Appendix 19A

California Water Economics Spreadsheet Tool (CWEST) Documentation

This appendix provides information about the California Water Economics Spreadsheet Tool (CWEST) methodology, assumptions, and results used for the Coordinated Long Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) Environmental Consequences analysis. The EIS uses CWEST to quantify effects of the alternatives on the economic benefits of deliveries to CVP and SWP Municipal and Industrial (M&I) water users. CWEST was developed for the EIS and this is the first official documentation of the tool.

This appendix is organized into three main sections as follows:

- Section 19A.1: CWEST Methodology
  - This section provides information about the development history, methodology, and coverage.
- Section 19A.2: CWEST Assumptions
  - This section provides information about the overall analytical framework, assumptions, and the input data obtained from publicly available sources. A description of how the No Action Alternative water supplies was formulated is also included.
- Section 19A.3: CWEST Results
  - This section provides a detailed description of the model simulation output format used in the analysis and interpretation of modeling results for the alternatives impacts assessment. Also included is a description of the model outputs used by other model analyses.

19A.1 CWEST Methodology

This section summarizes the CWEST development history, methodology, and coverage. It describes the overall analytical framework and the geographical extent of the economic evaluation of the alternatives. The EIS alternatives include several major components that will have significant effects on CVP and SWP operations and the quantity of delivered water to CVP and SWP M&I water users. CWEST was developed to provide consistent and transparent analysis of economic benefits of CVP and SWP M&I water supplies for CVP contractors and SWP Table A contract holders under 2030 conditions using publicly available information. Most demand data and data on local supply levels are from 2010 Urban Water Management Plans (UWMPs).

CWEST is an economic simulation and optimization tool that represents each individual CVP and SWP M&I water user's decision making. It provides estimates of water supply costs for each water user. The logic and methods are built on those used by other California M&I water economics tools. Similar to the existing California M&I water economics tools, CWEST minimizes the total costs of meeting annual M&I water demands that are subject to constraints. These costs include: conveyance and operations costs, costs of existing and new permanent supplies, transfer or other option costs, costs of local surface and groundwater operations, lost water sales revenues, and end-user shortage costs. The level of demand, quantity and type of local water supplies, and costs represent a 2030 development condition. The assumptions, sources of information, and description of the tool are discussed in the following sections.

19A.1.1 CWEST Development History

CWEST was developed in response to the requirements of the EIS quantitative analyses. CWEST provides a transparent, easy to use, and flexible tool that is applicable to many future studies. Table 19A.1 lists how CWEST fulfils the needs of the EIS quantitative analyses.

Table 19A.1 Comparison of CWEST to LCPSIM and OMWEM

Need for EIS	CWEST
Accurately represent each CVP and SWP M&I water user's individual behavior.	CWEST evaluates each CVP and SWP M&I water user separately.
Consistently evaluate across all CVP and SWP M&I water users.	All CVP and SWP M&I water users are in one spreadsheet. The same data structure and optimization routines apply to all.
Able to track and view model assumptions.	CWEST is an Excel tool designed to easily locate model assumptions.
Easily follow model logic and use of tool is simple.	CWEST optimization routine is traceable and the Excel tool is easy to use.
Need to estimate change in retail water sales revenues and groundwater pumping costs.	Includes water sales based on retail price and groundwater cost savings.

19A.1.1.1 Modeling Objectives

EIS modeling objectives accomplished with CWEST included the evaluation of the following potential impacts:

- Effects on CVP and SWP M&I water user costs and revenues
- Effects on end users from experiencing shortage costs
- Annual quantities of transferred water to CVP and SWP M&I water users

19A.1.2 CWEST Methodology

CWEST represents how CVP and SWP M&I water users will meet 2030 water demand levels at the lowest economic cost that are subject to constraints. The model assumes that each CVP and SWP M&I water user uses its contract delivery (modeled in CalSim II), local supplies, and imported water (if applicable) to meet annual demand. CWEST operates on an annual time step for the hydrologic period. The current application uses CVP and SWP delivery results modeled by CalSim II for the 1922 to 2003 period, but CWEST can easily be adapted to other input data and period of record. In years where available supplies are lower than demand, the CVP and SWP M&I water user will use local stored supplies, purchase or transfer water on a market, or short its customers—all of which results in an economic cost. If shortage and transfer costs occur frequently, the model could select to purchase additional fixed-yield supplies, such as additional desalination water treatment. Additional fixed-yield supplies will be purchased when the annual cost of the supply is less than the average annual costs of shortage. The model optimizes the additional supply decisions with perfect foresight to provide the lowest-cost water supply portfolio to meet 2030 demands throughout the 82-year hydrologic period.

CWEST uses water supply costs that represent the specific situation and supply conditions for each CVP and SWP M&I water user. Transfer and groundwater pumping costs vary by water-year type or by the region. All of these shortage costs are based on linear cost functions except for the end-user shortage costs. This cost function for retail water is non-linear; therefore, CWEST uses Excel Solver to find the optimal level of additional fixed-yield supply. CWEST uses the same cost function for each CVP and SWP M&I contractor and only has one function to represent all of their water users. At least one fixed-yield supply is included for every agency to choose when optimizing. Types of projects include stormwater, conservation, recycling, groundwater capacity, or desalination. The Metropolitan Water District of Southern California (MWDSC) can choose from five different fixed-yield project supply types, each with a unique increasing marginal cost function. The quantity of fixed-yield supply is a choice when optimizing and the cost for the new supply must be paid each year.

When annual supplies are in excess of demand, CWEST allows CVP and SWP M&I water users to reduce groundwater pumping, put water into local or regional storage (if applicable), or turn back the water. Each CVP and SWP M&I water user deals with excess water differently. Reduction in groundwater pumping results in a benefit based on the variable costs of groundwater pumping. Turning back water provides a cost savings based on the avoided conveyance charges. Fixed local supplies such as recycled water or desalination are not reduced in response to annual supply in excess of demand.

19A.1.3 CWEST Coverage

Individual CVP and SWP M&I water users are grouped into areas per the EIS. These regions correspond to the regions reported in Chapter 19, Socioeconomics. Table 19A.2 displays the CVP and SWP M&I water users included in each area.

Table 19A.2 CVP and SWP M&I Water Users Included in the EIS

Central Valley Region – Sacramento Valley	Centerville CSD, El Dorado Irrigation District, City of Folsom, Mountain Gate CSD, Napa County Flood Control and Water Conservation District, Placer County Water Agency, City of Redding, City of Roseville, Sacramento County Water Agency, San Juan Water District, Shasta CSD, Shasta County Water Agency, City of Shasta Lake, Solano County Water Agency, City of West Sacramento
Central Valley Region – San Joaquin Valley	Arvin-Edison Water Storage District, City of Avenal, City of Coalinga, Delano-Earlimart Irrigation District, City of Fresno, City of Huron, Kern County Water Agency, City of Lindsay, Lindsay-Strathmore Irrigation District, City of Orange Cove, Stockton-East Water District, City of Tracy
San Francisco Bay Area Region	Alameda County Water District, Contra Costa Water District, San Benito County Water District, Zone 6, Santa Clara Valley Water District, Zone 7 Water Agency
Central Coast Region	San Luis Obispo County Flood Control and Water Conservation District, Santa Barbara County Flood Control and Water Conservation District
Southern California Region	Antelope Valley-East Kern Water Agency, Castaic Lake Water Agency, Coachella Valley Water District, Crestline-Lake Arrowhead Water Agency, Desert Water Agency, Metropolitan Water District of Southern California, Mojave Water Agency, Palmdale Water District and Littlerock Creek Irrigation District, San Bernardino Valley Municipal Water District, San Gorgonio Pass Water Agency

Note:
CSD = Community Service District

Table 19A.3 displays why certain CVP and SWP M&I water users are not included in the EIS. Placeholders for San Gabriel Valley Municipal Water District, East Bay Municipal Utilities District, and Ventura County Watershed Protection District are included in CWEST, but are not modeled for the EIS.

Table 19A.3 CVP and SWP M&I Water Users excluded from EIS Analysis

CVP and SWP Water User	Reason
Bella Vista Water District	No discernible differences in deliveries in CalSim II model output.
Clear Creek CSD	No discernible differences in deliveries in CalSim II model output.
East Bay Municipal Utilities District	There is a lack of public information on major water supplies (Mokelumne Aqueduct).
El Dorado County Water Agency	Water user does not have conveyance.
Sacramento, City of	No discernible differences in deliveries in CalSim II model output.
San Gabriel Valley Municipal Water District	SWP water is solely for regional groundwater recharge.
Ventura County Watershed Protection District	No discernible differences in deliveries in CalSim II model output.

19A.2 CWEST Assumptions

This section describes the assumptions for the EIS Evaluation of Alternatives in Chapter 19, Socioeconomics, for the No Action Alternative, Second Basis of Comparison, and other alternatives.

The following CalSim II model simulations were performed as the basis of evaluating the impacts of the other alternatives:

- No Action Alternative
- Second Basis of Comparison

The following model simulations of other alternatives were performed:

- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools described in Appendix 5A, CalSim II and DSM2 Modeling.

Because Alternative 1 modeling assumptions are the same as the Second Basis of Comparison and Alternative 2 modeling assumptions are the same as the No Action Alternative, the assumptions for those alternatives are not discussed separately in this document.

Each of the EIS alternatives were evaluated under the same set of local supply, demand, and cost assumptions for 2030 conditions. The only model input that varied across alternatives is the CalSim II CVP and SWP M&I water user delivery data.

19A.2.1 CVP and SWP M&I Water User Demand and Supply

19A.2.1.1 2030 CVP and SWP M&I Water User Demand

CVP and SWP M&I water user demands developed for CWEST are sourced from publicly available data. The majority of 2030 demands are reported in each CVP and SWP M&I water user's 2010 UWMP, with exceptions for those that did not create one (see Appendix 5D, CVP and SWP M&I Water User Supplies, for more information on 2030 demand levels and UWMP sources). The 2030 demand levels for CVP and SWP M&I water users without published UMWPs are provided by the CVP M&I Water Shortage Policy (WSP) Draft Environmental Impact Statement (Reclamation 2014). The UWMP demands presented for 2030 are assumed to be compliant with the "20% by 2020" legislation. In some cases, additional conservation is presented as part of 2030 supply in the UWMP. If so, this is counted as a demand reduction, not as a new supply in CWEST. Table 19A.4 displays the 2030 contract quantities and demand levels included in the model.

Table 19A.4 CWEST Modeled Demands in 2030

CVP and SWP M&I Water User	2030 CVP and SWP Contract Quantities (acre-feet)	2030 Demands from UWMP (acre-feet)
Alameda County Water District	42,000	71,800
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	2,926	6,000
Antelope Valley-East Kern Water Agency	141,400	96,558
Avenal, City of	3,500	3,500
Castaic Lake Water Agency	95,200	105,313
Coachella Valley Water District	133,100	212,000
Coalinga, City of	10,000	10,000
Contra Costa Water District	195,000	215,471
Crestline-Lake Arrowhead Water Agency	5,800	2,250
Desert Water Agency	54,000	69,400
El Dorado Irrigation District	7,550	57,039

CVP and SWP M&I Water User	2030 CVP and SWP Contract Quantities (acre-feet)	2030 Demands from UWMP (acre-feet)
Folsom, City of	34,000	36,259
Fresno, City of	60,000	201,100
Huron, City of	3,000	3,000
Kern County Water Agency	134,600	51,750
Lindsay, City of	2,500	2,689
MWDSC	2,185,600	4,455,000
Mojave Water Agency	75,800	192,969
Napa County Flood Control and Water Conservation District	29,025	21,572
Orange Cove, City of	1,400	2,790
Palmdale Water District and Littlerock Creek Irrigation District	21,300	45,700
Placer County Water Agency	100,000	156,333
Redding, City of	27,140	27,852
Roseville, City of	62,000	49,334
Sacramento County Water Agency	81,438	77,535
San Benito County Water District, Zone 6	8,250	11,583
San Bernardino Valley Municipal Water District	102,600	305,447
San Gorgonio Pass Water Agency	17,300	66,420
San Juan Water District	82,200	57,265
San Luis Obispo County Flood Control and Water Conservation District	8,447	8,150
Santa Barbara County Flood Control and Water Conservation District	62,039	75,935
Santa Clara Valley Water District	219,400	409,370
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	10,672	10,942
Solano County Water Agency	47,756	82,250
Stockton-East Water District	75,000	64,960
Tracy, City of	20,000	31,000
West Sacramento, City of	23,600	19,273
Yuba City, City of	9,600	29,041
Zone 7 Water Agency	80,619	75,500

19A.2.1.2 Development of 2030 CVP and SWP M&I Water User Water Supplies

CWEST used the UWMP to report local supplies expected to be available in 2030. In some cases, UWMP supplies were adjusted for projects that may not be implemented by 2030. CWEST uses the 2030 UWMP "normal" year supplies to represent 2030 supplies in wet, above normal, and below normal years, and "multiple-year drought" supplies are used to represent 2030 supplies in dry and critical years. The Sacramento index is used for CVP and SWP M&I water users in the Sacramento Valley and the San Francisco Bay Area Region. The San Joaquin index is used for CVP and SWP M&I water users in the San Joaquin Valley, the Central Coast Region, and the Southern California Region.

Local, non-project supply amounts are as summarized in Table 19A.5. More information on normal year 2030 supply is described in Appendix 5D, CVP and SWP M&I Water User Supplies.

Table 19A.5 CWEST Assumed 2030 Non-Project Supplies

CVP and SWP M&I Water User	Non-Project Supplies in Below Normal or Better Water Year Type (acre-feet)	Non-Project Supplies in Dry or Critical Water Year Type (acre-feet)
Alameda County Water District	50,800	35,600
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District*	3,000	0
Antelope Valley-East Kern Water Agency	40,000	20,000
Avenal, City of*	0	0
Castaic Lake Water Agency	77,787	77,787
Coachella Valley Water District	238,840	238,850
Coalinga, City of*	0	0
Contra Costa Water District	64,000	51,600
Crestline-Lake Arrowhead Water Agency	481	481
Desert Water Agency	69,900	89,000
El Dorado Irrigation District	54,789	54,789
Folsom, City of	3,250	11,250
Fresno, City of	228,800	232,400
Huron, City of*	0	0
Kern County Water Agency	68,126	40,130
Lindsay, City of*	1,210	1,210
MWDSC	3,040,100	3,142,300
Mojave Water Agency	152,921	176,785

CVP and SWP M&I Water User	Non-Project Supplies in Below Normal or Better Water Year Type (acre-feet)	Non-Project Supplies in Dry or Critical Water Year Type (acre-feet)
Napa County Flood Control and Water Conservation District	19,082	21,565
Orange Cove, City of*	0	0
Palmdale Water District and Littlerock Creek Irrigation District	39,600	42,059
Placer County Water Agency	68,119	103,119
Redding, City of	13,424	13,424
Roseville, City of	3,397	3,397
Sacramento County Water Agency	74,898	74,898
San Benito County Water District, Zone 6	5,174	5,174
San Bernardino Valley Municipal Water District	314,225	314,225
San Gorgonio Pass Water Agency	43,952	43,952
San Juan Water District	0	0
San Luis Obispo County Flood Control and Water Conservation District	8,288	8,288
Santa Barbara County Flood Control and Water Conservation District	79,490	79,490
Santa Clara Valley Water District	246,830	179,980
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD*	1,064	1,064
Solano County Water Agency	75,276	75,276
Stockton-East Water District	28,000	50,000
Tracy, City of	15,250	16,050
West Sacramento, City of	5,000	5,000
Yuba City, City of	22,748	22,748
Zone 7 Water Agency	11,600	2,620

Note:
*CVP and SWP M&I Water User without 2010 UWMP and supply and 2030 supply conditions are from CVP M&I WSP (Reclamation 2014)

19A.2.1.3 CalSim II Linkage Information

CalSim II node identification for each CVP and SWP M&I water user in the EIS analysis is displayed in Table 19A.6.

Table 19A.6 CWEST and CalSim II Linkage

CVP and SWP M&I Water User	CalSim II Equivalent Nodes
Alameda County Water District	D814_PCO + D814_PMI + D814_PIN
All other Friant-Kern M&I water users (Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District)	2.926*(D910_C1/60)
Antelope Valley-East Kern Water Agency	D877_PMI + D877_PCO + D877_PIN
Avenal, City of	D844_PMI*0.35
Castaic Lake Water Agency	D896_PMI + D896_PCO
Coachella Valley Water District	D883_PMI + D883_PCO + D883_PIN
Coalinga, City of	D844_PMI*0.5
Contra Costa Water District	D420
Crestline-Lake Arrowhead Water Agency	D25_PMI + D25_PCO
Desert Water Agency	D884_PMI + D884_PCO + D884_PIN
El Dorado Irrigation District	D8F_NP + D8F_PMI
Folsom, City of	D8B_NP + D8B_PMI
Fresno, City of	MAX(0.25*60, D910_C1*(60/64.802))
Huron, City of	D844_PMI*0.15
Kern County Water Agency	D851A_PMI
Lindsay, City of	2.5*(D910_C1/60)
MWDSC	D895_PMI + D895_PMI+ D895_PIN+ D899_PCO + D899_PCO + D899_PIN + D27_PMI +D27_PIN + D27_PCO +D885_PMI + D885_PCO + D885_PIN
Mojave Water Agency	D881_PMI + D881_PCO
Napa County Flood Control and Water Conservation District	D403B_PMI + D403B_PCO + D403B_PIN
Orange Cove, City of	1.4*(D910_C1/60)
Palmdale Water District and Littlerock Creek Irrigation District	D878_PMI + D878_PCO
Placer County Water Agency	D8H_PMI+D300_NP
Redding, City of	D104_PSC*0.13779 + D104_PMI*0.5
Roseville, City of	D8G_NP + D8G_PMI
Sacramento County Water Agency	D168C+D167B
San Benito County Water District, Zone 6	0.065*D711_PMI+0.518*D710_PAG
San Bernardino Valley Municipal Water District	D886_PMI + D886_PCO
San Gorgonio Pass Water Agency	D888_PMI + D888_PCO

CVP and SWP M&I Water User	CalSim II Equivalent Nodes
San Juan Water Agency	D8D_NP + D8E_NP + D8E_PMI
San Luis Obispo County Flood Control and Water Conservation District	[MIN(D869_PMI + D869_PCO,8.447)]
Santa Barbara County Flood Control and Water Conservation District	[((D870_PMI + D870_PCO) + ((D870_PMI + D870_PCO)—8.4)) * (0.852 if WY is W,AN,BN, 0.522 if WY is D,C)]
Santa Clara Valley Water District	D710_PAG * 0.442 + D711_PMI * 0.935 + D815_PCO + D815_PMI +D815_PIN
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	D104_PMI*0.5 + D104_PMI*0.35
Solano County Water Agency	D403C_PMI + D403C_PCO
Stockton-East Water District	D520_SEWD_PMI
Tracy, City of	0.2*[South of Delta % PMI Delivery]
West Sacramento, City of	D165_PSC
Yuba City, City of	D204_PMI
Zone 7 Water Agency	D810_PCO + D810_PMI + D813_PCO + D813_PMI + D810_PIN

19A.2.1.4 Development of Storage Operations

CWEST includes storage operations for the CVP and SWP M&I water users with published information on local storage operations, who participate in a regional groundwater bank, or who use significant local groundwater banking to store water. CVP and SWP M&I water users that participate in Semitropic Water Storage District's groundwater banking program have their capacity share included. Most of MWDSC's portfolio of local storage projects are modeled. Table 19A.7 presents the list of storage operations included in CWEST.

Table 19A.7 Storage Operations Assumptions

Water User with Storage	Modeled Storage Capacities
Alameda County Water District	150,000 acre-foot Semitropic Water Storage District Share[a]
MWDSC	1,600,000 acre-foot Regional Groundwater Banks[b] 980,000 acre-foot Local Surface Storage[c]
Santa Clara Valley Water District	350,000 acre-foot Semitropic Water Storage District Share[a] 530,000 acre-foot Local Groundwater[d]
Stockton-East Water District	100,000 acre-foot Local Groundwater[e]
Zone 7 Water Agency	78,000 acre-foot Semitropic Water Storage District Share[a] 126,000 acre-foot Local Groundwater[f] 120,000 acre-foot Cawelo Water District[f]

Source:

a. SWSD 2015

b. Includes: Arvin Edison Water Storage District, Semitropic Water Storage District, Kern Delta Water District, Mojave Water Agency Storage Program, Conjunctive Use programs (MWDSC 2011)

c. Includes: Castaic Lake, Diamond Valley, Lake Mathews, Lake Skinner, and Cyclic Storage (MWDSC 2011)

d. SCVWD 2011

e. Stockton-East UWMP (SEWD 2011)

f. ACWD 2011

19A.2.2 Water Costs

Water costs include delivery, groundwater pumping, additional fixed-yield supply, storage operations, and shortage costs. Shortage costs include retail revenue losses, transfer and annual option, and end-user shortage costs. Increases in M&I deliveries raise total delivery costs, but may decrease shortage costs. Real increases in water and energy costs are used to escalate costs to the 2030 levels needed for the EIS analysis.

19A.2.2.1 Delivery Costs and Water Prices

CVP and SWP M&I deliveries are assigned a delivery cost based on Reclamation CVP M&I (Reclamation 2009) rates and Bulletin 132-10 (DWR 2013), respectively. In years when supply is in excess of demand, even after reductions in groundwater pumping are placed into storage, the quantity of excess water is credited the delivery costs. This represents a CVP and SWP M&I water user "turning back" water.

The delivery cost for SWP M&I water users is the variable OMP&R component plus the Off-Aqueduct charge, which is also charged based on the amount of deliveries (CCWA 2007). As an example, DWR calculates the Off-Aqueduct charges based on the requested deliveries submitted by the Central Coast Water

Authority on a calendar-year basis. The resulting total is paid by the Authority in 12 equal payments throughout the calendar year. Additionally, in May of each year, DWR provides an amended Off-Aqueduct bill based on the actual water deliveries and power costs for the first six months of the year. The delivery cost of CVP water is the "O&M rate" (Reclamation 2009).

Real energy costs are expected to increase in real terms leading up to 2030. The California Energy Commission (CEC) mid-demand scenario predicts that real electricity rates will increase 1.7 percent annually, over the 2014 to 2024 period (CEC 2013). This rate of increase is applied to water delivery costs up to 2030. Table 19A.8 provides the 2030 delivery costs for CVP and SWP M&I water users.

Table 19A.8 also shows representative retail water prices for each CVP and SWP M&I water user. MWDSC projects their water rates will have a 1.364 percent real rate of increase annually between 2014 and 2024. Other CVP and SWP M&I water users have not made long-range projections of real retail prices, so CWEST applies MWDSC's real rate of increase to all CVP and SWP M&I water user retail water prices to estimate 2030 levels. Retail water prices are used to estimate revenue losses to CVP and SWP M&I water users from a shortage.

Table 19A.8 Conveyance and Retail Water Price Assumptions

CVP and SWP M&I Water User	CVP and SWP Delivery Costs in 2030 ($/acre-foot)[a]	Retail Water Price in 2030 ($/acre-foot)[b]
Alameda County Water District	$30	$1,528
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$16	$228
Antelope Valley-East Kern Water Agency	$145	$580
Avenal, City of	$16	$1,130
Castaic Lake Water Agency	$99	$1,462
Coachella Valley Water District	$162	$472
Coalinga, City of	$24	$228
Contra Costa Water District	$26	$1,577
Crestline-Lake Arrowhead Water Agency	$173	$402
Desert Water Agency	$139	$527
El Dorado Irrigation District	$16	$475
Folsom, City of	$16	$235
Fresno, City of	$16	$228
Huron, City of	$16	$228
Kern County Water Agency	$18	$290
Lindsay, City of	$16	$228

CVP and SWP M&I Water User	CVP and SWP Delivery Costs in 2030 ($/acre-foot)[a]	Retail Water Price in 2030 ($/acre-foot)[b]
MWDSC	$122	$1,374
Mojave Water Agency	$232	$1,175
Napa County Flood Control and Water Conservation District	$33	$1,921
Orange Cove, City of	$16	$228
Palmdale Water District and Littlerock Creek Irrigation District	$192	$580
Placer County Water Agency	$16	$594
Redding, City of	$16	$514
Roseville, City of	$16	$197
Sacramento County Water Agency	$25	$454
San Benito County Water District, Zone 6	$32	$890
San Bernardino Valley Municipal Water District	$154	$402
San Gorgonio Pass Water Agency	$323	$624
San Juan Water Agency	$16	$235
San Luis Obispo County Flood Control and Water Conservation District	$156	$2,429
Santa Barbara County Flood Control and Water Conservation District	$157	$1,719
Santa Clara Valley Water District	$27	$1,204
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$16	$596
Solano County Water Agency	$21	$1,198
Stockton-East Water District	$15	$507
Tracy, City of	$16	$582
West Sacramento, City of	$16	$454
Yuba City, City of	$0	$681
Zone 7 Water Agency	$42	$1,162

Source:

a. (Reclamation 2009) and (DWR 2013) escalated from 2010 to 2030 in proportion to the change in real energy prices (CEC 2013)

b. Published retail prices were chosen from representative locations (Black and Veatch 2006) and updated using MWDSC

19A.2.2.2 Additional Fixed-Yield Supply Costs

For each CVP and SWP M&I water user, at least one fixed-yield supply is available to choose in optimization. Examples include reclamation water projects, desalination, new groundwater development, and some types of conservation. Every year fixed-yield supplies provide the same amount of water and the annualized cost for operations and capital is paid. The model selects a level of fixed-yield supply that minimizes total cost over the hydrologic period. Table 19A.9 shows the fixed-yield supply included for each CVP and SWP M&I water user and its annualized cost except for those with multiple fixed-yield supplies to choose from.

A variety of data sources were used to obtain capital costs of representative projects including the UWMPs, integrated resource water management (IRWM) grant applications, water master plans, and other public information, as summarized in Appendix 5B, Municipal and Industrial Water Demands and Supplies.

For some CVP and SWP M&I water users in the Sacramento Valley, the model chooses an optimal increase in total groundwater pumping capacity when that is the additional fixed-yield supply to choose from. The model currently uses information from four representative urban well developments in Sonoma County (SCWA 2010). The annualized cost of well development for four wells was $358 per acre-foot. When a CVP and SWP M&I water user chooses to increase their groundwater pumping capacity, the annual pumping cost is added to obtain a total cost per acre-foot per year.

Table 19A.9 Information on Additional Fixed-Yield Supplies

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Alameda County Water District	Variable—See Table 19A.10	Variable—See Table 19A.10
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$449	Develop groundwater[a]
Antelope Valley-East Kern Water Agency	$568	Regional aquifer project[b]
Avenal, City of	$266	Transfer/exchange[c]
Castaic Lake Water Agency	$400	None—assumed $400
Coachella Valley Water District	$258	Recycle golf course water[d]
Coalinga, City of	$274	Transfer/exchange[c]
Contra Costa Water District	$1,070	Bay Area Regional Desalination[e]
Crestline-Lake Arrowhead Water Agency	$423	Transfer/exchange[c]

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Desert Water Agency	$416	Additional Colorado River Aqueduct water[c]
El Dorado Irrigation District	$410	Develop groundwater[a]
Folsom, City of	$365	Willow Hill Pipeline Rehabilitation Project[f]
Fresno, City of	$449	Develop groundwater[a]
Huron, City of	$266	Transfer exchange[c]
Kern County Water Agency	$314	None—assumed $314
Lindsay, City of	$449	Develop groundwater[a]
MWDSC	Variable—See Table 19A.10	Variable—See Table 19A.10
Mojave Water Agency	$482	Transfer/exchange[c]
Napa County Flood Control and Water Conservation District	$233	Transfer/exchange[c]
Orange Cove, City of	$449	Develop groundwater[a]
Palmdale Water District and Littlerock Creek Irrigation District	$615	Regional Aquifer Project[g]
Placer County Water Agency	$410	Develop groundwater[a]
Redding, City of	$432	Develop groundwater[a]
Roseville, City of	$502	Develop groundwater[a]
Sacramento County Water Agency	$410	Develop groundwater[a]
San Benito County Water District, Zone 6	$384	Transfer/exchange[c]
San Bernardino Valley Municipal Water District	$366	Beaumont Avenue Recharge Facility[h]
San Gorgonio Pass Water Agency	$366	Beaumont Avenue Recharge Facility[h]
San Juan Water Agency	$138	Regional Indoor and Outdoor Efficiency[f]
San Luis Obispo County Flood Control and Water Conservation District	$475	Raise Lopez Dam 3-5 feet[i]
Santa Barbara County Flood Control and Water Conservation District	$804	Expand conjunctive use and groundwater[a]
Santa Clara Valley Water District	$1,795	Bay Area Regional Desalination[e]

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$216	Transfer/exchange[c]
Solano County Water Agency	$221	Expand exchange with Mojave Water Agency[c]
Stockton-East Water District	$338	Delta Water Supply Project[j]
Tracy, City of	$266	Transfer/exchange[c]
West Sacramento, City of	$410	Develop groundwater[a]
Yuba City, City of	$432	Develop groundwater[a]
Zone 7 Water Agency	Variable—See Table 19A.10	Variable—See Table 19A.10

Source:
a. SCWA 2010 for cost of well development plus pumping cost from Table 19A.13
b. AVEK 2011
c. Transfer cost from Table 19A.11 plus delivery cost from Table 19A.8
d. CVWD 2013
e. BARDP 2011
f. RWA 2011
g. PRWA 2014
h. SGPWA 2013
i. Zone 3 2015
j. ESJGB 2014

Zone 7 Water Agency, Alameda County Water District, and MWDSC have multiple additional fixed-yield supplies modeled in CWEST. For MWDSC, five fixed yield options are provided: reclamation, desalination, groundwater recovery, conservation, and stormwater. Cost functions are included that express the average cost of supply as an increasing function of the amount used. Table 19A.10 displays the range of average cost for each supply type.

Table 19A.10 CVP and SWP M&I Water Users with Multiple Additional Fixed-Yield Supply Options

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)	Type or Name of Additional Fixed-Yield Supply	Maximum Quantity Available (acre-foot)
Alameda County Water District	$410	Conservation	3,600[a]
	$500	Expansion of Newark Facility	5,100[a]
MWDSC	$500 to $1,500[b]	Groundwater Recovery	92,000[c]
	$600 to $1,500[b]	Recycling	360,000[c]
	$192 to $1,300[d]	Conservation	346,000[c]
	$300 to $1,500[e]	Stormwater Capture	75,000[c]
	$1,300 to $2,000[b]	Desalination	84,000[c]
Zone 7 Water Agency	$20	Arroyo Valle—Perfection of Existing Permit	3,800[f]
	$30	Reduction of Demineralization Losses	260[f]
	$100	Reduction of Unaccounted-for-Water	1,300[f]
	$110	Enhance Existing In-lieu Recharge	500 – 830[f]
	$200	Arroyo Las Positas Water Rights	750[f]
	$285	Confirm Byron-Bethany Irrigation District Yield	3,000[f]
	$1,400	Intertie Supply: Long-term Lease	10,900[f]
	$1,500	Recycled Water—Direct	3,700[f]
	$1,600	Groundwater Injection: Recycled Water	2,800[f]
	$2,000	Intertie Supply: Regional Desalination	9,300[f]
	$2,400	Recycled Water—Storage	17,300[f]

Source:
a. ACWD 2014
b. MWDSC 2010
c. LADWP 2011
d. Mitchell 2005
e. LADWP 2014
f. Zone 7 WA 2011

19A.2.2.3 Transfer Costs and Annual Options

Annual options are supplies that can be made available to meet demands annually. The model allows for separate costs of these supplies in dry and critical years, and a separate cost in below normal or wetter years. In below normal or wetter years, these supplies are generally transfers or groundwater. In dry or critical years, these supplies are generally transfers; providers are not allowed to pump groundwater in excess of their UWMP levels.

Costs of water transfers are based on publications summarizing observed market prices. Water transfer prices in California ranged from $50 to $550 per acre-foot from 1992 to 2004 (Hanak and Stryjewski 2012). From 2008 to 2012, transfers originating from north of the Delta (NOD) cost $47 to $200 per acre-foot while transfers originating south of the Delta (SOD) cost $237 to $436 per acre-foot (Mann and Hatchett 2012). Drought conditions in 2013 led to an estimated increase of up to 40 percent from 2012 prices (WestWater Research 2013). Transfer prices were created for multiple regions, based on historical transfer prices detailed earlier, in the same area of origin. Colorado River transfer prices are included as a supply option for agencies receiving their SWP Table A water by exchange. Prices are based on planned prices for the water transfer between Imperial Irrigation District and San Diego County Water Authority. The dry/critical year price is calculated as the weighted average of historical dry and critical year prices, where the weights are the frequency of the two year types in the historical hydrology (18 dry years and 12 critical years). The Gross National Product Implicit Price Deflator was used to bring historical transfer prices to equivalent years.

These prices are intended to represent the analysis, and are not predictions. Also, prices provided in Table 19A.11 are at the source (location of purchase) and do not include delivery costs or losses. A conveyance loss of 18 percent is assumed for cross-Delta transfers. Water delivery costs presented in Table 19A.8 are included for all transfers.

Table 19A.11 Assumed Water Transfer Prices in CWEST, 2030 Conditions*

Condition	North of Delta Origin	South of Delta Origin	North of Delta with Conveyance Loss	Colorado River Transfers
Below Normal or Wetter	$200	$250	$244	$416
Dry or Critical	$378	$480	$461	$416

Note:
* See 19A.2.2.3, Transfer Costs and Annual Options for source information

19A.2.2.4 Storage Operations and Groundwater Costs

19A.2.2.4.1 Storage Operations Costs

Storage operations are included for MWDSC, some CVP and SWP M&I water users in the San Francisco Bay Area Region, and Stockton-East Water District. The San Francisco Bay Area Region includes local groundwater storage and Semitropic Water Bank storage for Santa Clara Valley Water District, Zone 7 and Alameda County Water District. Storage operation costs for MWDSC are based on information provided in its Water Surplus and Demand Management Plan (MWDSC, 2011). Semitropic Water Storage District's published put and take costs for banking operations are used in CWEST in addition to the delivery cost to each banking partner (SWSD 2014). Local groundwater storage operation costs used by San Francisco Bay Area Region CVP and SWP M&I contractors and Stockton-East Water District are based on the groundwater costs detailed in Table 19A.12.

19A.2.2.4.2 Groundwater Costs

CWEST includes an estimate of cost savings for groundwater not pumped when excess CVP and SWP water is available. Data on groundwater costs are from CVP and SWP M&I water user UWMPs, where possible. When this information is not available in UWMPs, groundwater pumping costs are based on estimates of regional depth to groundwater and electricity price. Depths to groundwater are from DWR's Bulletin 118—Groundwater Basin Maps and Descriptions (DWR, 2004). The amount of groundwater available in below normal or wetter, and dry or critical conditions is based on individual CVP and SWP M&I water user UWMPs.

Groundwater pumping costs were estimated for each EIS area based on a representative value from published information. CVP and SWP M&I water users in the Southern California Region have a groundwater pumping cost based on an estimate published in a Groundwater Basin Assessment (MWDSC 2007). Representative groundwater pumping costs in the Central Coast Region are based on recent estimates from the City of Santa Barbara (City of Santa Barbara 2015). Groundwater pumping costs in the San Francisco Bay Area Region are based on published estimates from San Benito County (SBCWD 2014). San Joaquin Valley groundwater pumping costs are based on published estimates from James Irrigation District and Fresno Irrigation District (KBWA 2013). Sacramento Valley had no readily available information on groundwater pumping estimates. Groundwater depth estimates and published estimates of groundwater pumping from the previous sources were used to interpolate groundwater pumping costs in the Sacramento Valley. This method was used to adjust groundwater pumping prices in other regions.

Additional costs associated with groundwater use include lower groundwater tables, subsidence, streamflow depletion, depreciation, and well replacement that should be included. In some locations, groundwater must be treated for water quality, which adds additional cost. No consistent source of information is available to assess these other costs, so cost per acre-foot is conservatively

increased by 10 percent to account for some of these costs. Real increases in energy costs were applied to groundwater pumping costs (CEC 2013). Table 9A.12 displays groundwater variable costs used in the model.

Table 19A.12 Groundwater Variable Pumping Costs

CVP and SWP M&I Water User	Estimated Groundwater Pumping Cost in 2030 ($/acre-foot)*
Alameda County Water District	$52
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$91
Antelope Valley-East Kern Water Agency	$171
Avenal, City of	$91
Castaic Lake Water Agency	$94
Coachella Valley Water District	$171
Coalinga, City of	$91
Contra Costa Water District	$52
Crestline-Lake Arrowhead Water Agency	$171
Desert Water Agency	$171
El Dorado Irrigation District	$52
Folsom, City of	$52
Fresno, City of	$91
Huron, City of	$91
Kern County Water Agency	$168
Lindsay, City of	$91
MWDSC	$94
Mojave Water Agency	$171
Napa County Flood Control and Water Conservation District	$108
Orange Cove, City of	$91
Palmdale Water District and Littlerock Creek Irrigation District	$171
Placer County Water Agency	$52
Redding, City of	$74
Roseville, City of	$52
Sacramento County Water Agency	$52
San Benito County Water District, Zone 6	$52
San Bernardino Valley Municipal Water District	$171
San Gorgonio Pass Water Agency	$171
San Juan Water Agency	$52
San Luis Obispo County Flood Control and Water Conservation District	$298

CVP and SWP M&I Water User	Estimated Groundwater Pumping Cost in 2030 ($/acre-foot)*
Santa Barbara County Flood Control and Water Conservation District	$298
Santa Clara Valley Water District	$52
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$74
Solano County Water Agency	$108
Stockton-East Water District	$91
Tracy, City of	$91
West Sacramento, City of	$52
Yuba City, City of	$74
Zone 7 Water Agency	$52

Note:

* See 19A.2.2.4 Storage Operations and Groundwater Costs – *Groundwater Costs* for source information

19A.2.2.5 Shortage Costs

Shortages in critical years are represented in the common behavior of CVP and SWP M&I water users. CWEST requires that a 5 percent end-use drought conservation shortage is implemented before any annual supply is purchased in a critical year. A provider can then eliminate a shortfall using an annual option supply such as a transfer. There is no limit currently programmed in CWEST to limit annual option supplies; therefore, end-user shortages only occur during critical years.

Shortage costs are lost retail water revenue plus end-user shortage costs. Revenue losses are based on the water prices presented in Table 19A.8. The model calculates shortage costs based on a constant elasticity of demand function. This form of shortage loss function is standard practice in California water economics studies and has been documented (M. Cubed 2007). The 2030 retail water price presented in Table 19A.8 defines one point on the demand function, and the slope is defined by the price elasticity.

The short-run demand price elasticity assumed for all providers is -0.1. This elasticity represents a demand elasticity appropriate for drought conditions. A variety of studies have found short-run price elasticities in the range of -0.1 to -0.3 (Thomas and Syme 1988; A&N Technical Services 1996). California urban price elasticity is believed to be even more inelastic because of demand hardening. This means people's actions to reduce water use in response to shortages will already have been implemented by 2030. To evaluate 2030 conditions, -0.1 is used because it is the more inelastic estimate reported in the published information.

19A.3 CWEST Results

CWEST generates results for each CVP and SWP M&I water user, which can be aggregated into regions or a statewide total. Descriptions and interpretations of results for each region and EIS alternative are provided in Chapter 19, Socioeconomics. Table 19A.1 defines the report results and Tables 19A.14 through 19A.45 present the results for the EIS alternatives. CWEST results presented in this appendix are in 2014 dollars. Results provided in Chapter 19 have been translated to 2012 dollars to allow for comparison with SWAP and IMPLAN results.

Table 19A.13 Interpretation of Reported Results

Reported Results	Interpretation
Average Annual CVP and SWP Deliveries (TAF)	Average Annual CVP and SWP delivery quantity for the reported alternative
Delivery Cost ($1,000)	Delivery cost to deliver SWP/ CVP water
New Supply (TAF)	Additional 2030 fixed-yield supply above stated 2030 supplies. This is the cost-minimizing decision variable in the model.
Annualized New Supply Costs ($1,000)	Cost of optimal quantity of additional 2030 fixed-yield supply. Varies across water users by type of new supply listed in their UWMPs as likely new supply (e.g., desalination, recycling, conservation)
Surface/GW Storage Costs ($1,000)	Cost of annual puts/takes into local surface storage, local groundwater storage, or regional groundwater banks (e.g., Semitropic Water Storage District)
Lost Water Sales Revenues ($1,000)	Loss of retail water sales revenue due to shortage
Transfer Costs ($1,000)	Cost to purchase and deliver transfer water purchases on annual spot market, or other annual options if applicable
Shortage Costs ($1,000)	Estimated consumer surplus loss to water shortages
GW pumping savings ($1,000)	Savings from resulting reduction in groundwater pumping relative to UWMP levels
Excess Water Savings ($1,000)	Cost savings from contract water not used to meet demand or reduce groundwater pumping
Average Annual Cost ($1,000)	Lost water sales revenue plus change in delivery, new supply, storage, transfers, options, and groundwater costs

Notes:
GW = groundwater
TAF = thousand acre-feet

Table 19A.14 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative and Alternative 2	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	463	-16
Delivery Cost ($1,000)	$8,271	$8,566	$295
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$219	$213	$6
Transfer Costs ($1,000)	$761	$532	$229
Shortage Costs ($1,000)	$71	$70	$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,973	-$4,033	$60
Savings from Excess Water (-$1,000)	-$2,344	-$2,640	$296
Average Annual Cost ($1,000)	**$3,006**	**$2,709**	**$297**

Note: In 2014 dollars

Table 19A.15 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative and Alternative 2	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	214	237	-23
Delivery Cost ($1,000)	$3,563	$3,969	$-406
New Supply (TAF)	2	0	2
Annualized New Supply Costs ($1,000)	$442	$16	$426
Surface/GW Storage Costs ($1,000)	$970	$845	$125
Lost Water Sales Revenues ($1,000)	$372	$332	$40
Transfer Costs ($1,000)	$2,753	$2,701	$51
Shortage Costs ($1,000)	$119	$105	$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,837	-$16,490	$653
Excess Water Savings ($1,000)	-$1,060	-$1,358	$298
Average Annual Cost ($1,000)	**-$8,679**	**-$9,880**	**$1,201**

Note: In 2014 dollars

Table 19A.16 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative and Alternative 2	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	396	445	-48
Delivery Cost ($1,000)	$11,374	$12,889	-$1,515
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$617	$241	$376
Surface/GW Storage Costs ($1,000)	$1,624	$2,021	-$398
Lost Water Sales Revenues ($1,000)	$4,415	$1,643	$2,772
Transfer Costs ($1,000)	$5,893	$1,189	$4,704
Shortage Costs ($1,000)	$1,452	$538	$914
Reduction in Groundwater Pumping Costs (-$1,000)	-$508	-$815	$307
Excess Water Savings ($1,000)	-$232	-$565	$333
Average Annual Cost ($1,000)	**$24,635**	**$17,141**	**$7,494**

Note: In 2014 dollars

Table 19A.17 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative and Alternative 2	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	44	54	-10
Delivery Cost ($1,000)	$6,863	8,418	-1,556
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,309	-$8,901	$593
Excess Water Savings ($1,000)	-$3,058	-$4,301	$1,242
Average Annual Cost ($1,000)	**-$4,505**	**-$4,784**	**$279**

Note: In 2014 dollars

Table 19A.18 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative and Alternative 2	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,932	2,394	-461
Delivery Cost ($1,000)	$246,862	$305,673	-$58,811
New Supply (TAF)	47	11	35
Annualized New Supply Costs ($1,000)	$13,067	$4,153	$8,915
Surface/GW Storage Costs ($1,000)	$7,825	$2,909	$4,916
Lost Water Sales Revenues ($1,000)	$15,051	$1,153	$13,899
Transfer Costs ($1,000)	$11,827	$3,816	$8,011
Shortage Costs ($1,000)	$17,837	$363	$17,474
Reduction in Groundwater Pumping Costs (-$1,000)	-$59,193	-$94,244	$35,051
Excess Water Savings ($1,000)	-$4,768	-$10,889	$6,121
Average Annual Cost ($1,000)	**$248,509**	**$212,933**	**$35,576**

Note: In 2014 dollars

Table 19A.19 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	463	447	16
Delivery Cost ($1,000)	$8,566	$8,271	$295
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$213	$219	-$6
Transfer Costs ($1,000)	$532	$761	-$229
Shortage Costs ($1,000)	$70	$71	-$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,033	-$3,973	-$60
Excess Water Savings ($1,000)	-$2,640	-$2,344	-$296
Average Annual Cost ($1,000)	**$2,709**	**$3,006**	**-$297**

Note: In 2014 dollars

Table 19A.20 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	237	214	23
Delivery Cost ($1,000)	$3,969	$3,563	$406
New Supply (TAF)	0	2	-2
Annualized New Supply Costs ($1,000)	$16	$442	-$426
Surface/GW Storage Costs ($1,000)	$845	$970	-$125
Lost Water Sales Revenues ($1,000)	$332	$372	-$40
Transfer Costs ($1,000)	$2,701	$2,753	-$51
Shortage Costs ($1,000)	$105	$119	-$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,490	-$15,837	-$653
Excess Water Savings ($1,000)	-$1,358	-$1,060	-$298
Average Annual Cost ($1,000)	**-$9,880**	**-$8,679**	**-$1,201**

Note: In 2014 dollars

Table 19A.21 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	445	396	48
Delivery Cost ($1,000)	$12,889	$11,374	$1,515
New Supply (TAF)	6	8	-2
Annualized New Supply Costs ($1,000)	$241	$617	-$376
Surface/GW Storage Costs ($1,000)	$2,021	$1,624	$398
Lost Water Sales Revenues ($1,000)	$1,643	$4,415	-$2,772
Transfer Costs ($1,000)	$1,189	$5,893	-$4,704
Shortage Costs ($1,000)	$538	$1,452	-$914
Reduction in Groundwater Pumping Costs (-$1,000)	-$815	-$508	-$307
Excess Water Savings ($1,000)	-$565	-$232	-$333
Average Annual Cost ($1,000)	**$17,141**	**$24,635**	**-$7,494**

Note: In 2014 dollars

Table 19A.22 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	54	44	10
Delivery Cost ($1,000)	$8,418	$6,863	$1,556
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,901	-$8,309	-$593
Excess Water Savings ($1,000)	-$4,301	-$3,058	-$1,242
Average Annual Cost ($1,000)	**-$4,784**	**-$4,505**	**-$279**

Note: In 2014 dollars

Table 19A.23 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,394	1,932	461
Delivery Cost ($1,000)	$305,673	$246,862	$58,811
New Supply (TAF)	11	47	-35
Annualized New Supply Costs ($1,000)	$4,153	$13,067	-$8,915
Surface/GW Storage Costs ($1,000)	$2,909	$7,825	-$4,916
Lost Water Sales Revenues ($1,000)	$1,153	$15,051	-$13,899
Transfer Costs ($1,000)	$3,816	$11,827	-$8,011
Shortage Costs ($1,000)	$363	$17,837	-$17,474
Reduction in Groundwater Pumping Costs (-$1,000)	-$94,244	-$59,193	-$35,051
Excess Water Savings ($1,000)	-$10,889	-$4,768	-$6,121
Average Annual Cost ($1,000)	**$212,933**	**$248,509**	**-$35,576**

Note: In 2014 dollars

Table 19A.24 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	461	447	13
Delivery Cost ($1,000)	$8,533	$8,271	$262
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$250	$219	$31
Transfer Costs ($1,000)	$619	$761	-$143
Shortage Costs ($1,000)	$79	$71	$8
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,056	-$3,973	-$83
Excess Water Savings ($1,000)	-$2,592	-$2,344	-$249
Average Annual Cost ($1,000)	**$2,832**	**$3,006**	**-$174**

Note: In 2014 dollars

Table 19A.25 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	241	214	27
Delivery Cost ($1,000)	$4,013	$3,563	$449
New Supply (TAF)	0	2	-2
Annualized New Supply Costs ($1,000)	$13	$442	-$429
Surface/GW Storage Costs ($1,000)	$478	$970	-$491
Lost Water Sales Revenues ($1,000)	$292	$372	-$80
Transfer Costs ($1,000)	$2,167	$2,753	-$585
Shortage Costs ($1,000)	$92	$119	-$27
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,129	-$15,837	-$291
Excess Water Savings ($1,000)	-$1,419	-$1,060	-$359
Average Annual Cost ($1,000)	**-$10,492**	**-$8,679**	**-$1,813**

Note: In 2014 dollars

Table 19A.26 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	431	396	34
Delivery Cost ($1,000)	$12,458	$11,374	$1,083
New Supply (TAF)	$8	$8	$0
Annualized New Supply Costs ($1,000)	$593	$617	-$24
Surface/GW Storage Costs ($1,000)	$2,372	$1,624	$748
Lost Water Sales Revenues ($1,000)	$2,452	$4,415	-$1,962
Transfer Costs ($1,000)	$1,881	$5,893	-$4,012
Shortage Costs ($1,000)	$766	$1,452	-$687
Reduction in Groundwater Pumping Costs (-$1,000)	-$748	-$508	-$239
Excess Water Savings ($1,000)	-$404	-$232	-$172
Average Annual Cost ($1,000)	**$19,369**	**$24,635**	**-5,266**

Note: In 2014 dollars

Table 19A.27 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	51	44	8
Delivery Cost ($1,000)	$8,048	$6,863	$1,185
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,582	-$8,309	-$273
Excess Water Savings ($1,000)	-$4,099	-$3,058	-$1,041
Average Annual Cost ($1,000)	**-$4,633**	**-$4,505**	**-$129**

Note: In 2014 dollars

Table 19A.28 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,241	1,932	308
Delivery Cost ($1,000)	$286,403	$246,862	$39,541
New Supply (TAF)	40	47	-7
Annualized New Supply Costs ($1,000)	$10,901	$13,067	-$2,167
Surface/GW Storage Costs ($1,000)	$8,398	$7,825	$573
Lost Water Sales Revenues ($1,000)	$11,750	$15,051	-$3,301
Transfer Costs ($1,000)	$6,366	$11,827	-$5,461
Shortage Costs ($1,000)	$13,010	$17,837	-$4,827
Reduction in Groundwater Pumping Costs (-$1,000)	-$84,136	-$59,193	-$24,943
Excess Water Savings ($1,000)	-$9,275	-$4,768	-$4,507
Average Annual Cost ($1,000)	**$243,416**	**$248,509**	**-$5,092**

Note: In 2014 dollars

Table 19A.29 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	461	463	-2
Delivery Cost ($1,000)	$8,533	$8,566	-$33
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$250	$213	$36
Transfer Costs ($1,000)	$619	$532	$86
Shortage Costs ($1,000)	$79	$70	$9
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,056	-$4,033	-$23
Excess Water Savings ($1,000)	-$2,592	-$2,640	$48
Average Annual Cost ($1,000)	**$2,832**	**$2,709**	**$123**

Note: In 2014 dollars

Table 19A.30 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	241	237	4
Delivery Cost ($1,000)	$4,013	$3,969	$44
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$13	$16	-$3
Surface/GW Storage Costs ($1,000)	$478	$845	-$366
Lost Water Sales Revenues ($1,000)	$292	$332	-$40
Transfer Costs ($1,000)	$2,167	$2,701	-$534
Shortage Costs ($1,000)	$92	$105	-$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,129	-$16,490	$361
Excess Water Savings ($1,000)	-$1,419	-$1,358	-$61
Average Annual Cost ($1,000)	**-$10,492**	**-$9,880**	**-$612**

Note: In 2014 dollars

Table 19A.31 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	431	445	-14
Delivery Cost ($1,000)	$12,458	$12,889	-$432
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$593	$241	$352
Surface/GW Storage Costs ($1,000)	$2,372	$2,021	$350
Lost Water Sales Revenues ($1,000)	$2,452	$1,643	$810
Transfer Costs ($1,000)	$1,881	$1,189	$692
Shortage Costs ($1,000)	$766	$538	$227
Reduction in Groundwater Pumping Costs (-$1,000)	-$748	-$815	$68
Excess Water Savings ($1,000)	-$404	-$565	$161
Average Annual Cost ($1,000)	**$19,369**	**$17,141**	**$2,228**

Note: In 2014 dollars

Table 19A.32 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	51	54	-2
Delivery Cost ($1,000)	$8,048	$8,418	-$371
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,582	-$8,901	$320
Excess Water Savings ($1,000)	-$4,099	-$4,301	$202
Average Annual Cost ($1,000)	**-$4,633**	**-$4,784**	**$151**

Note: In 2014 dollars

Table 19A.33 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,241	2,394	-153
Delivery Cost ($1,000)	$286,403	$305,673	-$19,270
New Supply (TAF)	40	11	28
Annualized New Supply Costs ($1,000)	$10,901	$4,153	$6,748
Surface/GW Storage Costs ($1,000)	$8,398	$2,909	$5,489
Lost Water Sales Revenues ($1,000)	$11,750	$1,153	$10,597
Transfer Costs ($1,000)	$6,366	$3,816	$2,550
Shortage Costs ($1,000)	$13,010	$363	$12,646
Reduction in Groundwater Pumping Costs (-$1,000)	-$84,136	-$94,244	$10,108
Excess Water Savings ($1,000)	-$9,275	-$10,889	$1,615
Average Annual Cost ($1,000)	**$254,212**	**$218,820**	**$35,392**

Note: In 2014 dollars

Table 19A.34 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	447	-1
Delivery Cost ($1,000)	$8,262	$8,271	-$8
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$210	$219	-$9
Transfer Costs ($1,000)	$774	$761	$13
Shortage Costs ($1,000)	$70	$71	-$2
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,972	-$3,973	$1
Excess Water Savings ($1,000)	-$2,333	-$2,344	$10
Average Annual Cost ($1,000)	**$3,011**	**$3,006**	**$5**

Note: In 2014 dollars

Table 19A.35 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	211	214	-3
Delivery Cost ($1,000)	$3,513	$3,563	-$51
New Supply (TAF)	$2	$2	$1
Annualized New Supply Costs ($1,000)	$619	$442	$177
Surface/GW Storage Costs ($1,000)	$994	$970	$25
Lost Water Sales Revenues ($1,000)	$372	$372	$0
Transfer Costs ($1,000)	$2,740	$2,753	-$12
Shortage Costs ($1,000)	$119	$119	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,787	-$15,837	$50
Excess Water Savings ($1,000)	-$1,026	-$1,060	$34
Average Annual Cost ($1,000)	**-$8,457**	**-$8,679**	**$222**

Note: In 2014 dollars

Table 19A.36 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	394	396	-3
Delivery Cost ($1,000)	$11,290	$11,374	-$84
New Supply (TAF)	8	8	0
Annualized New Supply Costs ($1,000)	$617	$617	$0
Surface/GW Storage Costs ($1,000)	$1,540	$1,624	-$84
Lost Water Sales Revenues ($1,000)	$4,491	$4,415	$76
Transfer Costs ($1,000)	$6,340	$5,893	$447
Shortage Costs ($1,000)	$1,493	$1,452	$41
Reduction in Groundwater Pumping Costs (-$1,000)	-$484	-$508	$25
Excess Water Savings ($1,000)	-$232	-$232	$0
Average Annual Cost ($1,000)	**$25,056**	**$24,635**	**$421**

Note: In 2014 dollars

Table 19A.37 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	43	44	-1
Delivery Cost ($1,000)	$6,763	$6,863	-$100
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,258	-$8,309	$51
Excess Water Savings ($1,000)	-$2,986	-$3,058	$73
Average Annual Cost ($1,000)	**-$4,481**	**-$4,505**	**$24**

Note: In 2014 dollars

Table 19A.38 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,912	1,932	-20
Delivery Cost ($1,000)	$244,210	$246,862	-$2,652
New Supply (TAF)	81	47	34
Annualized New Supply Costs ($1,000)	$24,915	$13,067	$11,847
Surface/GW Storage Costs ($1,000)	$7,697	$7,825	-$128
Lost Water Sales Revenues ($1,000)	$14,631	$15,051	-$420
Transfer Costs ($1,000)	$10,820	$11,827	-$1,008
Shortage Costs ($1,000)	$17,160	$17,837	-$677
Reduction in Groundwater Pumping Costs (-$1,000)	-$60,068	-$59,193	-$875
Excess Water Savings ($1,000)	-$4,726	-$4,768	$42
Average Annual Cost ($1,000)	**$254,639**	**$248,509**	**$6,130**

Note: In 2014 dollars

Table 19A.39 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	463	-16
Delivery Cost ($1,000)	$8,262	$8,566	-$304
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$210	$213	-$3
Transfer Costs ($1,000)	$774	$532	$242
Shortage Costs ($1,000)	$70	$70	-$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,972	-$4,033	$61
Excess Water Savings ($1,000)	-$2,333	-$2,640	$306
Average Annual Cost ($1,000)	**$3,011**	**$2,709**	**$302**

Note: In 2014 dollars

Table 19A.40 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	211	237	-26
Delivery Cost ($1,000)	$3,513	$3,969	-$457
New Supply (TAF)	2	0	2
Annualized New Supply Costs ($1,000)	$619	$16	$603
Surface/GW Storage Costs ($1,000)	$994	$845	$150
Lost Water Sales Revenues ($1,000)	$372	$332	$40
Transfer Costs ($1,000)	$2,740	$2,701	$39
Shortage Costs ($1,000)	$119	$105	$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,787	-$16,490	$703
Excess Water Savings ($1,000)	-$1,026	-$1,358	$332
Average Annual Cost ($1,000)	**-$8,457**	**-$9,880**	**$1,423**

Note: In 2014 dollars

Table 19A.41 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	394	445	-51
Delivery Cost ($1,000)	$11,290	$12,889	-$1,599
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$617	$241	$376
Surface/GW Storage Costs ($1,000)	$1,540	$2,021	-$481
Lost Water Sales Revenues ($1,000)	$4,491	$1,643	$2,848
Transfer Costs ($1,000)	$6,340	$1,189	$5,152
Shortage Costs ($1,000)	$1,493	$538	$955
Reduction in Groundwater Pumping Costs (-$1,000)	-$484	-$815	$332
Excess Water Savings ($1,000)	-$232	-$565	$333
Average Annual Cost ($1,000)	**$25,056**	**$17,141**	**$7,915**

Note: In 2014 dollars

Table 19A.42: Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	43	54	-11
Delivery Cost ($1,000)	$6,763	$8,418	-$1,655
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,258	-$8,901	$644
Excess Water Savings ($1,000)	-$2,986	-$4,301	$1,315
Average Annual Cost ($1,000)	**-$4,481**	**-$4,784**	**$304**

Note: In 2014 dollars

Table 19A.43 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,912	2,394	-482
Delivery Cost ($1,000)	$244,210	$305,673	-$61,462
New Supply (TAF)	81	11	70
Annualized New Supply Costs ($1,000)	$24,915	$4,153	$20,762
Surface/GW Storage Costs ($1,000)	$7,697	$2,909	$4,788
Lost Water Sales Revenues ($1,000)	$14,631	$1,153	$13,478
Transfer Costs ($1,000)	$10,820	$3,816	$7,003
Shortage Costs ($1,000)	$17,160	$363	$16,797
Reduction in Groundwater Pumping Costs (-$1,000)	-$60,068	-$94,244	$34,176
Excess Water Savings ($1,000)	-$4,726	-$10,889	$6,164
Average Annual Cost ($1,000)	**$254,639**	**$212,933**	**$41,706**

Note: In 2014 dollars

The maximum single-year transfers are listed in Table 19A.44. An analysis on available capacity to complete these transfers concluded that transfer quantities in each alternative will not be limited by delta pumping capacity. Conservative estimates of the quantity of transfers going south of the Delta were used with published information (USFWS 2008) on transfer quantities that did not show any capacity limitations.

Table 19A.44 Annual Transfer Analysis

Maximum Single-Year Transfers by Region Across Alternatives				
Alternative	**NAA**	**SBC and Alt 1**	**Alt 3**	**Alt 5**
Central Valley Region— Sacramento Valley	18	15	16	17
Central Valley Region—San Joaquin Region	10	11	11	9
San Francisco Bay Area Region	209	110	143	209
Central Coast Region	0	0	0	0
Southern California Region	442	62	184	405
Statewide Total	679	197	354	641

Notes:
NAA – No Action Alternative
SBC – Second Basis of Comparison
Alt 1 – Alternative 1
Alt 3 – Alternative 3
Alt 5 – Alternative 5

Table 19A.45 Alternatives Difference in Annual Transfers

Maximum Single-Year Transfers by Alternatives Comparison			
Alternative	**Alt 1 vs NAA**	**Alt 3 vs NAA**	**Alt 5 vs NAA**
Central Valley Region— Sacramento Valley	-4	-2	-1
Central Valley Region—San Joaquin Region	1	1	-1
San Francisco Bay Area Region	-100	-66	0
Central Coast Region	0	0	0
Southern California Region	-380	-258	-36
Statewide Total	-482	-324	-38

Notes:
Alt 1 vs NAA – Alternative 1 compared to No Action Alternative
Alt 3 vs NAA – Alternative 3 compared to No Action Alternative
Alt 5 vs NAA – Alternative 5 compared to No Action Alternative
SOD transfer limits: 600 TAF Dry/Critical years, 360 TAF all other years (USFWS 2008)

19A.3.1 Result Data for Other Models

CWEST results are used by the IMPLAN model, as described in Chapter 19, Socioeconomics. Because of the cost recovery requirements of public utilities, changes to CVP and SWP M&I water user costs are passed directly to the utilities' customers, and therefore affect customers' income available to spend on other purchases. Changes in CVP and SWP M&I deliveries can also affect water sales. These two categories of changes, to water sales net revenue and to local utilities' spending on imported water supplies and other imports, are used to assess regional economic impacts.

19A.3.2 Model Limitations and Applicability

Although it is impossible to represent precisely and in detail the economic costs and tradeoffs faced by each CVP and SWP M&I water user, CWEST provides representative cost estimates across EIS alternatives. Economic models are inherently inexact because mathematical descriptions are used to simulate complex human and organizational decisions. However, CWEST can provide realistic and representative estimates of changes in economic costs for the EIS alternatives.

Other challenges in modeling reduce the accuracy of CWEST's estimates of the economic benefits of CVP and SWP M&I water user water supplies. Conducting the analysis at an annual time step does not allow for in-season water supply decisions. Decisions involving large capital investments are not always based entirely on economic criteria. CWEST does not model political concerns and constraints or other local preferences.

19A.4 References

A&N Technical Services. 1996. *Handbook for the Design, Evaluation, and Implementation of Conservation Rate Structures*.

ACWD (Alameda County Water District). 2011. *Urban Water Management Plan 2010-2015*.

_____. 2014. *Reliability by Design: Integrated Resources Planning at the Alameda County Water District*.

Antelope Valley – East Kern Water Agency (AVEK). 2011. *Water Supply Stabilization Project No. 2. Implementation Grant Proposal, Attachment 7, Economic Analysis: Water Supply Costs and Benefits*.

BARDP (Bay Area Regional Desalination Project). 2011. *Institutional Analysis Technical Memorandum #2—Analysis of Feasible Scenarios. Project Partners: Contra Costa Water District, East Bay Municipal Utility District, Zone 7 Water Agency, San Francisco Public Utilities Commission, and Santa Clara Valley Water District*.

Black & Veatch. 2006. *California Water Rate Survey*.

CCWA (Central Coast Water Authority). 2007. *Fiscal Year 2008/2009 Budget*.

CEC (California Energy Commission, Electricity Supply Analysis Division). 2013. *California Energy Demand 2014-2024 Revised Forecast, Volume 1: Statewide Electricity Demand, End-User Natural Gas Demand, and Energy Efficiency*. Publication Number: CEC-200-2013-004-SD-V1-REV.

City of Santa Barbara. 2015. *Groundwater Cost Information*. Site accessed June 3, 2015. http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/groundwater.asp.

CVWD (Coachella Valley Water District). 2013. *Coachella Valley IRWM Implementation Grant, Round 2, Attachment 7 Technical Justification of Projects*.

DWR (California Department of Water Resources). 2013. *Bulletin 132-10*.

_____. 2004. *Bulletin 118 – Groundwater Basin Maps and Descriptions*.

ESJGB (Eastern San Joaquin County Groundwater Basin Authority). 2014. *2014 Eastern San Joaquin Integrated Regional Water Management Plan Update*.

Hanak, E. and E. Stryjewski. 2012. *California's Water Market, By the Numbers: Update 2012*. Site accessed June 3, 2015. http://www.ppic.org/content/pubs/report/R_1112EHR.pdf.

KBWA (Kings Basin Water Authority). 2015. *Upper Kings Basin IRWM Authority IRWMP Grant Proposal. Attachment 8 – Benefits and Costs*. Site accessed June 3, 2015. http://www.water.ca.gov/irwm/grants/docs/Archives/Prop84/Submitted Applications/P84 Round2_Implementation/Upper Kings Basin IRWM Authority (201312340022)/KBWA IRWMP Implementation Projects.pdf

LADWP (Los Angeles Department of Water and Power). 2011. *2010 Urban Water Management Plan*.

_____. 2014. *Stormwater Capture Master Plan, Interim Report, Draft*.

M. Cubed. 2007. *Proposed Method for Calculating Customer Shortage Costs for Use in WSMP 2040 Portfolio Evaluations*. Site accessed June 3, 2015. https://www5.ebmud.com/sites/default/files/pdfs/Proposed Method for Calculating Customer Shortage Costs.pdf.

Mann, R. and S. Hatchett. 2012. *Methods for Valuing Agricultural Water in California and Some Recent Results*. For Bureau of Reclamation, Mid-Pacific Region.

MWDSC (Metropolitan Water District of Southern California). 2007. *Groundwater Assessment Study, Chapter IV – Groundwater Basin Reports, Los Angeles County Coastal Plains Basins – Central Basin*.

_____. 2010. *Regional Urban Water Management Plan*.

_____. 2011. *Water Surplus and Drought Management Plan. Report for Water Resource Management Board Meeting*. December 13.

_____. 2014. *Board of Directors Finance and Insurance Committee Board Meeting Letter, Attachment 10 Ten-Year Financial Forecast. Board Meeting on 8 April, 2014*.

Mitchell, D. 2005. Memo From: David Mitchell. To: Ray Hoagland. Cc: Roger Mann, Greg Young. Re: Urban Conservation Unit Costs and Savings Potential Date: March 9.

PRWA (Palmdale Recycled Water Authority). 2014. P*almdale Recycled Water Authority Recycled Water Facilities Plan, Initial Study/Mitigated Negative Declaration*.

Reclamation (Bureau of Reclamation). 2009. *Schedule of M&I Cost of Service Water Rates Per Acre-Foot by Contractor 2010 M&I Water Rates*.

_____ 2014. *Central Valley Project Municipal and Industrial Water Shortage Policy Draft Environmental Impact Statement*.

RWA (Regional Water Authority). 2011. American River Basin IRWM Implementation Program Grant Application, Attachment 7 Economic Analysis.

SBCWD (San Benito County Water District). 2014. Annual Groundwater Report.

SCVWD (Santa Clara Valley Water District). 2011. *Urban Water Management Plan 2010*.

SCWA (Sonoma County Water Agency). 2010. *Water Supply Strategies Action Plan*.

SEWD (Stockton-East Water District). 2011. *2010 Stockton-East Water District Urban Water Management Plan Update*.

SGPWA (San Gorgonio Pass Water Agency). 2013. *Draft EIR Beaumont Avenue Recharge Facility and Pipeline City of Beaumont, County of Riverside, California*.

SWSD (Semitropic Water Storage District). 2014. *Rate Structure for Customers*.

_____. 2015. *Banking Partners Allocation*. Site accessed June 3, 2015. http://www.semitropic.com/BankingPartners.htm.

Thomas, F. and G. Syme. 1988. *Estimating Residential Price Elasticity of Demand for Water; A Contingent Valuation Approach*. Water Resource Research, vol. 24, No II, pp 1847-1857.

WestWater Research. 2013. Water Market Insider: 2013 California Spot Market Price Forecast. April.

USFWS (United States Fish and Wildlife Service). 2008. *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the CVP and SWP. Reference Number 81420-2008-F-1481-5*. Page 129

Zone 3 (San Luis Obispo County Zone 3). 2015. *Spillway Raise July 2009 Project Cost Per Acre Foot Summary*. Site accessed June 3, 2015. http://www.slocountywater.org/site/Flood Control and Water Conservation District Zones/ZONE 3/Spillway Raise Feasibility Project/pdf/Spillway Raise Project Cost Per Acre Ft Summ.pdf.

Zone 7 WA (Zone 7 Water Agency). 2011. *2011 Water Supply Evaluation, A Risk-Based Approach to Evaluating Zone 7 Water Agency's Water Supply System*.

This page left blank intentionally.