Convey. seep.	33,600	---	---	30,240	---	---
Canal spillage	6,000	---	---	---	5,400	---
Gate Leakage	1,500	---	---	---	---	1,350
Sub-total	121,100	84,300	0	30,240	5,400	1,350
Irrecoverable Loss						
Leaching Req'mt	31,100	---	UNSPECIFIED	---	---	---
On-farm TW	2,600	2,600	UNSPECIFIED	---	---	---
On-farm DP & seep.	12,500	13,400	UNSPECIFIED	---	---	---
Convey. seep.	6,400	---	UNSPECIFIED	5,760	---	---
Canal spillage	1,100	---	UNSPECIFIED	---	990	---
Gate Leakage	300	---	UNSPECIFIED	---	---	270
Sub-total	54,000	16,000	54,000	5,760	990	270
Total	191,600	107,600	54,000	44,900	6,390	1,620

* Refer to Table 3-2.

Potential of Demand Management Options: CR-Imperial Valley* (Acre-Feet / Year)						
	Demand Management Options					
Demand Element	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	44,600	31,400	---	---	---	---
Conveyance	48,800	---	---	48,800	---	---
Sub-total	93,400	31,400	0	48,800	0	0
Recoverable Loss						
On-farm TW	21,200	14,700	---	---	---	---
On-farm DP & seep.	134,900	159,500	---	---	---	---
Convey. seep.	156,900	---	---	141,210	---	---
Canal spillage	28,700	---	---	---	25,830	---
Gate Leakage	7,200	---	---	---	---	6,480
Sub-total	348,900	174,200	0	141,210	25,830	6,480
Irrecoverable Loss						
Leaching Req'mt	222,300	---	UNSPECIFIED	---	---	---
On-farm TW	22,100	15,300	UNSPECIFIED	---	---	---
On-farm DP & seep.	140,200	165,900	UNSPECIFIED	---	---	---
Convey. seep.	163,100	---	UNSPECIFIED	146,790	---	---
Canal spillage	29,800	---	UNSPECIFIED	---	26,820	---
Gate Leakage	7,500	---	UNSPECIFIED	---	---	6,750
Sub-total	585,000	181,200	585,000	146,790	26,820	6,750
Total	1,027,300	386,800	585,000	336,800	52,650	13,230

* Refer to Table 3-2.

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Potential of Demand Management Options: CR-Other* (Acre-Feet / Year)

Demand Element	Demand Management Options					
	Existing Condition	Improved Irrigation Performance	Drainwater Reclamation	Canal Lining/Piping	Spill Reduction	Non-Leak Gates
Consumptive Loss						
On-Farm Evap.	1,600	1,400	---	---	---	---
Conveyance	600	---	---	600	---	---
Sub-total	2,200	1,400	0	600	0	0
Recoverable Loss						
On-farm TW	2,000	1,800	---	---	---	---
On-farm DP & seep.	11,500	13,100	---	---	---	---
Convey. seep.	2,900	---	---	2,610	---	---
Canal spillage	1,400	---	---	---	1,260	---
Gate Leakage	300	---	---	---	---	270
Sub-total	18,100	14,900	0	2,610	1,260	270
Irrecoverable Loss						
Leaching Req'mt	7,900	---	UNSPECIFIED	---	---	---
On-farm TW	0	0	UNSPECIFIED	---	---	---
On-farm DP & seep.	0	0	UNSPECIFIED	---	---	---
Convey. seep.	0	---	UNSPECIFIED	0	---	---
Canal spillage	0	---	UNSPECIFIED	---	0	---
Gate Leakage	0	---	UNSPECIFIED	---	---	0
Sub-total	7,900	0	0	0	0	0
Total	28,200	16,300	0	3,210	1,260	270

* Refer to Table 3-2.

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