4.8.6 AG6 - SAN FRANCISCO BAY

The San Francisco Bay Region is primarily urban with very little agricultural acreage. A 1990 land use survey shows only about 60,000 acres of agriculture in the region (DWR 1994). This amount represents a 60% reduction in 40 years. Agriculture only uses about 1% of the entire region's net water demand (80% of net demand is for environmental flows). Agricultural production generally is located on the outskirts of the urban areas and in isolated valleys, such as the Napa, Sonoma, and Livermore Valleys. More than half of the agricultural acreage is for wine grapes. It is anticipated that a small portion of the existing irrigated land will be lost to urbanization. However, the ability to grow vines in areas never before irrigated will add new acreage and result in little or no net change.

Because of the location of most of the agriculture, losses associated with irrigation are recaptured through deep percolation or surface runoff to streams and waterways. The region does not have irrecoverable losses associated with irrigated agriculture (urban use is discussed in a separate section).

AGRICULTURAL INFORMATION
San Francisco Bay Region

Types of crops grown:	Predominantly vineyards, with some truck crops and fruit trees.
Irrigated land:	Approximately 60,000 acres.
Types of irrigation systems in use:	Mostly pressurized systems using drip/micro or sprinklers.
Average applied water:	Approximately 97 TAF.
Source of water:	Groundwater is a key source for agriculture. Surface water is generated locally as well as imported from various areas, including directly from the Sierra Nevada and from the Delta. Reuse is an important feature in this area. Because losses typically recharge groundwater, no irre-coverable water is associated with agricultural use.

San Francisco Bay Region

Table 4-11a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	6-7	5-6	11-13
District	-	1-1	0	1-1
Total	**23**	**7-8**	**5-6**	**12-14**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-11b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-11a)

USE	TOTAL IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	2-4	2-3	4-7
District	-	0	0	0
Total	12	2-4	2-3	4-7

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-11c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-11a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	4	3	7
District	-	0	0	0
Total	**11**	**4**	**3**	**7**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.8.7 AG7 - CENTRAL COAST

The Central Coast Region encompasses land on the western side of the coastal mountains that is hydraulically connected to the Bay-Delta region. This includes southern portions of the Santa Clara Valley and San Benito County. Most of the agricultural water supplies are generated within the region. However, about 50 TAF of Delta waters are exported annually to this region through the San Felipe Unit of the CVP. Exported water is delivered both to agricultural and urban users in San Benito and Santa Clara Counties. The San Benito River also provides surface water to agriculture in the area. The San Benito River joins with the Pajaro River and flows through the agricultural areas around Watsonville and then on to the ocean.

Some of the coastal area around Watsonville is experiencing sea water intrusion as a result of groundwater overdraft. To combat this, a proposed extension of the San Felipe pipeline may bring additional Delta waters to the Watsonville area.

Agricultural acreage in the upslope portions of the Santa Clara Valley and around Watsonville is anticipated to decline slightly in the future as a result of increased urbanization and increasingly high water costs.

AGRICULTURAL INFORMATION
Central Coast Region

Types of crops grown:	Truck crops, strawberries, artichokes, fruit trees, and vines.
Irrigated land:	Approximately 100,000 acres.
Types of irrigation systems in use:	Mostly pressurized systems using drip/micro or sprinklers. Some furrow irrigation still occurs.
Average applied water:	Approximately 48 TAF annually.
Source of water:	Groundwater is a main source of water for many truck crop fields, except in areas experiencing sea water intrusion. Overdraft conditions exist in some areas of the region. Imported water delivered from the San Felipe Unit. Other surface water originates in the San Benito River. Reuse is an important feature in this area. Losses typically recharge groundwater, but in some coastal areas, deep percolation is "lost" to degraded groundwater.

Central Coast Region

Table 4-12a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	3-4	2-3	5-7
District	-	0	0	0
Total	**10**	**3-4**	**2-3**	**5-7**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-12b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-12a)

USE	TOTAL IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	0	0	0
District	-	0	0	0
Total	**1**	**0**	**0**	**0**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-12c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-12a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	3-4	2-3	5-7
District	-	0	0	0
Total	**9**	**3-4**	**2-3**	**5-7**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.8.8 AG8 - SOUTH COAST

The South Coast Region lies south of the Tehachapi Mountains and extends to the California border with Mexico. It is home for more than 50% of the state's population but only 7% of the state's total land area. Rivers and streams that originate in this region flow toward the Pacific Ocean. The climate is Mediterranean-like, with warm and dry summers followed by mild and wet winters. Of the region's 11,000-square-mile area, only around 300,000 acres currently are used for irrigated agriculture. The agricultural net water demand accounts for only about 15% of total net water demand in the region. It is projected that the region will increase from a 1990 population of 16 million to over 25 million by 2020. Urbanization of agricultural land is expected to be most pronounced in this region. It is projected that by 2020 irrigated crop acreage will decline to about 184,000 acres, a 42% reduction (DWR 1994). Some areas in the region may experience even greater reduction with more than two-thirds of the irrigated land going out of production. Reductions in irrigated land, coupled with existing high levels of efficiency, will result in little water savings potential through increased efficiency.

AGRICULTURAL INFORMATION
South Coast Region

Types of crops grown:	Primarily citrus, olives, and avocados (over 50% of the irrigated land). Vineyards, nursery products, and row crops make up another 40%.
Irrigated land:	Approximately 300,000 acres.
Types of irrigation systems in use:	Pressurized systems such as sprinklers, micro-sprays, and drip are widely used for the permanent tree and vine crops. Water delivery systems are mainly pipeline and, in some cases, extensions of municipal systems.
Average applied water:	Approximately 755 TAF annually.
Source of water:	Groundwater, supplying about a third of the total demand. Imported water delivered from the Colorado River and from the SWP; limited local surface supplies are also available. Reuse; the region is greatly increasing its recycling programs, some of which look to deliver treated urban wastewater to agricultural areas.

South Coast Region

Table 4-13a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	39-47	30-35	69-82
District	-	16-19	12-15	28-34
Total	**213**	**56-67**	**42-50**	**97-117**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-13b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-13a)

USE	TOTAL IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	14-22	10-16	24-38
District	-	6-9	4-7	10-16
Total	**123**	**20-31**	**15-23**	**34-54**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-13c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-13a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	26	19	45
District	-	10	8	18
Total	**90**	**36**	**27**	**63**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.8.9 AG9 - COLORADO RIVER

The Colorado River Region includes a large area of the state's southeastern corner, with about 650,000 acres of irrigated land. The region mainly includes the agriculturally rich Coachella and Imperial Valleys. The Salton Sea, located between the two valleys, is a prominent feature of this area.

AGRICULTURAL INFORMATION
Colorado River Region

Types of crops grown:	Row crops such as cotton, grain, sugar beets, corn, alfalfa, and other truck crops. Alfalfa constitutes about 34% of irrigated acreage. About 7% of irrigated land (50,000 acres) is vineyard and citrus.
Irrigated land:	Approximately 650,000 acres (plus 100,000 acres double cropped).
Types of irrigation systems in use:	The majority of the area is under surface irrigation (furrow). Sprinkler and drip/micro systems are more prevalent on trees and vines but are increasingly used on row and truck crops (such as melons).
Average applied water:	Approximately 2.8 MAF annually.
Source of water:	Groundwater, including an overdraft of approximately 75 TAF annually (although not all attributable to agriculture). The resort areas in the Coachella Valley also use a significant amount of groundwater resources. Surface water is delivered from the Colorado River via the All American Canal. A small amount of SWP water also is delivered to the Coachella Valley via an agreement that exchanges Colorado River water for Delta export water. Reuse of losses is an important feature and is increasing through the adoption of on-farm tailwater recovery systems and district-wide improvements, especially in the Imperial Valley.

The Sea currently is fed by rainfall from the surrounding desert mountains and by agricultural surface drainage from the two valleys. Rainfall in the mountains also recharges the groundwater aquifers that underlie the region. Because of constant evaporation, coupled with the rainfall runoff and agricultural drainage that contain naturally occurring salts, the salinity of the Salton Sea continues to increase. It is now more saline than the Pacific Ocean. However, agricultural drainage also is considered to play a vital role in supplying relatively fresh water supplies to the Sea to maintain water levels and dilute salinity and other toxicities that flow to the Sea from other sources. By 2020, an estimated 10 TAF of water may be needed annually to maintain a stable water level in the Salton Sea. Efforts to reduce the agricultural losses that flow to the Sea must consider this fact. Several plans to conserve water in the area while stabilizing the Sea's salinity and water levels have been developed by the Salton Sea Task Force, chaired by the State Resources Agency. However, these plans would incur substantial cost (DWR 1994).

Because the source of water used in this region originates in the Colorado River and not the Delta, conservation of losses not deemed irrecoverable have little value to the Bay-Delta (if it is not an irrecoverable loss that can be reallocated, there is no water quality or ecosystem benefits that can be transferred to the Bay-Delta).

Colorado River Region

Table 4-14a. Total Potential Reduction of Application (TAF)

USE	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	59-90	44-67	103-157
District	-	42-64	31-48	73-112
Total	**635**	**101-154**	**75-116**	**176-270**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-14b. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-14a)

USE	TOTAL IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
On farm	-	42-74	32-55	74-129
District	-	30-52	22-39	53-91
Total	**565**	**73-126**	**54-95**	**127-221**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-14c. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-14a)

USE	EXISTING RECOVERED LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
On farm	-	16	12	28
District	-	12	9	21
Total	**70**	**28**	**21**	**49**

[1] See regional table in Attachment A at the end of this document for derivation of values.

Special Conditions

The Imperial Valley and most of the Coachella Valley may play a limited role in a CALFED Bay-Delta solution. Since water used in this area is primarily imported from the Colorado River, reduction in losses will not directly affect the Bay-Delta watershed. However, the potential exists to transfer reductions in irrecoverable losses to offset existing or future demands of southern California, a primary exporter of Bay-Delta waters. To the extent that offsetting can occur, a benefit may be realized in the Bay-Delta watershed. If this conserved water is transferred to southern California, but not in a manner to reduce existing or future Bay-Delta exports, no benefit can be claimed by the CALFED Program. This is the most probable outcome, since California already diverts more than its allocation of Colorado River water entitlement.

Efforts by other states with entitlement to Colorado River water, including Arizona, Colorado, and Utah, may soon force California to reduce its total diversion from the Colorado River. Today, agriculture uses about 3.8 MAF annually of Colorado River water. Urban uses, delivered to southern California via the Colorado Aqueduct, account for an additional 1.3 MAF. California's entitlement is only 4.4 MAF annually, approximately 800 TAF less than existing diversions. The urban demands of southern California met by the Colorado River, delivered via the Colorado Aqueduct, most likely would remain at the levels seen today, or 1.3 MAF. Therefore, reduction probably would occur through reducing agriculture's use of California's entitlement in order to reach the 4.4-MAF limitation.

This process already has begun, with near completion of the MWD's transfer agreement with Imperial Irrigation District. This landmark agreement will result in just over 100 TAF being transferred annually from agricultural uses in the Imperial Valley to urban uses in southern California. The water is generated through conservation and efficiency improvements. The transferred quantity will be conveyed via the existing Colorado Aqueduct, which already runs at capacity. In essence, this is a method of reducing California's overall use of Colorado River water to its required entitlement but maintaining full use of the Colorado Aqueduct to deliver water to urban areas.

Recently, discussions between the Imperial Irrigation District and San Diego have proposed another agricultural-to-urban water transfer. This agreement potentially will transfer another 200 TAF to southern California. The water would be derived from on-farm conservation. If this transfer occurs with no resulting reduction in San Diego's Bay-Delta supplies, there will be no benefit to the Bay-Delta system from the Colorado River Region. Given that the total irrecoverable loss estimate is no greater than the proposed San Diego/Imperial Irrigation District transfer, there probably would be no further opportunities to benefit the Bay-Delta via water conservation in the Colorado River Region after the San Diego transfer is realized.

4.9 SUMMARY OF ESTIMATED AGRICULTURAL CONSERVATION POTENTIAL

Tables 4-15, 4-16, and 4-17 summarize the regional conservation estimates for agricultural conservation potential.

Although the total potential reduction associated with irrecoverable losses could amount to as much as 540 TAF, it must be recognized that this amount would require all farms to be irrigated at very high efficiency and would require regions to substantially improve delivery systems. Achieving this would require significant local, state, and federal support.

It also should be noted that the additional potential irrecoverable loss reduction resulting from the Water Use Efficiency Program is less than half of the total shown (233 of 540 TAF). This demonstrates CALFED's assumption that existing trends will continue to provide improved efficiency regardless of the outcome of the CALFED Program. In addition, a significant portion of the irrecoverable loss reduction is in the Colorado River Region, which may or may not provide any Bay-Delta benefit.

Much of the reduction in existing loss estimated in Table 4-15 is composed of recoverable losses (as shown in Table 4-17) and is not available for reallocation for other water supply purposes. However, this significant conservation potential can provide valuable water quality, water management, and ecosystem benefits that are also key objectives of the CALFED Program. In addition, reducing these losses may provide in-basin water management benefits and help reduce future demand projections.

Table 4-15. Total Potential Reduction of Application (TAF)

REGION	TOTAL EXISTING LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
Sacramento	2,182	766-819	574-614	1,340-1,434
Delta	358	124-134	93-100	217-234
Westside San Joaquin River	388	124-137	93-103	217-241
Eastside San Joaquin River	1,262	436-471	327-353	764-824
Tulare Lake	2,315	708-795	531-596	1,239-1,391
San Francisco Bay	23	7-8	5-6	12-14
Central Coast	10	3-4	2-3	5-7
South Coast	213	56-67	42-50	97-117
Colorado River	635	101-154	75-116	176-270
Total	**7,386**	**2,325-2,589**	**1,742-1,941**	**4,067-4,532**

[1] See Table 4-2. Much of this loss is reused downstream for other beneficial uses, including in-stream flow. Only the portion of these losses that is defined "irrecoverable" is available for reallocation to other beneficial water supply purposes.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-16. Potential for Recovering Currently Irrecoverable Losses (TAF) (Subset of 4-15)

REGION	EXISTING IRRECOVERED LOSS[2]	NO ACTION	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[2]
Sacramento	225	0-36	0-27	0-63
Delta	22	0	0	0
Westside San Joaquin River	68	0-9	0-7	0-16
Eastside San Joaquin River	104	0-7	0-6	0-13
Tulare Lake	602	23-110	17-82	40-192
San Francisco Bay	12	2-3	2-3	4-6
Central Coast	1	0	0	0
South Coast	123	20-31	15-23	35-54
Colorado River	565	73-126	54-95	127-221
Total	**1,722**	**118-322**	**88-243**	**206-565**

[1] See Table 4-2. The difference between these values and the total irrecoverable saving results from water leaching, water lost to channel evaporation and consumption, and limits on irrigation and water delivery technology.

[2] See regional table in Attachment A at the end of this document for derivation of values.

Table 4-17. Recovered Losses with Potential for Rerouting Flows (TAF) (Subset of 4-15)

REGION	EXISTING RECOVERABLE LOSS	NO ACTION[1]	INCREMENTAL CALFED SAVINGS[1]	TOTAL POTENTIAL[1]
Sacramento	1,957	766-783	574-587	1,340-1,370
Delta	336	124-134	93-100	217-234
Westside San Joaquin River	320	124-128	93-96	217-224
Eastside San Joaquin River	1,158	436-463	327-347	763-810
Tulare Lake	1,713	685	514	1,199
San Francisco Bay	11	4	3	7
Central Coast	9	3-4	2-3	5-7
South Coast	90	36	27	63
Colorado River	70	28	21	49
Total	**5,664**	**2,206-2,265**	**1,654-1,698**	**3,860-3,963**

[1] See regional table in Attachment A at the end of this document for derivation of values.

4.10 ESTIMATED COST OF EFFICIENCY IMPROVEMENTS

Reducing recoverable and irrecoverable losses through improved efficiency will result in additional district operation costs as well as on-farm production costs. These increases originate from irrigation system upgrades, changes in management style, and increased operation and maintenance. When cost-effective conservation measures are implemented, costs are incurred regardless of who pays or who benefits. Estimated costs presented in this document do not attempt to allocate the costs or determine whether implementation is cost effective. Determination of the cost effectiveness of various efficiency measures will not be estimated for purposes of the programmatic EIS/EIR, but will occur on a case-by-case basis during implementation phases. This information is provided to give a sense of the funding necessary to achieve higher levels of water use efficiency.

4.10.1 COST OF REDUCING APPLIED WATER VS. COST OF REAL WATER SAVINGS

Implementation of specific water delivery improvements, whether on the farm or district level, will cost relatively the same whether in the Sacramento Valley or around Bakersfield. This is because the cost of irrigation system hardware, skilled irrigation labor, or higher levels of management does not vary significantly throughout the state. What does vary is the associated reduction in losses. The percentage of applied water that results in recoverable and irrecoverable losses depends on the types of crops grown in a region, on-farm irrigation management, district water supply management and operation, hydrologic conditions, soils, and other physical and economic factors.

The cost to reduce losses, regardless of whether recoverable or irrecoverable, can be described in terms of dollars per acre-foot per year. This value would include the capital cost of any system improvements, amortized over the life of the system; and the increased costs of operation, maintenance, and management of the system—divided by the potential water savings (in acre-feet annually) that are anticipated to result from implementing the improvements. This value represents the cost to reduce total losses (irrecoverable and recoverable). **The cost associated with reductions in irrecoverable losses will be at least as great as that for overall loss reduction and in many cases, much greater, for reasons explained below.**

In areas where irrecoverable losses have been identified, each acre-foot of loss includes both recoverable and irrecoverable loss. The irrecoverable portion is generally a small percentage of the total, but in some cases it can approach 100%. The percentage will depend on the specific local conditions. Irrecoverable loss can be the result of either on-farm or district inefficiencies.

To illustrate this relationship, suppose a field is being irrigated at 75% **efficiency, defined as the ET of applied water and water needed to maintain salt balance and other cultural practices, divided by applied water**. In this case, 25% of applied water goes to losses. If losses (for example, surface runoff and percolation to degraded groundwater) are split evenly between recoverable and irrecoverable and if efficiency improvements equally reduce recoverable and irrecoverable losses, then a reduction by 1 acre-foot of applied water reduces irrecoverable loss by half that amount. Therefore, efficiency improvements that may cost $50 per acre-foot of overall loss reduction actually cost $100 per acre-foot of reduced irrecoverable loss.

Similarly, if irrecoverable loss accounts for only 20% of applied water savings, the actual (real) cost per acre-foot of conserving it would be five times greater, or $250 per acre-foot. The same example also could be made to describe this concept as it applies to district inefficiencies. However, in such an example, the field may be replaced with a set of delivery canals. Either way, some fraction of each acre-foot of loss is irrecoverable but not necessarily the entire acre-foot.

The analysis below uses a range of irrecoverable loss from 10 to 50% of total loss, based on estimates of existing on-farm conditions developed by Reclamation (DOI 1995). This translates to cost increases between 2 and 10 times the cost for applied water reduction.

4.10.2 ESTIMATED ON-FARM EFFICIENCY IMPROVEMENT COSTS

Cost estimates to increase on-farm efficiency are based on a study prepared for Reclamation "On-Farm Irrigation System Management" (CH2M HILL 1994). This study estimates the costs and performance characteristics of many different irrigation systems for eight crop categories common in the Central Valley. Costs are based on different combinations of hardware, operational regimes, and management and are expressed as dollars per acre per season. For a given crop, each irrigation system option is summarized by two main characteristics: the irrigation efficiency and the cost per acre per season.

For each crop, a nonlinear curve was fitted using each cost versus efficiency combination as a data point. The fitted curves describe the trade-offs between cost and irrigation efficiency. These curves have been incorporated into a regional agricultural production model called the Central Valley Production Model (CVPM). CVPM also incorporates data on cropping patterns, water use, and costs by region.

Using CVPM, estimates were made of the cost to improve average on-farm efficiency from current, or baseline, levels to 80%, then again to 85%. The model increases efficiency by 1% increments until the desired level is reached. The cost shown represents the cumulative cost to move from a baseline efficiency to an 85% level.

The values are presented on a per-acre-foot, per-year basis for regions in the Central Valley. Values for areas outside the Central Valley were extrapolated from the Central Valley data since the model is limited to the Central Valley. The cost shown in Table 4-18 represents the cost incurred for implementing and maintaining improved efficiency measures. In some cases, however, as a benefit of improved efficiency, a small discount may be subtracted from the values as a result of less water applied to the field (less water is purchased or pumped).

Table 4-18. Range of Annual Costs to Achieve On-Farm Efficiency of 85%

REGION	COST PER ACRE-FOOT OF APPLIED WATER REDUCED ($/af/yr)	IRRECOVERABLE LOSS IDENTIFIED (SEE TABLE 4-1)	COST PER ACRE-FOOT OF IRRECOVERABLE LOSS SAVED[1] ($/af/yr)
Sacramento	50-60	Yes	100-600
Delta	40-50	None identified	-
Westside San Joaquin River	35-45	Minimal	70-450
Eastside San Joaquin River	55-70	Minimal	110-700
Tulare Lake	75-95	Yes	150-950
San Francisco Bay	75-95[2]	Minimal	150-950[2]
Central Coast	75-95[2]	None identified	-
South Coast	75-95[2]	Yes	150-950[2]
Colorado River	-[3]	Yes	150-950[2]

[1] Costs shown for reducing irrecoverable losses are based on assuming from 10 to 50% of each acre-foot of applied water reduction is irrecoverable (i.e., costs are multiplied between 2 and 10 times the cost of applied water savings).

[2] These values have been extrapolated from the Tulare Lake Region results.

[3] The Colorado River Region has no water quality or ecosystem benefits that can be translated to the Bay-Delta as a result of applied water reductions. The only benefit is derived by reducing irrecoverable losses and transferring the water supply benefit to another entity dependent on Bay-Delta supplies.

This is only one of several economic benefits that may offset the cost of implementing improved irrigation. As discussed in the following two paragraphs, the cost can decrease or increase, depending on the situation.

Because water supply costs vary for each region, a beneficial savings that may be experienced from reducing applied water also will vary. Cost reductions also will depend on which supply of water is reduced, surface water or groundwater. If surface supplies are reduced, which are generally considered less expensive than groundwater, the savings benefit is lower. If groundwater pumping is reduced, the cost savings are usually greater. In general, reduced surface supply costs can offset the efficiency costs shown above by $2-$10 per acre-foot per year. Assuming a mix of reduced groundwater and surface supplies, this offset can be up to $10-$30, with the higher dollar savings occurring in areas with already higher per-acre-foot costs (for example, the Tulare Lake Region). These estimates assume that water supplies' fixed costs are held constant.

Although most water users will gain a minor savings from reduced water supply costs, some will see a minor increase. Increases will most likely be experienced by water users who currently depend on the losses of others to supply their needs. As these losses are reduced, so is their indirect water supply. To offset this reduction, these users will need to obtain water directly, either through groundwater pumping or direct delivery from a water supplier. In either case, the cost to obtain direct delivery of water is usually greater than the cost of indirect use.

4.10.3 ESTIMATED DISTRICT EFFICIENCY IMPROVEMENT COSTS

In addition to on-farm efficiency improvement costs to the growers as depicted in Table 4-18, districts or other local agencies may incur costs for on-farm improvements associated with necessary district or agency-level improvements. Without support by the water suppliers and other water agencies such as DWR and Reclamation, high on-farm efficiency, if not impossible, can be much more difficult to achieve. In addition, districts will incur significant costs for such district-level improvements as lining canals, flexible water delivery systems, regulatory reservoirs, and tailwater and spillwater recovery systems.

Estimates and projections of these costs for such improvements for different regions were made using information from local agencies, DWR, and Reclamation. Because of the unique situation at each water district, it is difficult to generalize about the costs. However, the estimates presented in Table 4-19 are intended to aid in the programmatic impact analysis. Costs shown for each region may vary for each specific project.

Table 4-19. Estimated District Efficiency Improvement Costs ($/yr)

REGION	COST TO SUPPORT ON-FARM EFFICIENCY IMPROVEMENTS[1]	COST FOR IMPROVEMENTS IN DISTRICT WATER DELIVERY[2]	TOTAL COST TO THE DISTRICTS	AVERAGE COST PER ACRE ($/af/yr)[4]
Sacramento	9,000,000	4,250,000	13,250,000	7.80
Delta	1,000,000	1,250,000	2,250,000	4.50
Westside San Joaquin River	4,000,000	1,080,000	5,080,000	11.80
Eastside San Joaquin River	6,000,000	3,180,000	9,180,000	7.25
Tulare Lake	13,000,000	8,000,000	21,000,000	6.60
San Francisco Bay	300,000	150,000	450,000	7.50
Central Coast	1,000,000	250,000	1,250,000	12.50
South Coast	1,000,000	none 3	1,000,000	3.30
Colorado River	3,000,000	1,630,000	4,630,000	7.10

[1] Improvements may include more district personnel, increased operation and maintenance costs, use of CIMIS stations, and hiring irrigation advisers. The cost will vary regionally because of the different crops and irrigation system mixes that are inherent in each region.

[2] Estimates are based on a $2.50 per-acre-foot, per-year cost for district-level activities such as improved delivery system monitoring and measurement, canal lining, system automation, and regional tailwater recovery systems. This cost is assumed to occur every year but may be higher in some years.

[3] No value is provided for the South Coast Region because most agriculture in this area is already served by pressurized municipal-type delivery systems. Additional improvement potential is limited.

[4] Average cost per acre is the total district cost divided by the average irrigated acreage in each region.

5. Urban Water Conservation

5. Urban Water Conservation **5-1**

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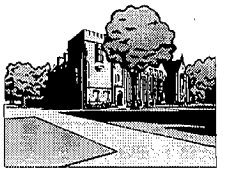

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5. Urban Water Conservation

This section presents the basis and background for estimating potential water savings that may occur as a result of the No Action Alternative and savings that are anticipated to result from implementation of the Water Use Efficiency Program., or CALFED alternative. As described in Section 2, the proposed CALFED approach to urban conservation focuses on identifying and implementing new measures, as well as expanding existing measures, to improve the efficiency of local urban water use.

The values derived by CALFED and presented in this section are for a few primary purposes:

- To provide information for programmatic-level impact assessments;
- To gain a better understanding of the order-of-magnitude role urban conservation can have in statewide water management; and,
- To aid CALFED in designing the appropriate types and levels of incentive programs and assurance mechanisms.

The values are not targets, objectives, or goals. CALFED is not mandating that these or any other levels of water savings be achieved. CALFED is, however, requiring that many actions be undertaken by water suppliers and water users that will result in the implementation of more conservation and more reuse projects, but the actual savings that will result cannot be accurately estimated. Please refer to Section 2 for further description of CALFED's intended Water Use Efficiency Program.

This section presents the following information:

- Potential reductions in existing losses resulting from efficiency improvements identified as either total loss reduction or irrecoverable losses reduction (a subset of total loss available for reallocation).

- The approximate cost associated with implementing cost-effective agricultural efficiency improvements. (No determination of "who pays" is included, only an identification of the cost incurred when a cost-effective measure is implemented.)

5.1 SUMMARY OF FINDINGS

Improvements in urban water use efficiency can result in reduction of urban per-capita use and reduction of existing or projected losses associated with that use. A large percentage of these reductions can result in a water savings that can be reallocated to meet other water

in per-capita water use can result in benefits to water quality and the ecosystem, and reduced energy needed for water treatment (both potable processes and wastewater) and home water heating. Potential conservation estimates developed by CALFED are separated into two categories:

- Estimated reduction in total loss (other than the "irrecoverable loss" portion; most of this reduction is available only to provide water quality and ecosystem benefits, and potentially reduce future demand projections of a particular basin).

- Estimated reduction in irrecoverable losses (available to reallocate to other beneficial water supply uses)

Based on the detailed assumptions and data described in this section, the following estimates of cumulative savings from conservation measures are shown in Figures 5-1 and 5-2.

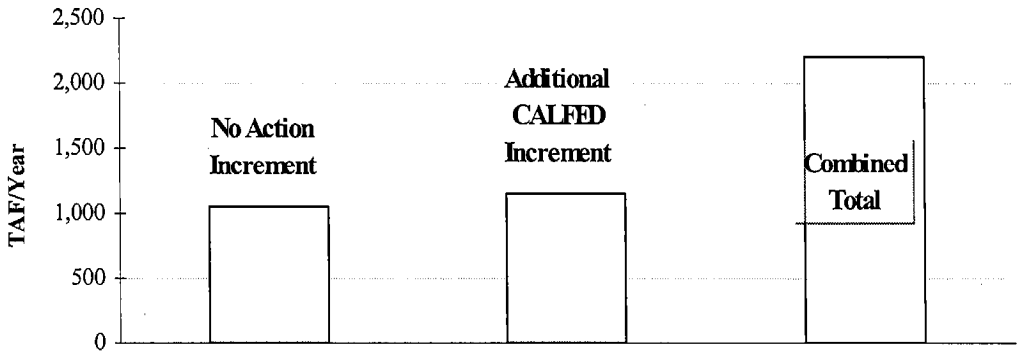


Figure 5-1. Estimated Conservation Potential of Existing Losses

These reductions can provide water quality and ecosystem benefits. The reductions do not constitute a reallocable water supply but can reduce projections of future demand.

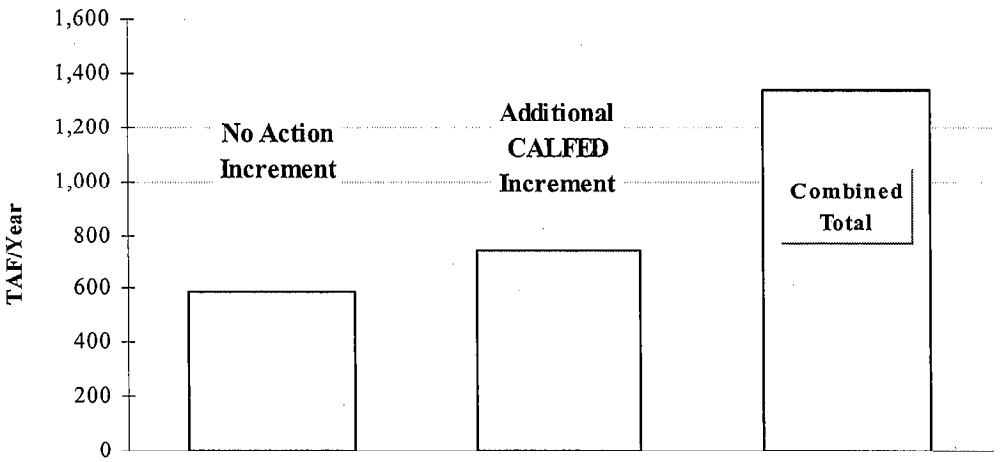


Figure 5-2. Estimated Conservation Potential of Irrecoverable

The incremental portion generated by CALFED is about half of the total projected saving water can be reallocated to other beneficial uses.

Although the conservation savings shown in these figures are sizable, it must be recognized that such savings require full implementation of conservation measures by all urban water use sectors. This effort will require increased levels of support and commitment from federal, state, and local agencies.

Costs associated with implementing conservation measures to achieve these loss reductions will vary by case. Both customer-level and water-supplier spending is necessary to obtain the anticipated levels of improvement. Water supplier expenses represent conservation support programs, including completing plans, developing customer programs, and education. A detailed discussion of conservation cost is provided toward the end of this section.

SECTION OVERVIEW

The remainder of this section provides a more detailed discussion on CALFED's assumptions used to estimate the potential reduction in per-capita water use. The section is subdivided into the following topics:

- General state-wide assumptions.
- Specific state-wide assumptions, including the basis for projecting indoor residential; urban landscape; commercial, industrial, and institutional; and system distribution loss savings for the No Action Alternative as well as those anticipated for the CALFED solution alternative.
- Irrecoverable losses vs. recoverable losses , including differentiation of the two types of loss and the benefits that can be derived from each.
- Regional reduction estimates, including descriptions and assumptions for each urban region (see Section 3) and the resulting estimates of conservation from reduced indoor water use; landscape water savings; reduced commercial, industrial, and institutional use; and distribution system loss reductions.
- Estimated cost of conservation measures, including cost information for each urban zone associated with implementing conservation measures.

5.2 GENERAL STATE-WIDE ASSUMPTIONS

It is important to note that the estimates presented in this section were developed to help understand the potential role urban conservation could play in the larger context of state-wide water management, as well as to provide information for purposes of programmatic-level impact analysis. **These estimates are not targets or goals and should not be interpreted as such.** Neither the information nor the analysis is intended for use as planning recommendations.

The general state-wide assumptions listed below helped guide the overall analysis and development of conservation estimates. Specific assumptions are described later in this section.

- It is assumed that any decrease from existing levels of water use will be first used to offset portions of future demands resulting from increasing urban populations. Increased water conservation in the urban sector is assumed to improve the reliability of water supplies for the local entities implementing the measures. Urban water conservation is not anticipated to result in dramatic decreases in existing levels of gross demand. However, it is assumed to result in future demands being less than otherwise may have occurred.

- Urban populations are expected to increase from approximately 32.7 million to 47.5 million by 2020 (see Figure 5-4 presented later). This estimate is based on the California Department of Finance projections and is used by DWR for water demand projections. State policy requires that all state agencies use Department of Finance population data for planning, funding, and policy-making activities.

- Conservation of water that results in additional water supply is limited to the reduction of urban consumptive use and irrecoverable losses. These include reductions in landscape consumption and CII consumption, as well as reduction of losses to evaporation, saline sinks, including ocean discharge, and poor-quality perched groundwater. More detailed discussion is included later in this section.

- Conservation of water in areas where water returns to the hydrologic system in a usable form can potentially be credited with ecosystem, water quality, or energy savings benefits. Such conservation could reduce the magnitude of future demand in a region or reduce the need to develop additional water supplies. However, such savings do not result in water that can be reallocated to other uses without potential impacts on existing beneficiaries. This assumption primarily relates to daily per-capita demand that generates wastewater which, after treatment, is returned to a useable body of water. Implementation of conservation measures needs to consider existing beneficiaries that may be adversely affected by change. Such considerations include wastewater discharges that contribute to historical in-stream flows or groundwater recharge, and downstream users of treated wastewater. For example, indoor residential conservation measures to reduce diversions may adversely affect historical wastewater discharges that benefit in-stream flows in a specific waterway.

- Water that is conserved is assumed to remain in the control of the supplier for its discretionary use or reallocation. The conserved water could be used to meet growing local urban demands; offset groundwater overdraft or saline intrusion; or transfer to another benefactor, including the environment. It cannot be assumed that conserved water is automatically available for environmental uses.

- Water savings experienced by export areas importing water sources in addition to water from the Bay-Delta system will not necessarily result in the reduction of Bay-Delta exports. The reallocation of conservation savings is a local decision based on local economic and water supply conditions. For example, assume that a water agency could save 100 TAF of water annually by Conservation Measure X. This savings could reduce demands for Bay-Delta water (future or existing); reduce demands from another source, such as the Colorado River; or offset the need for other new sources. As a result of this unknown, conservation savings in regions with multiple imported supplies should **not** be assumed to result in a direct reduction of Delta exports.

5.3 SPECIFIC STATE-WIDE ASSUMPTIONS

The assumptions listed here provide the specific basis for estimating conservation potential from implementation of efficiency measures. Estimates are based on determinations of:

- Existing conditions.

- No Action Alternative conditions, which include implementation of urban BMPs to levels targeted in the existing Urban MOU, as well as some additional urban conservation measures that are similar to those projected in DWR's Bulletin 160-98 (DWR 1998).

- The CALFED solution alternative, which includes projections of future conditions that could exist as a result of implementing the Water Use Efficiency Program.

Technical assumptions are presented below for the following categories:

- Urban per-capita water use

- Residential indoor conservation
  - Existing residential indoor use
  - Projected conservation under the No Action Alternative
  - Additional conservation as a result of the CALFED Program

- Urban landscape conservation
  - Existing use
  - Projected conservation under the No Action Alternative
  - Additional conservation as a result of the CALFED Program

- Commercial, industrial, and institutional conservation
  - Existing use
  - Projected conservation under the No Action Alternative
  - Additional conservation as a result of the CALFED Program

- Water delivery system loss and leakage reduction
  - Existing system losses
  - Projected reduction in losses under the No Action Alternative
  - Additional reduction in losses as a result of the CALFED Program

5.3.1 URBAN PER-CAPITA WATER USE

Since the 1976-77 drought, a combination of mandatory requirements and voluntary agreements have directed municipal government and urban water suppliers to implement water conservation practices. Current urban water conservation programs reflect state and federal legislation that mandated changes designed to improve the efficiency of plumbing fixtures, and a voluntary MOU that set the industry standard for conservation programs.

The Urban Memorandum of Understanding

One of the primary forces behind increased urban conservation in the recent past has been the adoption of the Memorandum of Understanding Regarding Urban Water Conservation in California (Urban MOU) by many urban agencies. The Urban MOU, originally drafted in 1991, has over 200 signatories, including over 150 urban water suppliers. The Urban MOU contains 14 BMPs that are to be implemented by each urban water agency, if deemed locally cost effective and technically feasible. These BMPs are listed in Table 5-1. Implementation rates of BMPs by the urban agencies have been behind those scheduled in the Urban MOU. Continuing efforts and a recent renewed focus on BMPs, however, are anticipated to result in increased levels of implementation by the signatory agencies.

Table 5-1. Revised Best Management Practices in the Urban MOU (Revised September 1997)

BMP NO.	BEST MANAGEMENT PRACTICE
1	Water survey programs for single-family residential and multi-family residential customers
2	Residential plumbing retrofit
3	System water audits, leak detection, and repair
4	Metering with commodity rates for all new connections and retrofit of existing connections
5	Large landscape conservation programs and incentives
6	High-efficiency washing machine rebate program (new)
7	Public information programs
8	School education programs
9	Conservation programs for commercial, industrial, and institutional accounts
10	Wholesale agency assistance programs (new)
11	Conservation pricing
12	Conservation coordinator (formerly BMP 14)
13	Water waste prohibition
14	Residential ultra low-flush toilet replacement program (formerly BMP 16)

Note: During 1997, the CUWCC reviewed the original BMPs. Based on input from MOU signatories, the BMPs were revised to incorporate technology and experience gained since the original BMPs were drafted.

The California Urban Water Conservation Council (CUWCC), formally established under the Urban MOU, is composed of water suppliers and public interests. The CUWCC updates the list of BMPs and revises implementation requirements. The CUWCC also disseminates information on BMPs among member agencies and reports to the SWRCB on the implementation by signatory agencies of BMPs listed in the Urban MOU. CALFED has proposed that the CUWCC certify water supplier compliance with terms of the Urban MOU.

Per-Capita Water Use

Urban water demand often is described in terms of per-capita water use. Most often, this term represents average daily water use in gallons per person per day. However, the daily use is an aggregate figure and actually represents the combination of several water-using sectors, divided by the population of the region. These sectors include:

- Residential
- Commercial, industrial, institutional
- Other, including fire flows, median landscapes, and other miscellaneous uses

For example, a per-capita demand of 200 gallons per-capita per day (gpcd) may represent a community's total residential, CII, and other uses (including fire fighting and distribution losses), divided by the area's population. Yet, the residential portion may constitute only 60% of the total (or 120 gpcd), with the remainder used by local commercial and industrial businesses, and others. Gross per-capita rates in some regions of the state reflect large industrial or commercial enterprises combined with low resident populations. For example, as shown in Table 5-2, the Colorado River Region has high per-capita water use rates because of tourist populations and a predominance of golf courses, coupled with the hot desert climate. The combination of the various water-use sectors will vary from community to community and region to region, and also can vary diurnally, weekly, monthly, and seasonally.

Table 5-2. DWR's Base and Projected Regional Urban Per-Capita Water Use (gpcd)

REGION[1]	1995 BASE URBAN DEMAND[2]	2020 PROJECTED URBAN DEMAND (WITH EXPECTED CONSERVATION)[2]	2020 PROJECTED URBAN DEMAND (WITHOUT CONSERVATION)[2,3]
Sacramento River	274	257	292
Eastside San Joaquin River	301	269	306
Tulare Lake	311	274	304
San Francisco Bay	177	169	199
Central Coast	180	164	192
South Coast	208	191	222
Colorado River	578	522	594
State-wide average	**224**	**203**	**237**

Notes:

This information is primarily for illustrative purposes and does not form the basis for all of CALFED's urban conservation estimates. CII and system distribution loss conservation do use these values.

[1] Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

[2] Values are from DWR's Bulletin 160-98 Public Review Draft, January 1998. The BMPs in the Urban MOU are the expected conservation measures implemented to project 2020 demands with conservation.

[3] Per-capita use generally increases when a region's population has more money to spend. This level of demand is projected to occur if no additional conservation measures beyond those already existing in the 1995 Base occur and the regions experience a positive change in socio\economic conditions.

Generally, the per-capita water use is used to characterize and understand the overall water demands for an area, to help plan for additional demands, and to look for opportunities to reduce demand. DWR has estimated per-capita demand through use of census data, models, local information, and an array of other investigations. DWR has noted that, in the long-term, permanent water conservation programs and other factors have begun to reduce overall per-capita water use in some areas. However, other factors tend to raise per-capita rates, thus making an analysis of trends difficult. Future per-capita use rates are estimated from current rates but are further influenced by on-going conservation efforts and anticipated increases in regional economics. The latter factor can increase residential water use and landscaping demand because of inherent lifestyle changes that accompany increases in income.

DWR projects that conservation measures will reduce current per-capita use rates, although economic effects will tend to offset some conservation gains. Table 5-2 shows DWR's estimates of future per-capita water use. The DWR per-capita projections primarily illustrate urban conditions expected to occur around the state by 2020. Only a portion of the CALFED methods used to estimate potential urban conservation is based on these projections (see the more detailed discussion of methodologies later in this section).Specifically, only the estimated conservation potentials for the CII sector and distribution system losses rely on these estimates.

The values shown for 2020 have been estimated by DWR independent of the CALFED Program and are based on DWR's estimate of full implementation of the BMPs currently included in the Urban MOU. Although the actual implementation of urban BMPs is behind schedule, DWR assumes that they will be fully implemented by 2020 (originally. implementation was to occur by 2001). This level of BMP implementation is anticipated by DWR to generate an estimated 870 TAF of depletion reduction (reduction in irrecoverable losses) annually statewide by 2020 (DWR 1998). This depletion reduction is an aggregate of the conservation occurring in residential, urban landscape, CII, and "other" water use sectors and is based on assumed reductions factors only for quantifiable BMPS.

Prior to reading the next subsection, it must be understood that "Full implementation" of BMPs, as defined used in this Section is the amount of savings determined by the DWR. It is based on a limited level of implementation of quantifiable BMPs included in the Urban MOU. Not all of the BMPs are quantifiable. As such, CALFED's No Action condition and its with-project condition are premised on the assumption that greater levels of implementation will occur (i.e., more users/water suppliers are implementing measures) than assumed in DWR's estimate.

CALFED believes that the current list of BMPs in the Urban MOU is extensive and incorporates most, if not all, types of conservation measures. The key, however, is in the assumption of how extensive the implementation of BMPs is under given conditions. Actions undertaken by water suppliers and users under the CALFED with-project condition are the same as under No Action and under baseline conditions. It is not the action that changes, but the increased levels of implementation that result in greater savings at each increment. CALFED's estimates assume more users and water suppliers implement more of the BMPs, at greater levels than assumed by DWR and as included as the baseline, as is described in the next subsection.

Finally, implementation of the BMPs included in the Urban MOU are based on a cost-effectiveness test. CALFED assumes this same cost-effectiveness test will result in more measures implemented because of No Action assumptions that will likely change current cost-effectiveness calculations (see Attachment A to the Programmatic EIS/EIR for a description of No Action features). As such, there would likely be more BMPS implemented by more water suppliers by 2020 without a CALFED Bay-Delta Program than are currently anticipated by urban water suppliers today.

5.4 ESTIMATING URBAN WATER CONSERVATION POTENTIAL

The methodology used to estimate urban water conservation potential that may result from the implementation of the Water Use Efficiency Program is described here. A different methodology is applied for each of the following conservation sectors:

- Residential indoor use
- Urban landscape use
- Commercial, industrial, and institutional use
- Water distribution system loss and leakage

These estimates are developed to help understand the potential role urban conservation could play in the larger context of state-wide water management, as well as to provide information for the programmatic-level impact analysis. These estimates are **not targets** or goals and should not be interpreted as such.

CALFED acknowledges that there exists limited empirical data from which to draw to make these estimates. In this context, the water savings cannot be assumed to predict the exact outcome of future conservation efforts, either with or without the CALFED Bay-Delta Program. However, it should be noted that the Water Use Efficiency Program itself is not predicated on the actual conservation estimates. Rather these values helped CALFED design the appropriate types and levels of incentives and assurance mechanisms that are fully described in Section 2.

Furthermore, to improve upon the shortcomings of data, for the benefit of future planning exercises, the CALFED Water Use Efficiency Program includes an actions aimed at data gathering, monitoring, and focused research. This will help bring needed resources to an important part of future conservation planning and implementation. Please refer to Section 2.3.3 for more information on this CALFED action.

5.4.1 RESIDENTIAL INDOOR CONSERVATION

Residential water use includes both indoor and outdoor demands and is influenced by many factors, including climate, type and density of housing, income level, cost of water, plumbing fixtures, and the kinds of water-using appliances. Family size, metering, and water costs also influence household and per-capita water use (Pacific Institute 1995). The methodology used by CALFED to estimate indoor residential conservation potential was based on assumed average indoor water use quantities, **not** on the total per-capita use of a region.

Existing Residential Indoor Water Use

Current average indoor residential water use is estimated to vary from 65 to 85 gpcd and is estimated statewide to average 75 gpcd (DWR 1998). The range results from the dynamic factors mentioned previously but is relatively similar in any part of the state. This is primarily because typical residential indoor habits, such as showering, laundry, and toilet use, are not influenced greatly by climate or location. Rather, indoor water use is influenced by family income, family size, housing type, and other

nongeographical factors. The similarity of residential indoor water use is in contrast to the wide fluctuation in urban landscape water use, as discussed later.

In addition to DWR's "minimum month" method, used to estimate existing indoor water use, a 1998 study by WaterWiser shows that a typical family home without conservation uses 74 gpcd (WaterWiser 1998).

Assumed 2020 Baseline Residential Indoor Water Use

With current indoor use around 75 gpcd, conservation experts tend to agree that indoor use will continue to drop, especially as more of the urban BMPs are implemented (see Table 5.1). DWR, in their Bulletin 160-98, estimated 2020 indoor water use to reach 65 gpcd as a result of continued implementation of BMPs by many urban water suppliers.

CALFED has chosen to use this same 2020 baseline value to be consistent with DWR's projections contained in Bulletin 160-98. Therefore, for purposes of estimating additional conservation potential, CALFED assumes that a base level of indoor conservation of 65 gpcd has occurred. This savings is not reflected in any of the CALFED conservation estimates. Rather, the CALFED conservation projections estimate the **additional** potential to conserve water, both under No Action conditions and as a result of CALFED Water Use Efficiency Program actions.

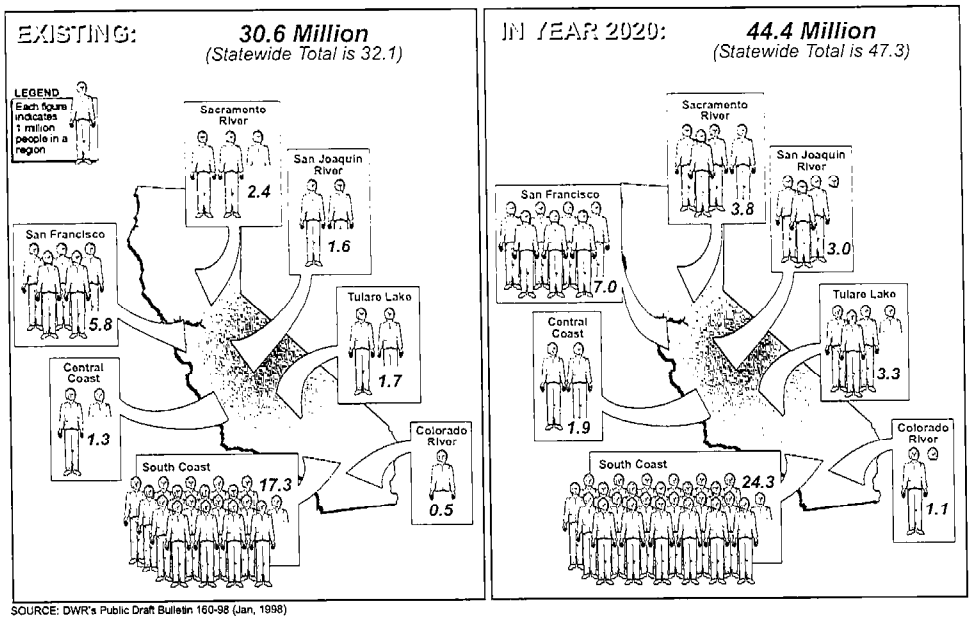
CALFED assumes that under the No Action condition additional conservation savings will still occur, beyond the 65 gpcd assumed in the baseline. This assumes that the level of indoor water use BMPs implemented to achieve 65 gpcd is limited and that additional measures are 1) still cost-effective but have not been implemented, 2) implemented for reasons other than water savings (i.e., toilet replacement associated with remodeling or with home resale), or 3) implemented through other incentive programs, such as conservation funding in California's 1997 Proposition 204, which are or will be available even without a successful CALFED Bay-Delta Program.

Projected Conservation Under the No Action Alternative

Under the No Action Alternative, indoor residential water use is expected to decrease to 60 gpcd, based on installation of new water-efficient appliances and plumbing fixtures. Such reduced levels are already being achieved in a few California communities and are assumed to be achievable statewide.

The highest percentage of indoor use is from toilets, showers, and faucets. Plumbing code changes made in the 1970s and again in the early 1990s have required installation of only low-water-using fixtures for toilets, showers, and, in some areas, for other plumbing fixtures. Although these changes are implemented slowly in existing structures as fixtures are replaced, change-out of many plumbing fixtures is anticipated by 2020 regardless of a CALFED solution. Because low-water-use fixtures are installed in new housing, further upgrades would not be necessary. Furthermore, replacement of existing high-water-using appliances (such as dishwashers and washing machines) with new, more efficient appliances also will help reduce the per-capita water use to achieve the anticipated levels.

For purposes of estimating the No Action Alternative conservation potential, CALFED assumed a value of 60 gpcd. The difference between this value and the 2020 baseline value of 65 gpcd (65 minus 60 equals 5) is multiplied by the 2020 projected population and converted to acre-feet per year. Population projections are shown in Figure 5-4.



SOURCE: DWR's Public Draft Bulletin 160-98 (Jan, 1998)

Figure 5-3. Regional Population Distribution
Note the continued population density in the South Coast Region.

Additional Conservation as a Result of the CALFED Program

Opportunities exist to further reduce indoor use below the 60 gpcd assumed under the No Action condition to levels as low as 55 gpcd or even 50.

This amount is still ample for continuation of existing lifestyle habits, such as daily showers, dishwashers, laundry, and use of water softeners, and will result in reductions in future demand statewide. This additional reduction can be obtained through measures such as more aggressive interior water audits; use of incentive programs to retrofit residences with low-water-use fixtures; conversion to low-water-use shower heads; and gradual conversion to very efficient appliances in the majority of households, such as horizontal-axis washing machines. (This technology is new to the United States but widely used in other parts of the world, such as Europe and the Middle East.) Estimates also assume the development of additional technologies and incentive programs that go beyond BMPs currently suggested in the Urban MOU. Lifestyle habits do not need to change to allow these gains to occur. To achieve these levels, however, will require strong incentive programs and public outreach to gain widespread acceptance and implementation.

For purposes of the Water Use Efficiency Program, indoor residential water use rates are assumed to reach 55 gpcd statewide. Again, this value is supported by information developed by WaterWiser in its 1998 end-use study. In graphs published on their web page, WaterWiser indicates that the typical family home could reduce its indoor use rates to 52 gpcd with full implementation of available conservation measures (WaterWiser 1998). CALFED believes that this reduction can be achieved by large sectors of the population by 2020 and feels confident that using 55 gpcd represents a realistically achievable level of indoor residential water conservation.

Estimated savings resulting from this indoor use reduction were calculated in the same manner as the No Action Alternative savings. The incremental difference between the No Action Alternative condition of 60 gpcd and CALFED's assumed level of 55 gpcd is multiplied by the projected 2020 population for each region (see Figure 5-4). The estimated savings are shown under each regional description provided later in this section.

5.4.2 URBAN LANDSCAPE CONSERVATION

Outdoor water use for landscape irrigation varies widely across California. In fact, this portion of urban water use is probably the most varied of all urban water use factors. In hot inland areas, average outdoor water use, primarily from landscaping evapotranspiration, can be as high as 60% of the total residential use. Conversely, in cooler coastal areas, outdoor use can be as low as 30% of total residential use. Effective precipitation occurring in coastal areas, either as rain or dew from fog, also acts to reduce coastal area outdoor use.

There is little empirical data that currently exists which provides sufficient information on statewide landscape acres and water use. Current estimates of state-wide urban acreage have been developed by DWR and indicate about 1 million acres of urban areas are part of an irrigated landscape. A large majority occurs in the South Coast Region, which includes the area from greater Los Angeles to San Diego. It is anticipated that as the state's population increases, so will the residential landscape acreage. However, data regarding current acreage amounts and relationships to potential increases are not readily available. For purposes of the CALFED Program, the 1 million acre estimate has been distributed, statewide based iitially on population. Values were adjusted to account for assumed regional differences, such as coastal areas generally characterized by smaller yards and more people per household than inland areas (for example, San Francisco versus Sacramento) and thus less total acreage per person. Estimated current and projected acreage values are shown in Table 5-3. Values for 2020 were projected by increasing current estimates by the ratio of a region's forecasted population to its existing population (population information is presented for each urban zone later in this section). Regional population estimates are displayed in Figure 5-4.

Table 5-3. Urban Landscaped Area (acres)

REGION[1]	1995 ESTIMATED	2020 FORECAST
Sacramento River	100,000	145,000
Eastside San Joaquin River	65,000	120,000
Tulare Lake	70,000	130,000
San Francisco Bay	155,000	180,000
Central Coast	35,000	50,000
South Coast	480,000	650,000
Colorado River	35,000	75,000
Total	**940,000[2]**	**1,350,000**

[1] Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

[2] Values shown in the table do not add to 1 million acres because some areas of the state, like the north coast and eastern side of the Sierra Mountains, are outside the CALFED Program geographic scope but are included in the estimated statewide value of 1 million.

Irrigation Needs of Urban Landscapes

Each acre of urban irrigated landscape represents a demand for water. The primary element in the determination of this demand is the evapotranspiration rate (ET). ET is the amount of water evaporated by the soil (evaporation) and used by the plants (transpiration) over a given period of time. Reference evapotranspiration (ET_0) is a measurement of a standard crop (well watered, cool-season grass, 4-6 inches tall) under standard conditions.

ET_0 usually is determined daily for a specific area, using climatological instruments at specific locations. Daily values are cumulated to form average monthly or annual values. Although the specific ET_0 for every location is not available, average ET_0 values for most regions of the state are fairly well accepted and used for planning and analysis. The values in Table 5-4, obtained from DWR, were assumed by CALFED to aid in conservation calculations.

Table 5-4. Reference ET_0 Values Assumed for Urban Regions

REGION[1]	REFERENCE ET_0
Sacramento River	4.2 (feet/year)
Eastside San Joaquin River	4.3
Tulare Lake	4.3
San Francisco Bay	3.3
Central Coast	2.8
South Coast	4.0
Colorado River	6.0

Note:

These values were provided by DWR staff at the Division of Planning and Local Assistance. They are similar to values used by DWR in the Bulletin 160-98 Public Draft (DWR 1998).

[1]Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Once the ET_0 is determined for an area, three other factors must be considered:

- The size of the area to be irrigated
- The plants within the area
- The efficiency of the irrigation system

The amount of water a plant needs in relation to the standard measurement of ET_0 varies, depending on the physiology of the plant. In general, cool-season grasses like Kentucky Bluegrass and Fescue, require 80% of ET_0 while warm-season grasses like Bermuda grass require 60% of ET_0. Trees, shrubs, and groundcovers in the moderate water-using category (close to 80% of the commonly grown plants in California) require 40-60% of ET_0. Low water-using plants range from 0 to 30% of ET_0.

The typical California residential landscape (also the majority of the urban landscape acreage), consists of a lawn, some shrubs or other smaller plants, and a few trees. This tends to be the case whether in the Bay Area or Palm Springs, Bakersfield, or Sacramento. Recent landscaping trends in some areas of the state include planting water-efficient landscapes, or xeriscape, a term given to the use of more low-water-using plants in combination with more efficient landscape designs and irrigation systems. These landscapes can use far less water than the more lawn-intensive landscapes but are slow to be adopted in some areas of the state.

The last factor in determining landscape water needs is the efficiency of the irrigation system and operation. Data developed by DWR's mobile irrigation laboratories show that the state-wide average landscape irrigation system has a distribution uniformity (one measure of irrigation efficiency: how evenly water is distributed over a given area) of about 50%. While distribution uniformity is more important for lawns than most other landscape plants, it is an indication that improvements could be made in this area. Surface runoff, because of poor percolation, high application rates, and sloping surfaces, contributes greatly to poor efficiency. Improvements in how water is applied can result in water savings without affecting the landscape water needs.

Thus, to determine landscape water needs, the following formula can be used:

Landscape water needs = (ET_o * area * plant factor) / irrigation efficiency

This formula can be converted to a percentage of ET_o, or an ET_o factor. These factors are used to estimate landscape water use by multiplying the factor times the ET_o for the region (for example, if an ET_o is 4 acre-feet per acre, but irrigation efficiency is poor, the water applied to the landscaping may be as much as 1.2 times ET_o)

Estimating Landscape Conservation Potential

DWR estimates that on average, state-wide residential landscaping is currently irrigated at 1.2 times ET_o. However, limited data are available to support this estimate.

To better address this unknown, the CALFED Program has assumed a distribution of landscape acreage over a range of ET_o factors. Since many residential customers have adopted landscape conservation measures, including changes in irrigation systems and operations as well as changes in landscape type, this distribution should more realistically reflect current conditions. Each region's landscaped area has been distributed for:

- A baseline condition
- The No Action Alternative condition
- The CALFED alternative condition

These are shown in detail in Attachment B and summarized in the regional discussions later in this document. To the extent possible, local climate, combined with assumed traditional attitudes toward landscaping, were considered for each region's acreage distribution.

Existing landscaped acreage was distributed differently than the increment of new landscape acreage assumed to be planted by 2020. For example, it is less likely that existing landscapes will be dramatically changed from their current configurations (what is primarily lawn now probably will remain lawn). However, new acreage could be planted with lower ET in mind, such as planting less lawn area, planting more Mediterranean-style landscape, or using xeriscape. As shown in Attachment B, the resulting distributions vary for each urban region.

Separating Aspects of Landscape Conservation Potential

CALFED has assumed a distinction between reduction of losses through irrigation improvements and reduction in landscape ET, using the following criteria:

- Any reduction in ET_o factor that is above or inclusive of 0.8 assumes reduction in losses that were attributable to irrigation (such as reducing surface runoff to gutters). ET_o values of 0.8 and above do not assume any change in the type of traditional lawn-oriented landscapes, whether existing or to be planted by 2020. Some fraction of this savings could include reduced evaporative losses associated with landscape irrigation.

- Any reduction below 0.8 is assumed to represent a change to or new planting of Mediterranean, xeriscape, or other landscaping with lower ET than traditional lawn landscaping. These savings are not attributed to irrigation system improvements.

For example, a change from a factor of 1.2 to an ET_o factor of 0.6 would assume that the increment of reduction from 1.2 to 0.8 is associated with reducing the losses from inefficient irrigation. The additional change from 0.8 to 0.6 would reflect a reduction in the ET of the landscape. Depending on the region, some or all of the initial reduction (that associated with irrigation system improvements) would be considered irrecoverable (see discussion of real water savings versus applied water reduction in Section 5.5 below). For example, if the runoff to the street from inefficient irrigation flowed directly to the Pacific Ocean, it would represent an irrecoverable loss reduction. If, however, the runoff flowed back to a river that was a source to downstream users, the reduction would constitute a reduction in applied water. In either case, the reduction in ET in this example would constitute a reduction in irrecoverable losses.

Baseline Urban Landscape Water Use

For each region, the landscape acreage is distributed among a range of ET_o factors, accounting for local considerations such as climate, historical landscaping trends, and public perception regarding landscaping. For example, for the South Coast Region, it is assumed that existing acreage is spread between ET_o factors of 1.2 down to and including 0.6. This amount assumes that some landscapes in this region are already planted in a Mediterranean or xeriscape style. All of the acreage for Sacramento, on the other hand, is assumed to have an ET_o of 1.2 under existing conditions. **The acreage distribution for each region is presented under the regional descriptions later in this section.** Attachment B contains tables that detail the assumptions and calculations.

To allow a comparison between the No Action Alternative and CALFED conditions, the same distribution of existing acreage was assumed for the future 2020 acreage. This created a baseline condition with which to compare savings from the No Action Alternative and CALFED conditions. For example, the Tulare Lake Region is assumed to currently include approximately 7,000 acres of urban landscaping. This amount is projected to increase to 130,000 acres by 2020. The distribution for the current acreage assumes that 15% is at a factor of 1.2 ET_o, 60% is at 1.0, and 25% is at 0.8. The future baseline condition assumes the same distribution for the 130,000 acres. This assumption allows for savings potential to be estimated as the projected 130,000 is redistributed as a result of expected efficiency improvements.

Projected Conservation under the No Action Alternative

The existing and future acreage were kept separate to allow different distributions to be made. No Action Alternative conditions assume that some improvements to irrigation are made for the assumed existing landscaped acreage. In addition, a small percentage of the existing landscaped area is assumed to be modified to lower-water-using landscapes. For example, using the Tulare Lake Region's 70,000 acres of existing landscape, increasing to 130,000 by 2020, the 70,000 acres is redistributed from the baseline assumption of 15%, 60%, 25% to a new pattern of 10%, 60%, 30% (see Attachment B). The acreage expected in the future (130,000 acres minus 70,000 existing; or 60,000 acres) is distributed as 10%, 30%, 60%. These two distributions are combined for a regional No Action Alternative distribution of 10%, 46%, 44% for ET_o factors 1.2, 1.0, and 0.8, respectively.

Estimates for new acreage, land that will be developed as population grows and new houses are built, assume that more efficient irrigation systems will be installed and greater amounts of lower-water-using landscape will be planted, when compared to expected changes to existing landscapes. For example, local landscape ordinances could be adopted that would result in more Mediterranean, or other landscapes conducive to the local climate, to be installed for all new housing instead of typical lawn-intensive landscapes. However, existing acreage would be slow to transition to these new landscape configurations. The distribution of acreage across the various ET_o factors is shown for each region below under the regional discussions and in Attachment B.

Additional Conservation as a Result of the CALFED Program

The Water Use Efficiency Program is assumed to result in even greater changes to landscape irrigation and plant types than envisioned under the No Action Alternative condition. These changes would occur through technical, planning, and financial support along with a more concerted effort, through urban agency certification, to implement cost-effective conservation measures.

For purposes of estimating potential incremental savings above the No Action Alternative condition, a third distribution of acreage among ET_o factors was made, both for existing acreage amounts and additional acreage expected to be planted. These distributions simply shifted more acreage lower on the range of ET_o factors compared to the No Action Alternative condition. Most of the distributions at this level were based on professional judgement. The incremental difference between the No Action Alternative distribution and the CALFED distribution is used to drive the conservation calculations.

5.4.3 INTERIOR COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL CONSERVATION

Statewide, the commercial, industrial, and institutional sectors, collectively referred to as CII, represent about 30% of the total per-capita daily use, on average. The actual amount of use, can vary significantly for each local water supplier, depending on the quantity of commercial and industrial use, and demand compared with other sector demands. For example, industry may be the predominant user for a particular water supplier, with little or no residential connections in the area. On the other hand, residential use may comprise the majority of a supplier's demands, with very little commercial or industrial uses. To estimate potential CII conservation, CALFED has assumed that the regional CII percentages shown in Table 5-5 represent the portion of this sector's urban demand. These values can be used only to represent a region and do not necessarily represent the variation that can occur when comparing water suppliers.

Table 5-5. Assumed Baseline Commercial, Industrial, and Institutional Percentage of Urban Per-Capita Use

REGION[1]	1995 CII PERCENTAGE	2020 ASSUMED CII BASELINE PERCENTAGE
Sacramento River	35	36
Eastside San Joaquin River	24	25
Tulare Lake	24	25
San Francisco Bay	38	38
Central Coast	30	30
South Coast	32	32
Colorado River	27	28

Note:

Values were obtained from DWR 1997.

[1] Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Commercial customers generally are defined as water users that provide or distribute a product or service, such as hotels, restaurants, office buildings, commercial business, and other places of commerce. Industrial users can vary from low-water-using industries, such as clothing manufacturing, to high-water-use industries, such as food processing or the semi-conductor industry. Institutional users include establishments dedicated to public service, such as schools, courts, churches, hospitals, and government facilities.

The demand for water from CII customers includes many of the same needs as residential users—toilets, sinks, laundry facilities, and kitchens—but the use is often much greater. CII demand also can come from process water, cooling towers, and large restaurant kitchens, as well as outdoor decorative landscaping. Landscape water use, however, is accounted for under the previous subsection, "Urban Landscape Conservation" and is not included here. The CII conservation estimates discussed in this section primarily focus on improving the efficiency of internal CII water use.

As noted in a recent study, the potential indoor water conservation opportunities for commercial water users ranges from a 20-25.6% reduction from existing use levels, with an average of 22.2 % (EPA 1997). DWR also has stated that the BMPs in the Urban MOU (see discussion earlier in this section) are projected to reduce CII water use by 12-15% by 2020 (DWR 1998). Given this information, it would appear that of the 22% reduction potential noted in the EPA study, approximately one-half to two-thirds of the potential would occur by 2020 under current efforts.

Baseline Commercial, Industrial, and Institutional Water Use

An estimate of projected baseline CII water use that could occur in 2020 is necessary to estimate potential conservation savings under the No Action and CALFED Program Alternatives, respectively. Per-capita water use values assumed to occur in 2020 as a result of population increases and economic influences, coupled with expected urban BMP implementation, were used (see Table 5-2 in the column "2020 Urban Demand with Expected Conservation").

As previously shown in Table 5-5, a portion of each region's projected per-capita water use value is attributable to CII demand. However, the percentage is not necessarily the same as occurs under 1995 assumed conditions. For example, the Sacramento Region has a 1995 CII demand of 35% of the total per-capita use value. In 20 years, the value may increase as a result of a shift in the make-up of the types of CII users in the region.

In general, **industrial** use is anticipated to continue to decline or stabilize as a result of:

- Increasing environmental constraints regarding wastewater discharge and recycling practices
- More energy- and water-efficient industrial processes and equipment
- A national shift away from a manufacturing economy to a service-oriented economy
- A shift of some industry to out-of-state areas

However, as the state's population and economy increase, **commercial** water use is expected to increase, although the extent is unknown. To estimate conservation potential, CALFED has assumed that the percentage of per-capita use resulting from commercial activities will increase to a greater extent than industrial use declines. The assumed baseline CII percentages are shown in Table 5-5.

Projected Conservation under the No Action Alternative

Since some CII water saving is inherent in the 2020 per-capita projections, an assumption is necessary to determine what additional savings could occur absent a CALFED Bay-Delta solution. CALFED has assumed that the 2020 per-capita projection with urban BMP implementation achieved half of the conservation potential (one-half of 22%, or 11%). It is assumed that additional CII conservation also could occur beyond the urban BMPs under the No Action Alternative conditions. This additional conservation is assumed to result in another 4% reduction in CII use, bringing the total CII savings under the No Action Alternative to an assumed 15% of existing conditions.

Several other factors besides the CII-related BMPs are believed to result in more efficient water use by this sector by 2020. Some of these factors include:

- The existing trends discussed under baseline conditions.
- Water and wastewater costs probably will increase faster than the rate of inflation to account for infrastructure replacement and population growth, creating an incentive to be more efficient.
- California's industrial and commercial sector will become more efficient with their processes, including water use, to gain or maintain a competitive edge.
- Existing and new businesses will use more efficient equipment as it becomes available.
- Continued state-wide demand for water will continue to bring greater attention to efficient water use practices and present "pressure" to implement conservation measures.

Since the 2020 per-capita values in Table 5-2 are assumed to include much of the 15% assumed conservation potential, additional potential is calculated by reducing the projected 2020 CII demand by only 4%.

To illustrate this, consider:

For the Sacramento Region (using 2020 per-capita with conservation as baseline):

Assume:	2020 per-capita use	=	257 gpcd (see Table 5-2)
	2020 population	=	3,900,000
	2020 CII portion of total	=	36% (see Table 5-5)
	No Action savings	=	4%
Calculations:	Projected CII use	=	404,130 acre-feet
	Projected savings	=	16,160 acre-feet [404,130 * 4%]
	2020 remaining CII use	=	388,000 acre-feet

Another possible method to calculate savings potential would use projected 2020 per-capita values absent conservation as a baseline (Table 5-2). If these values were used, they would need to be reduced by the full 15% to account for both the expected BMP-related savings and additional No Action Alternative reductions.

To compare the results of this methodology, consider:

For the Sacramento Region (using 2020 per-capita without conservation as baseline):

Assume:	2020 per-capita use	=	292 gpcd (see Table 5-2)
	2020 population =	3,900,000	
	2020 CII portion of total	=	36% (see Table 5-5)
	No Action savings	=	15%
Calculations:	Projected CII use	=	459,165 acre-feet
	Projected savings	=	68,875 acre-feet [459,000 * 15%]
	2020 remaining CII use	=	390,000 acre-feet

When the remaining CII use projected for 2020 is compared for each method, the answers are very similar. Thus, whether or not the expected BMP implementation is included in the calculation, the CII demand expected under 2020 conditions is the same.

CALFED has proceeded with its calculations using the 2020 projected per-capita values that already account for BMP savings. This assumption is consistent with the other urban conservation estimates that assume a baseline with conservation has been reached by 2020.

Additional Conservation as a Result of the CALFED Program

As with other components of urban conservation, the CALFED alternative is assumed to result in CII water use savings that reach beyond those estimated under No Action Alternative conditions. Since the No Action Alternative condition was assumed to result in 15% of the 22% goal, the CALFED alternative is expected to achieve another 7% reduction from the 2020 baseline.

It is assumed that these gains can be achieved through implementation of several measures, such as:

- Enlarging the scope of CII water audits to include warehouses, correctional facilities, military bases, utility systems, and passenger terminals (largely ignored under current audit programs).
- Developing incentive programs to obtain consistent, effective data at the water supplier level so they better understand the water needs of their CII customers.
- Developing local programs that offer financial incentives, public recognition, technical information, or water rate adjustments.
- Developing and enforcing local CII water use efficiency ordinances.
- Implementing state and federal programs that offer financial and technical assistance directly to the CII users.

The calculation to determine the potential water conservation as a result of the CALFED Program is similar to that used to determine the No Action Alternative savings. Since the CALFED increment is additive to the No Action Alternative projection, the same baseline must be used.

To illustrate this, consider:

For the Sacramento Region (using 2020 per-capita with conservation as baseline):

Assume:	2020 per-capita use	=	257 gpcd	(see Table 5-2)
	2020 population	=	3,900,000	
	2020 CII portion of total	=	36%	(see Table 5-5)
	CALFED savings	=	7%	
Calculations:	Projected CII use	=	404,130 acre-feet	
	Projected CALFED savings	=	28,290 acre-feet	[404,130 * 7%]
Previously calculated:	No Action savings	=	16,160 acre-feet	
	Combined total savings	=	44,450 acre-feet	(28,290 + 16,160)
	2020 remaining CII use	=	359,680 acre-feet	[404,130-44,450]

Thus, CALFED's incremental savings are assumed to reduce CII use from the same base as the No Action Alternative (i.e., they both calculate savings from the same 2020 per-capita use value). This assumption considers the reality that actions taken by CII users as a result of CALFED will not be independent of actions taken under the No Action Alternative

Depending on each region, a portion of this savings does constitute a reduction in irrecoverable losses and is available for reallocation to other purposes. See the regional discussions later in this section for the specific values.

5.4.4 WATER DELIVERY SYSTEM LOSS AND LEAKAGE REDUCTION

Throughout the state, urban retailers deliver water via pressurized pipelines to numerous residential and CII users. These pipelines are made of ductile iron, metal, concrete, plastic, or a combination of materials and are of various sizes and in a variety of working conditions. For the most part, urban water supplier maintenance and replacement programs tend to correct the worst conditions, but with many systems placed underground more than 50 years ago, and often during the 1930s and 1940s, many leaks still exist. In some instances, this can result in the loss of significant amounts of potable water, water otherwise available for meeting urban demands.

Leaks, the most common form of system losses, may be caused by several factors, including:

- Corrosion of pipe materials
- Faulty installation
- Natural events, such as earthquakes and land subsidence
- Aging water control structures

Current estimates place average unaccounted water in the various regions of the state between 6 and 15% of system deliveries. However, the amount varies significantly among urban suppliers, with some experiencing losses as high as 30% and others with less than 5%. Two percent is attributed to unmetered water use (including water used for construction, fire fighting, and flushing drains and hydrants) and meter errors; therefore, distribution system losses range between 4 and 13% (DWR 1998). CALFED has assumed for purposes of this estimate that reduction below 5% of system deliveries is cost prohibitive and technically difficult and therefore becomes the limit of conservation potential. With several hundred miles of pressurized pipeline for each utility, maintenance activities are continuous and new leaks arise as old ones are repaired, resulting in a loss constantly occurring somewhere in the system.

Current Funding Programs

For the past two decades, DWR has administered several programs to provide loans to local urban water suppliers for replacement of old, leaky systems. The programs include:

- ***Proposition 25—The Clean Water Bond Law of 1984*** - This program authorized the sale and issuance of $325 million in state bonds. Water conservation loans administered by DWR comprised $10 million of the total. This money was used to provide low-interest loans to aid in the conduct of voluntary, cost-effective capital outlay water conservation programs, including system leak reduction.

- ***Proposition 44—The Water Conservation and Water Quality Bond Law of 1986*** - This program authorized the sale and issuance of $150 million in state bonds. DWR was responsible for administering low-interest loans using about half of this funding. These loans were available for cost-effective capital outlay water conservation programs, including system leak reduction.

- ***Proposition 82—The Water Conservation Bond Law of 1988*** - This program authorized the sale and issuance of $60 million dollars that was available for cost-effective capital outlay water conservation programs, including system leak reduction.

These programs have resulted in substantial improvements in local urban distribution systems and have generated water savings of about 60 TAF annually.

Projected Conservation under the No Action Alternative

Minor reductions in distribution system losses will continue to occur regardless of the outcome of the CALFED Program. Through continuation of loan programs, mostly administered by DWR, and increasing focus by local agencies on the destination of their water, CALFED has assumed that system loss reductions potentially decreases a percent on average throughout many of the water districts in the state. However, several regions are believed to already have reduced system losses to 7%, leaving only slight reductions feasible before reaching CALFED's assumed practical limit. For these regions, reductions under the No Action Alternative condition are assumed to result in average regional system losses of 6%. Table 5-6 presents CALFED's assumed levels of reduction.

Estimates of potential savings were calculated based on an estimate of baseline distribution system conditions and future water delivery quantities. Because conservation estimates are regional, estimates of regional system loss conditions, not per-district conditions, were needed. Data from DWR regarding existing urban "unaccounted" delivered water was obtained and adjusted downward by 2% to account for unmetered water and meter errors (DWR1997) (see Table 5-6). The results for each region are shown under the regional discussion later in this section.

Reduction estimates were calculated by taking the difference in the baseline percentage and the assumed No Action Alternative savings, multiplied by the projected urban use for each particular region (2020 per-capita use multiplied by the projected population; see Table 5-2 and Figure 5-4).

To illustrate this method, consider:

For Region X:

Assume:	Baseline loss	=	9%
	No Action Alternative condition	=	7%
	2020 per-capita use	=	200 gpcd
	2020 population	=	TAF
Calculations:	Projected urban use	=	224,000 acre-feet [gpcd * population]
	Projected loss	=	20,000 acre-feet[224,000 * 9%]
	Saving potential	=	224,000 acre-feet * (9%-7%)
		=	4,480 acre-feet

Additional Conservation as a Result of the CALFED Program

Additional reduction in system losses are anticipated to occur as a result of the CALFED Program's additional assistance and funding programs, as well as assurance mechanisms designed to ensure that high levels of water use efficiency are being achieved. As previously stated, CALFED assumed that distribution system losses could be lowered to 5% of system deliveries. Table 5-6 shows how the 5% value relates to each region's assumed No Action Alternative condition.

Limiting the reduction potential to 5% assumes continuation of pipeline wear and breakage that will occur regardless of the time and effort spent trying to prevent it or to immediately correct it. Obtaining system losses of less than 5% is also technically limited by reduced ability to detect leaks in plastic pipes, the latest pipeline material to be used for urban water distribution systems. Although this material is less likely to corrode, cracks or breaks, which inevitably will occur, are difficult to detect when compared to iron or clay.

The same method used to calculate potential No Action Alternative savings was used to calculate incremental CALFED reductions. The difference between the assumed No Action Alternative system loss percentage and that assumed for CALFED formed the basis. Results are presented under the regional discussions.

Table 5-6. Assumed Levels of System Distribution Losses (Percent of Total Demand)

REGION[1]	BASELINE CONDITIONS[2]	2020 NO ACTION ALTERNATIVE CONDITIONS	2020 WITH *CALFED CONDITIONS*
Sacramento River	7	6	5
Eastside San Joaquin River	7	5	5
Tulare Lake	7	6	5
San Francisco Bay	6	6	5
Central Coast	8	7	5
South Coast	7	6	5
Colorado River[3]	12	8	5

1 Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

2 Existing percentage values are compiled from data submitted to DWR by many water agencies throughout the state. Values do not include unmetered water or meter errors, both of which are not considered distribution system losses (DWR 1997).

3 This region is assumed to have a high existing condition and is expected to make greater progress in reducing system losses under the No Action Alternative than is assumed for the other regions (4% versus 1%).

5.5 IRRECOVERABLE LOSSES VS. RECOVERABLE LOSSES

Similar to characteristics of water losses in agriculture, losses associated with urban water use can be characterized as resulting in irrecoverable or recoverable losses. Refer to the discussion in Section 4.4, "Irrecoverable vs. Recoverable Losses," for a more detailed explanation of this issue.

All urban water losses from landscaping, CII, and residential uses either directly or via a wastewater treatment plant return to surface water or groundwater bodies and may be recoverable. In theory, all losses are recoverable. 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 (that is, they become irrecoverable). Determining recoverability varies with location and time, as well as other factors (DOI 1995).

Distinguishing irrecoverable and recoverable losses typically depends solely on water quality considerations. This assumes that all losses to usable water bodies can be economically recovered. Principal water bodies that are regarded as irrecoverable include saline, perched groundwater underlying irrigated land on the west side of the San Joaquin Valley; the Salton Sea, which receives urban wastewater from the Coachella and Imperial Valleys; the San Francisco Bay; and the ocean.

Real water savings can be achieved only by reducing irrecoverable losses because that water is truly lost from the system. Water is considered "saved" when these losses are reduced. However, while the reduction of urban nonconsumptive use does not generate a new supply of water, the conserved water could be available to meet projected increases in local demand.

Recoverable losses, on the other hand, often constitute a supply to the downstream user. Downstream uses can include groundwater recharge; agricultural and urban water use; and environmental uses, including wetlands, riparian corridors, and in-stream flows. Often, recoverable losses are used many times over by many downstream beneficiaries. To reduce these losses would deplete such supplies with no net gain in the total water supply. Their reduction, however, provide significant opportunities to contribute to the achievement of other CALFED objectives, such as:

- Improving instream water quality through reduced runoff of water laden with residual landscape chemicals and other urban toxins that can flow into storm drains.
- Reducing temperature impacts resulting from resident time of wastewater during treatment process.
- Reducing entrainment impacts on aquatic species as a result of reduced diversions, and
- Reducing impacts on aquatic species, especially anadromous fish, through minor modifications in diversion timing and possibly providing in-basin benefits through subsequent modifications in the timing of reservoir releases.

5.6 REGIONAL CONSERVATION ESTIMATES

Estimates of the results of efficiency improvements are presented here for each of the agricultural regions defined previously in Section 3, "Determination of Geographical Zones." The values presented are to help understand the potential role conservation could play in the larger context of state-wide water management, as well as to provide information for purposes of a programmatic level impact analysis. **These estimates provide our best estimate of the potential for urban conservation but are not goals and targets and are not intended to be used for planning purposes.** Estimates of potential reduction in urban demand are presented under one of two categories:

- Estimated reduction in total loss (other than the "irrecoverable loss" portion, only available to provide water quality and ecosystem benefits, and potentially reduce future demand projections of a particular basin).
- Estimated reduction in irrecoverable losses (available to reallocate to other beneficial water supply uses).

For each urban region, the following tables are presented: assumed distribution of landscaped acreage among ET_0 factors, potential conservation of existing losses (including irrecoverable loss), and potential conservation of irrecoverable losses (available for reallocation). This information is included in Tables 5-7a through 5-14c.

Estimated reduced irrecoverable losses can be viewed as a source of water for reallocation to other purposes, such as improved local supply reliability; offsetting local groundwater overdraft; or a transfer to other beneficial water supply uses, including the environment. Reduction of loss that is not defined as irrecoverable is not available for reallocation to out-of-basin water supply purposes but can provide significant benefits to water quality and ecosystem health as well as improving local water supply reliability.

It is important to note that potential loss reductions in the Colorado River Region would not directly translate to water quality or ecosystem benefits in the Bay-Delta watershed. Similarly, reduction of losses in regions that import water from the Bay-Delta but are not tributary to the Delta (South Coast, Central Coast, and San Francisco Bay Regions) can only provide an ecosystem benefit through reductions in diversions or modified diversion timing. Their ability to provide water quality benefits is limited because wastewater treatment plant return flows, a primary source of degradation, from these regions do not re-enter the Delta watershed. Therefore, reduced urban use that reduces wastewater flows does not provide a Bay-Delta benefit. Other export areas whose return flows do re-enter the Bay-Delta watershed can provide water quality as well as ecosystem benefits.

5.6.1 UR1 - SACRAMENTO RIVER

The Sacramento River Region is defined by the Sacramento Valley, from Sacramento north to Redding. The area is predominantly in agriculture, but many growing communities are within its boundary, including the greater metropolitan areas of Sacramento. All rivers that flow into the valley are carried by the Sacramento River southward to the Delta. Here, surface flows head west to the Pacific Ocean. With abundant surface and groundwater resources, urban users in this region experiences few water shortages. Sacramento Valley water users possess some of the oldest rights to surface water, with some rights dating back to the Gold Rush era. Urban water use comprises only about 6% of the region's total water use. The more populated urban areas are located on the valley floor, where summer temperatures over 100 degrees are not uncommon.

The region is characterized by largely single-family dwellings with relatively large landscapes, numerous processing and packing facilities for agricultural products, and limited manufacturing industry. For its size, the Sacramento River Region is sparsely populated, with an average density of fewer than 90 people per square mile. Most of these people live in the southern end of the region in and around Sacramento.

Typically, nonconsumptive urban water use, such as indoor residential use and losses associated with landscape irrigation, tend to return to the system of rivers, streams, and aquifers. Water applied to the landscape in excess of landscape water requirements usually flows to the storm channels via paved gutters and back to the surface waters. Likewise, after treatment, industrial and municipal indoor water use also ends up in the surface waters and is available for subsequent reuse. The region does not experience significant irrecoverable losses, although water quality degradation does occur.

The potential for reduction of irrecoverable losses exists through the reduction in landscape water use and any potential reduction in consumption associated with commercial or industrial uses. Otherwise, conservation measures can primarily provide water quality, ecosystem, and timing and energy savings benefits, as well as potentially reducing future need for more water supply development.

Urban populations are expected to grow significantly in the next 20 years, primarily around the greater Sacramento metropolitan area.

In this region, 21 urban agencies have signed the Urban MOU.

URBAN INFORMATION
Sacramento River Region

	Population	*Baseline per-capita water use*
1995:	2.4 million	274 gpcd
2020:	3.9 million	257 gpcd (292 if no conservation occurs)
Approximate CII use in 1995:		35% of per-capita use
Estimated CII use in 2020:		36% of per-capita use
Assumed CII reduction as a result of conservation measures:		
	No Action Alternative:	4% (of 2020 projected per-capita water use)
	CALFED:	7%
Assumed residential indoor use (average):		
	2020 baseline	65 gpcd
	2020 No Action Alternative	60 gpcd
	2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of 1995 total urban use):		
	Existing:	7%
	No Action Alternative:	6%
	CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:		0.05 (5%)
Assumed existing urban landscape acreage:		100,000 acres
Assumed urban landscaped acreage in 2020:		145,000 acres
Assumed ET_0 Value:		4.2 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

As discussed above, the Sacramento River Region is characterized as having significant amounts of incidental reuse, especially of indoor residential water. Most indoor use returns to local surface streams and rivers after treatment and is relied on as part of downstream flows. In addition, changes in the type of outdoor landscaping are assumed to result in only negligible savings. The region has little potential water savings that can be reallocated to other beneficial uses. It is true, however, that potential exists to implement urban conservation measures for other purposes, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development. These benefits primarily relate to the savings shown in Table 5-7b.

Table 5-7a. Assumed Distribution of Landscaped Acreage among ET_0 Factors for the Sacramento River Region (%)

			2020 NO ACTION		2020 CALFED	
ET_0 FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	100	100	50	30	40	10
1.0			25	30	30	10
0.8			25	40	30	75
0.6						5
0.4						

Table 5-7b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Sacramento River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	20-25	20-25	40-50
Urban landscaping[1]	100-105	30-35	130-140
Commercial, industrial, institutional[1]	15-20	25-30	40-50
Distribution system[1]	10-15	10-15	20-30
Total	**145-165**	**85-105**	**230-270**

[1] For this region, it is assumed that 95% of all losses are recovered and available to the local water supply.

Table 5-7c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the Sacramento River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	1-2	1-2	2-4
Urban landscaping[1,2]	4-5	2-4	6-9
Commercial, industrial, institutional[1]	0-1	1-2	1-3
Distribution system[1]	0-1	0-1	0-2
Total	**5-9**	**4-9**	**9-18**

[1] For this region, it is assumed that only 5% of all loss reduction is available for reallocation.

[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.2 UR2 - EASTSIDE SAN JOAQUIN RIVER

The Eastside San Joaquin River Region encompasses the area from the San Joaquin River near Fresno north to the Cosumnes River, and from the eastern foothills to the San Joaquin River as it travels up the valley to the Delta. This area is predominantly agricultural but includes the metropolitan areas of Stockton, Modesto, and Merced along with numerous other communities. Several rivers originating in the Sierra Nevada flow out of the mountains and west into the San Joaquin River (as it travels through the center of the valley). These include the Merced, Tuolumne, Stanislaus, and Mokelumne Rivers as well as other small tributaries. Urban water use comprises only about 5% of the region's total water use. The more populated urban areas are located on the valley floor, where summer temperatures over 100 degrees are not uncommon.

With abundant surface water and groundwater resources, urban users in this region experience few water shortages. However, most of the urban communities in the region rely heavily on groundwater for municipal supplies. Recently, some agricultural irrigation districts in the region are developing agreements that would allow them to provide surface water to these communities as a supplemental source to the current groundwater supplies.

The region is characterized by largely single-family dwellings with relatively large landscapes, numerous processing and packing facilities for agricultural products, and limited manufacturing industry. The region has an average population density of just under 200 people per square mile. Most of these people are concentrated in the urban towns and cities.

Typically, non-consumptive urban water use, such as indoor residential use and losses associated with landscape irrigation, tend to return to the system of rivers, streams, and aquifers. Water applied to the landscape in excess of landscape water requirements usually flows to the storm channels via paved gutters and back to the surface waters. Likewise, after treatment, industrial and municipal indoor water use also ends up in the surface waters and is available for subsequent reuse. The region does not experience significant irrecoverable losses, although water quality degradation does occur.

The potential for reduction of irrecoverable losses exists through the reduction in landscape water use and any potential reduction in consumption associated with commercial or industrial uses. Otherwise, conservation measures can primarily provide water quality, ecosystem, and timing and energy savings benefits, as well as potentially reducing future need for more water supplies.

Urban populations are expected to grow significantly in the next 20 years, primarily around the cities of Stockton, Modesto, and Merced. These areas increasingly serve as "bedroom communities" for the Bay Area.

In this region, six urban agencies have signed the Urban MOU.

URBAN INFORMATION
Eastside San Joaquin River Region

	Population	*Baseline Per-capita water use*
1995:	1.6 million	301 gpcd
2020:	3.1 million	269 gpcd (306 if no conservation occurs)
Approximate CII use in 1995:		24% of per-capita use
Estimated CII use in 2020:		25% of per-capita use
Assumed CII reduction as a result of conservation measures:		
	No Action Alternative:	4% (of 2020 projected per-capita water use)
	CALFED:	07%
Assumed residential indoor use (average):		
	2020 baseline	65 gpcd
	2020 No Action Alternative	60 gpcd
	2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):		
	Existing:	7%
	No Action Alternative:	6%
	CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:		0.05 (5%)
Assumed existing urban landscape acreage:		65,000 acres
Assumed urban landscaped acreage in 2020:		120,000 acres
Assumed ET_0 Value:		4.3 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

As discussed above, the Eastside San Joaquin River Region is characterized by significant amounts of incidental reuse, especially of indoor residential water. Most indoor use returns to local surface streams and rivers after treatment and is relied on as part of downstream flows. Changes in the type of outdoor landscaping are assumed to result in only negligible savings. The region has little potential water savings that can be reallocated to other beneficial uses. The potential exists, however, to implement urban conservation measures for other purposes, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development. These benefits primarily relate to the savings shown in Table 5-8b.

Table 5-8a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the Eastside San Joaquin River Region (%)

			2020 NO ACTION		2020 CALFED	
ET_o FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	85	85	50	30	20	5
1.0	10	10	25	30	40	5
0.8	5	5	25	40	40	80
0.6						10
0.4						

Table 5-8b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Eastside San Joaquin River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	15-20	15-20	30-40
Urban landscaping[1]	65-70	60-65	125-135
Commercial, industrial, institutional[1]	5-10	15-20	20-30
Distribution system[1]	5-10	5-10	10-20
Total	**90-110**	**95-115**	**185-225**

[1] For this region, it is assumed that 95% of all losses are recovered and available to the local water supply.

Table 5-8c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the Eastside San Joaquin River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	0-1	0-1	0-2
Urban landscaping[1,2]	3-4	6-8	9-12
Commercial, industrial, institutional[1]	0-1	0-1	0-2
Distribution system[1]	0-1	0-1	0-2
Total	**3-7**	**6-11**	**9-18**

[1] For this region, it is assumed that only 5% of all loss reduction is available for reallocation.

[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.3 UR3 - TULARE LAKE

The Tulare Lake Region includes the southern San Joaquin Valley from the southern limit of the San Joaquin River watershed to the base of the Tehachapi Mountains. The area is predominantly agricultural, but many small agricultural communities as well as the rapidly growing cities of Fresno and Bakersfield are located here. The Kings, Kaweah, Tule, and Kern Rivers flow into this region from the east. All of the rivers terminate in the valley floor and do not drain to the ocean except in extremely wet years. Urban water use comprises only about 3% of the region's total water use. The more populated urban areas are located on the valley floor, where summer temperatures over 100 degrees are not uncommon.

The region is characterized by mainly single-family dwellings with large rural landscapes. The region has a substantial amount of dairy operations and processing and packing industries for agricultural products, but very little or no industrial manufacturing activities, beyond the extraction of oil from subterranean reserves. This activity primarily occurs south and west of Bakersfield and does not constitute a large municipal water demand. The region has an average population density of just over 100 people per square mile. Most of these people are concentrated in the urban towns and cities.

Like other Central Valley regions, municipal and residential water reuse is common. Landscape water runoff often percolates to the groundwater since the region is a closed basin. However, after being treated in wastewater treatment plants, the majority of the treated water is evaporated in large evaporation ponds. Some of this water also percolates downward and provides recharge to local groundwater sources. In many parts, shallow groundwater has become salty and, in some cases, contaminated with selenium. A significant amount of surface runoff from landscape irrigation percolates to shallow groundwater and may become unusable. After treatment, municipal water is reused for agricultural irrigation or used to recharge groundwater.

Urban populations are expected to grow significantly in the next 20 years, primarily around the cities of Bakersfield and Fresno. Bakersfield is experiencing rapid growth due in part to influences from nearby metropolitan southern California.

In this region, six urban agencies have signed the Urban MOU.

URBAN INFORMATION
Tulare Lake Region

	Population	*Baseline per-capita water use*
1995:	1.7 million	311 gpcd
2020:	3.3 million	274 gpcd (304 if no conservation occurs)
Approximate CII use in 1995:		24% of per-capita use
Estimated CII use in 2020:		25% of per-capita use
Assumed CII reduction as a result of conservation measures:		
	No Action Alternative:	4% (of 2020 projected per-capita water use)
	CALFED:	7%
Assumed residential indoor use (average):		
	2020 baseline	65 gpcd
	2020 No Action Alternative	60 gpcd
	2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):		
	Existing:	7%
	No Action Alternative:	6%
	CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:		0.3 (30%)
Assumed existing urban landscape acreage:		70,000 acres
Assumed urban landscaped acreage in 2020:		130,000 acres
Assumed ET_o Value:		4.3 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

As discussed above, the Tulare Lake Region is characterized as having incidental reuse, especially of indoor residential water. Some indoor use percolates to groundwater after treatment and is relied on as a groundwater source, especially for agricultural users adjacent to wastewater treatment plant disposal areas. However, a significant amount of water evaporates after being treated at regional wastewater treatment plants. Reductions in the amount of evaporation loss can constitute a reduction in irrecoverable loss available for reallocation.

Although the region does have potential water savings that can be reallocated to other beneficial uses, the reduction in other losses provide other benefits, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development. These benefits primarily relate to the savings in Table 5-9b.

Table 5-9a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the Tulare Lake Region (%)

			2020 NO ACTION		2020 CALFED	
ET_o FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	15	15	10	10	5	0
1.0	60	60	60	30	50	10
0.8	25	25	30	60	45	70
0.6						20
0.4						

Table 5-9b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Tulare Lake Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	15-20	15-20	30-40
Urban landscaping[1]	20-25	40-45	60-70
Commercial, industrial, institutional[1]	10-15	15-20	25-35
Distribution system[1]	10-15	10-15	20-30
Total	**55-75**	**80-100**	**135-175**

[1] For this region, it is assumed that 70% of all losses are recovered and available to the local water supply.

Table 5-9c. Potential Conservation of Irrecoverable Losses(Available for Reallocation) for the Tulare Lake Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	5-10	5-10	10-20
Urban landscaping[1,2]	7-10	18-20	25-30
Commercial, industrial, institutional.[1]	1-5	5-10	6-15
Distribution system[1]	2-5	2-5	4-10
Total	**15-30**	**30-45**	**45-75**

[1] For this region, it is assumed that only 30% of all loss reduction is available for reallocation.
[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.4 UR4 - SAN FRANCISCO BAY

The San Francisco Bay Region is primarily urban, with very little agricultural acreage. The region represents merely 3% of the states's land. The region generally is cool and often foggy along the coast, with Mediterranean-like weather in its inland valleys. The coastal range creates numerous micro-climates and allows cool air to flow at times from the Pacific Ocean into the interior of the state. Coastal areas are often about 10 degrees cooler than the interior part of the region, and sometimes as much as 20-30 degrees cooler in summer than the regions of the Central Valley. In contrast to the Sacramento and Tulare Lake Regions, the San Francisco Bay Region's urban demand accounts for 20% of the total demand. (Environmental use is a little less than of 80% of the total.)

The region is characterized by single- and multi-family dwellings with smaller landscapes; large amounts of industry, including computer and electronics manufacturing; and many commercial businesses. The commercial and industrial water demands can be significant, accounting for almost one-third of the total urban demand. The region is heavily populated, with an average density of over 1,300 people per square mile.

Unlike the Central Valley regions, downstream reuse of landscape runoff and treated wastewater is very minimal. The majority of unconsumed urban water ends up in the San Francisco Bay or is directly discharged to the Pacific Ocean. There is little opportunity for incidental reuse. For this reason, there is an increasing interest in capturing the discharges and recycling them back into the region. However, conservation measures also can help reduce the irrecoverable losses to these salt sinks. Almost all decreases in urban water use in this region, whether previously consumed or not, can provide a water supply benefit.

Urban populations are expected to expand only slightly, primarily because of limited land and other resources. However, even what is considered limited growth for this region can be significant when compared to the total projected populations in the Central Valley regions (see Figure 5-4).

In this region, 27 urban water agencies have signed the Urban MOU.

URBAN INFORMATION
San Francisco Bay Region

	Population	*Baseline per-capita water use*
1995:	5.8 million	177 gpcd
2020:	6.9 million	169 gpcd (199 if no conservation occurs)

Approximate CII use in 1995:	38% of per-capita use
Estimated CII use in 2020:	38% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	7%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):	
Existing:	6%
No Action Alternative:	6%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	0.9 (90%)
Assumed existing urban landscape acreage:	155,000 acres
Assumed urban landscaped acreage in 2020:	180,000 acres
Assumed ET_o Value:	3.3 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

Most of the conservation potential in the San Francisco Bay Region would constitute a water savings that could be made available to other beneficial uses, including offsetting future urban demands. Such savings also would provide other benefits, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development.

Table 5-10a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the San Francisco Bay Region (%)

			2020 NO ACTION		2020 CALFED	
ET_0 FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	15	15	10	10	0	0
1.0	60	60	50	30	35	20
0.8	25	25	40	60	55	55
0.6					10	20
0.4						5

Table 5-10b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the San Francisco Bay Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER *CALFED*	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	35-40	35-40	70-80
Urban landscaping[1]	25-30	55-60	80-90
Commercial, industrial, institutional[1]	15-20	30-35	45-55
Distribution system[1]	-	10-15	10-15
Total	**75-90**	**130-150**	**205-240**

[1] For this region, it is assumed that only 10% of all losses are recovered and available to the local water supply.

Table 5-10c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the San Francisco Bay Region

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER *CALFED*	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	30-35	30-35	60-70
Urban landscaping[1,2]	20-25	50-55	70-80
Commercial, industrial, institutional.[1]	15-20	30-35	45-55
Distribution system[1]	-	10-15	10-15
Total	**65-80**	**120-140**	**185-220**

[1]For this region, it is assumed that 90% of all loss reduction is available for reallocation.

[2]Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.5 UR5 - CENTRAL COAST

The Central Coast Region encompasses land on the western side of the coastal mountains that is hydraulically connected to the Bay-Delta region. This region includes southern portions of the Santa Clara Valley and San Benito County, as well as the urban communities from San Luis Obispo south to Santa Barbara. These areas are included because of the recent completion of the Coastal Aqueduct, envisioned to provide SWP water to urban users along its route. Exported water from the San Felipe unit of the CVP is delivered to urban users in San Benito and Santa Clara Counties. In contrast to the Sacramento and Tulare Lake Regions, the Central Coast Region's urban demand accounts for 20% of the total demand. (Agriculture uses just less than 80% of the total.)

The region has a diverse climate with summer months cool along the coastal areas and warm inland. During winter, however, interior parts of the region become cooler than coastal areas. The region is characterized by largely single-family dwellings with relatively small landscapes, and limited commercial and industrial operations. The region has an average population density of just under 120 people per square mile. Most of these people are concentrated in the urban towns and cities.

Unlike the Central Valley regions, downstream reuse of landscape runoff and treated wastewater is minimal. The majority of unconsumed urban water is directly discharged to the Pacific Ocean. There is little opportunity for incidental reuse. For this reason, there is an increasing interest in capturing the discharges and recycling them back into the region. However, conservation measures also can help reduce the irrecoverable losses to these salt sinks. Almost all decreases in urban water use in this region, whether previously consumed or not, can provide a water supply benefit.

In this region, 13 urban agencies have signed the Urban MOU.

URBAN INFORMATION
Central Coast Region

	Population	*Baseline Per-capita water use*
1995:	1.3 million	180 gpcd
2020:	1.9 million	164 gpcd (192 if no conservation occurs)

Approximate CII use in 1995:	32% of per-capita use
Estimated CII use in 2020:	33% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	7%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):	
Existing:	8%
No Action Alternative:	7%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	1.0 (100%)
Assumed existing urban landscape acreage:	35,000 acres
Assumed urban landscaped acreage in 2020:	50,000 acres
Assumed ET_o Value:	2.8 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

All of the conservation potential in the Central Coast Region would constitute a water savings that could be made available to other beneficial uses, including offsetting future urban demands. Such savings also would provide other benefits, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development.

Table 5-11a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the Central Coast Region (%)

			2020 NO ACTION		2020 CALFED	
ET_o FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	5	5	3	0	0	0
1.0	20	20	15	10	5	0
0.8	55	55	40	30	25	15
0.6	20	20	42	55	60	65
0.4				5	10	20

Table 5-11b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Central Coast Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	10-15	10-15	20-30
Urban landscaping[1]	10-15	10-15	20-30
Commercial, industrial, institutional[1]	0-5	5-10	5-15
Distribution system[1]	0-5	5-10	5-15
Total	**20-40**	**30-50**	**50-90**

[1] For this region it is assumed that none of the losses are recovered and available to the local water supply.

Table 5-11c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the Central Coast Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	10-15	10-15	20-30
Urban landscaping[1,2]	10-15	10-15	20-30
Commercial, industrial, institutional.[1]	0-5	5-10	5-15
Distribution system[1]	0-5	5-10	5-15
Total	**20-40**	**30-50**	**50-90**

[1] For this region, it is assumed that all loss reduction is available for reallocation.

[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.6 UR6 - SOUTH COAST

The South Coast Region lies south of the Tehachapi Mountains and extends to the California border with Mexico. It is home for more than 50% of the state's population but represents only 7% of the state's total land area. Rivers and streams that originate in this region flow to the Pacific Ocean. The climate is Mediterranean-like, with warm and dry summers followed by mild and wet winters. It is projected that the region will increase from a 1990 population of 16 million to over 25 million by 2020. In sharp contrast to all the other regions, this region's urban demand accounts for 80% of the total demand. The region also imports about two-thirds of its water from areas outside the region, including the Colorado River, the Owens Valley, and the Bay-Delta.

The region is characterized by single- and multi-family dwellings with smaller landscapes, large amounts of industry, and many commercial businesses. The commercial and industrial water demands can be significant, accounting for over one-quarter of the total urban demand. This region also has the highest population density, with nearly 1,600 people per square mile of land.

Unlike the Central Valley regions, downstream reuse of landscape runoff and treated wastewater is limited to inland reaches of the region. Coastal communities have little downstream reuse. The majority of unconsumed urban water (water passing through wastewater treatment plants) is directly discharged to the Pacific Ocean, resulting in little opportunity for incidental reuse. For this reason, there is an increasing interest in capturing the discharges and recycling them back into the region. However, conservation measures also can help reduce the irrecoverable losses to these salt sinks. Any decrease in water use in this region, whether previously consumed or not, can generate real water savings.

In this region, 89 urban agencies have signed the Urban MOU.

URBAN INFORMATION
South Coast Region

	Population	*Baseline per-capita water use*
1995:	17.3 million	208 gpcd
2020:	24.3 million	186 gpcd (218 if no conservation occurs)

Approximate CII use in 1995:	32% of per-capita use
Estimated CII use in 2020:	32% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	7%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):	
Existing:	7%
No Action Alternative:	6%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	0.8 (80%)
Assumed existing urban landscape acreage:	480,000 acres
Assumed urban landscaped acreage in 2020:	650,000 acres
Assumed ET_o Value:	4.0 feet of water annually

Estimated Reduction in Irrecoverable Losses for Reallocation to Other Water Supply Uses

Most of the conservation potential in the South Coast Region would constitute a water savings that could be made available to other beneficial uses, including offsetting future urban demands. Such savings would also provide other benefits, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development.

Table 5-12a. Assumed Distribution of Landscaped Acreage among ET_o Factors for the South Coast Region (%)

			2020 NO ACTION		2020 CALFED	
ET_o FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	10	10	5	0	0	0
1.0	40	40	30	20	15	5
0.8	40	40	50	60	60	55
0.6	10	10	13	15	20	30
0.4			2	5	5	10

Table 5-12b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the South Coast Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	130-140	130-140	260-280
Urban landscaping[1]	170-190	190-200	360-390
Commercial, industrial, institutional[1]	60-70	110-120	170-190
Distribution system1	50-60	50-60	100-120
Total	**410-460**	**480-520**	**890-980**

[1] For this region, it is assumed that 20% of all losses are recovered and available to the local water supply.

Table 5-12c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the South Coast Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	100-115	100-115	200-230
Urban landscaping[1,2]	150-160	170-180	320-340
Commercial, industrial, institutional [1]	50-60	90-100	140-160
Distribution system[1]	40-50	40-50	80-100
Total	**340-385**	**400-445**	**740-830**

[1] For this region, it is assumed that 80% of all loss reduction is available for reallocation.

[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.6.7 UR7 - COLORADO RIVER

The Colorado River Region includes a large area of the state's southeastern corner, the majority of which is desert or irrigated agriculture. The primary urban areas lie north and south of the Salton Sea. The resort-oriented communities of Palm Springs and Indio lie to the north, while the rural communities of Imperial and Brawley lie to the south. This area includes about 650,000 acres of irrigated agricultural land. The Salton Sea, located between the two urban areas, is a prominent feature. The sea is currently fed by rainfall from the surrounding desert mountains and by agricultural surface drainage. Rainfall in the mountains also recharges the groundwater aquifers that underlie the region. Groundwater plays a major role in providing for the urban demands, including the significant acreage devoted to golf courses. Urban water use comprises only about 5% of the region's total water use (agriculture uses 83%).

The region's climate is hot subtropical desert, with most of the annual precipitation falling as snow in the surrounding high mountains. Temperatures above 110 degrees are not uncommon during summer.

The region is characterized by single-family dwellings, some with large turf landscapes and others with desert landscape; commercial businesses; and resorts. The resort demand alone creates a significant need for water resources. The region has an average population density of around 25 people per square mile. Most of these people are concentrated in the urban towns and cities, not in the outlying desert or the Salton Sea area.

Unlike the Central Valley regions, downstream reuse of landscape runoff and treated wastewater is minimal. Although a large degree of groundwater reuse is associated with the resort golf areas, some of the urban water that is not consumptively used eventually reaches the Salton Sea. Conservation measures can help reduce the irrecoverable losses to this salt sink.

In this region, five urban agencies have signed the Urban MOU.

Special Conditions

Similar to agricultural conservation opportunities, the potential for real water savings to benefit the Bay-Delta depends on the use of the conserved water. For example, conservation savings in Palm Springs may be used to offset future demands. It is unlikely that savings would be transferred to another urban user as a replacement for imported Delta water. Therefore, the values shown for this region may provide little benefit to the Bay-Delta.

URBAN INFORMATION
Colorado River Region

	Population	*Baseline per-capita water use*
1995:	0.5 million	578 gpcd
2020:	1.1 million	522 gpcd (594 if no conservation occurs)

Approximate CII use in 1995:	27% of per-capita use
Estimated CII use in 2020:	28% of per-capita use
Assumed CII reduction as a result of conservation measures:	
No Action Alternative:	4% (of 2020 projected per-capita water use)
CALFED:	7%
Assumed residential indoor use (average):	
2020 baseline	65 gpcd
2020 No Action Alternative	60 gpcd
2020 CALFED	55 gpcd
Assumed distribution system losses (as a percent of total urban use):	
Existing:	12%
No Action Alternative:	8%
CALFED:	5%
Assumed ratio of irrecoverable losses to total existing loss:	0.3 (30%) Most urban use is in the Coachella Valley, where much of the deep percolation from golf courses or other losses actually recharge local aquifers.
Assumed existing urban landscape acreage:	35,000 acres
Assumed urban landscaped acreage in 2020:	75,000 acres
Assumed ET_o Value:	6.0 feet of water annually

Estimated Reduction of Irrecoverable Losses for Reallocation to Other Water Supply Uses

About 30% of the conservation potential in the Colorado River Region would constitute a water savings that could be made available to other beneficial uses, including offsetting future urban demands. Such savings also would provide other benefits, namely improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development.

Table 5-13a. Assumed Distribution of Landscaped Acreage among ET_0 Factors for the Colorado River Region (%)

			2020 NO ACTION		2020 CALFED	
ET_0 FACTOR	1995 ACRES (%)	BASE ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)	EXISTING ACRES (%)	NEW ACRES (%)
1.2	70	70	60	50	50	40
1.0	30	30	35	40	30	30
0.8			5	10	15	25
0.6					5	5
0.4						

Table 5-13b. Potential Conservation of Existing Losses (Including Irrecoverable Loss) for the Colorado River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER *CALFED*	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	5-10	5-10	10-20
Urban landscaping[1]	20-25	25-30	45-55
Commercial, industrial, institutional[1]	5-10	10-15	15-25
Distribution system[1]	20-25	15-20	35-45
Total	**50-70**	**55-75**	**105-145**

[1] For this region, it is assumed that 70% of all losses are recovered and available to the local water supply.

Table 5-13c. Potential Conservation of Irrecoverable Losses (Available for Reallocation) for the Colorado River Region (TAF/Year)

USE	PROJECTED REDUCTION UNDER NO ACTION ALTERNATIVE	INCREMENTAL REDUCTION UNDER CALFED	TOTAL ESTIMATED REDUCTION
Residential indoor[1]	0-5	0-5	0-10
Urban landscaping[1,2]	15-20	20-25	35-45
Commercial, industrial, institutional[1]	0-5	0-5	0-10
Distribution system[1]	5-10	5-10	10-20
Total	**20-40**	**25-45**	**45-85**

[1] For this region, it is assumed that 30% of all loss reduction is available for reallocation.
[2] Urban landscaping values include both reduction in losses and changes to landscaping types. See Attachment B for more details on landscape conservation estimates.

5.7 SUMMARY OF ESTIMATED URBAN WATER CONSERVATION POTENTIAL

The following tables summarize the regional conservation estimates for urban regions.

Table 5-14. Estimated Conservation Potential of Projected Losses (Including Irrecoverable Losses) for All Urban Regions (TAF/Year)

REGION[1]	NO ACTION ALTERNATIVE CONSERVATION	INCREMENTAL CALFED CONSERVATION	TOTAL CONSERVATION POTENTIAL
Sacramento River	145-165	85-105	230-270
Eastside San Joaquin River	90-110	95-115	185-225
Tulare Lake	55-75	80-100	135-175
San Francisco Bay	75-90	130-150	205-240
Central Coast	20-40	30-50	50-90
South Coast	410-460	480-520	890-980
Colorado River	50-70	55-75	105-145
Total	**845-1,010**	**955-1,115**	**1,800-2,125**

Other than the irrecoverable portion, which is the only water available for reallocation, these savings provide improved water quality, changed timing of flow releases, reduced fishery impacts, reduced treatment costs, and potentially reduced need for additional water supply development.

[1] Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Table 5-15. Estimated Conservation Potential of Irrecoverable Loss (a Subset of Total Loss) for All Urban Regions (TAF/Year)

REGION[1]	NO ACTION ALTERNATIVE CONSERVATION	INCREMENTAL CALFED CONSERVATION	TOTAL CONSERVATION POTENTIAL
Sacramento	5-9	4-9	9-18
Eastside San Joaquin River	3-7	6-11	9-18
Tulare Lake	15-30	30-45	45-75
San Francisco Bay	65-80	120-140	185-220
Central Coast	20-40	30-50	50-90
South Coast	340-385	400-445	740-830
Colorado River	20-40	25-45	45-85
Total	**470-590**	**615-745**	**1,085-1,335**

These savings, a subset of the values in Table 5-14, are available for reallocation to other water supply uses.

[1] Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Although the total potential reduction associated with irrecoverable losses could amount to as much as 1.3 MAF, it must be recognized that amount this would require the majority of urban water users as well as urban water suppliers to implement most all available conservation measures. Achieving this amount will require significant local, state and federal support.

It also should be noted that the additional potential irrecoverable loss reduction resulting from the Water Use Efficiency Program is only slightly more than half of the total shown (745 TAF of 1.3 MAF). This demonstrates CALFED's assumption that existing trends will continue to generate conservation savings at rates greater than quantified by DWR or others. This results from No-Action factors such as the Central Valley Project Improvement Act (CVPIA) that are not fully accounted for in previous estimates of savings achievable under "full implementation" of urban BMPS.

In addition, a significant portion of the irrecoverable loss reduction is in the South Coast Region, which may or may not provide any Bay-Delta benefit. This will depend on how water suppliers in this region reallocate the water saved (Would water savings offset demand growth; reduce Colorado River or other imported, non-Delta supplies; or would they be "left in the Delta"?)

Slightly less than half of the reduction in existing loss estimated in Table 5-14 is composed of recoverable losses and is not available for reallocation for other water supply purposes. However, this significant conservation potential can provide valuable water quality, water management, and ecosystem benefits that are also key objectives of the CALFED Program. In addition, reduced losses may provide in-basin water management benefits and help reduce future demand projections.

5.8 UNIT COST ESTIMATES FOR URBAN WATER USE EFFICIENCY PROGRAMS

The CALFED Water Use Efficiency Program will call on urban water suppliers to fully implement cost-effective Urban MOU Best Management Practices (BMPs). While many urban water suppliers have already made substantial progress towards satisfying the terms of the Urban MOU, others will be just starting out. Meeting CALFED water use efficiency objectives will require substantial conservation program investments in some regions. Determining which investments are cost-effective and which are not will be of key importance. This section presents unit cost ($/AF) estimates for eight different BMP programs. These programs are:

- Residential ULFT Rebate Program
- Residential ULFT Direct Installation Program
- Commercial & Industrial ULFT Rebate Program
- High-Efficiency Washing Machine Rebate Program
- Untargeted Residential Water Survey Program
- Targeted Residential Water Survey Program
- Low Flow Showerhead Distribution Program
- Residential Metering Program

Survey programs for large landscape and commercial/industrial users also were examined. However, the degree of heterogeneity across these programs both in terms of cost and design prevented the development of useful unit cost ranges.

Program unit cost estimates presented in this section are for active conservation (i.e., the cost to increase conservation above what it would be in the absence of intervention by water suppliers). To the degree possible the estimates account for, and therefore do not include, background conservation due to changes in plumbing codes, natural replacement of water using appliances and fixtures, and other factors which are not considered to be part of "active" conservation.

Two types of unit costs are presented: (1) simple unit cost and (2) discounted unit cost. A simple unit cost is defined as the present value of project costs divided by the total yield over the life of the project. A discounted unit cost is defined as the amortized cost of the project divided by its average annual yield. Both estimates are frequently used in project evaluations. Generally, discounted unit costs result in higher estimates than simple unit costs. In both cases a 4.5 percent discount rate is assumed.

These estimates are intended to demonstrate the likely range of cost water suppliers will experience implementing various BMP programs. It is important to emphasize, however, that these **estimates are for informational purposes only**. They are not being used by CALFED for project selection or ranking. Economic feasibility studies for specific projects and programs will occur in later design phases of the Urban Water Use Efficiency Program and during investigations performed by individual water suppliers.

Furthermore, it should be noted that unit costs are only half of the equation when evaluating the merits of a conservation program. Benefits achieved from the measure are the other half. Information on both costs and benefits are essential for appropriate judgments to be made regarding the appropriateness of any particular water conservation program.

5.8.1 Perspective of Unit Cost Analysis

Because the majority of conservation investments will be made at the local level, these estimates are presented from the perspective of an urban water supplier implementing the conservation program. Focusing on the supplier perspective helps to identify which BMP investments are likely to require CALFED cost-sharing assistance and which are not. It is CALFED's belief that in most cases BMPs will be cost effective from a statewide perspective. Those with low unit costs from the supplier's perspective are less likely to require cost-sharing assistance, while those with high unit costs are more likely to require assistance.

5.8.2 Limitations of Unit Cost Estimates

While unit costs can be indicative of cost-effectiveness, they do not directly address the question of economic feasibility. It is always possible that a conservation project with very high unit costs also has very high unit benefits, and vice-versa. Similarly, unit costs are useful for ranking projects only when (1) competing projects are expected to produce exactly the same result or (2) all results can be measured in terms of a single, non- monetary unit (say AF). Neither of these conditions will occur for the majority of water supply, conservation, and recycling projects CALFED may consider. Unit costs are therefore a useful first step to cost-benefit analysis, but they are not a substitute for it.

The estimates presented within this section also do not account for diminishing returns. Showerhead and ULFT distribution programs are both thought to be subject to diminishing returns as device saturation levels increase. For example, consider a 2.5 bathroom house which has a ULFT in the most used bathroom, but not the other two. As additional ULFT's are added, the total savings potential for the dollar investment is not as great as the first toilet replaced. This is because there are less flushes occurring to offset the invested cost. This translates to a higher cost per unit of savings. Conservation experts are starting to notice that unit costs in areas where these programs have been active for long periods are likely to be higher than the unit cost estimates presented in this section.

5.8.3 Data Sources for Unit Cost Estimates

The unit cost estimates shown in Table 5-16 were constructed using methods outlined in the CUWCC's "Guidelines for Preparing Cost-Effectiveness Analyses of Urban Water Conservation Best Management Practices" (Pekelney et al., 1996). Water supplier BMP implementation reports provided most of the program cost data used for these estimates. The cost data account for average expenditures for material, labor, and overhead costs incurred by water suppliers implementing these programs. In some instances it was necessary to supplement this cost data either with cost data from other sources or with engineering estimates. Published conservation program evaluations provided data for expected water savings and savings life expectancy. These studies included but were not limited to:

- THELMA H-Axis Washing Machine Water and Energy Savings Study (THELMA, 1997);
- Oak Ridge National Laboratory's H-Axis Washing Machine Water Savings Study (Oak Ridge, 1998);
- CUWCC's 1997 CII ULFT Savings Study (Whitcomb et al., 1997);
- Metropolitan Water District's 1994 Public Facilities Toilet Retrofits Evaluation (Bamezai et al., 1994);
- Metropolitan Water District's 1994 Ultra Low Flush Toilet Programs Evaluation (Bamezai et al., 1994);
- Metropolitan Water District's 1994 Residential Water Audit Program Evaluation (Bamezai et al., 1994).

Much of this data is compiled in the CUWCC's forthcoming "Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices" (Pekelney et al.).

There is scant data on the extent of program free-ridership, savings decay, and natural replacement rates for these programs. Most of the estimates employ assumptions for these variables. The ranges for program unit costs reflect uncertainty regarding these assumptions as well as variations in program design that affect expected savings and administrative costs. All estimates were rounded to the nearest $100/AF.

TABLE 5-16. Unit Cost Estimates for Various BMP Programs

BMP Program	Simple Unit Cost [4] Estimate ($/AF)	Discounted Unit Cost [5] Estimate ($/AF)
Residential ULFT Rebates	$200 - $400	$300 - $600
Residential ULFT Direct Install	$100 - $300	$300 - $500
CII ULFT Replacement [1]	$200 - $500	$400 - $900
H-Axis Washer Rebates	$400 - $900	$800 - $1700
Home Survey - Untargeted	$700 - $1,000	$1,300 - $1,900
Home Survey - Targeted	$900 - $1,000	$1,700 - $1,900
Residential Metering [2]	$100	$200 - $300
Low Flow Showerhead Distribution	$200 - $300	$300 - $600
Landscape Audits [3]	N/A	N/A
CII Audits [3]	N/A	N/A

[1] Range is based on targeted versus untargeted replacements.
[2] No range for simple unit cost estimates because high and low estimates both rounded to $100.
[3] No estimate provided because of heterogeneity of program designs and costs.
[4] Simple unit cost = P.V. (Costs) ÷ Sum of Yield over Life of Project
[5] Discounted unit cost = Amortized Cost ÷ Average Annual Yield of Project

6. Water Recycling

6. Water Recycling **6-1**

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6. Water Recycling

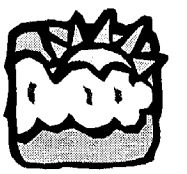
Water recycling offers significant potential to improve water supply reliability for California, one of the primary objectives of the CALFED Program. Water recycling is a safe, reliable, and locally controlled water supply. Tertiary treated, disinfected recycled water is permitted for all non-potable uses in California through Title 22 of the California Code of Regulations. With the majority of the state's population in coastal areas, the majority of resulting wastewater flows currently are discharged to the ocean and rendered unavailable for reuse. If these flows are recycled, they can represent a new and somewhat drought-proof source of supply for water users.

Currently, the total agricultural and urban water use in the state is about 42 MAF annually. Of this, the urban sector uses about 8.7 MAF, nearly 70% of which is used in the urban coastal areas of California (DWR 1997). In southern California, about 30% of this use goes directly to outdoor urban landscaping and does not generate a wastewater flow (MWD 1996). In hotter inland areas, this percentage can increase to more than 60% (DWR 1997). In coastal areas of the state, the remaining urban uses (indoor residential and CII) result in more than 2 MAF of wastewater being treated and discharged annually (BARWRP 1997). Recycling of any portion of this water constitutes a new water supply—a water supply that can be allocated to other beneficial uses.

By 2020, wastewater flows from coastal areas are expected to increase to over 3 MAF annually, even considering significant levels of future urban water conservation. This amount can provide substantial opportunities for water recycling and help achieve CALFED Program objectives for water supply reliability, water quality, and ecosystem restoration. Recycling creates a unique contribution to improved reliability by providing an additional source of water that is local rather than imported. Further, this source can be relatively resistant to drought, making it available when it is needed most. Perhaps most important, recycling often provides increased water for one beneficial use without reducing the water available for other beneficial uses. From a Bay-Delta perspective, recycling projects in export areas increase water supply without increasing Delta exports or reducing Delta outflow. Thus, water recycling projects can simultaneously help meet CALFED Program objectives for water supply reliability, water quality, and ecosystem restoration.

Potential benefits from water recycling include:

- Reduced demand for Delta exports
- Improved timing of diversions
- Increased carryover storage
- Reduced fish entrainment
- Reduced discharge of treated wastewater into useable surface water bodies
- Improved water quality
- Increased availability of Delta supplies for urban, agricultural, and environmental purposes



6.1 NEW WATER SUPPLY VS. TOTAL WATER RECYCLING

Water recycling increases total water supply by providing a new source of water previously "lost" to the ocean, bays, estuaries, and evaporation ponds. However, in non-coastal area regions (and even in minor portions of coastal regions), recycling of current wastewater flows does not provide additional new water supply because the treated wastewater already is discharged into rivers, streams, and aquifers where, in many cases, downstream users (including the environment) may depend on this flow. It is important to distinguish the new water supply potential from total water recycling because of the value of new water to water supply reliability; however, the total recycling potential is still important to help meet eco-system and water quality goals of the Program.

The amount of new water supply generated from recycled water depends on the type of water body that receives the discharged wastewater. These include:

- Rivers and streams
- Saline water bodies, such as the Pacific Ocean or San Francisco Bay
- Recharge and evaporation ponds

When treated wastewater is discharged into rivers or streams, it contributes to baseline flows downstream of the discharge point. This water may not be available for recycling without diminishing streamflow and causing impacts that may need to be mitigated with additional flow from other sources. To use terminology consistent with the analysis of urban and agricultural water conservation in this program plan, **recycling of this stream discharge would represent a reduction in applied water and contribute to total recycling but would not constitute a reduction in irrecoverable losses**. (See also the discussion in Section 4.4, "Recoverable vs. Irrecoverable Losses.")

Many communities in the Sacramento and San Joaquin Valleys fall into the first category—rivers and streams. For example, the Sacramento metropolitan area currently discharges most of its treated wastewater into the Sacramento River, downstream of Sacramento. This water is then part of the flow available in the Delta today. Therefore, the expanded use of recycled water by Sacramento would not contribute to CALFED's water reliability objective. It will contribute to local water supply reliability, but potentially at the expense of others. Primarily, it may result in positive contributions to CALFED's water quality and ecosystem restoration objectives.

As wastewater flows increase with population growth, however, the incremental increase in flows may be available as a new water supply to be recycled for use in and around these inland areas. In other valley communities with less secure water supplies, recycling may be an important way of reducing the need to obtain new water supplies. The Water Code requires the owner of a wastewater treatment plant currently discharging treated wastewater into a natural water course to petition the SWRCB prior to ceasing the discharge and beginning reclamation for other beneficial uses. The SWRCB can permit such a change only if the petitioner establishes that the change will not injure any legal user of that water.

The majority of the state's wastewater flow is generated in coastal areas and discharged to the ocean and San Francisco Bay—for example, Los Angeles, San Diego, and San Francisco. The recapture and recycling of wastewater from those regions could generate a new water supply and further CALFED water supply reliability, water quality, and ecosystem restoration objectives.

Many cities in the Sacramento-San Joaquin River watershed, including the cities of Fresno and Bakersfield, discharge to recharge and evaporation ponds. The wastewater is "disposed of" by percolating into the local aquifer or evaporating from the pond surfaces. Recycling the portion that evaporates under this discharge method would benefit CALFED's water reliability and other objectives. Recycling the portion percolating into useable groundwater may or may not further these objectives.

For purposes of this analysis, the evaluation of water recycling potential is limited to the ability to further CALFED's water supply reliability objective through water recycling in the state's three primary coastal areas, the San Francisco Bay Area, the Central Coast, and southern California. The ability to further CALFED's water quality and ecosystem restoration objectives through water recycling has not been analyzed. Similarly, CALFED did not analyze the potential for Central Valley water recycling to help meet any of these objectives.

6.2 UNDERSTANDING WATER RECYCLING OPPORTUNITIES

Water recycling is gaining in recognition as a viable supply source. More and more urban water agencies are analyzing and implementing water recycling projects for several different reasons, depending on their local conditions. Current drivers include:

- Increasingly stringent waste discharge requirements, which affect the timing and quantity of wastewater discharge as well as the type and level of treatment required prior to discharge (an example may include the California Toxics Rule which, if implemented as proposed, could favor more recycling).
- A need to secure more reliable sources of water to meet growing populations as other new supply alternatives become increasingly more difficult to find or implement.
- A need to offset physical or legislated reductions in some existing surface water and groundwater sources (the result of actions taken under the state and federal ESAs).
- Increasing use of integrated water resource planning policies that dictate local supply development actions to address environmental issues and enhance water supply reliability through the diversification of the sources of water made available to the customers.
- California Water Code provisions that define use of potable water for nonpotable purposes as a waste and unreasonable use.

However, the potential for water recycling is currently limited by several impediments, the greatest of such is considerations of local cost-effectiveness. Inter-jurisdictional issues (e.g., rights to wastewater resources), public acceptance of recycled water, and complex permitting and regulatory compliance processes also discourage some local agencies.

One of the more daunting impediments to water recycling noted by urban water agencies has been cost, especially as it is affected by the quality of the source water. The CALFED Program approach to water use efficiency (see Section 2) is based on cost-effectiveness. The CALFED Program proposes to encourage local water suppliers to analyze all options for reducing the mismatch between supply and demand. Further, through the actions detailed in Section 2, CALFED agencies will help water suppliers implement appropriate options starting with the least expensive. This is anticipated to result in identification of feasible recycling

projects. CALFED acknowledges that there is limited information regarding the effect of source water quality on the costs of producing recycled water and is proposing to support necessary research (see Section 2.3.3). However, the Preferred Alternative does include actions targeting improvements in Delta water quality, the source for many potential water recycling projects. (For more information on source water quality improvement strategies, see the Water Quality Program Plan and the Revised Phase II Report.)

When considering local cost-effectiveness issues in the past, many agencies found several options to meet demands that were less expensive than water recycling. This statement is supported by findings of Reclamation's "Least-Cost CVP Yield Increase Plan" (DOI 1995). However, the Reclamation study did not attempt to evaluate the state-wide water supply reliability, water quality, and ecosystem benefits attributable to water recycling.

When water transfers are available as a source, they often provide the least expensive increment of additional water supply. Careful avoidance or mitigation of third-party impacts associated with water transfers can add to the cost, but transfers still may be a locally least-cost alternative. It should be noted that many transfers are conducted on a year-to-year basis, while water recycling provides a long-term supply. Difficulties in conveying water from a "seller" to a "buyer," especially if the transfer involves moving water across the Delta, also can reduce the reliability of transfers as an effective water supply option. Water recycling has the potential of enhancing the water transfer market by making additional water supplies available for transfer. The Water Code provides that a water right holder that has reduced its use of water as a result of recycling efforts is able to transfer the "saved" water, pursuant to applicable state and federal transfer laws.

For many agencies, water conservation measures also can be and have been implemented at a lower unit cost than recycling (see the urban conservation costs outlined in Section 5). Despite the extensive implementation of conservation measures that has occurred over the last decade, CALFED estimates that the potential for additional water conservation in the urban sector remains substantial—over 1.5 MAF. Even with full implementation of cost-effective water conservation measures, CALFED is predicting shortages in available water supply. Additional water recycling will be necessary to help reduce the mismatch between Bay-Delta water supplies and the current and projected beneficial uses dependent on its water.

For the reasons described above, recycling projects typically are evaluated by local water suppliers only in comparison to new supply development. The drivers listed previously, as well as shrinking opportunities for additional supply projects (with their associated impacts and the need to avoid or mitigate these impacts), are driving up the cost of new supply projects and making recycling more competitive. Nevertheless, several factors can continue to make new supply development more attractive to local water suppliers. In the past, many new supply projects have been planned, financed, and built by regional, state, or federal agencies, thus relieving local suppliers of the initial burdens of project development (although local agencies may pay back the costs over time through contractual arrangements). Like large storage projects, water recycling projects improve local water supply reliability and help meet CALFED Program objectives. Given the contribution of federal and state financial assistance to traditional water supply development, it may be appropriate for CALFED agencies to assume a planning and financing assistance role for recycling projects that help fulfill one or more CALFED objective.

Impediments to water recycling also make it difficult to project future levels of recycling. In particular, the inter-jurisdictional nature of water recycling tend to complicate projections. For example, one agency may secure raw water supplies for a region and deliver water to customers, while another agency may treat wastewater. Who is responsible for any recycled water? Water supply from a recycling project may need to move across agency boundaries in order to be delivered to customers. In addition, recycled water supplies in an area may be greater than demand in that area, resulting in recycled water that must be conveyed to another area if customers can be identified. CALFED could effectively address these institutional planning issues by providing technical and financial planning assistance for local planning efforts. CALFED's assurances program could include policies designed to encourage coordination of water recycling planning among water and wastewater agencies and ensure thorough examination of water recycling opportunities

throughout the state. For example, water suppliers could be required to prepare water recycling plans that evaluate potential sources of recycled water and coordinate plans with wastewater utilities.

Other impediments to water recycling include the public and market perceptions. Local project sponsors are regularly called on to defend the need for water recycling. Public concern exists regarding the safeguard of potable supplies and perceptions that recycled water could adversely affect the quality of current water supplies. In addition, some agricultural commodity buyers have disallowed the use of recycled water on certain crops, primarily because of concerns about the public's willingness to purchase food crops grown with recycled water. Overcoming these public perceptions is a necessary prerequisite to achieve the water recycling potential identified by CALFED. Public education is an important effort where CALFED can provide a leadership role. CALFED and the CALFED agencies also can improve the understanding and acceptance of water recycling through their individual and collective public outreach efforts. To foster a high degree of public confidence in water recycling, CALFED could provide funding to support current public education programs, and research and development efforts.

Impediments to the implementation of recycling projects may require vigorous efforts by CALFED agencies to make these projects feasible. The water recycling assistance programs of CALFED and the CALFED agencies will require much additional refinement and input from stakeholders to maximize program effectiveness. Only through additional innovation and assistance will California be able to realize a significant increase in the use of recycled water. These actions are discussed in detail in Section 2 of this document.

6.3 DETERMINING WATER RECYCLING POTENTIAL

Water recycling is and will continue to be an important element of California's water management strategy. To emphasize this importance, the Legislature, in 1991, adopted goals for the beneficial use of recycled water to include achieving 700 TAF per year of recycling by 2000 and 1 MAF per year by 2010 (Cal. Water Code Section 13577). Currently, about 485 TAF of urban water recycling occurs or is under construction in the state, with more projects being completed over the next several years (DWR 1997).

CALFED acknowledges that there is much uncertainty in developing water recycling estimates because of limited information about the effects of source water quality on the feasibility of projects and due to numerous other impediments previously discussed. With this in mind, CALFED has developed a broad range of water recycling potential, as presented in Section 6.5.1. Furthermore, CALFED's estimates were developed for a few primary purposes:

- To provide information for programmatic-level impact assessments;
- To gain a better understanding of the order-of-magnitude role recycling can have in statewide water management; and,
- To aid CALFED in designing the appropriate types and levels of incentive programs and assurance mechanisms.

The estimates are not targets, objectives, or goals. CALFED is not mandating that these or any other levels of water recycling be achieved. CALFED is, however, requiring that many actions (see Section 2) be undertaken by water suppliers that will result in the implementation of more reuse projects, but the actual savings that will result cannot be more accurately estimated without extensive studies that are beyond the scope of this Programmatic EIS/EIR.

6.3.1 REGIONAL WATER RECYCLING STUDIES

About 2.1 MAF of treated wastewater is discharged by urban California into the Pacific Ocean and San Francisco Bay (BARWRP 1997). As populations continue to increase, the amount of discharge also will rise, potentially reaching more than 3 MAF by 2020. As identified in Section 2 under "Water Recycling Approach," the CALFED Program seeks to identify and encourage regional water recycling opportunities that maximize reuse at minimum cost.

Currently, two regional water recycling studies are under way. The Bay Area Regional Water Recycling Program (BARWRP), previously referred to as the Central California Regional Water Recycling Project, is in its second phase of feasibility analysis. The Southern California Comprehensive Water Reclamation and Reuse Study (SCCWRRS) also is in its second phase of feasibility analysis to identify means of maximizing the use of recycled water in southern California. The goal of these studies is to identify regional recycling systems and develop potential capital projects through comprehensive planning processes.

Since both programs are still in their development stages, clear estimates of water recycling potential are not available. Also unknown is the overlap that may exist between the regional recycling potentials and the values portrayed in survey results and other data (supplied later in this section). These projects will provide valuable insight into the future potential of recycling when they are complete. But for now, use of regional data for this analysis is limited to the projections of future wastewater flow generated by the anticipated populations in 2020 and existing (or soon to be completed) levels of local recycling.

The Bay Area Regional Water Recycling Program

The BARWRP is a partnership of 17 Bay Area water and wastewater agencies, DWR, and Reclamation. This partnership is committed to maximizing the beneficial reuse of highly treated wastewater to provide a safe, reliable, and drought-proof new water supply. The product of the BARWRP efforts is a comprehensive regional water recycling master plan released in September 1999.

The master planning process has led to some important innovations and preliminary conclusions regarding recycled water. Some of these are discussed below:

Importance to CALFED. BARWRP has demonstrated that recycled water is an important component in the CALFED solution and can provide a significant, cost-effective new source of water for California. As stated in BARWRP correspondence to the CALFED process, recycled water is a potentially significant water supply option and would help CALFED achieve its objectives for water supply, water quality, and ecosystem quality.

Innovative Approaches. Innovative approaches to project implementation have been developed by BARWRP to significantly increase the feasibility of recycled water use. Such approaches include (1) crossing jurisdictional boundaries to serve customers from the least-cost recycled water source, (2) promoting the application of highest quality water to the highest uses through water exchanges, and (3) promoting trade of recycled water use for Bay Area discharge credits in a watershed approach for pollutants of concern.

BARWRP has developed new tools for identification and evaluation of recycled water projects. One tool, the Evaluation Decision Methodology, carefully scrutinizes cost and benefit allocation among agencies for

each alternative, sheds light on any disparities in cost and benefits, and helps highlight implementation strategies that should be taken to facilitate implementation.

Potential Recycled Water Demand. BARWRP has estimated that the wastewater treatment entities in the Bay Area will be generating recycled water volumes of approximately 670 TAF per year of water by 2010 and 730 TAF per year by 2040 (BARWRP 1999). For 2020, the estimate may be around 690 TAF annually (based on linear interpolation by CALFED staff). Current recycling levels are estimated by BARWRP at 20 TAF. This would leave approximately 670 TAF that ultimately could receive further treatment and be recycled by 2020.

BARWRP also has estimated a potential demand for recycled water of over 400 TAF per year by 2010. This demand includes satisfying existing demands for agriculture; irrigating parks, golf courses, and cemeteries; and industrial process requirements, as well as projected demands for environmental enhancement programs and major new residential and commercial developments.

BARWRP has analyzed the constraints that have inhibited implementation of this potentially important new water supply. These constraints include lack of a driving force for implementation, institutional barriers, and public perception issues. The chief constraint, however, has been lack of funding.

Recommended Recycling Levels. BARWRP, in its September 1999 Recycled Water Master Plan (BARWRP, 1999) recommends implementation of about 125 TAF of new water recycling by 2010 and 240 TAF by 2040. This represents over half the assessed demand of 400 TAF, but accounts for feasibility and acceptability issues that constrain satisfying the full demand.

The Southern California Regional Study

Although yet to determine a potential customer demand, the SCCWRRS has estimated that 2.47 MAF of treated wastewater would be available for recycling by 2010. By 2040, the estimate increases to 3.03 MAF annually. For 2020, the estimate may be around 2.6 MAF annually (based on linear interpolation by CALFED staff). Estimates of existing levels of water recycling are around 263 TAF annually. These estimates translate to roughly 2.3 MAF of additional treated wastewater that ultimately could receive further treatment and be recycled in 2020 (SCCWRRS, 1998). (It should be noted that there is disagreement among local water interests regarding existing levels of water recycling. However, for this document, CALFED is assuming the existing value is appropriate.)

Total Potential Treated Wastewater Flow Projected by the Regional Studies

Combined, the Bay Area and Southern California regional studies indicate about 3.3 MAF of wastewater being generated by 2020 (2.6 MAF from Southern California and 690 TAF from the Bay Area), not including any additional increment that would occur along the central coast (Monterey Bay area and Santa Barbara, although these are minor in comparison to the major population centers).

The approximately 500 TAF currently or soon to be recycled in California represents about 15% of the future treated wastewater stream. With additional projects in the feasibility and design phases, even more facilities are expected to be completed in the near future.

6.4 PROJECTED WATER RECYCLING UNDER THE NO ACTION ALTERNATIVE

To determine the effect of any incremental improvements in recycling as a result of a Bay-Delta solution, it is necessary to determine what level of recycling may occur in the future **without** a Bay-Delta solution. The CALFED Program No Action Alternative condition presented here is that estimate. Several assumptions used to develop this estimate are detailed in the following paragraphs.

6.4.1 SUPPLY AND DEMAND CONSTRAINTS ON POTENTIAL NO ACTION LEVELS

The No Action estimate presented later in this section indicates that a significant level of water will be recycled in 2020. Current levels of recycling (485 TAF) would increase to an estimated 1.0 MAF, representing an increase from about 15% up to 30% of the total wastewater flow (see discussion later). To make use of this recycled supply, however, there must be a demand. Customers must be available who can integrate recycled water with existing water sources, use it to replace existing sources, or use it as an entirely new source.

As shown in Table 6-1, customers of existing water recycling projects vary. However, the majority of current customers use the recycled water to meet plant ET requirements (either crop or landscape). Groundwater recharge represents the next most significant customer use. Use of recycled water by industry or for environmental uses has been limited to date but could represent significant potential, depending on the quality and timing of the available supply.

Table 6-1. Customers of Existing Water Recycling Projects

TYPE OF RECYCLING	1997 AMOUNT (TAF/YEAR)	PERCENT OF TOTAL
Agricultural irrigation	155	32
Landscape irrigation	82	17
Groundwater recharge	131	22
Industrial uses	34	7
Environmental uses	15	3
Sea water intrusion barrier	5	1
Other	63	13
Total	**485**	**100**

Source: DWR's California Water Plan Update, Bulletin 160-98, November, 1998

Timing of when recycled water is available to meet a customer's demand is among the most crucial limitations to the amount of recycling ultimately realized. For current agricultural and landscape irrigation uses, the demand is cyclical, peaking in summer but minimal in winter. The magnitude of variation in the cycle depends on such local conditions as climate and the type of plants (i.e., agricultural plants are harvested at the end of a seasonal but landscape plants may need some irrigation during winter, especially in Mediterranean climates like the South Coast). However, recycled water is generated on a relatively consistent basis, with very little seasonal fluctuation in the amount available. Thus, matching supply to demand can be limited by the type of demand. Strategies to overcome this include finding users whose demand is not seasonal, on a local or regional level, and storing recycled water for later use.

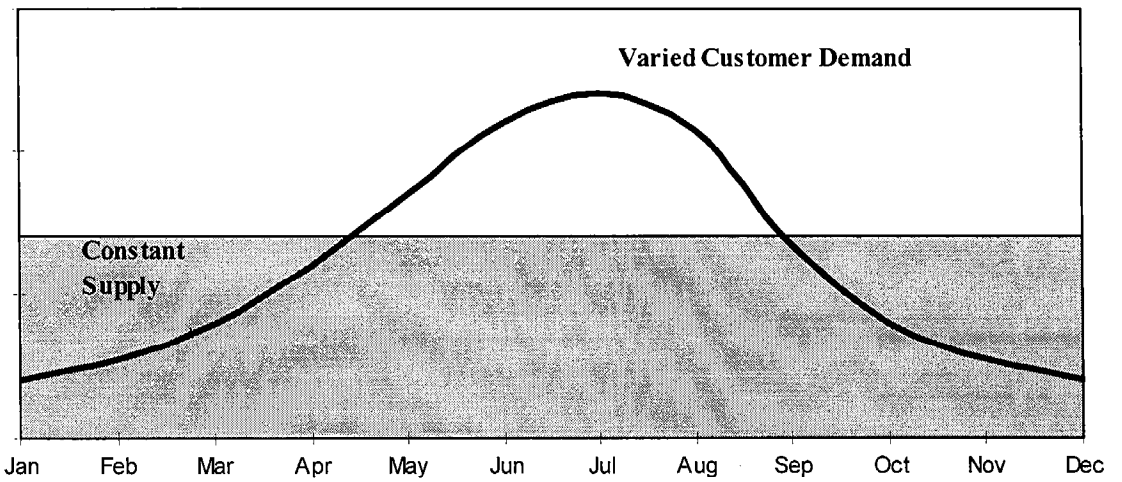


Figure 6-1. Supply/Demand Timing Difference
Note that only a portion of the water recycled can directly meet this customer's needs. The remainder must be stored or used by customers with a different demand pattern.

Figure 6-1 illustrates how recycling treated wastewater provides a relatively constant supply source, while some customer demands, such as agricultural irrigation, are more cyclical. This timing mismatch limits the amount of recycled water that can be used by seasonal customers without a method to store supplies during non-peak periods. The increased use of groundwater recharge to temporarily store recycled water or, as in some Southern California projects, to act as a barrier to sea water intrusion, provides added flexibility to manage the relatively constant supply and meet seasonal customer demands.

In addition, total water recycling levels are limited by the availability of customers in a particular geographic region. As a project looks for customers further away from the treatment plant, the cost of distribution can increase significantly. Lacking regional distribution facilities, agencies generating recycled water must look locally for customers, which can greatly limit the potential opportunities. Industrial and environmental uses can broaden the customer base.

Storing water in aquifers also can be limited in its ultimate applicability, depending on its purpose. If the water is being stored temporarily for later withdrawal and use, these limitations include:

- Recharge rates are limited by aquifer characteristics and recharge pond or injection well capacity.
- Locations for recharge ponds may be limited in heavily populated areas.
- Future additional storage potential in existing aquifers may be limited either as a result of storage already being used for recycled water or being used to temporarily store other surface sources.

If the water is being placed into aquifers as a barrier to sea water intrusion, as is occurring with some recycling projects, these limitations may not cause as much concern. When recycled water is used as a barrier to salty water, it is not primarily intended to be removed and reused. It can continue to "push" more fresh water toward the ocean, increasing the thickness of the barrier. However, there may be a practical limit to how far or how much of a barrier is necessary compared to the cost of providing a barrier. Thus, a practical consideration may constrain this use of recycled water.

Surface storage of recycled water has yet to occur at any significant level. A project originally proposed in San Diego would have been the first to treat a significant quantity of wastewater and recycle it into San Diego's drinking water reservoir. There, the recycled water would have blended with other untreated water and been conveyed to the water treatment facility and into the potable system. This project would have recycled approximately 15 TAF of indirect potable reuse. However, due to outcry from the public regarding the acceptability of this type of recycling caused the project to be canceled. Direct potable reuse currently is prohibited by state regulation. Other indirect potable reuse sites are under consideration in the BARWRP and SCCWRRS.

Use of other surface facilities to temporarily store recycled water will be limited by the capacity of the reservoirs and the distance from the recycling plant (if reservoir sites are distant or upslope from a treatment plant, pumping the recycled water to the reservoir is costly)

Lacking adequate storage or a distribution system that would allow a more diverse, widely distributed customer base to be included, the potential for water recycling may reach an upper limit of feasibility. For this analysis, the No Action Alternative levels discussed in the following subsection are assumed by CALFED to represent a practical upper limit (1.0 MAF of total water recycling in 2020).

6.4.2 AVAILABLE DATA FOR USE IN ESTIMATING THE NO ACTION ALTERNATIVE LEVEL

As previously discussed in Section 2.2.4 of this document, under "Water Recycling Approach," DWR, in partnership with the WateReuse Association of California, conducted a Survey of Water Recycling Potential in 1995-96 to help identify and quantify local agencies' plans for future water recycling (DWR 1996). The 230 survey respondents identified 1996 water recycling levels at over 450 TAF per year, and projected the potential for recycling at 1.49 MAF annually by 2020. The respondents listed projects by stages of planning: conceptual, feasibility study, preliminary design, final design, and under construction. "Base" conditions include any current recycling projects (projects already in operation) plus all projects that were under construction at the time of the survey. By the end of 1997, with the recent completion of a few more local recycling projects, the base was increased to 485 TAF (from 450 TAF). Greater production from existing projects as well as completion of other projects still under construction are expected to increase the base to around 615 TAF by 2020 (DWR 1997). Further refinement and incorporation of these survey data were completed for use by DWR in the "California Water Plan Update, Bulletin 160-98 Public Draft." This refinement resulted in the following assumptions for use in this analysis:

- The base condition for 2020 is 615 TAF of total water recycling (of which 485 TAF already has been implemented — leaving 130 TAF in the permitting or construction phase, or as completed build-out of existing facilities).

- Of this total, 468 TAF is considered new water supply.

- The total represents approximately 15% of the 2020 wastewater flow generated.

Data from the survey regarding potential water recycling projects above the base were distributed over three hydrologic regions as "planned" or "conceptual" projects. "Planned" values indicate any recycling projects that are undergoing feasibility study, preliminary design, or final design. Conceptual values reflect what survey respondents believed to be feasible in the future, but no formal studies have been undertaken. Table 6-2 presents the survey information as incorporated into DWR data for use in the "California Water Plan Update, Bulletin 160-98 Public Draft" (DWR 1998).

ESTIMATES OF CURRENT WATER RECYCLING

Although the DWR survey identified about 450 TAF of existing urban recycling projects, another survey by the SWRCB identifies only 355 TAF (SWRCB 1998).

Comparing the two sources, it appears that the SWRCB summary has identified a much smaller amount of groundwater recharge from recycling. This accounts for about 80 TAF of the difference. Additional differences may be from recycling reported to DWR that is considered "nonreportable" by the SWRCB (in-plant service water, respondents including permitted levels rather than actual levels). The difference also may be explained by the SWRCB survey including only "new water" while the DWR survey is "total water."

The July 1998 SWRCB survey is still in draft. Revised values should be available shortly and may further clarify differences.

Table 6-2. Cumulative Estimates of Water Recycling in 2020 (TAF/Year)

	TOTAL WATER RECYCLING POTENTIAL				NEW WATER SUPPLY			
	SAN FRANCISCO BAY	CENTRAL COAST	SOUTH COAST	TOTAL	SAN FRANCISCO BAY	CENTRAL COAST	SOUTH COAST	TOTAL
Base	40	44	364	615[1]	35	42	328	468[2]
Planned	101	40	640	837[1]	92	38	569	699
Conceptual	-	-	-	131	-	-	-	31
Total	-	-	-	**1,583**	-	-	-	**1,198**

[1] The difference between the total for the three hydrologic regions shown and the total for base or planned recycling projects represents projects in the Central Valley that do not generate new water supply. As previously discussed, Central Valley regions have not been included in this analysis at this time.

[2] The difference between the total for the three hydrologic regions shown and the total for base projects represents projects in the North and South Lahontan and in the Colorado River hydrologic regions already in service and providing new water supply.

Source: Draft information developed for "California Water Plan Update, Bulletin 160-98 Public Draft" (DWR, 1998).

6.4.3 ASSUMED WATER RECYCLING POTENTIAL UNDER NO ACTION ALTERNATIVE CONDITIONS

Projected levels of urban wastewater recycling under the No Action Alternative conditions assume that the base value already has been fully implemented by 2020. This would mean that existing recycling would need to increase from 485 to 575 TAF, an addition of 90 TAF. (CALFED assumes that only 75% of the difference between existing levels and the 615-TAF value shown in Table 6-2 is achieved. Most of this increment represents expansion to build-out capacity of existing recycling facilities, however, according to industry sources, it is unlikely that more than 75% will actually be achieved under the No Action Alternative scenario [MacLaggan 1998]). CALFED assumes this value to represent the incremental base value. Figure 6-2 on the following page graphically displays CALFED's assumed relationship between the values in Table 6-2 and the assumed level of recycling under the No Action and with CALFED's Preferred alternatives.

For purposes of this document, CALFED assumes that the No Action Alternative condition represents implementation of **50%** of the planned values and the incremental increase in the base value of 90 TAF. Therefore, the No Action condition assumes that **510 TAF of additional recycling** will occur (derived by taking 50% of 837 TAF from Table 6-2 and adding it to the 90 TAF incremental increase in the base value). Combined with existing level of 485 TAF, this would represent about 995 TAF of annual wastewater recycling by 2020.

New water generated from recycling under the No Action Alternative is estimated at 415 TAF (derived by taking 50% of the 699 TAF from Table 6-2 plus 75% of the incremental base recycling).

The existing levels of recycling and the anticipated No Action Alternative increment, together comprising nearly 1.0 MAF, would indicate that about 30% of the 2020 wastewater flow could be recycled regardless of the outcome of the CALFED Bay-Delta Program

.CALFED's assumption of only 50% of the planned value shown in Table 6-2 being achieved under a No Action Alternative condition is based on two influencing factors:

- The Metropolitan Water District of Southern California (MWD) recently updated their Integrated Resource Plan (IRP), which evaluates at a multitude of water supply and demand management options. Their report establishes goals for a diverse mix of local and imported water resource elements that is optimized to meet future supply reliability in a cost-effective manner. The IRP set an aggressive 2020 water recycling and groundwater recovery goal of 500 TAF per year, of which 225 TAF are already being produced (MWD 1998). This represents only about half of the sum of base and planned values for the South Coast shown in Table 6-2.

- Analysis by the WateReuse Association of California indicates that the original survey that resulted in the values shown in Table 6-2 was completed when the drought of the 1990s was still fresh in the minds of those being surveyed. Also, it appears that actual implementation of projects is much less ambitious than survey respondents may indicate (MacLaggan 1998). This discrepancy may be a result of the difference between surveying a water purveyor's staff member in charge of studying recycling potential and actually having a project brought before the purveyor's board of directors for approval.

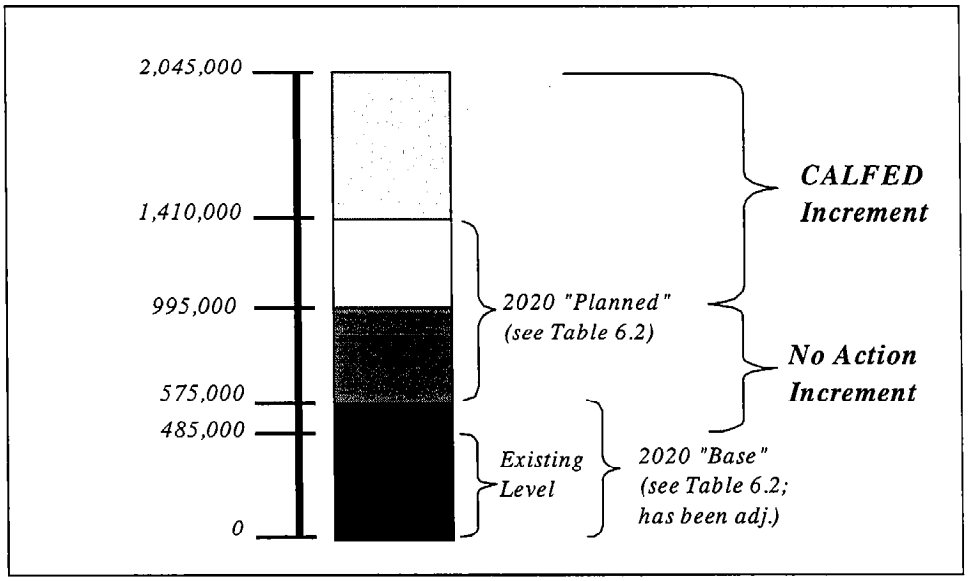


Figure 6-2. Increments of Existing and Anticipated Water Recycling
(These values are used to derive No Action and CALFED recycling levels.)

[It should be noted that the "California Water Plan Update, Bulletin 160-98" [DWR, November 1998] includes a lower level of water recycling for the South Coast Region than indicated in Table 6-2. According to DWR, other options, including resolution of the Colorado River water supply controversy and CALFED Program solutions would provide more water to this region at less cost than additional levels of water recycling. As a result only about 30% of the planned recycling potential shown in Table 6-2 for the South Coast, in addition to the South Coast's 2020 base recycling, was assumed to be implemented as part of Bulletin 160-98. However, the CALFED Program's No Action Alternative conditions do **not** include a CALFED Program solution and do not make judgement on how the Colorado River use issue is resolved. Thus, for purposes of this analysis, CALFED has assumed that 50% of the planned potential shown for the South Coast Region in Table 6-2 is included in the No Action Alternative level.)

6.5 ADDITIONAL WATER RECYCLING AS A RESULT OF THE CALFED PROGRAM

When a Bay-Delta solution is reached, it is anticipated that the actions outlined in Section 2 of this document would facilitate the implementation of the No Action Alternative levels of water recycling and probably facilitate additional levels.

For greater levels of water recycling to occur, the CALFED Program needs to provide solutions to several of the constraints discussed earlier. At a minimum, these include availability of financial support, assistance in resolving the issue of supply and demand timing, the need for regional distribution to reach a broader customer base, and improvements in source water quality at the Delta. Undertaking a stronger leadership role by state and federal governments will also aid in achieving greater levels of water recycling.

Without resolution of these issues, levels of water recycling could be expected to increase but not much beyond the identified planned levels shown in Table 6-2 (i.e., the additional 50% of the planned value **not** assumed to occur under No Action Alternative probably would be implemented with modest financial support through CALFED). The extent to which additional recycling occurs beyond this level under a Bay-Delta solution will depend on CALFED helping solve institutional and physical challenges. CALFED intends to work with local agencies to overcome these potentially limiting factors. Figure 6-2 graphically displays CALFED's assumed range of incremental improvement over No Action Alternative conditions. As indicated on the figure, CALFED assumes that, by helping overcome impediments, statewide urban water recycling could reach over 2.0 MAF annually.

6.5.1 ESTABLISHING AN UPPER LIMIT OF WATER RECYCLING POTENTIAL

To develop an upper limit of recycling potential, CALFED has assumed that the issue of supply and demand timing, and other impediments previously discussed, are solved such that their remaining presence does not impede the implementation of cost-effective water recycling projects. Thus, significantly increased levels of water recycling beyond No Action Alternative levels are possible. Given this assumption, the extent of future recycling levels depends on the future wastewater flow present in 2020 and any remaining limiting factors.

Since a CALFED Bay-Delta solution also anticipates extensive urban conservation, it can be expected that the wastewater flow generated in 2020 will be decreased comparably. The level of reduction, however, will depend on the types of conservation measures implemented and their impact on the wastewater flow (for example, changes in the type of urban landscape will affect the consumption of water but will not affect flows to a wastewater treatment plant).

For this analysis, CALFED has assumed the increment of urban conservation expected to result from a Bay-Delta solution will reduce wastewater flows by 7.5% from the anticipated 2020 No Action Alternative level (the CALFED increment of urban conservation was projected at 5-10%, with a significant portion obtained through indoor residential and CII conservation; see Section 5). Therefore, the previous estimates of a total wastewater flow of 690 TAF in the Bay Area and 2.6 MAF in the South Coast (see previous discussion in this section regarding the regional projects), will be reduced to 640 TAF and 2.4 MAF respectively; or about 3.1 MAF combined.

Of this total wastewater flow, the No Action Alternative condition is expected to already have resulted in about 1.0 MAF of water recycling annually (the sum of the base and 50% of the planned values in Table 6-2). Subtracting this amount from the total wastewater flow potential of 3.1 MAF leaves about 2.1 MAF of treated wastewater still being discharged to coastal waters.

It is impossible to say whether water recycling projects ever could be implemented to achieve 100% recycling, but it is unlikely that such would occur. Many factors work against this, including:

- The distance between potential customers and water recycling sources;
- Physical restrictions of existing treatment plants (space, inflow capacity);
- The limitation of storage;
- Infeasible cost or technology limitations;
- Poor water quality of incoming waste stream (high salinity levels); and
- Other impediments, such as public or market perceptions, local laws or ordinances, a bias in favor of new supply development over recycling, and other institutional/ challenges.

Even assuming that the issue of supply and demand timing is addressed, these factors are still likely to limit the incremental recycling of the remaining 2.1 MAF.

Considering the factors listed above, **CALFED has assumed for this analysis that a maximum of 50% of the remaining 2020 wastewater flow could realistically be recycled**. Fifty percent of 2.1 MAF is about 1.05 MAF annually. When combined with the No Action Alternative water recycling increment of 510 TAF, the expected increase in total water recycling **above existing levels** would be over 1.5 MAF annually.

When existing recycling programs are included, the sum would represent about 65%, or two-thirds, of the total 2020 wastewater flow—slightly over 2.0 MAF. Additional indirect potable reuse, direct potable reuse, expansion of treatment plants, and technological advances all could eventually drive the level of recycling up even further.

CALFED has assumed that, based on the No Action Alternative values, the new water supply generated from this additional increment of total water recycling is about 790 TAF annually (75% of 1.05 MAF). This increment would be new water available for allocation to other beneficial uses. Table 6-3 shows how these quantities may be distributed among the three hydrologic regions, using No Action Alternative values as a basis.

To allow for this level of total water recycling, the various impediments listed directly above and at the beginning of this section, as well as the supply and demand timing issue all must be adequately resolved. Otherwise, the CALFED Program would result only in facilitated implementation of levels much lower than this.

As a result, a broad range of water recycling potential is expected for the CALFED Program increment; ranging from 460 TAF of additional recycling up to 1.05 MAF. In terms of a percentage of the total wastewater flow, the increment would range roughly from **30 to 65% of the projected wastewater flow.**

6.6 SUMMARY OF STATEWIDE WATER RECYCLING POTENTIAL

The table below provides a summary of the potential water recycling estimated to occur both under the No Action Alternative and CALFED Program conditions. The combined total water recycling potential represents an upper range of 65% recycling of the total 2020 wastewater flows. **Note that these values are absent the existing recycling levels of 485 TAF.**

Table 6-3. Summary of Incremental Statewide 2020 Water Recycling Potential (TAF/Year)

	NO ACTION INCREMENT (INCREMENTAL "BASE" PLUS "PLANNED")		CALFED PROGRAM INCREMENT	
	TOTAL WATER RECYCLING	NEW WATER SUPPLY	TOTAL WATER RECYCLING	NEW WATER SUPPLY
San Francisco Bay	53	48	50-170[2]	40-130[2]
Central Coast	35	33	30-70[2]	20-50[2]
South Coast	392	349	350-810[2]	260-610[2]
Total	**510[1]**	**455[1]**	**460-1,050**	**345-790**
Combined water recycling potential (No Action Alternative + CALFED increment)			970-1,560[1]	800-1,245[1]

[1] The three hydrologic region values do not add up to the total because of recycling that occurs in other areas of the state (see Table 6-2).

[2] These regional values were prorated from the total based on the distribution of the No Action Alternative regional values. (For example, for the No Action Alternative increment, the South Coast represents about 77% of the total new water supply. Therefore, the South Coast's CALFED increment is assumed to be 77% of the CALFED increment total).

7. References

7. References

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ATTACHMENTS

ATTACHMENT A

DETERMINATION OF POTENTIAL AGRICULTURAL CONSERVATION SAVINGS

Determination of Potential Agricultural Conservation Savings (Low End of Range)

Sacramento River

Input Data from DWR

Applied Water	6,278	(1,000 af)
Depletion	4,321	(1,000 af)
ET of Applied Water	4,096	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Requirement = 4%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	2	based on region variation
meas/price:	2	in water districts)
	4	(points for this region's districts of 4 points for average)
	1	**= adjustment factor**
	33%	= district portion
	67%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**2182**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**225**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,957**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	10%	(Irrecov divided by total existing losses)
Portion lost to leaching	17	(Leach Req. * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	251	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	1,914	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,914**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	766	0	766
CALFED Increment =	next 30%	0.30	574	0	574
Remaining =	final 30%	0.30	574	0	574
			1,914	0	1,914

Summary of Savings:

Existing Applied Water Use = 6,278

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	511	383	894
District	--	255	191	446
Total	2,182	766	574	1,340

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	511	383	894
District	--	255	191	446
Total	1,957	766	574	1,340

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	225	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)

Sacramento River

Input Data from DWR

Applied Water	6,278	(1,000 af)
Depletion	4,321	(1,000 af)
ET of Applied Water	4,096	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Requirement = 2%

2. % lost to Channel Evap/ET [3] = 2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	2	based on region variation
meas/price:	2	in water districts)
	4	(points for this region's districts of 4 points for average)
	1	**= adjustment factor**
	33%	= district portion
	67%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**2182**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**225**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,957**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	10%	(Irrecov divided by total existing losses)
Portion lost to leaching	8	(Leach Req. * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	126	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	2,048	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**91**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,957**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	819	36	783
CALFED Increment =	next 30%	0.30	614	27	587
Remaining =	final 30%	0.30	614	27	587
			2,048	91	1,957

Summary of Savings:

Existing Applied Water Use = 6,278

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	546	410	956
District	--	273	205	478
Total	2,182	819	614	1,434

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	522	392	914
District	--	261	196	457
Total	1,957	783	587	1,370

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	24	18	42
District	--	12	9	21
Total	225	36	27	64

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)
Delta

Input Data from DWR

Applied Water	1,116	(1,000 af)
Depletion	780	(1,000 af)
ET of Applied Water	758	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 6%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	1	(adjustment factor
flexibility:	0	based on region variation
meas/price:	1	in water districts)
	2	(points for this region's districts of 4 points for average)
		0.5 = adjustment factor
		17% = district portion
		83% = on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**358**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**22**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**336**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	6%	(Irrecov divided by total existing losses)
Portion lost to leaching	3	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	45	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	311	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**311**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	124	0	124
CALFED Increment =	next 30%	0.30	93	0	93
Remaining =	final 30%	0.30	93	0	93
			311	0	311

Summary of Savings:

Existing Applied Water Use = 1,116

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	104	78	182
District	--	21	16	37
Total	358	124	93	217

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	104	78	182
District	--	21	16	37
Total	336	124	93	217

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	22	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)

Delta

Input Data from DWR

Applied Water	1,116	(1,000 af)
Depletion	780	(1,000 af)
ET of Applied Water	758	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 4%

2. % lost to Channel Evap/ET [3] = 2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	1	(adjustment factor
flexibility:	0	based on region variation
meas/price:	1	in water districts)
	2	(points for this region's districts of 4 points for average)
		0.5 = adjustment factor
		17% = district portion
		83% = on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**358**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**22**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**336**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	6%	(Irrecov divided by total existing losses)
Portion lost to leaching	2	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	22	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	334	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**334**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	134	0	134
CALFED Increment =	next 30%	0.30	100	0	100
Remaining =	final 30%	0.30	100	0	100
			334	0	334

Summary of Savings:

Existing Applied Water Use = 1,116

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	111	83	194
District	--	22	17	39
Total	358	134	100	234

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	111	83	194
District	--	22	17	39
Total	336	134	100	234

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	22	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)

Westside San Joaquin River

Input Data from DWR

Applied Water	1,361	(1,000 af)
Depletion	1,041	(1,000 af)
ET of Applied Water	973	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 14%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	1	
tailwater:	1	(adjustment factor
flexibility:	1.5	based on region variation
meas/price:	1	in water districts)
	4.5	(points for this region's districts of 4 points for average)
	1.125	**= adjustment factor**
	37%	= district portion
	63%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**388**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**68**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**320**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	18%	(Irrecov divided by total existing losses)
Portion lost to leaching	24	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	54	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	310	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**310**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	124	0	124
CALFED Increment =	next 30%	0.30	93	0	93
Remaining =	final 30%	0.30	93	0	93
			310	0	310

Summary of Savings:

Existing Applied Water Use = 1,361

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	77	58	135
District	--	46	35	81
Total	388	124	93	217

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	77	58	135
District	--	46	35	81
Total	320	124	93	217

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	68	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)
Westside San Joaquin River

Input Data from DWR

Applied Water	1,361	(1,000 af)
Depletion	1,041	(1,000 af)
ET of Applied Water	973	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 10%

2. % lost to Channel Evap/ET [3] = 2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	1	
tailwater:	1	(adjustment factor
flexibility:	1.5	based on region variation
meas/price:	1	in water districts)
	4.5	(points for this region's districts of 4 points for average)
	1.125	**= adjustment factor**
	37%	= district portion
	63%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**388**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**68**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**320**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	18%	(Irrecov divided by total existing losses)
Portion lost to leaching	17	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	27	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	344	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**24**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**320**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	137	9	128
CALFED Increment =	next 30%	0.30	103	7	96
Remaining =	final 30%	0.30	103	7	96
			344	24	320

Summary of Savings:

Existing Applied Water Use = 1,361

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	86	64	150
District	--	52	39	91
Total	388	137	103	241

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	80	60	140
District	--	48	36	84
Total	320	128	96	224

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	6	4	10
District	--	4	3	7
Total	68	9	7	17

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)

Eastside San Joaquin River

Input Data from DWR

Applied Water	4,043	(1,000 af)
Depletion	2,885	(1,000 af)
ET of Applied Water	2,781	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 4%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	2	based on region variation
meas/price:	0	in water districts)
	2	(points for this region's districts of 4 points for average)
	0.5	**= adjustment factor**
	17%	= district portion
	83%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**1262**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**104**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,158**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	8%	(Irrecov divided by total existing losses)
Portion lost to leaching	9	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	162	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	1,091	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,091**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	436	0	436
CALFED Increment =	next 30%	0.30	327	0	327
Remaining =	final 30%	0.30	327	0	327
			1,091	0	1,091

Summary of Savings:

Existing Applied Water Use = 4,043

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	364	273	637
District	--	73	55	128
Total	1,262	436	327	764

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	364	273	637
District	--	73	55	128
Total	1,158	436	327	764

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	104	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)

Eastside San Joaquin River

Input Data from DWR

Applied Water	4,043	(1,000 af)
Depletion	2,885	(1,000 af)
ET of Applied Water	2,781	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 2%

2. % lost to Channel Evap/ET [3] = 2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	2	based on region variation
meas/price:	0	in water districts)
	2	(points for this region's districts of 4 points for average)
	0.5	**= adjustment factor**
	17%	= district portion
	83%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**1262**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**104**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,158**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	8%	(Irrecov divided by total existing losses)
Portion lost to leaching	5	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	81	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	1,177	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**19**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,158**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	471	7	463
CALFED Increment =	next 30%	0.30	353	6	347
Remaining =	final 30%	0.30	353	6	347
			1,177	19	1,158

Summary of Savings:

Existing Applied Water Use = 4,043

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	392	294	686
District	--	78	59	137
Total	1,262	471	353	824

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	386	290	676
District	--	77	58	135
Total	1,158	463	347	811

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	6	5	11
District	--	1	1	2
Total	104	7	6	13

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)

Tulare Lake Basin

Input Data from DWR

Applied Water	9,209	(1,000 af)
Depletion	7,496	(1,000 af)
ET of Applied Water	6,894	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 12%
   adjustment factor = 1.25

2. % lost to Channel Evap/ET [3] = 3%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0.5	
tailwater:	1	(adjustment factor
flexibility:	1.5	based on region variation
meas/price:	1.5	in water districts)
	4.5	(points for this region's districts of 4 points for average)
		1.125 = adjustment factor
		37% = district portion
		63% = on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**2315**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**602**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,713**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	26%	(Irrecov divided by total existing losses)
Portion lost to leaching	269	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	276	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	1,770	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**57**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,713**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	708	23	685
CALFED Increment =	next 30%	0.30	531	17	514
Remaining =	final 30%	0.30	531	17	514
			1,770	57	1,713

Summary of Savings:

Existing Applied Water Use = 9,209

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	443	332	775
District	--	265	199	464
Total	2,315	708	531	1,239

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	429	321	750
District	--	257	193	450
Total	1,713	685	514	1,199

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	14	11	25
District	--	9	6	15
Total	602	23	17	40

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)

Tulare Lake Basin

Input Data from DWR

Applied Water	9,209	(1,000 af)
Depletion	7,496	(1,000 af)
ET of Applied Water	6,894	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction =	8%
adjustment factor =	1.25
2. % lost to Channel Evap/ET [3] =	2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0.5	
tailwater:	1	(adjustment factor
flexibility:	1.5	based on region variation
meas/price:	1.5	in water districts)
	4.5	(points for this region's districts of 4 points for average)
	1.125	**= adjustment factor**
	37%	= district portion
	63%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**2315**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**602**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**1,713**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	26%	(Irrecov divided by total existing losses)
Portion lost to leaching	143	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	184	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	1,987	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**274**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**1,713**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	795	110	685
CALFED Increment =	next 30%	0.30	596	82	514
Remaining =	final 30%	0.30	596	82	514
			1,987	274	1,713

Summary of Savings:

Existing Applied Water Use = 9,209

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	497	373	870
District	--	298	223	521
Total	2,315	795	596	1,391

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	429	321	750
District	--	257	193	450
Total	1,713	685	514	1,199

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	69	51	120
District	--	41	31	72
Total	602	110	82	192

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)

San Francisco Bay

Input Data from DWR

Applied Water	97	(1,000 af)
Depletion	86	(1,000 af)
ET of Applied Water	74	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 6%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	0	based on region variation
meas/price:	1	in water districts)
	1	(points for this region's districts of 4 points for average)
		0.25 = adjustment factor
		8% = district portion
		92% = on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**23**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**12**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**11**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	52%	(Irrecov divided by total existing losses)
Portion lost to leaching	2	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	4	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	17	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**6**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**11**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	7	2	4
CALFED Increment =	next 30%	0.30	5	2	3
Remaining =	final 30%	0.30	5	2	3
			17	6	11

Summary of Savings:

Existing Applied Water Use = 97

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	6	5	11
District	--	1	0	1
Total	23	7	5	12

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	4	3	7
District	--	0	0	0
Total	11	4	3	8

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	2	2	4
District	--	0	0	0
Total	12	2	2	4

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (High End of Range)

San Francisco Bay

Input Data from DWR

Applied Water	97	(1,000 af)
Depletion	86	(1,000 af)
ET of Applied Water	74	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 4%

2. % lost to Channel Evap/ET [3] = 2%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	0	based on region variation
meas/price:	1	in water districts)
	1	(points for this region's districts of 4 points for average)
	0.25	**= adjustment factor**
	8%	= district portion
	92%	= on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**23**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**12**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**11**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	52%	(Irrecov divided by total existing losses)
Portion lost to leaching	2	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	2	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	20	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	9	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	11	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	8	3	4
CALFED Increment =	next 30%	0.30	6	3	3
Remaining =	final 30%	0.30	6	3	3
			20	9	11

Summary of Savings:

Existing Applied Water Use = 97

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	7	5	12
District	--	1	0	1
Total	23	8	.6	14

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	4	3	7
District	--	0	0	0
Total	11	4	3	8

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	3	2	5
District	--	0	0	0
Total	12	3	3	6

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.

Determination of Potential Agricultural Conservation Savings (Low End of Range)

Central Coast

Input Data from DWR

Applied Water	48	(1,000 af)
Depletion	39	(1,000 af)
ET of Applied Water	38	(1,000 af)

Assumptions for Calculations

1. Ave. Leaching Fraction = 6%

2. % lost to Channel Evap/ET [3] = 4%

3. Assumed allocation of conservation betw District and On-farm
district portion = 1/3 of savings * "adjustment factor"

canal lining:	0	
tailwater:	0	(adjustment factor
flexibility:	0	based on region variation
meas/price:	1	in water districts)
	1	(points for this region's districts of 4 points for average)
		0.25 = adjustment factor
		8% = district portion
		92% = on-farm portion

Calculations from Input Data

	(1,000 af)	
Total Existing Losses	**10**	(Diff betw. Applied Water and ETAW)
Total Irrecoverable losses	**1**	(Diff betw. Depletion and ETAW)
Total Recoverable losses	**9**	(Diff betw. Applied Water and Depletion)
Ratio of Irrecoverable Loss	10%	(Irrecov divided by total existing losses)
Portion lost to leaching	0.23	(Leach Fraction * ETAW * Irrec. Loss Ratio * Adj. Factor)
Portion lost to Channel Evap/ET	1.92	(Applied Water * % lost to Channel Evap/ET)
Total Loss Conservation Potential	8	(Total Existing loss - portion to leaching - portion to channel evap/ET)
Irrecoverable Portion	**0.00**	(Irrec loss - portion to leaching - portion lost to channel evap/ET)
Recoverable Portion	**8**	(Total Existing loss - Irrecoverable Loss Portion)

Incremental Distribution of Conservable Portion of Losses

		Distrib. Factor	Applied Water Reduction [1] (1,000 ac-ft)	Irrec. Loss Reduction [2] (1,000 ac-ft)	Rec. Loss Reduction (1,000 ac-ft)
No Action Increment =	1st 40%	0.40	3	0	3
CALFED Increment =	next 30%	0.30	2	0	2
Remaining =	final 30%	0.30	2	0	2
			8	0	8

Summary of Savings:

Existing Applied Water Use = 48

Total Potential Reduction of Application

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	3	2	5
District	--	0	0	0
Total	10	3	2	5

Recovered Losses with Potential for Rerouting Flows

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	3	2	5
District	--	0	0	0
Total	9	3	2	5

Potential for Recovering Currently Irrecoverable Losses

(1,000af)	Existing	No Action	CALFED	Total
On-Farm	--	0	0	0
District	--	0	0	0
Total	1	0	0	0

Notes:
1. Calculated as the distribution factor times the "conservable portion" of the total existing loss. The first 40% of savings potential occurs under *No Action*. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
2. Calculated as the distribution factor times the "conservable portion" of irrecoverable loss. The first 40% of savings potential occurs under No Action. The next 30% of saving potential is the CALFED increment. The final 30% is considered "non-conservable".
3. Derived from comparing consumptive conveyance loss values from USBR *Least-Cost CVP Yield Increase Plan*, T.A #3 (Sept. 1995) to applied water values for the region. A range of 2 to 4% was used to account for uncertainty. This value accounts for consumption by bank and riparian vegetation and channel evaporation.