RECLAMATION

Managing Water in the West

Initial Economic Evaluation for Plan Formulation

Los Vaqueros Expansion Investigation, California

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

July 2006

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Initial Economic Evaluation for Plan Formulation

Los Vaqueros Expansion Investigation, California

Prepared by

Bureau of Reclamation
Mid-Pacific Region

with

MWH

U.S. Department of the Interior
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Mid-Pacific Region
Sacramento, California

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

ABBREVIATIONS AND ACRONYMS

A	AIP	Alternative Intake Project
B	Bay Area	San Francisco Bay Area
	(b)(2) water	800,000 acre-feet of water designated in Section 3406(b)(2) of the CVPIA
C	CAEWG	CALFED Common Assumptions Economic Workgroup
	CALFED	CALFED Bay-Delta Program
	CALSIM-II	California Water Allocation and Reservoir Operations Model
	CCI	Construction Cost Index
	CCWD	Contra Costa Water District
	CDF	California Department of Finance
	CEQA	California Environmental Quality Act
	cfs	cubic feet per second
	CVP	Central Valley Project
	CVPIA	Central Valley Project Improvement Act
	CVPM	Central Valley Production Model
D	Delta	Sacramento-San Joaquin Delta
	DSM2	Delta Simulation Model
	DWR	California Department of Water Resources
E-G	EBMUD	East Bay Municipal Utility District
	E/I	export/import
	EIR	Environmental Impact Report
	EIS	Environmental Impact Statement
	EQ	Environmental Quality
	EWA	Environmental Water Account
	GDP	Gross Domestic Product
H-I	IAIR	Initial Alternatives Information Report
	IDC	interest during construction
J-K	JPOD	joint point of diversion
L	LCPSIM	Least Cost Pricing Simulation Model
	LVE	Los Vaqueros Expansion Investigation
M	MAF	million acre-feet
	M&I	municipal and industrial

	MG	million gallons
	mg/L	milligrams per liter
	MWD	Metropolitan Water District of Southern California
N	NED	National Economic Development
	NEPA	National Environmental Policy Act
O-P	O&M	operation and maintenance
	OCAP	Operations Criteria and Plan
	OMR&R	operation, maintenance, repair, and replacement
	OSE	Other Social Effects
	P&G	Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
	PL	Public Law
Q-R	Reclamation	U.S. Department of the Interior, Bureau of Reclamation
	RED	Regional Economic Development
	ROD	Record of Decision
S	SBA	South Bay Aqueduct
	SCRB	separable costs – remaining benefits
	SDIP	South Delta Improvements Program
	SWP	State Water Project
	SWRCB	State Water Resources Control Board
T-V	TAF	thousand acre-feet
	TDS	total dissolved solids
	TH	total hardness
	TOC	total organic carbon
	VAMP	Vernalis Adaptive Management Program
W-Z	WAP	Water Acquisition Program
	WTP	Water Transfer Program

EXECUTIVE SUMMARY

PURPOSE OF THIS REPORT

This report is not a Federal decision document and is not suitable for seeking Congressional authority to construct the project. The purpose of this initial economic evaluation is to provide information on study progress primarily in two key areas: economics and plan formulation. This report identifies potential project benefits and describes methods available to estimate their monetary value. For the purpose of this initial economic evaluation, a single alternative was selected for analysis; project benefits and costs for this alternative were then estimated and compared. Selection of this alternative for evaluation in this report does not represent the identification of a recommended or preferred alternative for display in a Feasibility Report or for consideration by Congress.

A focus of the report is on economics related to one of the LVE's primary objectives, to provide a less costly water supply for a long-term Environmental Water Account (EWA). Established by CALFED in 2001, the EWA facilitates pumping curtailments in the south Sacramento-San Joaquin Delta (Delta) and other changes to Central Valley Project (CVP) and State Water Project (SWP) operations to protect at-risk fisheries. To date, the short-term EWA has relied on transfer market water purchases and short-term transfer agreements to secure water supplies, primarily from agricultural users, for EWA actions. However, uncertainty exists regarding the cost and sources of water for environmental water acquisition programs such as the EWA in the future. A key future without-project condition for the LVE is that the EWA, or a similar program, will exist in the long-term future.

BACKGROUND

In 2001, the U.S. Department of Interior, Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), and Contra Costa Water District (CCWD) began appraisal-level studies of the potential to expand Los Vaqueros Reservoir to address regional water quality and supply reliability needs. Expansion of Los Vaqueros was one of five potential surface water storage projects identified by the CALFED Bay-Delta Program (CALFED) as warranting further study. In 2003, Reclamation was directed in Public Law 108-7 (Omnibus Appropriations Act of 2003) to conduct a feasibility-level investigation of the potential expansion of Los Vaqueros Reservoir. Reclamation and DWR are the Federal and State agencies conducting the Los Vaqueros Expansion Investigation (LVE), respectively. CCWD, as owner of the existing Los Vaqueros Project, also has an integral role in the LVE. The LVE study location is shown in **Figure ES.1**.

FIGURE ES.1 - STUDY LOCATION

Initial results of the first phase of the LVE were described in the *Initial Alternatives Information Report* (IAIR) of September 2005. The IAIR identified technically feasible alternatives to meet project objectives within established criteria and constraints, but did not evaluate the potential economic feasibility of a project to expand Los Vaqueros Reservoir.

The three objectives identified for the LVE focus on using an expanded Los Vaqueros Project to accomplish the following:

- *Increase drought period water supply reliability for municipal and industrial water providers within the study area.*
- *Develop a less costly replacement water supply for the long-term Environmental Water Account.*
- *To the extent possible through pursuit of the water supply reliability and Environmental Water Account replacement supply objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

Alternative Evaluated in This Report

The current phase of the LVE is focused on developing detailed alternatives for comparison and evaluation in the Draft Feasibility Report / Environmental Impact Statement / Environmental Impact Report. Technical studies are focused on refining operations, facility sizes, and facility locations. For the purpose of this initial economic evaluation, a single alternative was selected for analysis. To select this alternative, operational model simulations were performed for two potential reservoir sizes: a 275-thousand-acre-foot (TAF) reservoir and a 400 TAF reservoir (total capacity). These reservoir sizes were selected because they appeared to be most cost effective in previous operational analyses.

Preliminary operational modeling was performed to determine the most efficient Delta intake and conveyance facility sizes associated with the two reservoir expansion options. In these model simulations, the expanded reservoir was operated exclusively to provide EWA replacement supplies via the South Bay Aqueduct (SBA); no deliveries are made from the expanded reservoir to increase SBA or CCWD water supply reliability, and no additional storage space was dedicated to supply reliability. In addition, no operational changes were made specifically to improve water quality. Based on current modeling results and engineering analyses, a 275 TAF (total capacity) reservoir alternative that includes the following major facilities was selected for evaluation in this report:

- Reconstruct the existing Los Vaqueros Dam in-place to create a reservoir with a total capacity of 275 TAF (current reservoir capacity is 100 TAF)
- Expand the existing Old River intake and pumping plant by 170 cubic feet per second (cfs) to a total capacity of 420 cfs
- Construct a new 350 cfs pipeline from the expanded Old River intake to the existing Transfer Facility; this new pipeline would likely parallel the existing 320 cfs pipeline, providing total conveyance of 670 cfs from the Delta to the Transfer Facility
- Replace the existing Transfer Facility balancing reservoir with a larger, 8-million-gallon reservoir
- Construct a new 470 cfs pump station at the Transfer Facility and replace pumps in the existing 200 cfs transfer pump station, for a total transfer capacity of 670 cfs to the expanded reservoir

- Construct a new 670 cfs pipeline from the Transfer Facility to Los Vaqueros Reservoir
- Construct a new 175 cfs pump station and new pipeline to convey water from Los Vaqueros Reservoir to the SBA at the Dyer Canal

The configuration of the alternative selected for evaluation is shown in **Figure ES.2**.

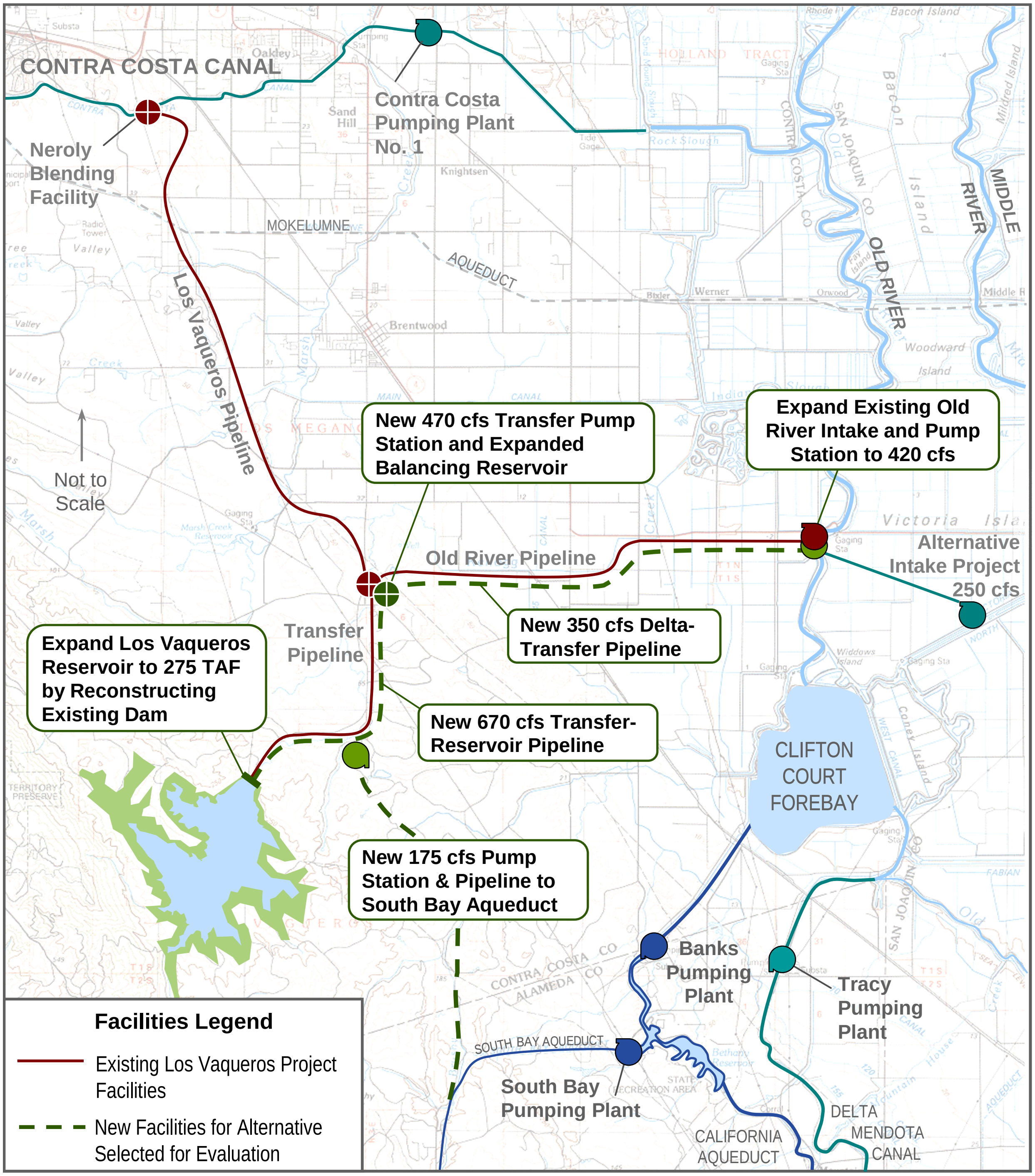

FIGURE ES.2 – ALTERNATIVE EVALUATED IN THIS REPORT

This alternative develops EWA replacement supplies by delivering SWP water supplies to the SBA that would otherwise have been delivered via Banks Pumping Plant and the South Bay Pumping Plant. Space made available at Banks is then used to pump EWA supplies to San Luis Reservoir, for later use by EWA when pumping is curtailed. In this manner, EWA supplies stored in San Luis Reservoir as a result of Los Vaqueros deliveries would replace EWA purchases south of the Delta.

This alternative is being used only for the purpose of preliminary economic analysis in this report to determine if a potentially feasible alternative exists under current formulation parameters.

Future Without-Project Conditions

An important aspect of any economic analysis is establishing appropriate future conditions, both with and without the proposed action. The following summarizes important conditions that are assumed to exist in the future without the LVE:

- The EWA or a similar program continues to purchase water to support pumping curtailments and other actions that promote protection and recovery of at-risk Delta fisheries. The program continues to be funded by both the Federal and State governments and operates/functions similar to the existing program. The program is assumed to use the EWA asset acquisition and management resources identified in the 2000 EWA Operating Principles Agreement, as may be amended, including the following:
    - Storage in existing CVP/SWP reservoirs (as available)
    - Dedicated pumping capacity of 500 cfs (July through September) at Banks Pumping Plant
    - SWP annual carryover debt in San Luis Reservoir of 100 TAF, when available
    - Existing water purchase mechanisms (primarily spot market purchases and short-term transfer agreements)
- The CCWD Alternative Intake Project is constructed and operating with a capacity of 250 cfs (high lift pump station) on Victoria Canal.
- The East Bay Municipal Utility District Mokelumne Aqueduct Intertie with the CCWD Los Vaqueros Pipeline is constructed.
- The South Bay Aqueduct Improvements and Enlargement Project is constructed, increasing the capacity of the SBA to 430 cfs.
- Allowable pumping capacity at Banks Pumping Plant is increased to 8,500 cfs, per the South Delta Improvements Program.

INITIAL ECONOMIC ANALYSIS

The initial economic analysis presented in this report was performed at the concept level (pre-feasibility). Construction is assumed to begin in 2013 and conclude in 2015. The economic benefits and annual operating costs of the project would begin to accrue in 2016, and were analyzed over a 100-year period ending in 2115. The Federal discount rate of 5-1/8 percent was used in this initial economic analysis to adjust the stream of benefits and costs to the base year of 2016. Costs and benefits estimated for the alternative selected for evaluation in this report are summarized below.

Costs

Total implementation cost (including appropriate factors for unlisted items, contingencies, and indirect costs, and interest during construction) and annual operation, maintenance, and replacement costs are summarized in **Table ES.1**.

TABLE ES.1
SUMMARY OF ESTIMATED PROJECT COSTS FOR ALTERNATIVE EVALUATED IN THIS REPORT (2006 PRICES)

Type	Item	Cost[1]
Implementation Costs	Los Vaqueros Dam and Appurtenances	$139,426,000
	Delta Intake, Pumping, and Conveyance to Transfer Facility	$42,669,000
	Transfer Facility Pumping and Conveyance to Reservoir	$76,957,000
	Pumping and Conveyance from Reservoir to SBA	$48,783,000
	Total Field Cost	**$307,835,000**
	Unlisted Items (15%)	$46,176,000
	Subtotal	**$354,011,000**
	Contingency (25%)	$88,503,000
	Total First Cost	**$442,514,000**
	Indirect Costs[2] (25%)	$110,629,000
	Subtotal	**$553,143,000**
	Interest During Construction[3]	$43,746,000
	Total Implementation Cost	**$596,889,000**
Annual Operation, Maintenance, Repair, and Replacements	**Operation and Maintenance**	
	- Dam and Appurtenances	$211,200
	- Delta Intake	$82,500
	- Pipelines	$645,500
	- Pump Stations	$792,000
	- Substations and Transmission Lines	$61,500
	Subtotal	**$1,792,700**
	Net Power[4]	$1,518,000
	Replacements (annualized)	$235,300
	Total Annual OMR&R	**$3,546,100**
	Capital Value of OMR&R	**$70,353,000**
TOTAL COSTS	**Capital Value of All Costs**	**$667,242,000**
	Average Annual Cost over 100 Years	**$34,429,000**

KEY: OMR&R = operation, maintenance, repair, and replacements SBA = South Bay Aqueduct

Notes:
1. *All costs are presented at 2006 price levels.*
2. *Indirect costs include engineering, design, inspection, administration, and legal costs.*
3. *Interest during construction calculated for a 3-year construction period.*
4. *Net power cost represents the difference between pumping costs in the with-project and without-project conditions.*

The estimation of project costs is based on pre-feasibility level engineering and designs. Construction costs are based primarily on the cost to construct the original Los Vaqueros Project facilities, which were completed in 1997.

The unit cost of EWA replacement yield is the estimated average annual cost to develop the project divided by the estimated yield of the project. Estimated average annual EWA replacement yield for the alternative selected for this analysis is about 104.2 TAF per year, resulting in a unit cost of about $330 per acre-foot for this alternative.

Benefits

Benefits of this initial economic evaluation include the following:

- EWA replacement supplies, valued based on the estimated future cost of EWA purchases on the water transfer spot market
- Emergency water supply, valued based on the emergency storage provided by an expanded reservoir in the event of an interruption in imported Delta water supplies
- Improvement in the quality of water supplies delivered to the SBA from the expanded reservoir
- Fishery benefits potentially achieved when SWP supplies for SBA contractors are delivered via the screened Old River Intake instead of the unscreened Banks Pumping Plant

Various economic valuation methods were identified for these benefit categories that are consistent with guidance provided in the 1983 U.S. Water Resources Council *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. Methods used to calculate benefits in this initial economic evaluation, and initial results for the alternative selected for analysis, are summarized below.

EWA Replacement Supplies

Estimation of the value of EWA replacement supplies focused on estimating future prices on the annual water transfer spot market. This analysis found that, in response to increasing water demands and the lack of planned new water supply infrastructure, water users will likely rely increasingly on spot market water transfers to bridge the gap between supply and demand. As early as 2020, traditional sources of spot market water supply may be unable to put more water on the market in response to price signals due to conveyance and contract constraints. If no new water supplies are developed, prices will likely increase at a rate faster than the rate of normal inflation.

Unlike many other commodities subject to supply and demand, there are no substitutes for water and it is essential to life. In addition, an important dynamic of water supplies is that they need to be both temporally and spatially available (water when needed, where needed). Conveyance, hydrology, and storage all limit the temporal and spatial availability of water supplies. Physical and biological constraints are limiting factors in the movement of water through the Delta during certain periods, an occurrence that is likely to intensify in the future as more users enter the transfer market. Furthermore, there are few new water supply projects currently approved, under construction, or in the environmental review phase that would significantly increase the State's water supplies.

While this analysis suggests that the price of water in the spot market will increase over time faster than the rate of inflation, at this initial level of analysis, identifying a precise rate of increase is not recommended. Rather, a reasonable range of potential prices may be identified. Consequently, three possible rates of growth were examined: 0 percent, 1.1 percent, and 2 percent (above inflation). The 1.1 percent growth rate is an interim estimate developed by the CALFED Common Assumptions Economic Workgroup (CAEWG) based on historical EWA purchases. The 0 percent growth rate is presented as a low book end for the purpose of this initial economic evaluation, but this trend is unlikely to occur. A 4 percent growth rate was also examined as a high book end, but is not presented in the benefits analysis. Rather than letting the spot market price increase over time without any limit, prices were constrained by an upper bound reflecting current estimates for the cost of desalting brackish water.

Figure ES.3 illustrates the estimated spot market water price paths given growth rates of 0 percent, 1.1 percent, and 2 percent above inflation, and considering a $1,200 per acre-foot price cap. The weighted average initial price of water used in the analysis is $215 per acre-foot (2006 price levels, 2004 level of development), based on interim values developed by the CAEWG.

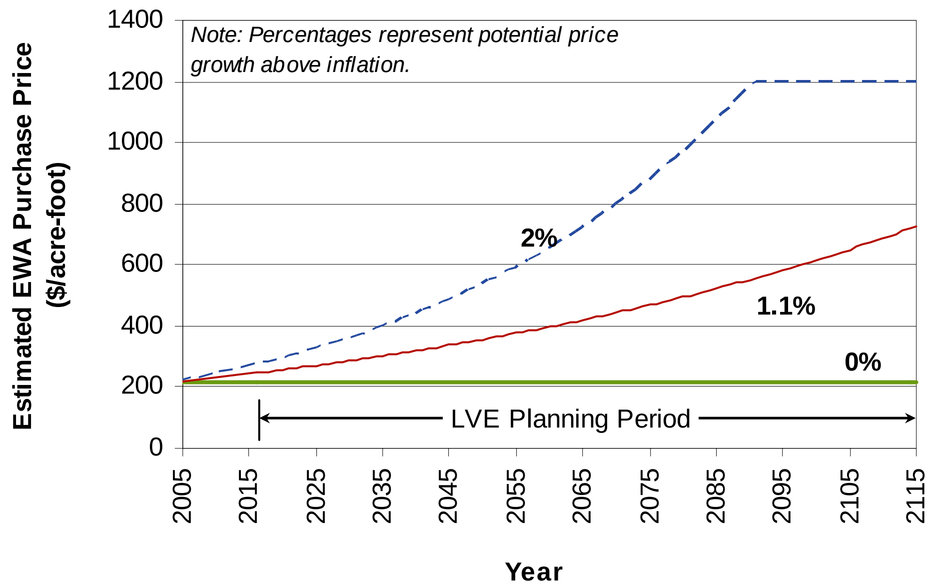

FIGURE ES.3 – CHANGE IN EWA SPOT MARKET PURCHASE PRICE OVER LVE PLANNING PERIOD AT VARIOUS GROWTH RATES, $1,200/ACRE-FOOT PRICE CAP

Other Benefits Evaluated

Preliminary benefits also were estimated for three other potential benefit categories: emergency water supply, water quality, and fishery benefits.

The reservoir expansion alternative selected for evaluation in this report was formulated primarily to provide EWA replacement supplies. Although no yield was dedicated to improving Bay Area water supply reliability, the project would provide emergency supplies in the event of an earthquake or levee failure in the Delta. Consequently, the water supply reliability benefits calculated for the alternative are based solely on preliminary estimates of the value of these emergency supplies.

Emergency storage benefits are the value of supplies stored in Los Vaqueros Reservoir in the event of a major levee failure in the Delta that would significantly degrade water quality, or a major earthquake in the San Francisco Bay Area (Bay Area) that would disrupt the ability of Bay Area water agencies to import water into their service areas. The amount of water available for emergency purposes is estimated as the average reservoir storage with the expanded reservoir, less the average storage without the expansion, or 143,400 acre-feet for the alternative evaluated. For the purpose of this initial economic evaluation, the value of this water during an emergency was conservatively estimated to be $1,700 per acre-foot (2006 prices). Based on work by others, the combined probability of an earthquake or levee emergency occurring is estimated as once in every 50 years, or a 2 percent chance in any year. Using these values, the economic benefit of additional water stored in an expanded Los Vaqueros Reservoir was estimated to be $5.0 million per year (2006 prices). Further analysis is needed to better quantify the economic value of emergency supplies.

Water quality benefits result from improvements to the water quality of municipal supplies. These improvements fall into three categories: (1) lower consumer costs associated with changes in total dissolved solids (TDS) and total hardness (TH), (2) lower groundwater management costs by recharging the local groundwater basins with lower TDS water, and (3) lower water treatment costs by delivering water with lower turbidity, total organic carbon, and bromides. These cost savings were estimated for agencies receiving water from the SBA. Categories of consumer cost savings considered in the analysis include reduced bottled water purchases, longer life of household appliances and plumbing, less use of home water softeners, and reduced purchases of detergents. These benefits accrue when water supplies with lower TDS and TH are delivered to households served by water treatment plants that receive water from the SBA. Economic benefits from lower groundwater basin management costs were estimated as the avoided cost of additional treatment prior to recharge, or about $22 per acre-foot recharged. Savings in water treatment plant operating costs were not estimated as part of this evaluation. The average annual water quality benefits of the alternative evaluated in this report are estimated to total about $5.53 million per year.

Water delivered to the SBA from Los Vaqueros Reservoir would be diverted from the Delta through modern, state-of-the-art fish screens similar to the existing fish screens at CCWD's Old River intake and pumping station. Currently, water delivered to the SBA passes through Clifton Court Forebay, which is not equipped with modern, positive-barrier fish screens. The economic benefit of diverting water through a screened intake versus an unscreened intake could be valued in several ways. For the purpose of this initial economic analysis, a nonmarket valuation approach based on the fish and wildlife mitigation charge for CVP contractors was used. This charge, established through the Central Valley Project Improvement Act to fund restoration projects, is currently $16 per acre-foot for CVP municipal and industrial contractors. Applying this nonmarket valuation to the average annual EWA supply of 104,200 acre-feet developed by the alternative under evaluation would result in an annual economic benefit of about $1.71 million. Further analysis is needed to better define the nature of potential fishery benefits and the methods to value the benefits, if appropriate.

Preliminary Comparison of Benefits and Costs

Table ES.2 summarizes estimated benefits and costs for the alternative evaluated in this report. Based on the initial economic analysis, this alternative appears to be economically feasible, resulting in average annual positive net benefits between about $0.37 million and $22.30 million (annual), and with a ratio of average annual benefits to costs between about 1.01 and 1.65.

TABLE ES.2
SUMMARY OF AVERAGE ANNUAL ECONOMIC EFFECTS

		2006 Prices ($ millions)[1]		
		0% Real Price Escalation[4]	**1.1% Real Price Escalation**	**2% Real Price Escalation**
Costs	**Total Annual Costs[2]**	**(34.43)**	**(34.43)**	**(34.43)**
Benefits	EWA Replacement Supplies	22.56	32.31	44.49
	Water Supply Reliability	0.00	0.00	0.00
	Emergency Water Supply	5.00	5.00	5.00
	Bay Area Water Quality	5.53	5.53	5.53
	Fishery Benefits[3]	1.71	1.71	1.71
	Total Annual Benefits	**34.80**	**44.55**	**56.73**
Net Benefits	**Net of Annual Costs & Benefits**	**0.37**	**10.12**	**22.30**
	Ratio of Annual Benefits to Costs (B:C)	**1.01**	**1.29**	**1.65**

Notes:

1. *Values reflect 2006 price levels with the exception of EWA benefits (which have been escalated based on a range of potential growth rates above inflation, then discounted back using the Federal discount rate of 5-1/8 percent). A $1,200 per acre-foot price cap was applied (corresponding to the cost to desalinate brackish water supplies).*
2. *Total annual costs include implementation (construction cost with unlisted items and contingencies, interest during construction, and engineering, administration, and legal costs), operation and maintenance, power, and major replacements.*
3. *Further analysis is needed to better define the nature of potential fishery benefits and the methods to value the benefits, if appropriate.*
4. *The 0 percent growth rate is presented as a low book end for the purpose of this initial economic evaluation, but this trend is unlikely to occur based on a preliminary assessment of supply and demand conditions affecting the spot market. A 4 percent growth rate was also examined as a high book end, but is not presented in the table because the lower growth rates resulted in positive net benefits.*

Uncertainties

Uncertainty and variability are inherent in water resources planning. For this initial economic analysis, key areas of uncertainty relate to the following:

- The rate of growth in water transfer prices, and the extent to which these prices may or may not reflect the opportunity cost of the water supply in other uses, is uncertain and requires further analysis.

- The continued presence of the EWA or similar program in the future is uncertain, including the level of Federal participation in such a program. To date, the EWA has predominantly benefited the SWP by maintaining reliable supplies to SWP contractors.
- Operations modeling results used in this initial economic analysis used the stand-alone CALSIM-II operations model. Future analyses using the integrated CALSIM-II model, under development by the CALFED Common Assumptions group, will allow assessment of how an expansion of Los Vaqueros might affect other Central Valley water management operations. This may lead to refinements in reservoir operations and adjustments in yield.
- Existing and potential future Delta pumping and export constraints (biological opinions, export/import ratio restrictions, future restoration actions, etc.) could affect ability to fill the expanded reservoir or increase the cost to achieve the same benefits. Adaptive management and operational flexibility should be assessed in future analyses.
- Water quality delivered to the SBA generally increases for the alternative selected for evaluation in this report. Future model runs will investigate operation methods to mitigate potential seasonal fluctuations in delivered water quality.
- The cost estimates used in this initial economic analysis are based on appraisal-level engineering and designs. Consequently, conservative factors were applied to account for unlisted items and contingencies. Detailed engineering and design work is needed to refine the cost estimates.
- Numerous factors exist that could potentially impact future water demands, supplies, and scarcity, and could affect operation of the State's water management system. All of these factors have the potential to influence prices on the water transfer spot market.

FINDINGS

This initial economic analysis indicates that feasibility-level studies for the LVE should continue, progressing toward the identification of a plan to be recommended for implementation in a Feasibility Report with accompanying environmental documentation.

The alternative selected for analysis in this report would involve rebuilding the existing Los Vaqueros Dam in-place to create a reservoir with a total capacity of 275 TAF, in combination with a 170 cfs increase in Delta pumping and conveyance and construction of a 175 cfs delivery pipeline from the reservoir to the SBA. Based on the initial economic analysis, this alternative appears to be economically feasible, resulting in average annual positive net benefits between about $0.37 million and $22.30 million (annual), and with a ratio of average annual benefits to costs between about 1.01 and 1.65. This conclusion is preliminary, and may be revised after a more thorough evaluation of project benefits and costs for the feasibility study. Specifically, use of a market price estimation approach for EWA benefits may or may not reflect the opportunity cost of the water supply in other uses.

Federal interest appears to exist in the development of EWA replacement supplies. Assuming this Federal interest is confirmed, it is possible that some portion of the project could be financed by the Federal Government. While some Federal costs may be non-reimbursable, the majority of costs could be assumed to consist of both reimbursable Federal costs, and non-Federal costs. Additional work is required to complete the cost allocation.

The alternative selected for analysis in this report appears to be economically feasible, and it is not necessary to consider adding project objectives to develop an economically feasible project. Plan formulation efforts should continue to develop alternatives focused on less-costly EWA replacement supplies and Bay Area water supply reliability, while considering the effect of study assumptions and formulation constraints on such alternatives.

FUTURE ACTIONS

Future plan formulation efforts will focus on refining, evaluating, and comparing alternative plans for display in the Feasibility Report. These efforts should include the following activities:

- Identify potential project participants and the financial responsibilities of Federal and non-Federal sponsors; specifically, determine how EWA costs could be shared between the Federal Government and non-Federal cost-sharing sponsor(s)
- Determine project ownership, operation, and maintenance arrangements
- Identify potential water rights issues associated with an expansion project
- Identify any additional elements or requirements of a locally preferred plan
- Identify a recommended alternative for display in the Feasibility Report

Future economic analyses will likely focus on confirming the valuation methodology and refining the estimate of project costs and benefits. Sensitivity analysis of key variables can provide an indication of how the economic analysis results could change given different assumptions. Based on preliminary estimates, it is recommended that future economic analyses include sensitivity analysis of the following variables:

- Inflation and potential changes in the real growth of water prices over time
- Key demand and supply factors influencing the price of water on the spot market
- Hydrologic variability

Future economic analyses also should evaluate the potential economic tradeoffs between formulating alternatives to provide EWA replacement supplies versus improving Bay Area water supply reliability. In addition, a more thorough estimate of other potential benefit categories and associated methods, including emergency water supply and fishery benefits, is required for feasibility.

Future operations analysis, engineering, and design work is needed to refine facility operations, configuration, size, and cost. These activities should include the following:

- Use the integrated CALSIM-II Common Assumptions Model Package to simulate alternative plans and refine operations for the recommended alternative

- Continue to evaluate both moderate (up to 275 TAF total capacity) and larger (up to 500 TAF total capacity) reservoir expansion opportunities
- Assess hydrodynamic impacts in the Delta, including Delta water quality
- Evaluate sensitivity of CALSIM-II modeling results to various input parameters
- Develop feasibility-level designs and costs for a recommended alternative; specifically, refine facility layouts and configurations, including a potential connection to the SBA

CHAPTER 1
INTRODUCTION

This chapter provides background information on the Los Vaqueros Expansion Investigation (LVE), including the purpose, scope, and organization of this document.

BACKGROUND

Contra Costa Water District (CCWD) is the owner and operator of the Los Vaqueros Project. The existing Los Vaqueros Project includes a 100,000-acre-foot offstream reservoir, intake and pump station at Old River in the eastern Sacramento – San Joaquin Delta (Delta), and transmission pipelines to the reservoir and to the Contra Costa Canal. The dam and reservoir are located within an 18,500-acre watershed owned and maintained by CCWD. The project was completed in 1996 at a total cost of $450 million, financed with local revenue bonds. The primary purposes of the existing project are to improve water quality and provide emergency storage.

In 2001, the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), and CCWD began appraisal-level studies of the potential to expand Los Vaqueros Reservoir to address regional water quality and supply reliability needs. Expansion of Los Vaqueros was one of five potential surface water storage projects identified by the CALFED Bay-Delta Program (CALFED) as warranting further study. Appraisal-level studies indicated that expanding the reservoir by as much as 400,000 acre-feet was technically feasible and could provide water quality and supply reliability to agencies in the region, as well as providing potential benefits to fisheries sensitive to water management operations in the Delta.

Reclamation was directed in Public Law (PL) 108-7 (Omnibus Appropriations Act of 2003) to conduct a feasibility-level investigation of the potential expansion of Los Vaqueros Reservoir. Reclamation and DWR are the Federal and State agencies conducting the investigation, respectively. CCWD, as owner of the existing Los Vaqueros Project, also has an integral role in the LVE, and has worked under contract to DWR and Reclamation to perform engineering studies and environmental review.

LOS VAQUEROS RESERVOIR

CCWD stores water in Los Vaqueros Reservoir that is diverted from the Delta when water quality is favorable, for later release and blending when Delta water quality is poor. The 100,000-acre-foot reservoir also provides important emergency water supply storage and, as secondary benefits, recreation and flood control.

Initial results of the first phase of the LVE were described in the *Initial Alternatives Information Report* (IAIR) of September 2005 (CALFED, 2005b). The IAIR identified technically feasible alternatives to meet project objectives within established criteria and constraints, but did not examine the economic feasibility of a project to expand Los Vaqueros Reservoir.

Study Area

The study area includes the Los Vaqueros Reservoir watershed and associated project facilities, the central and south Delta, and service areas of San Francisco Bay Area (Bay Area) water agencies that may choose to participate in an expansion project. The location of the study area is shown in **Figure 1.1**.

Los Vaqueros Reservoir is located in the Kellogg Creek watershed of Contra Costa County, California, in the foothills west of the Delta and east of the Bay Area. Los Vaqueros Project facilities and other relevant Delta facilities are shown in **Figure 1.2**.

FIGURE 1.1 - STUDY AREA

Mission Statement

The LVE has the following mission:

> *The purpose of the Los Vaqueros Expansion Investigation is to identify and evaluate opportunities to increase drought period water supply reliability for municipal and industrial water providers in the Bay Area; provide a less costly water supply to facilitate Environmental Water Account fish protection and recovery actions in the Delta; and, to the extent possible through exploring these opportunities, improve the quality of water delivered to Bay Area municipal and industrial water users.*

PURPOSE AND SCOPE OF DOCUMENT

This report is not a Federal decision document and is not suitable for seeking Congressional authority to construct the project. The purpose of this initial economic evaluation is to provide information on study progress primarily in two key areas: economics and plan formulation.

This report will identify potential project benefits and describe methods available to estimate their monetary value. For the purpose of this initial economic evaluation, a single alternative will be selected for analysis; project benefits and costs for this alternative will then be estimated and compared. Based on these findings, an assessment will be made regarding whether an expansion of Los Vaqueros Reservoir is likely to be economically feasible. Selection of the alternative for evaluation in this report does not represent the identification of a recommended or preferred alternative for display in a Feasibility Report or for consideration by Congress.

A focus of the report is on economics related to one of the LVE primary objectives, to provide a less costly water supply for a long-term Environmental Water Account (EWA). Established by CALFED in 2001, the EWA facilitates pumping curtailments in the south Delta and other changes to Central Valley Project (CVP) and State Water Project (SWP) operations to protect at-risk fisheries. To date, the short-term EWA has relied on transfer market water purchases and short-term transfer agreements to secure water supplies for EWA actions.

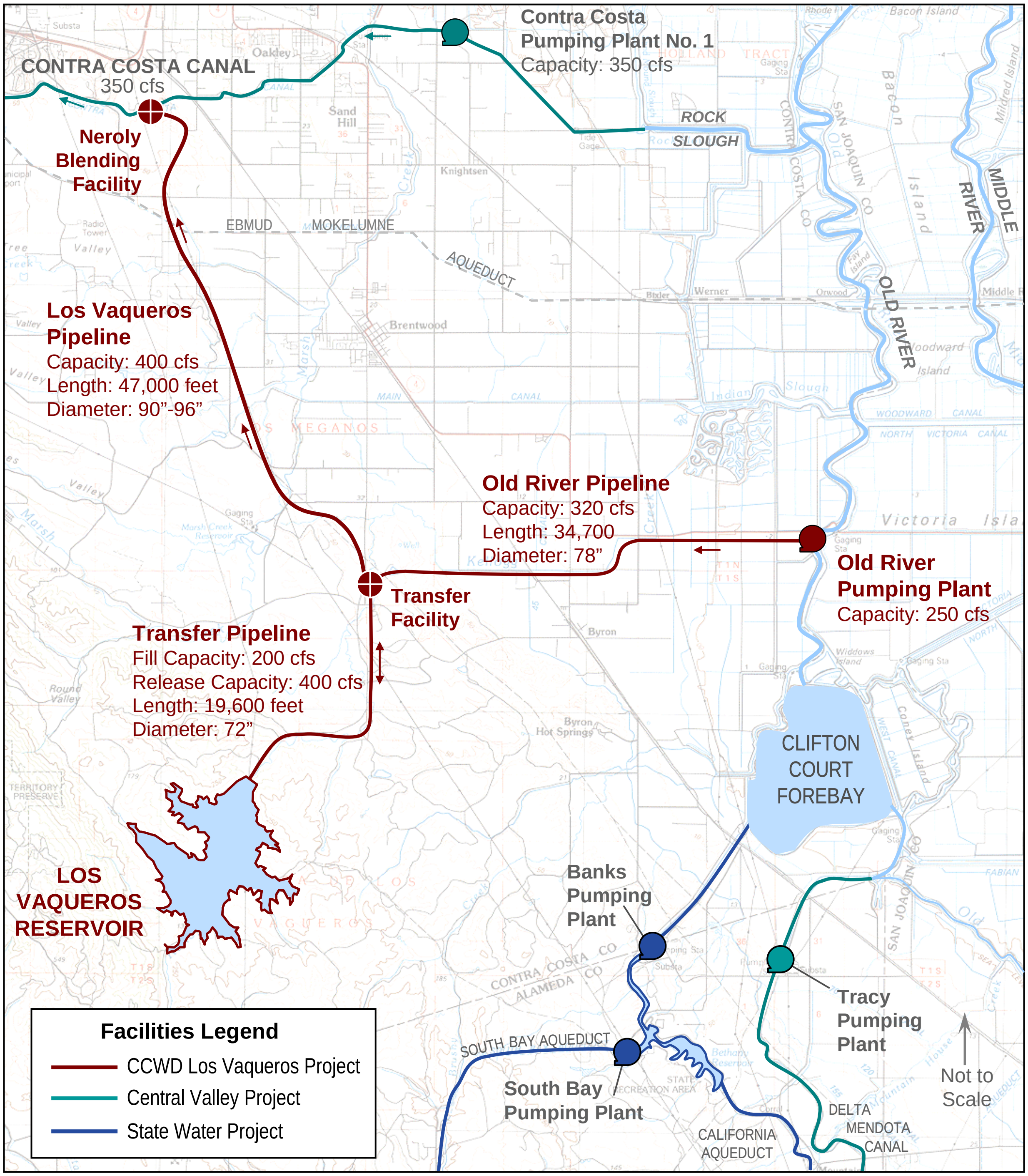

FIGURE 1.2 – LOS VAQUEROS PROJECT AND OTHER DELTA FACILITIES

A key future without-project condition for the study is that some form of the EWA will continue in the future with a primary focus on offsetting water delivery reductions resulting from regulatory actions that curtail Delta pumping to protect at-risk fish. However, a great deal of uncertainty exists regarding the cost of water for programs such as the EWA in the future. Because all of the CALFED surface storage projects have been asked to examine how they might contribute to a long-term EWA, the CALFED Common Assumptions Economic Workgroup (CAEWG) is evaluating future transfer market water costs. CAEWG analyses are ongoing.

This document also will examine Federal economic principles and potential methods for calculating project benefits and allocating project costs to those benefits. Various methods are available to estimate or quantify the water supply reliability and quality benefits provided by the alternatives under consideration in the LVE. Methods for calculating project benefits and evaluating contributions to National Economic Development (NED) are identified.

This document also will highlight key issues affecting plan formulation. Ongoing feasibility studies for the LVE have identified new ways to formulate, configure, and operate an expansion project that differ from scenarios previously studied.

ORGANIZATION OF THIS DOCUMENT

This report is organized as follows:

- This chapter provides general background information on the current investigation.
- **Chapter 2** summarizes alternatives formulation for the LVE, including study objectives, criteria, constraints, and project baselines.
- **Chapter 3** describes Federal economic principles and recommends methods for calculating project benefits and identifying the plan that maximizes NED.
- **Chapter 4** examines the future cost of water transfers over the 100-year LVE planning horizon.
- **Chapter 5** provides a preliminary comparison of potential project benefits and costs.
- **Chapter 6** presents a method for allocating project costs to Federal and potential non-Federal sponsors.
- **Chapter 7** summarizes findings.

CHAPTER 2
SUMMARY OF ALTERNATIVES FORMULATION

This section summarizes the results of plan formulation efforts to date, including the identification of planning objectives, criteria, and constraints; project baselines; and the LVE plan formulation approach.

PLANNING OBJECTIVES

LVE study objectives were developed based on identified problems and opportunities in the study area and specific direction in the study authorization, and are consistent with the Federal *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G)(WRC, 1983) and other Reclamation guidance.

The three objectives identified for the LVE focus on using an expanded Los Vaqueros Project to accomplish the following:

- *Increase drought period water supply reliability for municipal and industrial water providers within the study area.*
- *Develop a less costly replacement water supply for the long-term Environmental Water Account.*
- *To the extent possible through pursuit of the water supply reliability and Environmental Water Account replacement supply objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

The planning objectives help clarify the identified problems and opportunities and narrow the focus of study efforts. Although the objectives focus on enlarging Los Vaqueros Reservoir, this has not limited which measures or alternatives should be considered to address each of the objectives.

The first study objective speaks to the need to improve Bay Area water supply reliability during drought periods, when water supplies for urban uses are needed most. During recent droughts, Bay Area water agencies have experienced substantial cutbacks in water supplies despite aggressive conservation programs, storage in local reservoirs and groundwater basins, and water transfers. Shortages in dry and critically dry years are expected to increase in the future, while competition for the State’s finite water supplies will intensify and affect the ability of Bay Area water providers to acquire water on the open market to supplement their local and contract supplies. An increasing need remains to improve dry-year water supply reliability for Bay Area providers and the State as a whole, particularly into the future beyond 2020.

The second planning objective directs the study to determine whether an expansion of Los Vaqueros Reservoir could provide a less costly water supply for the EWA. Such a supply would replace all or a portion of the water the EWA currently acquires through transfer market water purchases.

Although not a specific LVE objective, an expanded Los Vaqueros Reservoir also could provide dedicated storage and conveyance capacity for EWA water supplies. The EWA currently relies on surplus storage space in reservoirs such as San Luis Reservoir, and available pumping capacity at Banks and Tracy pumping plants to move EWA water south of the Delta. An expansion project also could provide the opportunity for the EWA to divert Delta supplies via more efficient screened intakes, further reducing impacts to Delta fisheries.

The last objective highlights the opportunity to improve delivered water quality while addressing the objectives of water supply reliability and EWA replacement supply. This objective does not direct the study to identify ways to improve delivered water quality independent of the first two objectives; rather, alternatives formulated to address the first two study objectives could be refined, modified, and/or enhanced, as appropriate, to improve the quality of delivered water supplies from the project.

CRITERIA AND CONSTRAINTS

Fundamental to the plan formulation process is identifying and developing basic constraints specific to this investigation. Major constraints in formulating and ultimately implementing a plan to address LVE study objectives include study authorization and applicable laws, regulations, and policies. Other considerations in the planning process include the CALFED Record of Decision (ROD) (CALFED, 2000b) and the CCWD Board of Director's Principles of Participation. Criteria and constraints related to Federal study guidance and CCWD's Principles of Participation are described below.

Federal Study Guidance

The Omnibus Appropriations Act of 2003 authorized the Secretary of the Interior when carrying out CALFED-related activities to undertake feasibility studies for enlarging Los Vaqueros Reservoir. Congress restated authorization for the Secretary to conduct planning and feasibility studies for enlarging Los Vaqueros Reservoir in the October 2004 Water Supply, Reliability, and Environmental Improvement Act (PL 108-361).

The CALFED ROD includes program goals, objectives, and projects primarily to benefit the San Francisco Bay/Sacramento – San Joaquin River Delta system. The multiagency adoption of the ROD recognized that each agency would exercise its respective authority over only those portions of the ROD relevant to its existing Federal or State authority. While signatories may individually support programs and planning consistent with their specific authorities, it is believed that all projects, especially those directly affecting the Delta, should be in harmony with the ROD and the Preferred Program Alternative it supports.

CCWD Principles of Participation in LVE

The CCWD Board of Directors' Principles of Participation and voter approval represent an agreement between one of the potential non-Federal sponsors and its constituents. The CCWD Board of Directors on April 19, 2000, adopted seven principles to inform and guide identification of a locally supportable project involving the expansion of Los Vaqueros Reservoir:

"Contra Costa Water District will not support a proposal involving the existing Los Vaqueros Project or use of the Los Vaqueros or Kellogg reservoir sites without the following assurances:

- The project improves water quality and reliability for CCWD
- The project enhances the Delta environment
- The project protects and enhances the fisheries and terrestrial species benefits provided by the existing Los Vaqueros Project
- The project preserves and increases the recreation opportunities of the Los Vaqueros Project
- CCWD must retain control of the watershed and operation of the reservoir
- The project protects and reimburses the financial investment made by the CCWD customers, who financed the existing $450 million Los Vaqueros Project
- The proposal would be placed before the voters of the Contra Costa Water District"

On June 25, 2003, the Board adopted Resolution No. 03-24, in which the Board found that "the District will not participate in or support the CALFED Bay-Delta Program proposal for expansion of Los Vaqueros Reservoir unless the Board determines that the CALFED Bay-Delta Program proposal meets the following conditions:

1. Improves drinking water quality for CCWD customers beyond that available from the existing Los Vaqueros Project;
2. Improves the reliability of water supplies for CCWD customers during droughts;
3. Enhances Delta habitat and protects endangered Delta fisheries and aquatic resources by installing state-of-the-art fish screens on all new intakes and creating an environmental asset through improved location and timing of Delta diversions and storage of water for environmental purposes;
4. Increases the protected land and managed habitat for terrestrial species in the Los Vaqueros Watershed and the surrounding region;
5. Improves and increases fishing, boating, hiking, and educational opportunities in the Los Vaqueros Watershed, consistent with the protection of water quality and the preservation of the watershed and the watershed's unique features;
6. CCWD continues as owner and manager of the Los Vaqueros Watershed;
7. CCWD maintains control over recreation in the Los Vaqueros Watershed;
8. CCWD continues as operator of the Los Vaqueros Reservoir system;
9. CCWD will be reimbursed for the value of the existing Los Vaqueros Project assets shared, replaced, rendered unusable or lost with the expansion project and said reimbursement will

be used to purchase additional drought supply and water quality benefits or reduce debt on the existing Los Vaqueros Project;

10. Water rates for CCWD customers will not increase as a result of the expansion project."

In accordance with the CCWD Principles of Participation, continued participation in the LVE was brought before CCWD voters in Measure N and approved on March 2, 2004. Hence, the language of the ballot measure, provided below, has also been observed for study purposes.

> *Shall Contra Costa Water District work with public water agencies to expand Los Vaqueros Reservoir, at no cost to District ratepayers, to: (1) increase water supplies for drought protection; (2) improve drinking water quality; and (3) protect endangered fish in the Delta, on condition that: (a) CCWD water rates will not increase; (b) no water will be exported to Southern California or a peripheral canal; and (c) CCWD will still operate the expanded reservoir?*

The CCWD Principles of Participation provide insight into the conditions under which CCWD would be willing to participate in an expansion project. Elements of the principles of particular importance to plan formulation include facility ownership and operations, and no export of water developed by the project to Southern California.

PROJECT BASELINES

Representative existing and future project baselines are under development for the LVE consistent with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). Predicting future changes to the physical, biological, social, and economic environments in the study area is complicated by ongoing programs and projects, including those related to CALFED, the CVP, and SWP. Although they may not yet meet the conditions generally required for projects to be included in the NEPA No Action Alternative and/or CEQA No Project Alternative (authorized, funded, and permitted, or under construction at this time), some of these projects are likely to be implemented over the 100-year LVE planning horizon.

Major assumptions and potential projects that could affect conditions in the primary study area, and planning efforts for the LVE, include the following:

- **Long-Term EWA Environmental Impact Statement / Environmental Impact Report -** An important without-project condition is that the EWA, or a similar water acquisition program, will continue into the long-term future. The EWA program received authorization through 2010 under the Water Supply, Reliability, and Environmental Improvement Act (2004), and the corresponding Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) (currently under preparation) is evaluating a planning horizon through 2030. However, it is likely that CVP and SWP pumping at Banks and Tracy will increase in the future to meet south-of-Delta demands, resulting in greater impacts to Delta fisheries and water quality and the potential for more frequent pumping curtailments. Consequently, the EWA, or a similar program, will likely continue in the long-term future to promote fish recovery without interrupting deliveries to south-of-Delta and Bay Area water users.

However, it is unclear at this time whether a long-term EWA would operate comparably to the current, short-term program. Currently, the EWA relies primarily on short-term water transfers to provide water for EWA actions, but the long-term EIS/EIR is considering other measures to make up water supplies interrupted by pumping curtailments. These may include additional water use efficiency (agricultural and/or urban) and conservation measures, desalination, or surface storage. The long-term EWA EIS/EIR is scheduled for completion in fall of 2007.

- **CVP/SWP Operations Criteria and Plan –** Numerous actions contained in the 2004 revision to the 1992 Operations Criteria and Plan (OCAP) may be implemented to address how the CVP and SWP will operate in the future as new projects come online and as water demands increase. These new actions were included in OCAP for the purpose of pre-consultation, and have not undergone environmental review and approval. This includes increasing south Delta pumping at Banks to 8,500 cubic feet per second (cfs) as part of the South Delta Improvements Program (SDIP).
- **South Delta Improvements Program –** Reclamation and DWR are responsible for implementing the SDIP. The proposed project under the SDIP has a physical/structural component and an operational component. The physical/structural component incorporates dredging and the installation of permanent, operable gates at four locations in the south Delta. The operational component addresses increasing the allowable SWP Delta export limit to 8,500 cfs during certain periods. The Final EIS/EIR, and the associated ROD and Notice of Determination, will decide upon the physical/structural component only. A subsequent public process is planned to address the operation component. An order recently passed by the State Water Resources Control Board (SWRCB) requires Reclamation and DWR to remove a threat of not complying with water quality standards in the south Delta by July 1, 2009. The physical/structural components of the SDIP are the means for meeting this order, and to meet the deadline, the ROD/Notice of Determination must be issued in August 2006. A strong likelihood exists that both the physical/structural and operational components will be implemented during the LVE planning horizon.
- **Freeport Regional Water Project –** The Freeport Regional Authority (comprising the Sacramento County Water Agency and East Bay Municipal Utility District (EBMUD)), in coordination with Reclamation, is developing a joint regional water supply project involving construction of a new Sacramento River intake near Freeport. A Final EIS was filed and an EIR was certified in April 2004. As part of this project, CCWD is implementing an intertie between the EBMUD Mokelumne Aqueduct and the CCWD Los Vaqueros Pipeline, which will enable up to 3,200 acre-feet of CCWD’s water to be diverted from the new Freeport intake. The Mokelumne-Los Vaqueros Pipeline intertie (scheduled to begin operating by 2007) is being considered in engineering and planning studies for the LVE.
- **Alternative Intake Project –** CCWD and Reclamation are evaluating the benefits of a new intake in the central Delta to protect and improve water quality for CCWD’s customers by accessing better source water quality. The proposed action could include a new intake and fish screen, pumping plant, and associated pipeline from the new intake to CCWD’s Old River Pumping Plant. A Draft EIS/EIR for the project was released in May 2006. LVE engineering and planning studies are considering how an expansion project could operate in conjunction with the Alternative Intake Project (AIP).

CALFED Common Assumptions Process

Efforts are underway primarily by Reclamation and DWR to establish a series of Common Assumptions for use in developing each of the CALFED storage projects. These Common Assumptions would be used to develop without-project conditions, a critical element in the plan formulation process. The various Common Assumptions workgroups are meant to establish recognized baseline conditions, including (1) period of analysis, (2) evaluation levels (for existing and future conditions), (3) water supply demands, (4) water supply system facilities and operations, (5) regulatory standards, including minimum flow and temperature requirements, and (6) likely foreseeable actions. The primary analytical tool being used for establishing baseline assumptions for water supply budgeting is the joint Reclamation/DWR simulation model for the CVP/SWP system, or CALSIM-II. This mathematical model also is used for studying water supply impacts of various potential alternative system operations and project modifications. In addition, CALSIM-II is used in conjunction or coordination with other models and tools to perform analyses related to the storage programs, including the following:

- DWR's Delta Simulation Model (DSM2) is used in conjunction with CALSIM-II to evaluate water quality conditions in the Delta under existing and future conditions.
- Reclamation's Central Valley Production Model (CVPM) is an economic model that estimates market prices for California crops, accounting for crop production costs in different areas of the Sacramento and San Joaquin valleys and water supply availability.
- DWR's Least Cost Pricing Simulation Model (LCPSIM) estimates municipal and industrial water (M&I) supply costs.

These are some of the tools available to the LVE and other CALFED storage project investigations. The Common Assumptions Economic Workgroup (CAEWG) has proposed using CALSIM-II, CVPM, and LCPSIM to help identify the cost of future EWA water supplies. Work on this methodology is ongoing; initial results of the CAEWG are included in the economic analysis in this report, as appropriate.

PLAN FORMULATION

The planning process for the LVE, which is consistent with the Federal P&G, was separated into three major phases:

- **Initial Plans Phase** (documented in the September 2005 IAIR (CALFED 2005b)) – Identify without-project future conditions; define resulting resource problems and opportunities; define a specific set of planning objectives; identify the constraints and criteria in addressing the planning objectives; identify potential resource management measures to address planning objectives; and formulate, coordinate, and compare a set of concept plans. From these concept plans, identify a set of initial alternatives for further development in the next phase of the study.
- **Alternative Plans Phase –** From the initial alternatives, formulate specific alternative plans to address the planning objectives; evaluate, coordinate, and compare the plans; and identify a plan for tentative recommendation.

- **Recommended Plan Phase –** Complete the development of a tentatively recommended plan and prepare, coordinate, and process supporting decision documentation.

The IAIR documented the formulation of a set of initial alternatives to address the planning objectives identified for the LVE. The planning approach for this initial phase of the feasibility study was not to develop an exhaustive list of alternatives or to optimize outputs; rather, the purpose was to (1) explore the range of different strategies to address the planning objectives, constraints, and criteria and (2) identify plans that may warrant further development into more detailed, comprehensive alternatives.

This report provides an interim update of progress on the current phase of the LVE, the Alternative Plans Phase. This phase of the study focuses on formulating and evaluating more complete or comprehensive alternative plans, from which a plan will be tentatively selected for implementation.

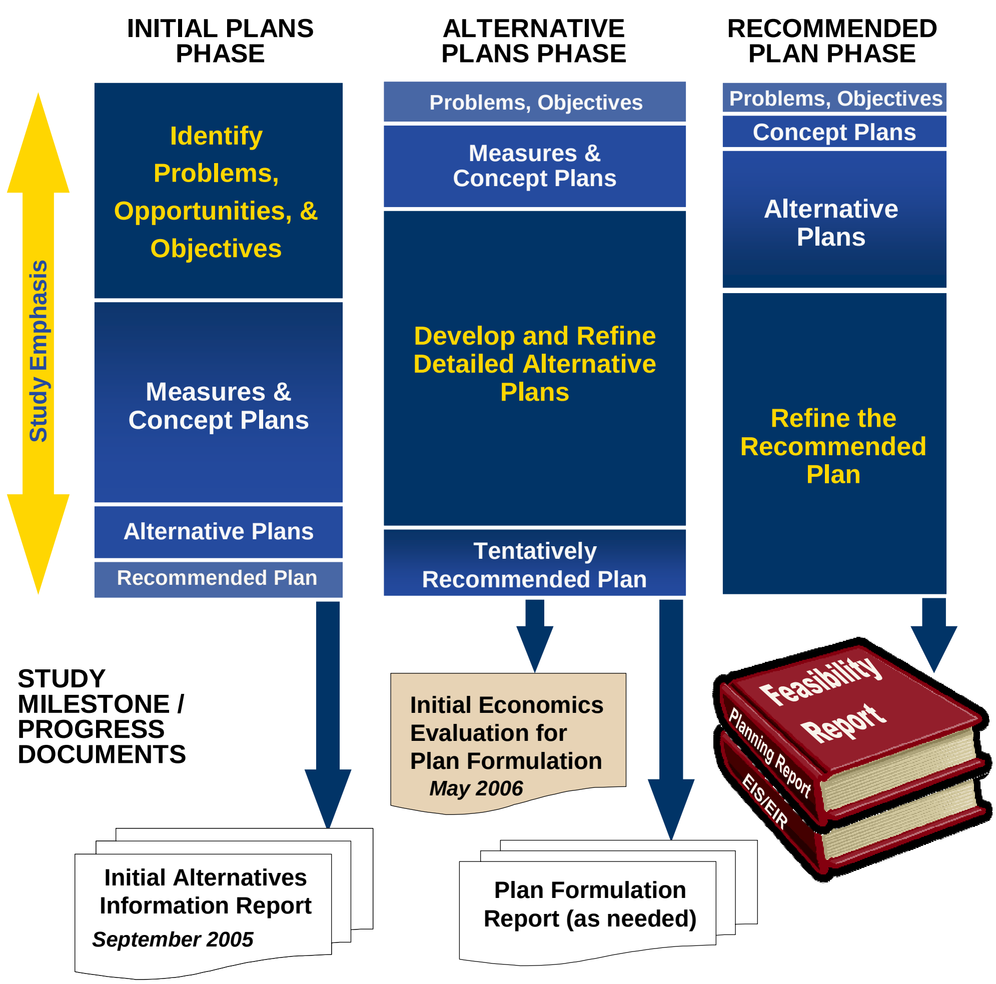

FIGURE 2.1 – LVE FEASIBILITY STUDY PHASES

In the final phase of the study, the Recommended Plan Phase, the tentatively recommended plan would be developed to a feasibility level in terms of engineering and designs, environmental impacts and mitigation, economics, and implementation. The recommended plan would be displayed in the Draft Feasibility Report and accompanying environmental documentation (EIS/EIR), for public review and comment.

Concept Plans Considered

Over 30 measures were identified in the IAIR to address the planning objectives of the LVE; based on their ability to address the objectives consistent with the criteria and constraints, several measures were selected for further consideration and potential inclusion in concept plans. These included the following:

- Enlarging Los Vaqueros Reservoir by raising the existing dam 10 to 15 feet (in-place) to achieve about 25,000 acre-feet of additional storage
- Enlarging Los Vaqueros Reservoir by construction of a new dam to achieve up to 400,000 acre-feet of additional storage
- Increasing Delta water diversion capacity
- Constructing a new delivery pipeline from Los Vaqueros Reservoir to the South Bay Aqueduct (SBA), tying in to either Bethany Reservoir or the Dyer Canal segment of the SBA
- Desalination
- Reoperating an expanded Los Vaqueros Reservoir to improve delivered water quality

Eight concept plans were formulated from the retained management measures, representing an array of different strategies to address the planning objectives. The concept plans are not considered complete alternative plans for various reasons, but primarily because facility sizes have not been refined and specific impacts and mitigation measures have not been identified.

The concept plans were compared against four general criteria: completeness, effectiveness, efficiency, and acceptability. Because many potential combinations of facility sizes (reservoir and pump station capacity, for example) exist, the comparison primarily considers the combination of measures and facilities represented by each plan, with the assumption that appropriate facility sizes will be refined in future studies. Based on this comparison, and the ability of plans to address LVE study objectives, the No Action plan and seven concept plans were identified in the IAIR for further consideration as initial alternatives in the LVE, and one plan that was not carried forward:

- **Concept Plan 1 - Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability –** This plan includes a small raise (15 to 20 feet) of the existing dam to create an additional 25 thousand acre-feet (TAF) of storage, which would be operated primarily to provide Bay Area supply reliability benefits.
- **Concept Plan 2 - Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability –** This plan includes reconstruction of Los Vaqueros dam to form a new reservoir with 300 TAF to 500 TAF total capacity, and construction of a new delivery intertie from the reservoir to the SBA Dyer Canal. It would be operated primarily for Bay Area water supply reliability, while providing some EWA replacement supplies.

- **Concept Plan 3 - Desalination with Storage for Bay Area Water Supply Reliability –** This plan focused on increasing water supply reliability through construction of a regional desalination facility in the Bay Area that would operate in conjunction with an expanded Los Vaqueros Reservoir. Desalinated supplies in excess of base demands would be stored in the reservoir for later delivery to Bay Area water users during dry periods. This concept plan was not carried forward as formulated, although desalination was retained as a potential measure for further consideration.
- **Concept Plan 4 - Enlarge Los Vaqueros with Dyer Canal Intertie for EWA –** This plan would be similar to Concept Plan 2, but the additional capacity would be operated primarily to provide an EWA replacement supply. Some Bay Area water supply reliability would also be provided.
- **Concept Plan 5 - Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA –** This plan is similar to Concept Plan 4, except water supplies from the reservoir would be delivered to Bethany Reservoir (rather than directly to the SBA at the Dyer Canal), providing some additional operational flexibility.
- **Concept Plan 6 - Water Supply/EWA Combination with Dyer Canal Intertie –** This plan is similar to Concept Plans 2 and 4, but the reservoir would be operated to balance the EWA replacement supply and Bay Area supply reliability objectives.
- **Concept Plan 7 - Water Supply/EWA Combination with Bethany Reservoir Intertie –** This plan is similar to Concept Plan 6, except supplies from the reservoir would be delivered to Bethany Reservoir rather than to the SBA Dyer Canal.
- **Concept Plan 8 - Water Supply/EWA Combination with Water Quality Improvements –** This concept plan is similar to Concept Plans 6 and 7, but the reservoir would be operated to enhance the quality of water supplies delivered from the reservoir (at the expense of other project benefits).

Los Vaqueros develops EWA replacement supplies by delivering water to the SBA that would otherwise have been delivered via Banks Pumping Plant and the South Bay Pumping Plant; space made available at Banks is then used to pump EWA supplies to San Luis Reservoir, for later use by EWA when pumping is curtailed. In this manner, EWA supplies stored in San Luis Reservoir as a result of Los Vaqueros deliveries would replace EWA purchases south of the Delta.

The primary differences between the initial alternatives concern (1) the magnitude of reservoir expansion, (2) the location of the delivery intertie, and (3) the operational focus (emphasis on developing EWA replacement supplies or providing Bay Area supply reliability). The influence of these elements on plan formulation is described briefly below.

Preliminary engineering studies determined that the existing dam could not be raised more than about 10 to 15 feet without fully dewatering the reservoir and reconstructing the dam and spillway facilities, likely just upstream from the existing dam. A small, 10- to 15-foot raise would provide an additional 20 to 25 TAF storage, whereas a new, larger dam would be capable of increasing storage by up to 400 TAF (to a total of 500 TAF). The IAIR considered alternatives with both the small (20 to 25 TAF) and large (up to 400 TAF) reservoir expansion scenarios. However, recent engineering studies indicate that a moderate raise, capable of accommodating up to about 275 TAF (total storage), could be accomplished by reconstructing portions of the existing dam core and cross section in-place. This moderate expansion scenario would still require dewatering during construction, but portions of the existing dam and inlet/outlet facilities could be reused, resulting in a cost savings over larger expansion scenarios. Engineering and design analysis for the moderate expansion scenario is ongoing.

In each of the initial alternatives, a new pipeline is required to deliver supplies from the expanded reservoir to potential project beneficiaries. Two options for the delivery intertie have been identified: a pump station and pipeline to deliver supplies from the reservoir to the SBA at the Dyer Canal, or a gravity pipeline that would deliver supplies to Bethany Reservoir. Engineering analyses are underway to determine which intertie option would be more cost effective from a design standpoint. The Bethany intertie also may provide additional flexibility in operation of the reservoir.

Alternatives Currently Under Development

The current phase of the LVE is focused on developing detailed alternatives for comparison and evaluation in the Draft Feasibility Report and EIS/EIR. The initial alternatives described previously are the starting point for developing these detailed plans, with input from ongoing technical studies, and agency and stakeholder coordination. Technical studies are focused on refining operations, facility sizes, and facility locations.

Two additional alternatives have been identified since completion of the IAIR, as summarized below:

- **Moderate In-Place Dam Raise –** Previous plan formulation efforts considered major reservoir expansion (up to 500 TAF total capacity), which would require demolition of the existing dam and construction of a new dam a short distance upstream (also requiring dewatering of the existing reservoir). However, recent engineering studies and analyses indicate it may be possible to use the existing dam core and structure to achieve a moderate reservoir expansion of up to about 275 TAF (total capacity). This alternative has the potential for cost savings because portions of the existing dam structure, inlet/outlet, and associated facilities could be preserved. Dewatering of the reservoir would be required. It should be noted that enlarging the reservoir to capacities greater than 275 TAF is still believed to require construction of a new dam at a different location.

- **Desalination Without Storage –** This alternative would involve constructing a new brackish water desalination plant near Mallard Slough. To meet its water quality goals, CCWD would use high quality water from the desalination plant in lieu of receiving water supplies from Los Vaqueros. Desalinated supplies would be blended with other CCWD supplies in a manner similar to existing conditions. Storage space in Los Vaqueros Reservoir that would have been exercised to meet CCWD water quality objectives would instead be used to contribute to the EWA replacement supply and Bay Area water supply reliability objectives of the LVE. The reservoir and other existing Los Vaqueros Project facilities would not be enlarged or modified, but a new intertie pipeline would be constructed to deliver supplies to other project beneficiaries.

These potential alternatives will be developed and evaluated further over the course of the feasibility investigation.

Alternative Evaluated in This Report

For the purpose of this initial economic evaluation, a single alternative was selected for economic analysis. To select this alternative, operational model simulations were performed for two potential reservoir sizes: 275 TAF and 400 TAF (total capacity). These reservoir sizes were selected because they appeared to be most cost effective in previous operational analyses. Preliminary operational modeling was performed to determine the most efficient Delta intake and conveyance facility sizes associated with the two reservoir sizes. In these model simulations, the expanded reservoir was operated exclusively to provide EWA replacement supplies via the SBA; no deliveries were made from the expanded reservoir to increase SBA or CCWD water supply reliability, and no additional storage space was dedicated to supply reliability. In addition, no physical changes were made to project configuration or facility sizes to improve water quality (at the cost of other benefits). Simulated operations/configurations also are consistent with CCWD's Principles of Participation.

These simplifying assumptions were made for several reasons. First, although SBA water agencies have expressed interest in the LVE, none have committed to participating in an expansion project; should one or more agencies agree to participate, the degree to which these agencies might be willing to participate financially also is uncertain. Second, of the currently formulated LVE objectives, the EWA replacement supply objective has a high potential for Federal interest because the current EWA has existing Federal authorization. It is believed that a project with an established Federal interest has the greatest chance for local financial participation and implementation.

Based on current modeling results and preliminary engineering analyses, a 275 TAF reservoir alternative was selected for further analysis in this report because it appears to be more cost effective than a 400 TAF reservoir, under the above noted formulation conditions. This alternative includes the following major facilities:

- Reconstruct the existing Los Vaqueros Dam in-place to create a reservoir with a total capacity of 275 TAF
- Expand the existing Old River intake and pumping plant by 170 cfs to a total capacity of 420 cfs (note that the existing facility has a current capacity of 250 cfs and a planned buildout capacity of 320 cfs, total)
- Construct a new 350 cfs pipeline from the expanded Old River intake to the existing Transfer Facility (paralleling the existing 320 cfs pipeline to provide total conveyance of 670 cfs from the Delta to the Transfer Facility)
- Replace the existing Transfer Facility balancing reservoir with a larger, 8-million-gallon (MG) reservoir
- Construct a new 470 cfs pump station at the Transfer Facility and replace pumps in the existing 200 cfs transfer pump station, for a total transfer capacity of 670 cfs to the expanded reservoir
- Construct a new 670 cfs pipeline from the Transfer Facility to Los Vaqueros Reservoir

- Construct a new 175 cfs pump station and new pipeline to convey water from Los Vaqueros Reservoir to the SBA at the Dyer Canal

The pipeline that would deliver LVE supplies to the SBA was sized to maximize its use; in other words, to deliver a relatively constant supply to the SBA. This delivery capacity was initially targeted by comparing EWA south-of-Delta purchase targets by year type with SWP Table A deliveries to SBA users, shown in **Figure 2.2**. An initial replacement supply target of just under 125 TAF per year was selected because it could be delivered to the SBA to replace the EWA's purchased south-of-Delta supplies in all but the driest years. Adjusted for deliveries SBA agencies typically make to San Joaquin Valley groundwater banks, this volume amounts to about 105 TAF per year, and corresponds to a delivery pipeline with a capacity of about 150 cfs.

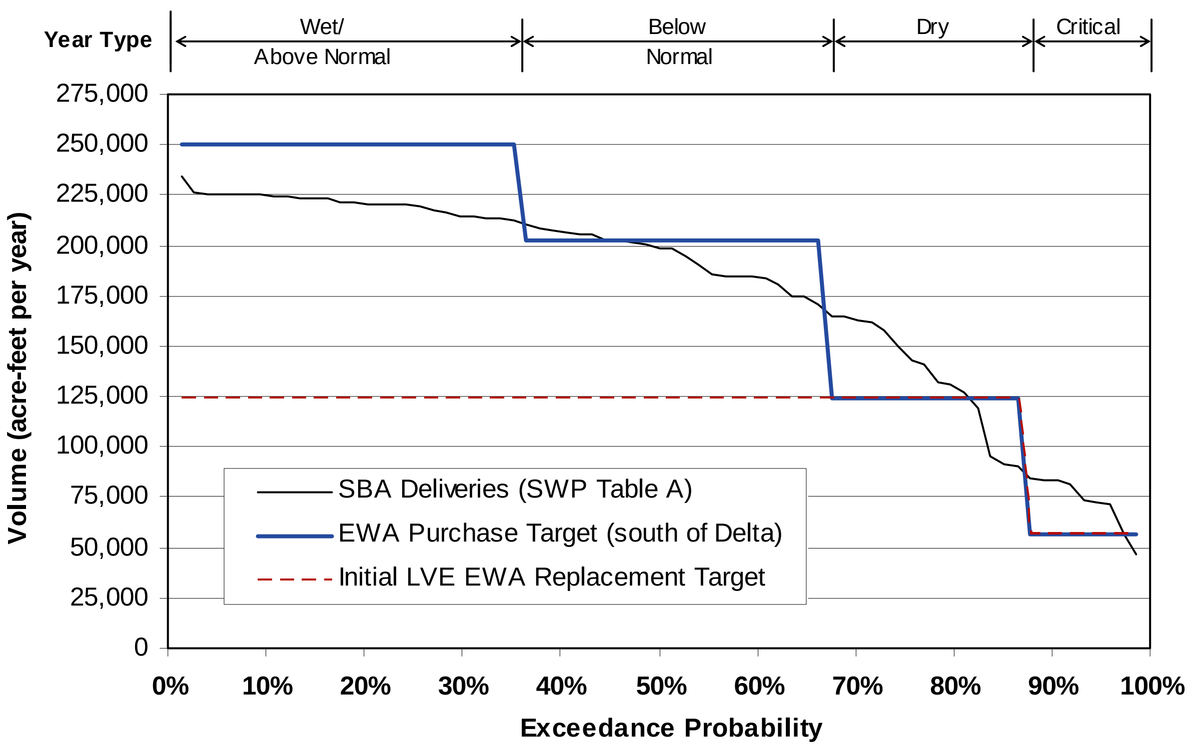

FIGURE 2.2 – DEVELOPMENT OF EWA REPLACEMENT SUPPLY DELIVERY TARGET FOR ALTERNATIVE EVALUATED IN THIS REPORT

An iterative modeling approach was then used to determine Delta intake capacity and size conveyance and other facilities, and to refine the size of the delivery pipeline to maximize use of available reservoir storage. The resulting facility sizes are summarized in **Table 2.1**, and facility configuration is illustrated in **Figure 2.3**

TABLE 2.1
SUMMARY OF FACILITIES INCLUDED IN THE ALTERNATIVE EVALUATED IN THIS REPORT

Facility Description	Capacity or Size
Dam and Appurtenances	
Expand Los Vaqueros Reservoir (reconstruct dam in-place)	275 TAF (total)
Dam Outlet Pipeline	132 in diam; 3,000 LF
Balancing Reservoir	4,000,000 gallons
Delta Intake and Conveyance Facilities - Delta to Transfer Facility	
AIP (assumed to be in-place on Victoria Canal)	250 cfs
Expanded Old River Intake	420 cfs
Total Intake Capacity	**670 cfs**
Existing Delta Pipeline (Intake to Transfer Facility) - 320 cfs	78 in diam; 34,700 LF
New Delta Pipeline (Intake to Transfer Facility) - 350 cfs	96 in diam; 34,700 LF
Transfer Pumping and Conveyance - Transfer Facility to Reservoir	
Existing Transfer Pump Station (replace pumps)	200 cfs
New Transfer Pump Station	470 cfs
Total Transfer Capacity	**670 cfs**
Expanded Balancing Reservoir at Transfer Facility	8,000,000 gallons
New Transfer Pipeline (Transfer to Reservoir) - 670 cfs	132 in diam; 19,600 LF
Delivery Facilities - Reservoir to SBA (near Dyer Canal)	
New SBA Delivery Pipeline (Reservoir to SBA) - 175 cfs	66 in diam; 43,800 LF
New SBA Pump Station	175 cfs

KEY: AIP = Alternative Intake Project; cfs = cubic feet per second; diam = diameter; in = inch; LF = linear feet; SBA = South Bay Aqueduct; TAF = thousand acre-feet

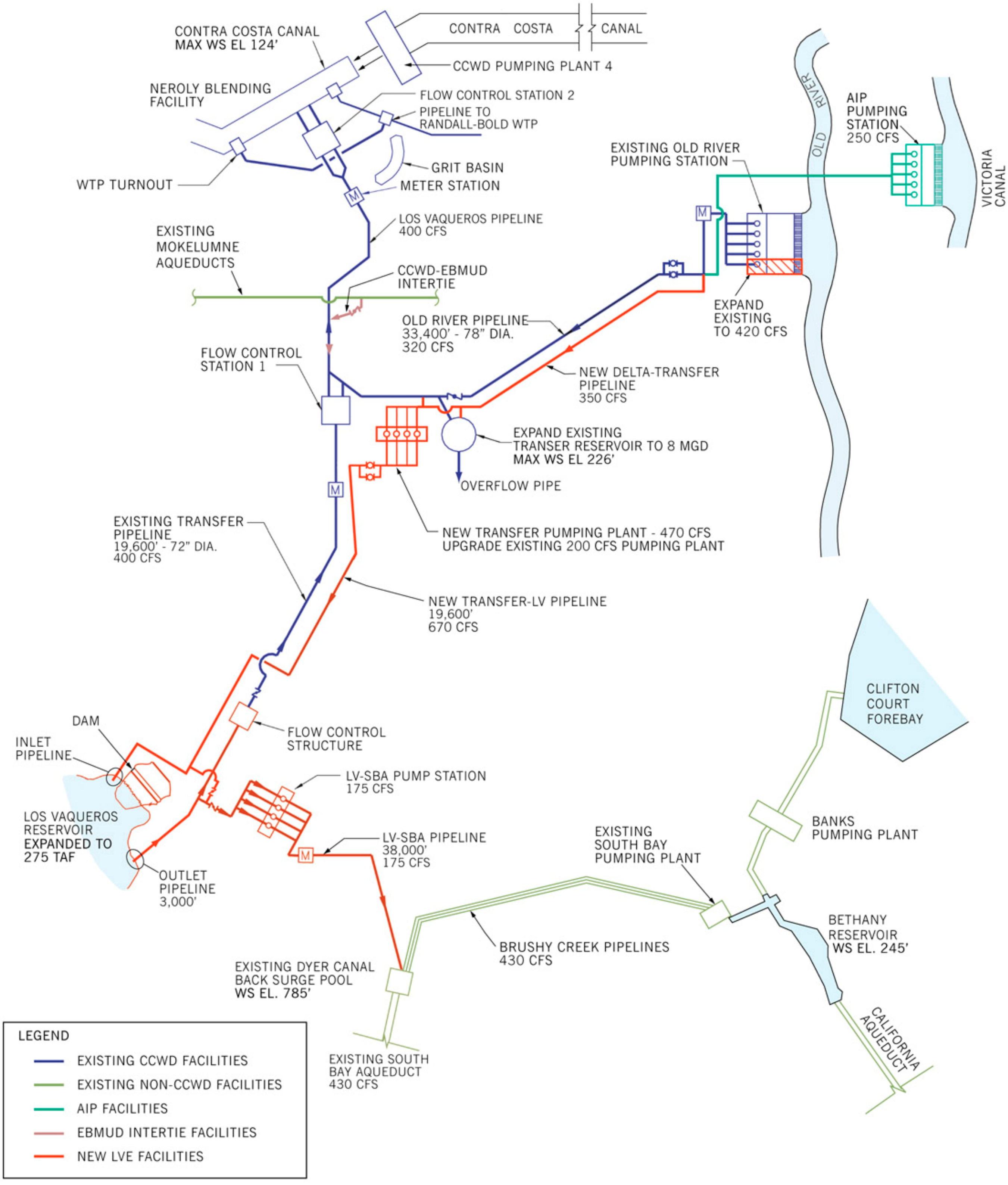

FIGURE 2.3 – EXPANSION PROJECT CONFIGURATION SELECTED FOR ANALYSIS IN THIS REPORT

The stand-alone CALSIM-II model, developed to simulate a Los Vaqueros Reservoir expansion, was used to estimate EWA replacement supply yield for the alternative. Future without-project conditions and other parameters related to the CALSIM-II modeling are summarized below:

- The stand-alone CALSIM-II model does not integrate the operation of Los Vaqueros Reservoir with that of the CVP and SWP systems. Future modeling analyses using the Common Assumptions Model Package will be required to verify project yield and identify any potential impacts to the water management system.
- Model simulations assume the AIP is constructed and operating with a capacity of 250 cfs.
- Because of the changing nature of what is believed to be necessary to protect fish and wildlife in the Delta, adaptive management was assumed to be a part of the operational requirements. No biological or export/import (E/I) restrictions were simulated in the monthly operations model with respect to deliveries to the reservoir from Old River; however, results were reviewed to verify that Delta pumping capacity and operations were flexible enough to accommodate a variety of biological protection measures.
- No assessment was made of potential water quality impacts in the Delta. Previous studies with larger intakes and reservoir sizes indicate that potential impacts can be managed to less than significant levels. Future modeling analyses will assess potential impacts of alternative plans on Delta hydrodynamics and water quality.
- Direct delivery of water from Old River to the SBA (bypassing the reservoir) was allowed during certain conditions of Delta surplus, reservoir storage, and Delta water quality.
- Deliveries from the reservoir to the SBA are generally limited by the lesser of (1) SBA demands by year type, (2) EWA demands by year type, and (3) Los Vaqueros-SBA delivery pipeline capacity.
- An in-reservoir water quality target of 50 milligrams per liter (mg/L) chlorides was used to preserve the current water quality function of the reservoir for CCWD.

Simulated yield by year type (EWA replacement supplies only) for the alternative evaluated in this report is summarized in **Table 2.2**.

Model simulations also were used to evaluate potential improvements in the quality of water delivered to the SBA. On average, deliveries from Los Vaqueros Reservoir to the SBA were about 33 mg/L lower in total dissolved solids (TDS) than deliveries that would otherwise have been made from Bethany Reservoir, with reductions as high as 150 mg/L during some periods. In general, water quality in the SBA (representing blended supplies from both Los Vaqueros and Bethany Reservoir) was about 16 mg/L lower in TDS than under the without-project conditions.

This alternative is being used only for the purpose of preliminary economic analysis in this report to determine if a potentially feasible alternative exists under current formulation parameters.

TABLE 2.2
SIMULATED EWA REPLACEMENT SUPPLY YIELD FOR ALTERNATIVE EVALUATED IN THIS REPORT

Year Type[1]	Yield[2] (acre-feet per year)
Wet	121,500
Above Normal	118,900
Below Normal	112,700
Dry	99,400
Critical	55,700
Average Annual	**104,200**

Notes:

1. *Year types based on 40-30-30 Sacramento River index.*
2. *Values represent yield from expanded reservoir for EWA purposes only, for the modeling conditions documented above; excludes supplies used by CCWD to achieve or meet existing Los Vaqueros Project purposes of water quality and emergency storage. No new yield or storage space was dedicated to other purposes.*

CHAPTER 3
ECONOMIC PRINCIPLES AND METHODS

This chapter describes Federal economic principles and methods related to plan formulation, calculation of project benefits, and derivation of total annual equivalent benefits. This chapter also will describe potential economic valuation methods and recommend methods to be used for the LVE.

BACKGROUND

Reclamation guidance for the evaluation of water resources project plans is provided by the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (WRC, 1983), approved by the President on February 3, 1983. The P&G provide guidance for measuring the monetary and nonmonetary benefits or effects of Federal water resources projects. However, it is often difficult to fully measure all benefits associated with a multipurpose water resources project. For example, it is difficult to value intangible benefits such as operational flexibility or improvements in general social welfare.

Four accounts are established in the P&G to facilitate evaluation and display the effects of alternative plans:

- **National Economic Development (NED) –** Effects on the national economy, expressed in monetary units.
- **Environmental Quality (EQ) –** Effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms.
- **Regional Economic Development (RED) –** Regional incidence of economic effects, income transfers, and employment.
- **Other Social Effects (OSE) –** Urban and community impacts and effects on life, health, and safety.

The NED account is the only required account, although information that could have a bearing on Federal decision-making should be presented in the other accounts. For the purpose of this initial economic evaluation, only the NED account will be considered.

NED FORMULATION APPROACH

In general, the objectives of Congress in Federally financed water resource projects are to enhance regional economic development, the quality of the environment, the well-being of people in the U.S., and national economic development. NED costs and benefits are the decrease or increase in the value of the national output of goods and services expressed in dollars. NED figures measure the costs and benefits to the Nation, rather than to a particular region.

As described in the P&G, water resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to NED. The alternative plan with the greatest net economic benefit (the NED plan) determines the greatest potential Federal investment in the project. If the local sponsor prefers a different plan than the one that maximizes NED, the NED process is used to define the Federal financial interest in the locally preferred plan.

The NED account includes the following *categories of goods and services*: M&I water supply; agricultural floodwater, erosion, and sediment reduction; agricultural drainage and irrigation; urban flood damage reduction; power (hydropower); transportation (including both inland navigation and deep draft navigation); recreation; and commercial fishing. While multipurpose projects may provide additional types of benefits, these categories coincide with project purposes in which an established Federal financial interest exists. Other categories of benefits may be allowed or may be included in Congressional authorization for a specific project.

NED costs are the *opportunity costs of resource use*, and require consideration of the private and public uses that producers and consumers are making of available resources, now and in the future. Due to scarcity, choosing to use a resource for any one purpose costs society the opportunity to use that resource for another purpose. For goods and services produced in a competitive market, price is often used to reflect opportunity cost. Consequently, market prices should be used to determine NED costs provided the market prices reflect the full economic value of a resource to society. The market price approach should reflect the interaction of supply and demand. If market prices do not reflect total resource values, surrogate values may be used that approximate opportunity costs based on an equivalent use or condition.

For M&I water supplies, the conceptual basis for evaluating benefits is society's willingness to pay for the increase in goods and services attributable to the water supply. According to the P&G, when the market price reflects the *marginal cost of water*, that price should be used to calculate willingness to pay for additional water supply. In the absence of a direct measure of the willingness to pay, the benefits are instead measured by the resource cost of the alternative most likely to be implemented in the absence of that alternative.

Other direct benefits in the NED evaluation are those direct effects of a project that are incidental to the purposes or objectives for which the project is being formulated. Other direct benefits may include improvement in commercial/industrial production possibilities (such as reduced water treatment process costs at industrial facilities) or benefits in the nonmarket sector (some types of recreation, for example). For the LVE, other direct benefits might include environmental benefits (reduced impacts to aquatic resources from changing the location and timing of Delta diversions or avoided costs associated with screening diversions) and recreation.

The two primary decision criteria used in a Federal economic analysis are net benefits and the benefit-cost ratio. The *net benefit* is the difference between the net present value of benefits and costs, and measures the extent to which benefits to the Nation exceed project costs. The benefit-cost ratio is calculated by dividing annual project benefits by annual project costs. A benefit-cost ratio greater than one indicates that a project is economically justified.

The net benefits and costs of alternative plans are compared to identify the plan that reasonably maximizes net benefits, or the NED plan. This is not necessarily the plan with the greatest benefits, but rather the plan that maximizes benefits given the cost to the Nation. Section 1.10.2 of the P&G requires that the NED plan is selected unless the Secretary of the Interior grants an exception.

ECONOMIC VALUATION METHODS

Economic valuation methods generally fall into one of two categories: market valuation or nonmarket valuation. Market values refer to conditions for which a price can be observed, such as for human consumptive uses. Nonmarket valuation methods usually apply to resources for which it is difficult or inappropriate to apply monetary values, such as ecosystem restoration or wildlife conservation. The three objectives of the LVE relate to consumptive uses and therefore can be valued using market-based techniques.

Market values may be determined by one of two basic methods: user value (willingness to pay) or least-cost alternative to accomplish the same goals. The potential application of these methods to the three objectives of the LVE is summarized in **Table 3.1**.

TABLE 3.1
SUMMARY OF APPLICABLE MARKET VALUATION METHODS

Benefit Group	User Value (willingness to pay)	Least-Cost Alternative
Bay Area Water Supply Reliability	Market value of water in M&I use	Least cost to obtain the next unit of M&I supply reliability
EWA Replacement Water Supply	Market value of water purchased by the EWA	Least cost to obtain the same unit of EWA water supply
Bay Area Water Quality	Not applicable	Least cost to obtain the same improvement in M&I water quality

Key: EWA = Environmental Water Account M&I = municipal and industrial

User-Value Valuation Method (Willingness to Pay)

The user-value, or willingness to pay, method refers to the value of the resource to the consumer. Markets may be used to estimate the maximum value for which a resource user is willing to pay. From a commercial or industrial perspective, this might represent the contribution of additional water supplies to production and, ultimately, profits. From a domestic perspective, this might represent the value that a homeowner places on their ability to water their lawn or fill their swimming pool.

Applying the user-value method to M&I water supplies, for example, requires an understanding of both domestic and commercial/industrial water uses. Domestic user preferences for water use, and willingness to avoid shortages, often are determined by surveying the water users. However, these surveys can be cumbersome and generate inaccurate responses. Also, differences in population and water use make it difficult to apply survey results at a regional level. Applying the user-value method to industrial and commercial uses requires estimating the output value of goods and services, such as the price of a computer chip. However, industrial market values include profit margins and other competitive criteria, and their use may result in overestimated water values.

Least-Cost Alternative Method

The least-cost alternative method identifies the lowest cost of obtaining or developing the next unit of a resource to meet a particular objective. The net benefit would be calculated by subtracting the cost of developing the project under consideration from the cost of the alternative unit. For water supply reliability, for example, the least-cost alternative represents the next unit of water supply the water user would purchase or develop if the project under consideration were not in place.

RECOMMENDED VALUATION APPROACHES

This section describes available and recommended methods to value economic contributions to the three purposes or objectives of the LVE: EWA replacement supplies, Bay Area water supply reliability, and Bay Area water quality.

EWA Replacement Supplies

The recommended method for assessing the benefits of a lower cost EWA implementation is the *cost effectiveness* approach. This approach is based on the premise that water supplies and operations for EWA purposes developed through the LVE project would have the same outputs with respect to water quantity, timing and location of supplies, and environmental benefits as under existing conditions (no increase in EWA water supplies or increase in EWA actions to protect fish). Because EWA actions are not expected to change as a result of the source of the water (storage in an expanded Los Vaqueros reservoir versus transfer market purchase), the corresponding program benefits are expected to be the same.

Different alternatives would vary in benefits with respect to (1) quantity of water for EWA purposes and (2) cost of developing the water through the LVE project. The LVE water development cost will be compared in this report to the cost of implementing the EWA program as conceived under the long-term EIS/EIR (scheduled for completion in fall 2007), and will be measured as the cost of obtaining EWA supplies on the water transfer spot market.

Bay Area Water Supply Reliability

User-values for water can be cumbersome to obtain and difficult to extrapolate from surveys to populations, and may overstate benefits to users. For this reason, it is recommended that the *least-cost alternative method* be used to establish the benefit value for measuring Bay Area water supply reliability benefits. In the event that multiple providers receive reliability benefits from the project, the likely alternative supply for each of the providers would need to be evaluated.

Determination of the least-cost alternative supply comparable to expanding Los Vaqueros Reservoir should consider the location, cost, and relative reliability of the alternative supply. Bay Area water agencies have identified various potential sources of future water supplies in their urban water management plans, including increasing reliance on out-of-basin water transfers, groundwater, conservation, recycling, and desalination. Few opportunities exist to develop new surface water supplies within the Bay Area; surface water supplies developed outside the Bay Area (including surface storage and transfers) are subject to potential interruption due to earthquakes or other events. Groundwater is a largely developed resource in the Bay Area; in addition, groundwater quality (due to saltwater intrusion and contamination) and groundwater overdraft are problematic. Most Bay Area water agencies already have aggressive conservation programs in the event of drought or water supply interruptions; it is unlikely that significant water savings can be made regionally through additional conservation. Similarly, recycling is limited in its ability to provide large supplies and can be very costly. Desalination of brackish water or seawater has been gradually gaining popularity in California; a Bay Area regional desalination study recently identified several potential desalination sites in the Bay Area. Desalination is not subject to the hydrologic uncertainty of other supplies, such as water transfers, surface supplies, and groundwater use.

Opportunities to develop new onstream or offstream surface water storage in the Bay Area are limited, and out-of-basin water transfers already are relied on in dry and critical years to meet current demands. Consequently, the next increment of supply reliability in the Bay Area would likely be obtained by higher-cost water transfers (either long-term or short-term,) or desalination of brackish or ocean water supplies.

Another benefit related to water supply reliability is the creation of emergency storage supplies in an expanded reservoir. These benefits would likely be measured as costs avoided in the event of emergencies that result in infrequent shortages or outages in water supply. This might include supply disruption caused by a levee failure in the Delta that causes water quality to degrade, or an earthquake that damages a major distribution or supply pipeline. For example, the existing Los Vaqueros Reservoir provides emergency water supply in the event that Delta water quality is significantly degraded by a levee failure. Estimation of costs avoided in emergencies and outages requires careful consideration of (1) the types of emergencies likely to occur, (2) their expected intensity and frequency, and (3) the expected economic costs for each level of intensity and frequency in the without-project and with-project conditions.

Bay Area Water Quality

Water quality benefits result from improvements in the quality of municipal water supplies. Several methods could potentially be used to estimate water quality benefits, including the following:

- **Least-cost alternative to achieve the same incremental improvement in water quality –** The cost to construct new water treatment facilities, modify existing treatment facilities, or construct other facilities to improve water quality could be used to value the benefits of improved water quality.
- **Direct consumer/user benefits of improved water quality –** Consumer cost savings may be applied when customer water quality costs incurred in the without-project condition are not incurred because of water quality improvements in the with-project conditions. Such savings may include residential costs for alternate supplies (such as bottled water), home treatments, and reduced life of household features.
- **Avoided cost of treatment –** Improvements in raw water quality, such as lower turbidity, total organic carbon (TOC), and bromides, can reduce municipal water treatment costs. This might include cost savings at treatment plants and lower groundwater management costs.

- **Contingent valuation –** The use of direct questioning or surveys can be used to elicit society's willingness to pay for improvements in water quality. However, these surveys can be difficult to obtain and results may be biased.

For the LVE, water quality benefits generally result from lower consumer costs, lower groundwater management costs, and lower water treatment costs when raw water of higher quality is delivered to municipal agencies receiving supplies from the project.

In previous studies of potential expansion of Los Vaqueros Reservoir, consumer-related water quality cost savings were estimated using methodologies developed by Sonnen (2002). This analysis considered the number of households receiving supplies from the project and calculated benefits related to reduced bottled water purchases; longer life of household appliances, plumbing, and fixtures; lower use of home water softeners; and reduced purchases of soaps and detergents. These benefits would accrue when water supplies with lower TDS and total hardness (TH) are delivered to households served by water treatment plants that receive water from the SBA. The economic benefit would then be estimated by subtracting the consumer costs for the without-project condition from the costs of the with-project condition.

Economic benefits from lower groundwater basin management costs could be estimated using the avoided cost approach. Groundwater is actively managed in the SBA service area to control saltwater intrusion and maintain the quality of these supplies for urban and agricultural use. Groundwater recharge occurs from two primary sources: active recharge via spreading basins, and passive recharge from outdoor irrigation of urban landscapes. Groundwater quality benefits would be realized if supplies with lower TDS were delivered from an expansion project. The economic benefit could be calculated as the avoided cost to achieve the same reduction in TDS, which would likely require desalination or another advanced treatment method prior to use.

Savings in water treatment plant operating costs might include the avoided cost of advanced treatment, reduced energy or chemical use, or other operating efficiencies. CCWD is currently developing a detailed water quality model that will estimate the water quality parameters of interest in this benefit category. This model is expected to be completed by the end of 2006 and available for use in subsequent LVE feasibility studies.

Other Direct Benefits

Other direct benefits are those plan effects that are incidental to project purposes. For the LVE, these would be project benefits not directly associated with increased water supply reliability and quality or EWA replacement supplies. Potential other direct benefits relevant to the LVE might include reduced impacts to Delta aquatic resources and recreation, as described below.

- **Reduced impacts to Delta aquatic resources -** Delta aquatic resources would be affected by changes in the location, timing, and amount of diversions as a result of the project. However, estimation of these benefits may be very difficult because of complexities associated with the relationship between Delta fisheries and export operations. Alternately, reduced impacts to Delta aquatic resources may be appropriate for inclusion in the EQ account, rather than the NED account.

Water delivered to the SBA from Los Vaqueros Reservoir would be diverted from the Delta through modern, state-of-the-art fish screens similar to the existing fish screens at CCWD's Old River intake and pumping station. Currently, water delivered to the SBA passes through Clifton Court Forebay, which does not have modern, positive-barrier fish screens. The economic benefit of diverting water through a screened intake versus an unscreened intake could be valued in several ways. One potential method would be to estimate the avoided cost of equivalent fish screens at Clifton Court Forebay. Another potential valuation method might use the fish and wildlife restoration fund charge for CVP contractors; the charge of $16 per acre-foot for CVP M&I contractors was established in the Central Valley Project Improvement Act (CVPIA) to help pay for fishery restoration and other environmental projects.

- **Recreation -** Economic benefits associated with an expansion of Los Vaqueros Reservoir include increased recreational opportunities for Bay Area residents. Existing recreational uses at Los Vaqueros Reservoir include boating, fishing, hiking, sightseeing, and related outdoor activities (water contact sports are prohibited). Recreation was not included as an objective of the LVE because a need for additional recreation opportunities in the Bay Area, such as those that could be provided by reservoir expansion, could not be specifically established. Potential estimation methods identified in the P&G include (1) unit day values, (2) travel cost method, or (3) contingent valuation. Should recreation benefits be included in future economic analyses for the LVE, they are not likely to account for a significant portion of total project benefits.

Future studies should assess the appropriateness of including these or other direct benefits in the economic analysis for the LVE.

ECONOMIC ANALYSIS PARAMETERS

Economic parameters and future without-project conditions that form the basis for the economic analysis presented in this report are summarized below.

Economic Parameters

Economic analysis assumptions outlined in the P&G include those related to full employment, risk neutrality, and others. Parameters specific to the LVE include period of analysis and discount rate, summarized briefly below.

- **Period of analysis -** The period of analysis is the anticipated period over which project benefits or effects are likely to accumulate. The P&G allow for a period of analysis for up to 100 years based on anticipated project life. A 100-year period of analysis is believed appropriate for LVE due to the anticipated longevity of a dam and reservoir project. The economic benefits of the project would begin to accrue the year construction is completed.
- **Discount rate -** Benefits and costs are worth more if they are experienced sooner. The discount rate is the rate at which society as a whole is willing to trade off present for future benefits. NED benefits and costs are compared at a common point in time in average annual equivalent terms. This is accomplished by discounting the benefit stream, deferred installation costs, and operation, maintenance, and replacement costs to the beginning of the period of analysis using

an established Federal discount rate. Installation costs (including construction costs) are brought forward to the end of the installation period by charging compound interest from the date costs are incurred (interest during construction (IDC)). The Federal discount rate for plan formulation and evaluation is established annually by the Secretary of the Treasury pursuant to 42 United States Code 1962d-1. The Federal discount rate of 5-1/8 percent will be used in this initial economic analysis.

Future Without-Project Conditions

An important aspect of any economic analysis is establishing appropriate future conditions, both with and without the proposed action. Project benefits are measured as the difference between two alternative futures: the without-project condition (future without any action) and with-project condition. The following summarizes important conditions that are assumed to exist in the future without the LVE (see also discussion of Project Baselines in **Chapter 2**):

- The EWA or a similar program continues to purchase water to support pumping curtailments and other actions that promote protection and recovery of at-risk Delta fisheries. The program continues to be funded by both the Federal and State governments and operates/functions similar to the existing program. The program is assumed to use the EWA asset acquisition and management resources identified in the EWA Operating Principles Agreement (CALFED, 2000c), as may be amended, including the following:
    - Storage in existing CVP/SWP reservoirs (as available)
    - Dedicated pumping capacity of 500 cfs (July through September) at Banks Pumping Plant
    - SWP annual carryover debt in San Luis Reservoir of 100,000 acre-feet, when available
    - Existing water purchase mechanisms (primarily spot market purchases and short-term transfer agreements)
- The CCWD AIP is constructed and operating with a capacity of 250 cfs (high lift pump station) on Victoria Canal.
- The EBMUD Mokelumne Aqueduct Intertie with the CCWD Los Vaqueros Pipeline is constructed.
- The South Bay Aqueduct Improvements and Enlargement Project is constructed, increasing the capacity of the SBA to 430 cfs.
- Allowable pumping capacity at Banks Pumping Plant is increased to 8,500 cfs, per the SDIP.

CHAPTER 4
FUTURE COST OF EWA SPOT MARKET WATER PURCHASES

This chapter discusses the potential future cost of EWA water supplies in relation to the acquisition of water on California's water transfer market. The chapter begins with background information on the EWA program, including a summary of its objectives and anticipated long-term implementation. It further describes the characteristics of the water transfer market and identifies key assumptions related to estimating future changes in the cost of supplies acquired on the spot market. It concludes with a preliminary estimate of the potential range of water costs, and recommendations for future work to support the LVE.

BACKGROUND

The Delta is the largest estuary on the West Coast and provides essential habitat for a diverse array of fish and wildlife. A variety of factors have potentially contributed to the decline of fish species in the Delta, including loss of habitat, water quality degradation, and water resources development, resulting in the listing of various species as threatened or endangered. In response to environmental changes and species listings, several programs and practices to address Delta fisheries and water quality have been developed, such as the CVPIA (b)(2), the SWRCB Water Right Decision 1641, various CALFED programs, and the Vernalis Adaptive Management Plan (VAMP). However, pumping curtailments and other actions in the Delta that have been beneficial to fish often have had adverse impacts on cities, farms, and businesses that depend on water supplies pumped from or through the Delta. Consequently, the EWA was developed to provide water project operators with additional flexibility in meeting or exceeding flow, water quality, and fishery protection objectives in the Delta.

The EWA was identified as one of several program elements in the CALFED ROD. It is a cooperative management program that allows resource agencies to protect at-risk fish species in the Delta through environmentally beneficial changes in CVP/SWP pumping operations at no uncompensated water cost to project water users. Currently, the EWA relies primarily on water acquisitions and transfers to obtain targeted supplies, using the supplies to replace deliveries interrupted by actions taken to benefit fish. Originally a 4-year program (2001 to 2004), the EWA agencies signed a Memorandum of Understanding in September 2004 extending the "short-term" or pilot program through 2007.

EWA Participating Agencies

- Bureau of Reclamation
- California Department of Water Resources
- U.S. Fish and Wildlife Service
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- California Department of Fish and Game

Purpose and Objectives of EWA Program

The EWA is authorized to use acquired water assets to (1) augment instream flows and Delta outflows, (2) modify or reduce water exports to benefit fisheries, and (3) replace regular project water supply reduced by pumping curtailments at Banks and Tracy pumping plants.

The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers, and releases the water as needed to protect fish and to compensate water users. EWA implementing agencies have developed water acquisition targets (based on south-of-Delta delivery) for a long-term EWA operation. Typically, the EWA Program purchases 200,000 to 300,000 acre-feet of water annually.

EWA Operations

The EWA primarily uses Banks Pumping Plant to move water south of the Delta. The EWA has 500 cfs (about 60 TAF annually) dedicated capacity at Banks from July through September, above the 6,680 cfs maximum pumping capacity. In wet years, the CVP and SWP use all remaining Banks available capacity, while in dry years the EWA is often afforded some added capacity. When water cannot be conveyed through the Delta, the EWA will typically try to store water in CVP or SWP reservoirs until the summer transfer season begins.

The EWA incurs debt to the CVP/SWP from December through June, and returns water to the CVP/SWP from July through September, sometimes later. Sellers provide some storage until transfers begin in July, and the EWA can store assets in CVP and SWP reservoirs (primarily San Luis, Folsom, and Oroville reservoirs). The EWA can store water in these reservoirs to the extent that space is available; when a reservoir spills, EWA assets are converted to project supplies and are no longer available to offset pumping curtailments or for use in taking other EWA actions. The EWA has also pursued source-shifting and exchanges. For example, the EWA pursued dry-wet exchanges with Metropolitan Water District of Southern California (MWD) in 2005. The EWA can also store water in groundwater banks, but has avoided this option because it is currently more expensive and recharge/extraction rates are limited.

Expected Future EWA Without-Project Conditions

It is expected that the EWA, or a similar water acquisition program, will continue into the future. Federal legislation enacted in October 2004 authorized appropriations for the EWA for 6 years. Reclamation is leading development of an EIS/EIR anticipated to be completed by fall 2007 for the proposed long-term program. The proposed long-term EWA is likely to be an acquisitions-based program similar to the short-term EWA. Although the EWA is not funded beyond 2007, it is believed that the need for the EWA, or a similar program to promote protection and restoration of Delta fisheries, will continue into the long-term future. **Table 4.1** summarizes existing EWA water acquisition targets by year type (based on current OCAP assumptions).

Currently, the EWA is granted 500 cfs dedicated pumping capacity at Banks between July and September, which is considered in addition to the maximum pumping capacity of 6,680 cfs. If pumping is increased at Banks to 8,500 cfs, this total capacity would include the 500 cfs capacity dedicated to the EWA. In general, with pumping increased to 8,500 cfs at Banks, the EWA would need to buy more water to facilitate pumping curtailments. This increase amounts to about 20 TAF per year, on average, according to OCAP.

TABLE 4.1
EWA ACQUISITIONS BY YEAR TYPE

Year Type (40-30-30)	North-of-Delta Acquisitions (TAF)	South-of-Delta Acquisitions (TAF)	Total (TAF)
Wet	0	250	250
Above Normal	47.3	202.7	250
Below Normal	47.3	202.7	250
Dry	105.7	124.3	230
Critical	153.2	56.8	210

KEY: EWA = Environmental Water Account TAF = thousand acre-feet
Source: CALSIM II EWA acquisition quantities in Common Assumptions Plan Formulation Package, based on OCAP, 2020 level of development.

The long-term EWA is seeking to diversify its assets and enter into longer-term water transfer agreements, such as the proposed water purchase agreement with Yuba County Water Agency under the proposed Lower Yuba River Accord. Source-shifting and exchanges may become more difficult for the EWA in the future as water transfers increase and conveyance limitations intensify. For example, dry/wet transfers may become more difficult due to increased movement of transfer water throughout the year (not just during the peak transfer season) and related conveyance constraints.

CHARACTERIZATION OF CALIFORNIA'S WATER MARKET

California's water market developed as a result of the last major drought in California (1987 to 1992) and Federal and State legislation pertaining to water rights and entitlements. Passage of the CVPIA in 1992 and negotiation of the "Monterey Agreement" in 1996 changed the operating rules of CVP and SWP allocations, respectively, and induced the development of an active water transfer market within California's two major water projects. Water transfers occur both within the CVP and SWP and with external water agencies. In recent years, extensive transfers of water through the Delta have occurred.

Environmental water demands have increased significantly over the past decade, particularly in the Delta. Primarily in response to environmental legislation and regulatory requirements, both the Federal and State governments have developed programs to reallocate and/or purchase water for environmental purposes. These programs include Reclamation's Water Acquisition Program (WAP) and Water Transfer Program (WTP) pursuant to the CVPIA, and the EWA. As a result, programs that acquire water for environmental purposes have a significant effect on California's water market.

Agricultural water districts are increasingly entering the California water market, where they can sell portions of their supplies to urban users at higher prices to help maintain affordable supplies to farmers. Because agricultural users retain contract entitlements or water rights to the majority of California's water supplies, many urban water agencies in the State are negotiating agreements with agricultural users to meet growing M&I demands. Real estate developers, in seeking to comply with recent laws requiring new developments to secure adequate water supplies, also are entering the market in search of agricultural water rights and long-term transfers.

In the future, California's water market also may be affected by water-related grant programs, such as Proposition 50. Passed by California voters in November 2002, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act (Proposition 50) has dedicated over $1.5 billion to CALFED and other programs focused on improving water supply reliability.

Water transactions in the State generally fall into one of three categories: permanent sales of water rights or entitlements, long-term transfers, or short-term transfers (spot market). Transfers are distinguished as north of the Delta or south of the Delta. South-of-Delta (export service area) includes areas served by the CVP and SWP Delta pumping facilities, encompassing agricultural and urban development in the Central Valley and central and southern coasts.

Permanent Sales and Long-Term Transfers

Permanent sales and long-term transfers are often characterized by the permanent or temporary reallocation of water from agricultural to urban or environmental uses (usually through temporary or long-term land fallowing). Examples of recent permanent sales of CVP and SWP contract supplies are included in **Table 4.2**. Although sales prices vary, the price of permanent contract sales has increased over the last decade.

TABLE 4.2
RECENT CVP AND SWP WATER CONTRACT SALES

Year	Buyer	Seller	Type	Quantity (AF)	Price $/AF
2004	Westlands WD	Widren WD	CVP	2,990	$1,500
2004	Westlands WD	Centinella WD	CVP	2,500	$1,400
2003	West Kern WD	Berrenda Mesa WD	SWP	6,000	$1,000
2003	Lemoore Naval Military Base	Tulare lake Basin WSD	SWP	5,000	$2,150
2003	Coachella Valley WD	Tulare Lake Basin WSD	SWP	9,900	$2,150
2002	City of Tracy	Banta Carbona ID	CVP	2,500	$1,000
2002	City of Tracy	West Side ID	CVP	5,000	$1,000
2002	Zone 7	Tulare Lake Basin WSD	SWP	400	$1,600
2002	Zone 7	Belridge WSD	SWP	2,219	$1,500

KEY: AF = acre-feet; CVP = Central Valley Project; ID = Irrigation District; SWP = State Water Project; WD = Water District; WSD = Water Storage District

Notes: Reliability of supplies varies, but is typically moderate to high. Prices presented represent the capital outlay to purchase the water contract from the current holder, and do not include future payments for the contracted supplies.

Long-term transfers differ from permanent sales in that the seller retains the underlying water right. Examples of recent long-term water purchases are included in **Table 4.3**. As shown in the table, historic long-term transfers have varied significantly by region (north of the Delta versus south of the Delta), volume, reliability, and price. South-of-Delta transfers with a high reliability (such as those purchased by the cities of Lodi, Tracy, Lathrop, Manteca, and Escalon, and Newhall Land and Farming) account for the highest prices on the long-term transfer market. The unit price of permanent contract sales and long-term transfers cannot be directly compared with annual spot market transfers without taking into account the volume of the transfer, reliability of the supply, and duration of the transaction. However, increases in historical prices appear to be occurring at a rate above inflation.

TABLE 4.3
RECENT AND PROPOSED LONG-TERM WATER PURCHASES

Year[4]	Buyer	Seller	Water Source	Length	Quantity (AF/yr)	Reported Price ($/AF)[1]
2005[2]	DWR & CVP	Yuba County Water Agency	NOD	9 years	Varies by Year Type Wet, AN: 63 – 80 BN, Dry, C: 100 – 188	Varies by Year Type Wet, AN: $25 - $60 BN, Dry, C: $50 - $125
2003	City of Lodi	Woodbridge Irrigation District	NOD	40 years	6,000	$200
2003	Cities of Tracy, Lathrop, Manteca, and Escalon	South San Joaquin Irrigation District	SOD	30 years	43,090	$191
2003	Newhall Land and Farming Co.	Nickel Family	SOD	30 years	1,600	$475
2000[3]	CCWD	East Contra Costa Irrigation District	NOD	Permanent	8,200	$27
2000	Northridge Water District	Placer County Water Agency	NOD	15 years	12,000	$35
1999	Reclamation	San Joaquin River Group Authority	SOD	10 years	Varies 11,000 - 110,000	Varies $27 - $60
1997	MWD	Arvin Edison Water Storage District	SOD	25 years	50,000	$165

KEY:
AF = acre-feet
AN = above normal
BN = below normal
C = critical
CCWD = Contra Costa Water District
CVP = Central Valley Project
DWR = Department of Water Resources
MWD = Metropolitan Water District of Southern California
NOD = north of the Delta
SOD = south of the Delta

Notes:
1. *Unit price excludes additional costs associated with conveyance/delivery of the supplies to the buyer. Price does not reflect the reliability of the supplies, which varies.*
2. *This transfer is proposed as part of the Lower Yuba River Accord, pending completion of a final EIS/EIR.*
3. *Water can only be used within the East Contra Costa Irrigation District service area (not an out-of-basin transfer).*
4. *Table excludes recent transfers from out-of-state sources (such as the Colorado River Basin).*

Spot Market Transfers

Short-term spot market sales differ from long-term transfers in that they are negotiated and implemented within a single year. Both the number and price of short-term spot market sales have increased in recent years, particularly in dry years. Historical spot market purchases south of the Delta and north of the Delta are summarized in **Tables 4.4** and **4.5**, respectively.

TABLE 4.4
HISTORICAL SPOT MARKET WATER PURCHASES SOUTH OF THE DELTA

Year	Buyer	Seller	Year Type	Quantity (AF)[2]	Price ($/AF)[2]
2004	EWA	Kern County WA	D	35,000	$190
2004	Reclamation	Stevinson WD	D	9,350	$100
2004	Reclamation	Patterson WD	D	10,000	$100
2004	Reclamation	San Joaquin River Exchange Contractors	D	80,000	$120
2004	Reclamation	Broadview WD	D	5,400	$110
2004	Reclamation	Del Puerto WD	D	5,000	$65
2003	Reclamation	Westside Mutual Water Company	BN	10,000	$130
2003	EWA	Santa Clara WD	BN	20,000	$162
2003	EWA	Kern County WA	BN	125,000	$169
2003	Reclamation	Kern County WA	BN	20,000	$162
2003	Reclamation	San Joaquin River Exchange Contractors	BN	60,000	$120
2003	Reclamation	San Joaquin River Group Authority	BN	58,064	$74
2003	Reclamation	San Joaquin River Group Authority	BN	12,500	$65
2002	Reclamation	Lost Hills WD	D	3,550	$120
2002	Reclamation	Patterson WD	D	825	$80
2002	Reclamation	Banta Carbona ID	D	4,000	$80
2002	EWA	Kern County WA	D	97,400	$181
2002	Reclamation	San Joaquin River Exchange Contractors	D	64,500	$120
2002	Reclamation	Del Puerto WD	D	2,000	$64
2002	Reclamation	Broadview WD	D	4,000	$100
2002	Reclamation	Banta Carbona ID	D	2,000	$63
2001	Reclamation	San Luis WD	D	3,100	$125
2001	EWA	Semitropic WSD, Tulare ID	D	15,000	$300
2001	Reclamation	San Luis Canal Company	D	16,000	$150
2001	EWA	Cawelo WD, Kern County WA	D	5,000	$360
2001	EWA	Santa Clara WD, Kern County WA	D	30,000	$290
2001	Reclamation	San Joaquin River Exchange Contractors	D	49,000	$135
2001	EWA	Westside Mutual, Tejon-Castaic, Dudley Ridge WDs	D	21,000	$280
2001	EWA	Westside Mutual Water Company	D	15,000	$138
2001	EWA	Kern County WA	D	10,000	$280
2001	EWA	Kern County WA	D	10,000	$460
2001	EWA	Buena Vista, Rosedale, West Kern WDs	D	23,718	$280
2001	EWA	Rosedale Rio Bravo WSD	D	19,026	$138
2001	EWA	Arvin Edison WSD	D	10,000	$138
2001	EWA	MWD	D	50,000	$75
2001	Reclamation	West Stanislaus ID	D	3,000	$105
2001	Reclamation	West Stanislaus ID	D	2000	$75
2000[1]	Reclamation	CVP	AN	72,280	$138
2000	Reclamation	San Luis Canal Company	AN	16,500	$125

TABLE 4.4 (CONT.) HISTORICAL SPOT MARKET WATER PURCHASES SOUTH OF THE DELTA

Year	Buyer	Seller	Year Type	Quantity (AF)[2]	Price ($/AF)[2]
2000	Reclamation	San Joaquin River Exchange Contractors	AN	21,500	$110
2000	Reclamation	Tri-Valley WD	AN	799	$62
2000	Reclamation	Hills Valley ID	AN	2,324	$61
2000	Reclamation	County of Tulare	AN	3,716	$64
1999	Reclamation	San Luis Canal Company	AN	5,905	$65
1999	Reclamation	San Luis Canal Company	AN	4,762	$60
1999	Stockton East WD	Oakdale and San Joaquin IDs	AN	30,000	$55
1999	Reclamation	Semitropic WSD	AN	6,112	$25
1999	Reclamation	San Joaquin River Exchange Contractors	AN	20,000	$60
1998	Reclamation	San Joaquin River Group Authority	W	30,000	$15
1997	Reclamation	San Joaquin River Exchange Contractors	W	40,000	$45
1997	Reclamation	San Joaquin River Exchange Contractors	W	10,000	$70
1997	Reclamation	Modesto ID	W	5,000	$70
1996	Reclamation	Merced ID	W	16,161	$50
1996	Reclamation	San Joaquin River Exchange Contractors	W	30,348	$45
1996	Reclamation	Semitropic WSD	W	6,047	$25
1995	Reclamation	Semitropic WSD	W	5,200	$25
1995	Central Coast Water Authority	Reclamation	W	13,750	$58
1995	Reclamation	San Joaquin River Exchange Contractors	W	25,000	$40
1994	Reclamation	West Side ID	C	691	$34
1994	Reclamation	San Luis Canal Company	C	12,000	$50
1994	Reclamation	Widren WD	C	12	$39
1994	Reclamation	West Stanislaus ID	C	12	$39
1994	Reclamation	Plainview WD	C	114	$38
1994	Reclamation	Patterson WD	C	191	$40
1994	Reclamation	Pacheco WD	C	28	$38
1994	Reclamation	Oro Loma WD	C	57	$37
1994	Reclamation	Mercy Springs WD	C	154	$36
1994	Reclamation	Banta Carbona ID	C	300	$35

KEY:
AF = acre-feet
EWA = Environmental Water Account
ID = Irrigation District
MWD = Metropolitan Water District of Southern California
SOD = South of the Delta
WA = Water Agency
WD = Water District
WSD = Water Storage District

1. *This water, purchased by Reclamation, was determined to be unneeded and later given to the EWA in 2001.*
2. *Prices and quantities do not include carriage losses or costs to convey water to point of use. Year types based on 60-20-20 San Joaquin River index (AN = above normal, BN= below normal, C=critical, D=dry, and W=wet).*

TABLE 4.5
HISTORICAL SPOT MARKET WATER PURCHASES NORTH OF THE DELTA

Year	Buyer	Seller	Year Type	Quantity (AF)	Price ($/AF)
2005	Westlands Water District	Sacramento River Settlement Contractors	AN	14,000	$115
2005	EWA	Yuba County WA	BN	4,600	$80
2004	EWA	Placer County WA	BN	20,000	$83
2004	EWA	Yuba County WA	BN	100,000	$88
2004	DWR (DYWPP)	Yuba County WA	BN	485	$88
2003	Reclamation (EWA)	Yuba County WA	AN	65,000	$85
2003	EWA	Oroville-Wyandotte ID	AN	4,915	$75
2003	MWD	Sacramento River Settlement Contractors	AN	50,000	$105
2003	DWR (DYWPP)	Butte Water District	AN	11,355	$105
2003	MWD	Richvale ID	AN	15,000	$105
2003	MWD	Western Canal Water District	AN	20,000	$105
2003	MWD	Glenn-Colusa ID	AN	60,000	$105
2002	EWA	Sacramento Groundwater Authority	D	7,145	$75
2002	Reclamation	Sutter Mutual Water Co.	D	1,202	$30
2002	Reclamation	Reclamation District #108	D	2,460	$30
2002	Reclamation	Natomas Central Mutual Water Company	D	855	$30
2002	EWA	Yuba County WA	D	135,000	$75
2002	CCWD	Yuba County WA	D	5,000	$75
2002	DWR (DYWPP)	Yuba County WA	D	22,050	$75
2002	Central San Joaquin WCD	South San Joaquin ID	D	20,000	$15
2001	EWA	Placer County WA	D	20,000	$75
2001	Westlands Water District	Sacramento River Settlement Contractors	D	160,000	$70
2001	DWR (DYWPP)	Western Canal Water District	D	16,755	$75
2001	DWR (DYWPP)	Browns Valley ID	D	8,000	$75
2001	DWR (DYWPP)	Yuba County WD	D	114,050	$75
2001	EWA	Merced ID	D	25,000	$75
2001	EWA	Yuba County WD	D	50,000	$100
2000	Reclamation	Merced ID	AN	24,748	$60
2000	EWA	Oroville-Wyandotte ID	AN	10,000	$75
2000	CCWD	Western Water Co.	AN	8,180	$65
1999	Sacramento County WA	Browns Valley ID	W	1,000	$50
1999	Reclamation	Oakdale & South San Joaquin IDs	AN	50,000	$60
1998	Reclamation	Corning, Proberta, Thomes Creek WDs	W	4,800	$38
1997	Reclamation	Yuba County WA	W	25,000	$50
1996	Sacramento County WA	Browns Valley ID	W	2,000	$75
1995	Reclamation	Sacramento River Water Contractors	W	57,809	$36
1994	Various SWP Users	DWR	C	115,083	$67.50
1994	Reclamation	Oakdale & South San Joaquin IDs	C	33,119	$50

TABLE 4.5 (CONT.)
HISTORICAL SPOT MARKET WATER PURCHASES NORTH OF THE DELTA

Year	Buyer	Seller	Year Type	Quantity (AF)	Price ($/AF)
1994	Reclamation	Oakdale & South San Joaquin IDs	C	15,000	$50
1994	Reclamation	Merced ID	C	15,000	$50
1994	Reclamation	Merced ID	C	13,450	$50
1994	Reclamation	CA Department of Fish and Game	C	15,855	$24

KEY: AF = acre-feet
CCWD = Contra Costa Water District
DWR = Department of Water Resources
DYWPP = Dry Year Water Purchase Program
EWA = Environmental Water Account
ID = Irrigation District
MWD = Metropolitan Water District of Southern California
SWP = State Water Project
WA = Water Agency
WCD = Water Conservation District

Notes: Prices and quantities do not include carriage losses or costs to convey water to point of use. Year types based on 40-30-30 Sacramento River index (AN = above normal, BN= below normal, C=critical, D=dry, and W=wet).

Information in these tables is based on existing and available information and may not include all historic transfers. In addition, costs do not include carriage losses, Delta or other pumping costs, or other delivery costs required to convey water to the point of use. It is provided for the purpose of illustrating general trends in the cost, frequency, location, and volume of spot market transfers over the past decade. Sources include Reclamation's Water Acquisition Program (http://www.usbr.gov/mp/ cvpia/3406b3_wap/index.html), DWR's State Water Transfer Office (http://wto.water.ca.gov), information developed by the SWRCB, and various CALFED reports.

SWP contractors are restricted in that they are not allowed to directly purchase or sell unused SWP supplies contractor-to-contractor. The SWP Turnback Pool was created to facilitate the annual sale of unneeded Table A allocations back to SWP contractors. DWR determines the price of water in the Turnback Pool, which has remained relatively constant in recent years. Because it is essentially a closed market, the Turnback Pool has a relatively small impact on the price of spot market water. However, it does influence the demand for transfers by SWP water users in the greater spot market, particularly in wet years.

The majority of transactions on the spot market have been for environmental purposes, although the volume of these transfers has often been small. The WAP is a joint effort by Reclamation and the U.S. Fish and Wildlife Service to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve Reclamation's ability to meet regulatory water quality requirements. Reclamation has made annual spot market purchases for the WAP since 1994, targeting up to 163,000 acre-feet annually. The WAP has historically limited itself to annual transfers due to the Federal appropriations cycle. The price of these purchases has ranged from $15 per acre-foot to $150 per acre-foot. These prices may be lower than typical south-of-Delta spot market purchases because they are part of a mandated settlement. The majority of WAP purchases has been from within the CVP. WAP purchases have been limited in recent years by financial constraints and the increasing cost of water.

With the exception of the proposed transfer as part of the Lower Yuba River Accord, the EWA historically has purchased its supplies annually from the spot market. This generally has allowed the program to adjust to current year hydrologic and environmental conditions and reduce spills of

EWA supplies stored in CVP and SWP reservoirs. Initial EWA water acquisitions in 2001 were the most costly, largely because the program purchased two-thirds of its total water supplies from sources south of the Delta. In subsequent years, the program has adjusted its purchasing strategy to purchase more water from sources north of the Delta and has sought larger purchase volumes from fewer sellers. The price of EWA water purchased on the spot market has varied from $65 to $460 per acre-foot.

As shown in **Tables 4.4** and **4.5**, the EWA has paid more (on average) for its spot market supplies than the WAP. One reason may be that the WAP has the ability to purchase water directly from CVP contractors south of the Delta, while the EWA is restricted from purchasing Table A supplies directly from SWP contractors. As a result, many of the EWA's south-of-Delta purchases have been from stored supplies (such as Kern County groundwater banks), which include additional storage and conveyance costs. In addition, early EWA acquisitions targeted more costly south-of-Delta purchases; more recently, the program has adjusted its purchasing strategy to purchase water north of the Delta and is seeking longer-term transfer agreements.

Although a detailed statistical analysis was not performed for the purpose of this initial economic evaluation, spot market prices appear to have risen at a rate higher than normal inflation in recent years. As shown in **Figure 4.1**, prices for water purchases south of the Delta have typically been higher than for purchases north of the Delta, particularly in recent years. South-of-Delta transactions by water year type are shown in **Figure 4.2**. The figure also illustrates the relative increase in the number of spot market transactions, a trend that is expected to continue in the future as urban water users enter the market to meet growing demands. Because the spot market has only been established for a little over a decade, it is difficult to assess the influence of water year type and the volume of transactions on spot market prices.

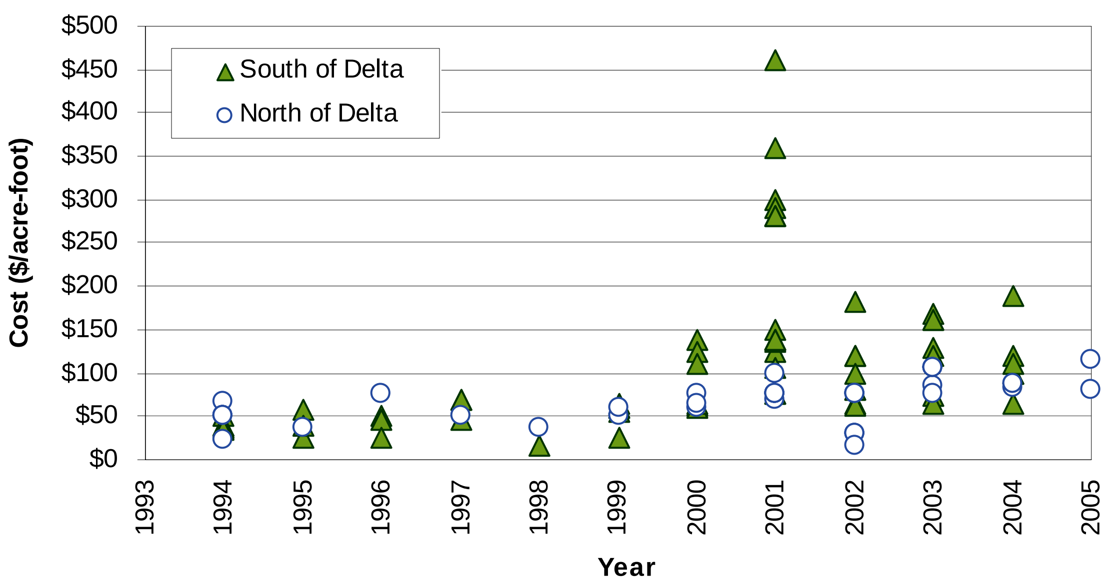

FIGURE 4.1 – COMPARISON OF HISTORICAL SPOT MARKET WATER PRICES NORTH OF THE DELTA AND SOUTH OF THE DELTA

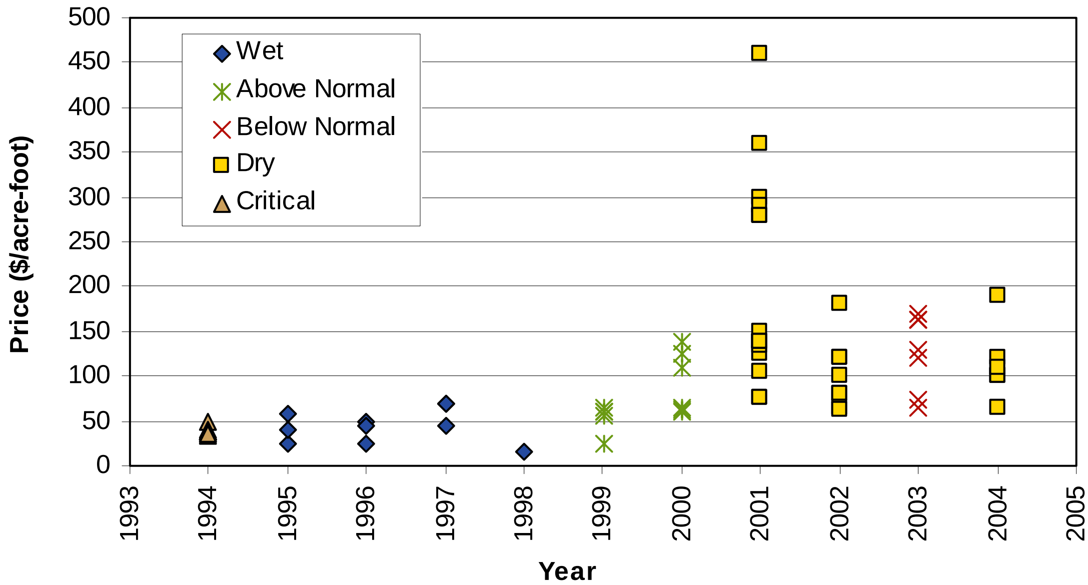

FIGURE 4.2 – COMPARISON OF HISTORICAL SPOT MARKET WATER PRICES SOUTH OF THE DELTA BY YEAR TYPE

Factors Influencing the Spot Market

The following sections discuss various factors that influence the price of water on the spot market, including demand, supply, and conveyance constraints.

Demand Considerations

Water demand considerations for environmental, agricultural, and urban water uses are summarized below.

Environmental

Environmental water demands have increased significantly over the past decade, particularly in the Delta. Primarily in response to environmental legislation and regulatory requirements, both the Federal and State governments have developed programs to reallocate and/or purchase water for environmental purposes. These programs include the CVPIA, Reclamation's WAP, the EWA, and others. As a result, programs that acquire water for environmental purposes have a significant effect on California's water transfer market. It is anticipated that the desire to purchase water for environmental purposes will continue into the future. The 2005 California Water Plan Update (Bulletin 160-05)(DWR) notes an estimate by Environmental Defense of well over 900 TAF per year in potentially unmet environmental water needs (primarily to achieve mandated instream flows). DWR included varying environmental water needs in the water demand scenarios presented in the 2005 Water Plan Update; environmental water demand increases for the three demand scenarios are summarized in **Table 4.6**. Consequently, environmental water acquisition programs are expected to continue to exert an influence on the spot market, particularly south of the Delta.

TABLE 4.6
SUMMARY OF 2030 WATER DEMANDS PRESENTED IN 2005 CALIFORNIA WATER PLAN UPDATE FOR VARIOUS DEMAND SCENARIOS

	Change in Demand from 2000 to 2030 (TAF)		
Scenario:	**Current Trends**	**Less Resource Intensive**	**More Resource Intensive**
Demand Type	Current population growth, population density, and conservation trends	Current population growth, increased density, and increased conservation	Increased population growth, decreased density, and decreased conservation
Environmental	494	987	0
Agricultural	-3,486	-2,818	-1,864
Urban	2,969	1,365	5,822
Total	**-23**	**-466**	**3,958**

Source: DWR 2005 California Water Plan Update, Bulletin 160-05.

Agricultural

Agricultural water demands vary by region and crop type, but additional reliability is generally needed in dry years to maintain permanent crops. In Bulletin 160-05, DWR estimates that agricultural demand will generally decrease over time (about a 5 percent decrease in irrigated crop area by 2030 according to the "Current Trends" scenario presented in the plan). Planting of permanent crops, such as almonds and grapes, has significantly increased in California over the last decade. The trend toward permanent crops and the use of water-efficient irrigation measures may lead to a hardening of agricultural demand in the future. Farmers are less likely to sell supplies needed to maintain orchards and other permanent crops during dry periods, resulting in less volume and flexibility on the spot market. While agricultural water districts are increasingly entering the water market to sell supplies to urban users, a few are still seeking water supplies (such as Westlands Water District).

Urban

Population is the primary driver behind growth in M&I water demand. Bulletin 160-05 does not make specific estimates for future water demand, but the previous bulletin published (Bulletin 160-98)(DWR, 1998) estimates that the State's urban water demand will increase by over 3 million acre-feet (MAF) per year between 1995 and 2020. This is largely in response to increased population. The California Department of Finance (CDF) estimates that population in the state will grow by about 14 million people to a total of over 48 million by 2030. Bulletin 160-05 examined several future water demand scenarios that included population increase at, below, and above the CDF estimates, combined with various water use and conservation assumptions. These scenarios illustrate a range of potential increases in urban water demand by 2030, from 1 MAF to almost 6 MAF (see **Table 4.6**). Based on CDF population growth predictions and current demand trends, Bulletin 160-05 anticipates about a 3 MAF increase in urban water demand by 2030 (DWR, 2005).

Supply Considerations

Various programs are currently examining the feasibility of developing new water supplies or increasing the reliability of existing supplies in the State. These efforts include integrated regional water management plans, conjunctive use, desalination, new surface storage, and groundwater banking projects. However, few major water supply projects are currently approved, entering construction, or in the final environmental planning stage (EIS/EIR) that would result in a significant increase in the State's water supplies, and it is difficult to anticipate what projects might be developed in the future. Projects that are under development, such as conjunctive management and recycled water, are likely to improve local supplies but may not contribute to statewide supplies. Despite the absence of new supplies on the horizon, population continues to grow and drive the demand for M&I water.

Because few significant new supplies of water are under development in California, future demands will likely be met through a combination of conservation/recycling, conjunctive management and other strategies that store excess supplies during wet periods, and reallocation from other uses. While increased conservation and recycling have the potential to slow the rate of shortages, they would also have the effect of increasing water prices. Reallocated supplies will likely move from agricultural to urban and environmental uses, facilitated by California's water markets.

Groundwater

Bulletin 160-05 indicates that California currently extracts 5.8 MAF from groundwater storage in normal years, increasing to over 14 MAF in dry years (DWR, 2005). These values are offset somewhat by the estimated 5.4 MAF returned to groundwater in wet years via recharge (both natural and active). Bulletin 160-05 also recognizes that most regions of the State are in a condition of groundwater overdraft, and reports a need for 1 MAF to 2 MAF of alternative supplies per year to eliminate groundwater overdraft, statewide. Currently, no programs are in place (or entering the environmental compliance stage) that would significantly change statewide groundwater management practices and reduce the potential for future overdraft conditions. Even with the addition of new groundwater development projects suggested in Bulletin 160-05, a statewide groundwater storage deficit is likely to remain. This suggests that in the future, it will not be possible to rely on either additional groundwater or groundwater overdraft as a reasonable resource management policy.

Hydrology

The historic hydrologic record in California generally extends back about 100 years. California's water management system was designed based on this relatively short hydrologic record. Uncertainties related to hydrology - such as the volume, timing, and location of precipitation and subsequent water supplies - are often difficult to quantify. Further, the potential impacts of climate change have yet to be seen in California's water markets, and there is much disagreement on how or when such changes might affect the State's water resources. Hydrologic variability is not addressed in this report, but may be considered as part of future risk and uncertainty analyses for the LVE.

Conveyance Constraints

The Delta has become the hub of California's water management system, moving water from the water-rich north to the water-poor south. The major CVP and SWP Delta pumping facilities – Tracy and Banks pumping plants – are relied on to export or "wheel" supplies from north to south. This includes both CVP and SWP contract supplies as well as water transfers. Pumping from Tracy and Banks is limited by biological requirements and may be further curtailed when at-risk fish are present. As shown in **Figure 4.3**, CVP and SWP demand at Tracy and Banks pumping plants currently exceeds allowable pumping during the summer months.

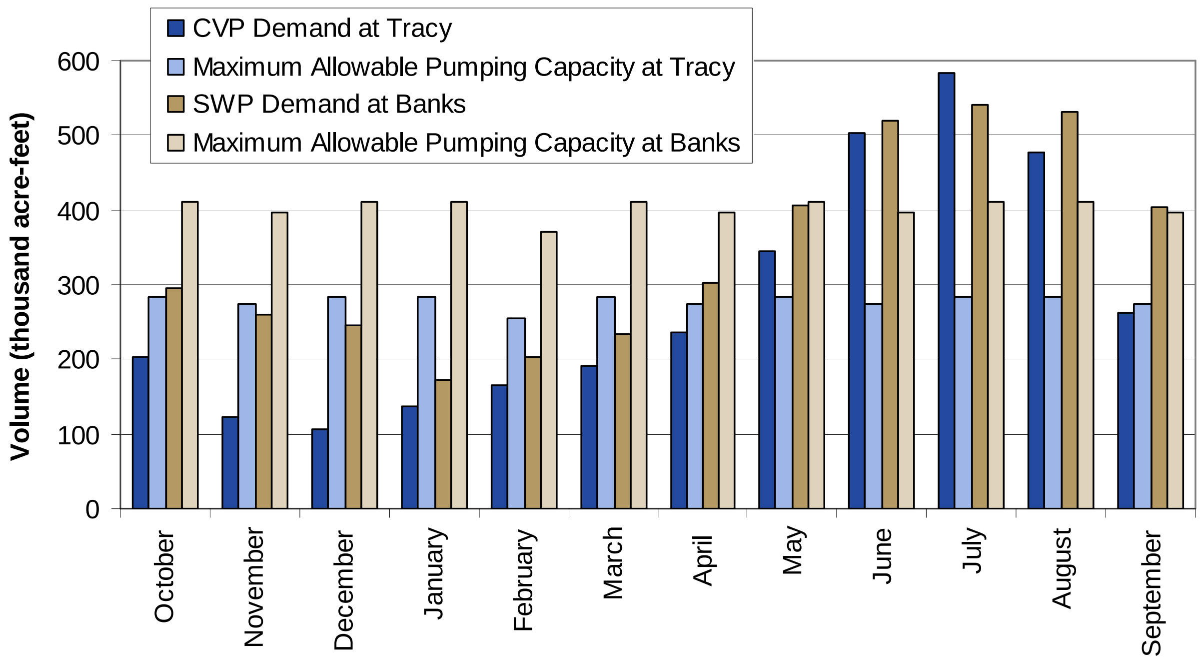

FIGURE 4.3 – COMPARISON OF CVP AND SWP DEMANDS AND ALLOWABLE PUMPING CAPACITIES AT TRACY AND BANKS PUMPING PLANTS, RESPECTIVELY

In recent years, instances have occurred in which capacity has not been available to transfer all desired supplies through these facilities. In 2003, for example, MWD negotiated water transfers with growers in the Sacramento Valley but was unable to move these supplies through the Delta because the conveyance system was flowing full; MWD also was unable store the water in Lake Oroville because the reservoir had filled in the late spring. These occurrences are likely to continue in the future and increase in frequency as the demand for water south of the Delta grows. Consequently, capacity at Tracy and Banks can have a considerable influence on the ability to move water south and on the subsequent price of south-of-Delta supplies on the spot market.

With pumping capacity limited, priority at the pumps also is an important factor. As illustrated in **Figure 4.4**, the highest priority is given to CVP and SWP contract supplies, followed by Phase 8 supplies, CVP and SWP contractor transfers, etc. Movement of non-CVP/SWP water transfers and environmental water has lower priority.

The EWA is granted 500 cfs of dedicated pumping capacity at Banks from July through September, or about 60 TAF per year. In comparison, the EWA's north-of-Delta water acquisition target ranges from 0 acre-feet in wet years to just over 153 TAF in critically dry years (see **Table 4.1**). In dry years, the EWA is often afforded additional capacity for transfers, but in wet years the CVP and SWP typically use all remaining Banks transfer season capacity. When EWA water cannot be transferred through the Delta, the program will typically try to store north-of-Delta purchases in CVP or SWP reservoirs until the summer (if space is available). Limits on the ability to move less costly, north-of-Delta wet year water supplies often create a need to purchase more costly south-of-Delta supplies. In addition to capacity available at the pumps, the export of supplies is limited by the capacity of the California Aqueduct and Delta-Mendota Canal.

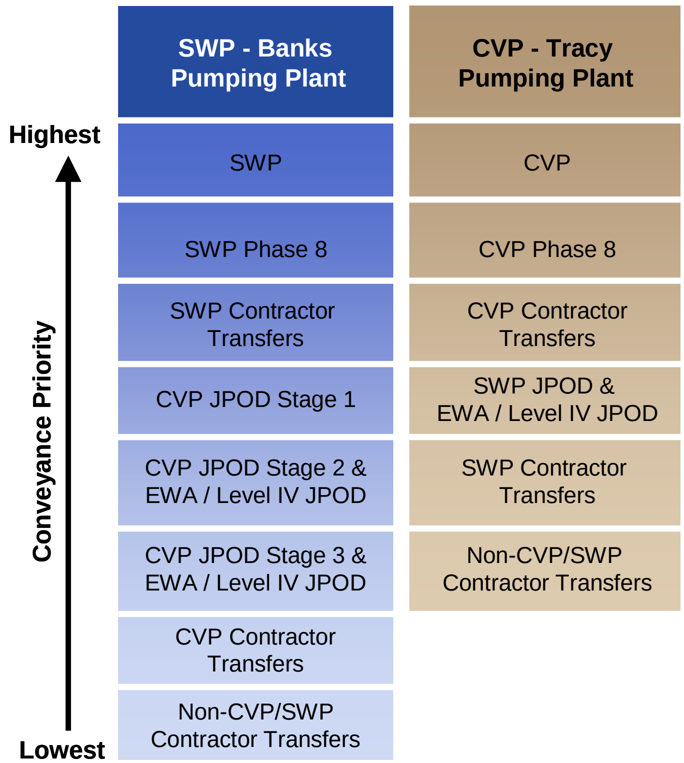

FIGURE 4.4 – RELATIVE PRIORITIES AT CVP AND SWP DELTA PUMPING FACILITIES

PRELIMINARY ESTIMATION OF FUTURE SPOT MARKET WATER PRICES

The EWA relies primarily on the spot market to purchase water supplies. Because the LVE has the potential to replace south-of-Delta EWA purchases, this analysis will focus on the likely future price of south-of-Delta spot market water purchases. In the future, the EWA is likely to continue to rely on south-of-Delta purchases to meet a portion of its demands due to physical and biological constraints limiting the movement of north-of-Delta purchases; the need to replace south-of-Delta SWP supplies interrupted by pumping curtailments; and need to repay debt in south-of-Delta reservoirs.

Because it is difficult to predict how water prices on the spot market might react to changes in supply and demand over the 100-year LVE planning period, this analysis estimates EWA benefits based on a range of potential future spot market water prices. This range reflects three potential future trends in prices: (1) prices do not increase at a rate greater than normal inflation, (2) prices increase according to historical observations, and (3) prices increase at a rate greater than normal inflation. This section describes the data and methods used to estimate future spot market prices and estimate a range of potential EWA replacement supply benefits for the alternative evaluated in this report.

This discussion is presented in three parts. The first part presents an assessment of how spot market prices might respond to future increases in urban water demand in the State. The second presents interim spot market prices developed by the CALFED Common Assumptions Economic Workgroup (CAEWG) and potential future price growth trends. The third summarizes EWA replacement supply benefits estimated for each of the price growth trends.

Assessment of Future Spot Market Conditions

In estimating future spot market prices, it is important to understand how the price of water on the spot market might respond to future disparities between water supplies and demands. The purpose of this approach is not to quantify the timing or magnitude of potential future water shortages, but rather to emphasize that under the stated assumptions, and without new water supply infrastructure, (1) M&I users will increasingly rely on the spot market to meet their future water needs, and (2) the spot market will respond to signals of supply shortage through increasing prices. The following sections present the data, assumptions, and methods used in this approach.

Data and Input

Data sources for the analysis include the California Water Plan Update (Bulletin 160-05)(DWR, 2005) for water demand and supply information, demographics reports on population growth through 2050 by CDF, the 2002 State Water Project Delivery Reliability Report (DWR), and various CVP annual delivery reports. Key data parameters are summarized in **Table 4.7**.

TABLE 4.7
SUMMARY OF ANALYSIS DATA AND PARAMETERS

Parameter	Value Used in Analysis	Source
Conveyance		
Space for Transfers at Banks (6,880 cfs)	134 TAF	CALSIM-II analysis
Space for Transfer at Banks (8,500 cfs)	331 TAF	CALSIM-II analysis
Water Balance		
Population	Growth rate varies over study period	California Department of Finance
Demand Factor (TAF per capita)[1]	0.244	Bulletin 160-05, Bulletin 160-98 (DWR, 2005;1998)
M&I Supply	8,900 TAF	Bulletin 160-05 (Volume 3, based on year 2000 supplies delivered for M&I)
San Joaquin Valley SWP Table A Contracts	1,183 TAF	State Water Project Delivery Reliability Report (DWR, 2002)
Market Information		
Desalination Cost: High Low	$1,200 /acre-foot $800 / acre-foot	Range based on cost of desalination facilities currently planned or under construction in California

KEY: CAEWG = Common Assumptions Economic Workgroup
cfs = cubic feet per second
EWA = Environmental Water Account
M&I = municipal and industrial
SWP = State Water Project
TAF = thousand acre-feet

Notes:
1. *Based on comparison of urban, industrial, and commercial water demands relative to supplies reported in Bulletin 160-05 and Bulletin 160-98. The value is adjusted downward to reflect the potential for increased conservation.*

Important analysis inputs include population growth, water demand, water supply, and conveyance constraints, as described below.

Population Growth

Population is a key driver of M&I water demand. **Figure 4.5** depicts potential population growth rate trends over the 100-year study period. Growth rates through 2050 are based on demographic estimates published by the CDF. Based on observed decreasing population growth in the CDF rates, two potential population growth trends are displayed after 2050 for discussion purposes: a 10 percent annual decrease in the growth rate, and a 20 percent annual decrease in the growth rate. For projections after 2050, it is assumed that population growth would not fall below zero (i.e., total population in the State would not decrease over the 100-year period of analysis).

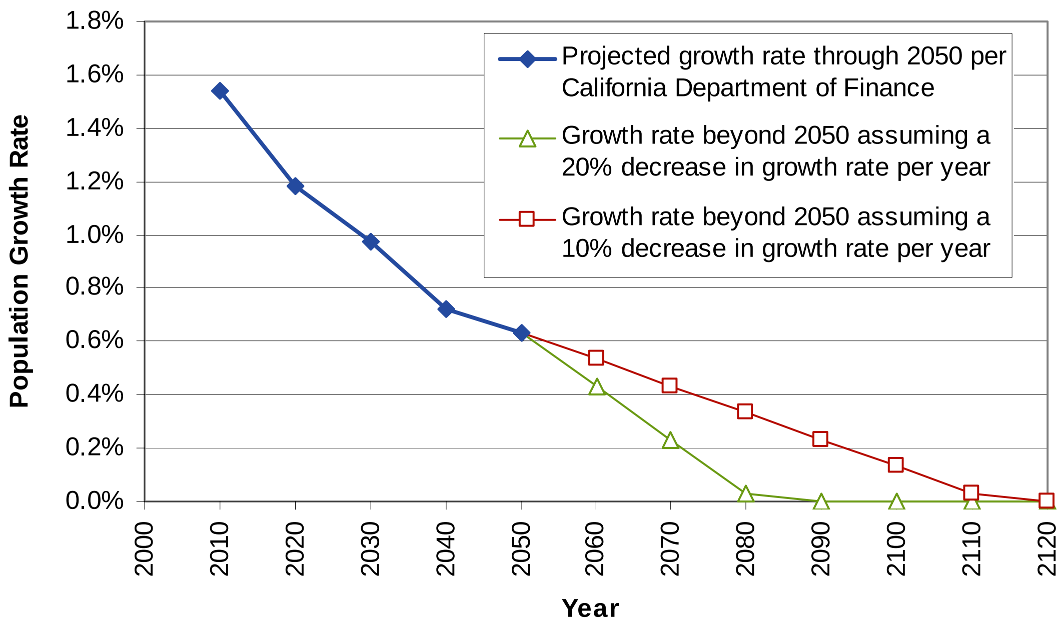

FIGURE 4.5 – TREND IN POPULATION GROWTH OVER PERIOD OF ANALYSIS

Figure 4.6 depicts statewide population over the period of analysis under the growth rate trends presented in **Figure 4.5**. Between 2010 and 2050, population is expected to increase from 38.8 million to over 54 million, based on CDF projections. After 2050, the figure indicates that total population will likely continue to grow but will level off over the study period.

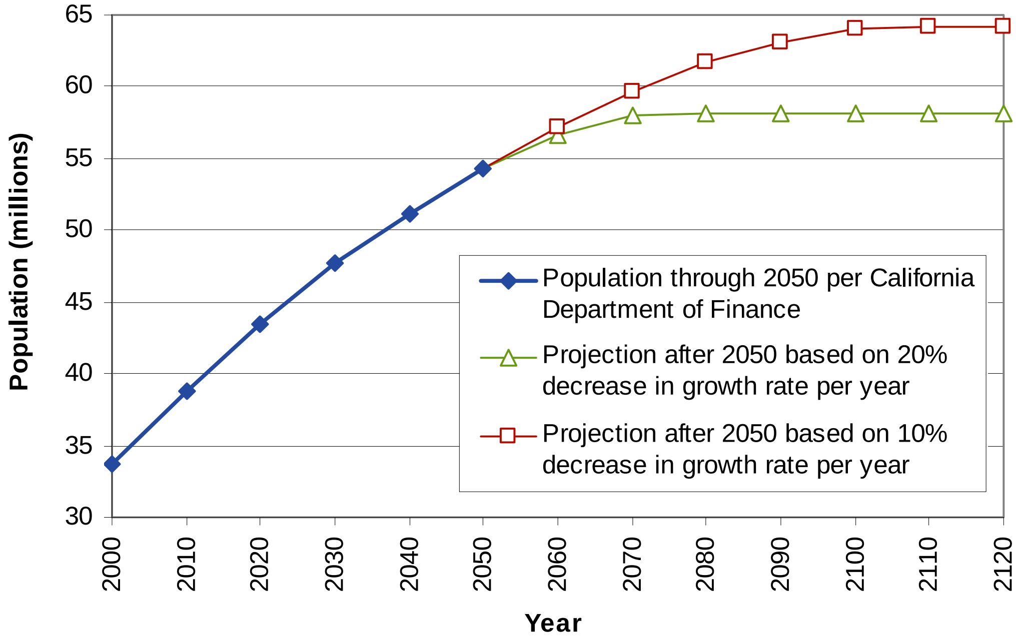

FIGURE 4.6 – POPULATION OF CALIFORNIA OVER PERIOD OF ANALYSIS

Urban Water Demand and Supply

Based on water year 2000 water demands for urban, industrial, and commercial users presented in Bulleting 160-05 (DWR, 2005), a water demand factor of 0.244 acre-feet/capita was used to calculate water demand. This factor was applied to the population sizes (shown in **Figure 4.6**) throughout the period of analysis to estimate potential future water demand. The resulting water demands, illustrated in **Figure 4.7**, are consistent with findings in Bulletin 160-05 through 2030. The growth in population, regardless of geographic location, affects the availability of water supplies statewide and creates a more competitive market.

Bulletin 160-05 (DWR, 2005) reports M&I water use in the State for 1999, 2000, and 2001. In 2001, an above normal water year, Bulletin 160-05 reports that 8.9 MAF of water were supplied to M&I users. For the purpose of discussion, this value is used as a surrogate for the volume of developed, deliverable water supplies in the State. This value, also shown in **Figure 4.7**, consists of SWP Table A contracts, CVP urban water supplies, and local water supplies. This value is used to represent available, developed water supplies because of the difficulty associated with estimating statewide water supplies and because 2000 was an above normal water year in which most contractual requests for water were met. It should be noted that the estimated 8.9 MAF does not account for hydrologic variability over the planning period. Also, the figure does not consider that, for various reasons, some M&I contractors may not have requested their full entitlements in 2000 (because demands have not been fully realized, or due to storage/conveyance limitations, for example). Further, potential exists to more aggressively use groundwater supplies, pursue higher conservation, and increase recycled water use, although it is uncertain whether these local supply measures could significantly increase statewide water availability. While it is understood that this value may not fully represent developed, available water supplies in the State for M&I use, it does provide an important indication of the potential disparity in future water supplies and demands.

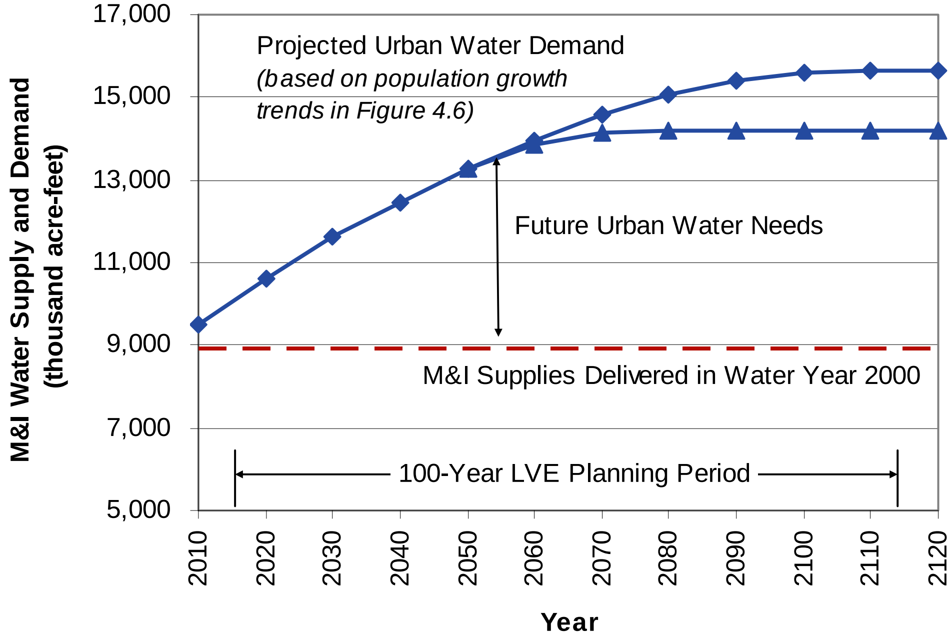

FIGURE 4.7 – ESTIMATED M&I WATER DEMAND OVER PERIOD OF ANALYSIS

Figure 4.7 illustrates that future urban water needs could increase to over 6 MAF by the end of the LVE planning period due to population growth, the resulting increase in urban water demand, and a lack of new water supply infrastructure in the final development stages that would significantly contribute to State water supplies.

Role of Transfer Markets in Meeting Water Shortages

With an understanding that few new supplies are planned, permitted, or financed that would significantly contribute to existing water supplies, potential for supply augmentation is limited. The transfer market will grow in importance over time, largely because of its ability to move water from areas of high supply to areas of high demand. An important dynamic of water supplies is that they need to be both temporally and spatially available (water when needed, where needed). The temporal availability of water is largely a function of storage and conveyance. Without adequate storage and conveyance, excess supplies cannot be moved and stored during wet periods for later use during dry periods. The spatial availability of water is similarly affected; without adequate storage and conveyance capacity, supplies cannot be moved from water rich to water poor areas, or from high supply to high demand areas. Conveyance is already a limiting factor in the movement of water through the Delta during certain periods, an occurrence that is likely to increase in the future as more users enter the transfer market.

For users south of the Delta, reliance on north-of-Delta transfers is risky, given conveyance constraints during wet, above normal, and below normal years due to physical and environmental limitations. Once Delta conveyance constraints are reached, additional north-of-Delta supplies become irrelevant for the market. Such a condition occurred in 2003 when MWD was unable to transfer additional north-of-Delta supplies due to conveyance constraints. In addition to pumping and conveyance limitations associated with the major Delta export facilities, other conveyance limitations may arise in the future, depending on the timing and location of demands/supplies. Use of south-of-Delta water supplies is also constrained by Table A contracts and associated transfer restrictions, particularly for meeting SWP demands.

While future M&I shortages appear likely, uncertainty exists regarding when and where shortages might be realized. **Figure 4.8** depicts the potential effect that transferring north-of-Delta water at Banks Pumping Plant capacities of 6,880 cfs and 8,500 cfs could have on potential shortages, and on the effect that transferring all SWP San Joaquin Valley Table A water to urban users could have on potential shortages. This is not to imply that San Joaquin Valley water should be transferred, but rather to demonstrate that the ability of water transfer markets to satisfy future water demands is limited by conveyance constraints and contractual agreements.

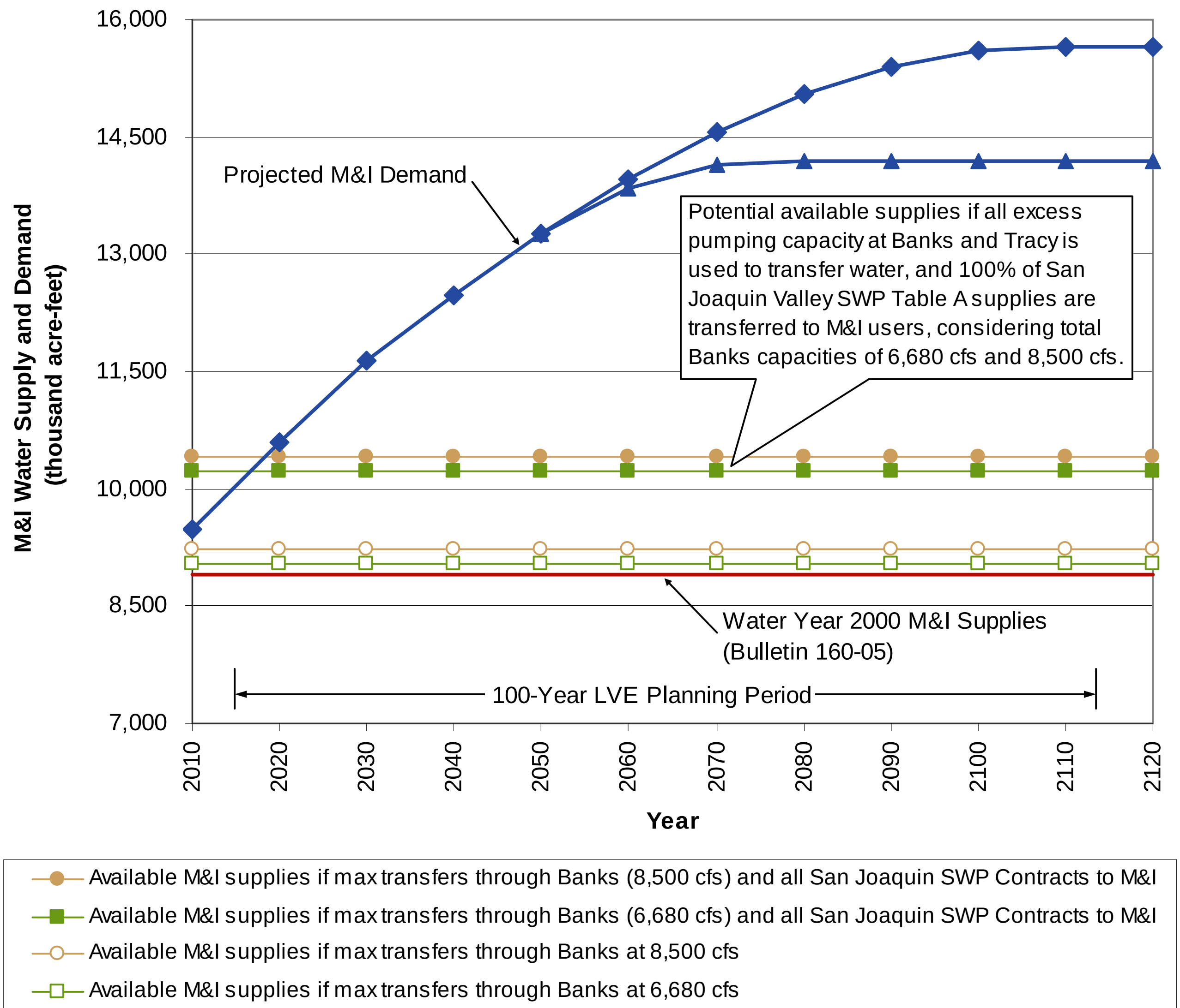

FIGURE 4.8 – LIMITED POTENTIAL OF NORTH-OF-DELTA AND SAN JOAQUIN VALLEY SWP SUPPLIES TO REDUCE FUTURE SHORTAGES

The implication of **Figure 4.8** is that in the future, demands will likely be greater than water supplies, and that conveyance constraints will limit the ability of north-of-Delta supplies to ameliorate the shortages. The strong assumption that all SWP Table A San Joaquin Valley water supplies would be transferred to urban uses underscores that relying on existing contracts to meet demands south of the Delta is likely insufficient.

In response to increasing urban water needs, and the deficiency of planned new supplies, urban water users will likely rely increasingly on water transfers in spot markets to bridge the gap between supply and demand. As early as 2020, traditional sources of spot market supply may be unable to respond to price signals and put more water on the market, because of conveyance and contract constraints. Unlike many other commodities subject to supply and demand, no substitutes exist for water, which is essential to life.

The implication of this finding is that as urban water demands increase, prices on the spot market will increase without significant augmentation of supply and associated conveyance improvements. As competition for water increases, prices will continue to increase. The inability of supply to respond to the growing water needs of the State will cause water prices to rise faster than the rate of inflation. That is, water prices will increase faster than the prices of other goods, due to scarcity. The effect of scarcity on water prices is built into the water market process through both demand and supply relationships. From the demand side, water is a necessary good for which there is an absolute need and no substitute. From the supply side, conveyance, hydrology, and regulatory constraints limit annual availability.

Potential Future Spot Market Price Growth Trends

The shortages and constraints described above suggest that the price of water in the spot market will increase over time faster than the rate of inflation. Because it is not possible to know precisely the timing or rate at which water prices might increase in the future, three future spot market price trends are presented in this analysis: 0 percent growth rate above inflation, 1.1 percent growth rate above inflation, and 2 percent growth rate above inflation. The methods and assumptions used to estimate these price trends are described below.

The CALFED Common Assumptions Economic Workgroup (CAEWG), to support ongoing plan formulation efforts by the CALFED storage projects, has developed preliminary methodology and estimates for 2020 water market prices for use in valuing EWA benefits. While the ways in which the various CALFED storage projects could provide EWA benefits differ, the interim methodology developed by the CAEWG provides useful information for initial economic evaluations in the plan formulation stage.

The interim CAEWG estimates of EWA water acquisition prices are based on historical transfer prices, recent trends in water transfer acquisitions, and an initial estimate of the effect of acquisitions on prices. The interim estimates are intended to provide preliminary values for use in plan formulation; more detailed analyses are ongoing and/or planned to support more rigorous feasibility-level economic analyses. Interim CAEWG estimates were used to establish the starting price of water for the three spot market growth trends considered in this analysis. The CAEWG made an interim recommendation that EWA acquisition prices would increase annually by 1.1 percent over inflation, which is represented in one of the growth trends presented in this analysis.

The CAEWG estimated this real price escalator from historical EWA water acquisitions between 2001 and 2004. The analysis recognizes that the history of EWA water market transactions is limited, both in the number of transactions and hydrologic conditions experienced, and that market imperfections have occurred during this period.

CAEWG interim maximum purchase prices for 2004 development conditions (at 2004 prices) are shown in the first column of prices in **Table 4.8**. The prices are termed "maximum" because they represent the most expensive 150,000 acre-feet of EWA water purchased. These interim values have been used in this analysis based on the assumption that the LVE would replace the most expensive increment of EWA water purchases. Since the average yield of the alternative evaluated in this report (104,200 acre-feet per year) is less than the 150,000 acre-feet per year used by the CAEWG to estimate the maximum prices, use of these values may underestimate actual benefits.

The 2004 CAEWG prices were escalated to 2006 prices using the Gross Domestic Product (GDP) Implicit Price Deflator. This adjustment estimates the prices for 2004 development conditions in 2006 prices, shown in the second column of prices in **Table 4.8**. The weighted average of the estimated EWA prices is also shown in **Table 4.8**. These values reflect the percent of time each year type occurs and the average volume of EWA purchase in each year type.

TABLE 4.8
INTERIM CAEWG EWA PURCHASE PRICES

Year Type	Frequency of Occurrence	CAEWG Interim Maximum EWA Purchase Price Per Acre-Foot, South-of-Delta	
		2004 Development Conditions (2004 Prices)[1]	2004 Development Conditions (2006 Prices)
Wet	28.8%	$151	$160
Above Normal	14.0%	$172	$182
Below Normal	19.2%	$190	$201
Dry	16.4%	$268	$284
Critical	2.4%	$268	$284
Driest Years[2]	19.2%	$321	$340
Weighted Average Price		**$203**	**$215**

KEY: EWA = Environmental Water Account; CAEWG = Common Assumptions Economic Workgroup

Notes:
1. *The CAEWG maximum price reflects the price paid for the most expensive 150,000 acre-feet of water purchased by the EWA under 2004 development conditions, expressed in 2004 dollars.*
2. *Driest years include 1924, 1929-1934, 1977, and 1987-1992.*

The interim CAWEG prices for 2004 demand conditions (at 2004 price levels) were used to estimate prices for future development conditions over the 100-year planning period (2016 to 2115), using the growth trends selected for analysis. The spot market water price was constrained by an upper bound, rather than allowing the prices to increase over time without any limit. For the purpose of this initial economic evaluation, two bounds were selected, $800 per acre-foot and $1,200 per acre-foot, reflecting the range of current estimates for the cost of desalting brackish water. These costs do not include conveyance necessary to deliver supplies to users and brine disposal costs. Desalination often is considered as an incremental source of water supply in California. Although it is unlikely that desalination will provide all of the water needed to close the estimated gaps between water demand and supply in future, the per-unit cost of desalination is helpful as a conservative guide to the upper bound of water prices in the spot market. The anticipated water price paths, based on growth rates of 0 percent, 1.1 percent, and 2 percent above inflation, are depicted in **Figures 4.9** and **4.10**.

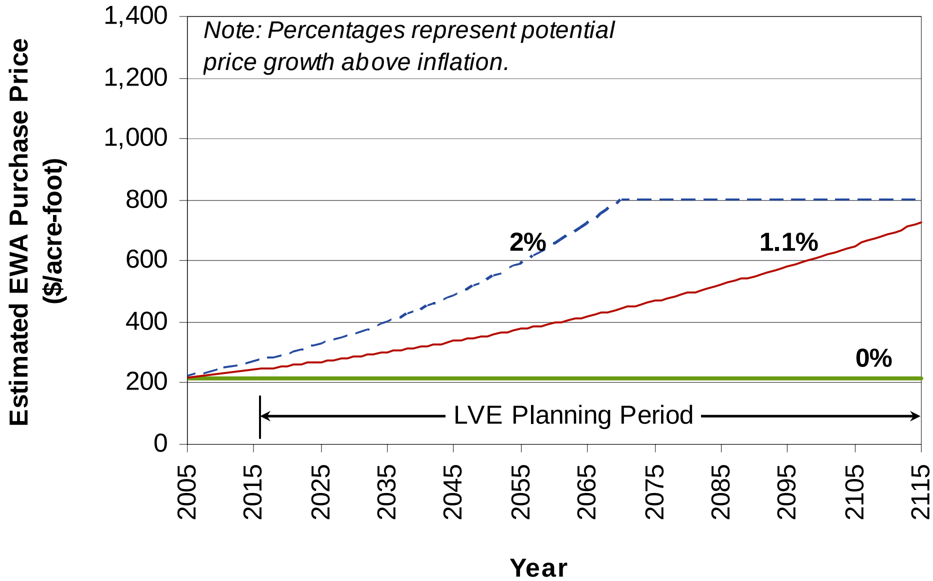

FIGURE 4.9 – PROJECTED EWA SPOT MARKET PURCHASE PRICE OVER LVE PLANNING PERIOD WITH $800 PER ACRE-FOOT PRICE CAP

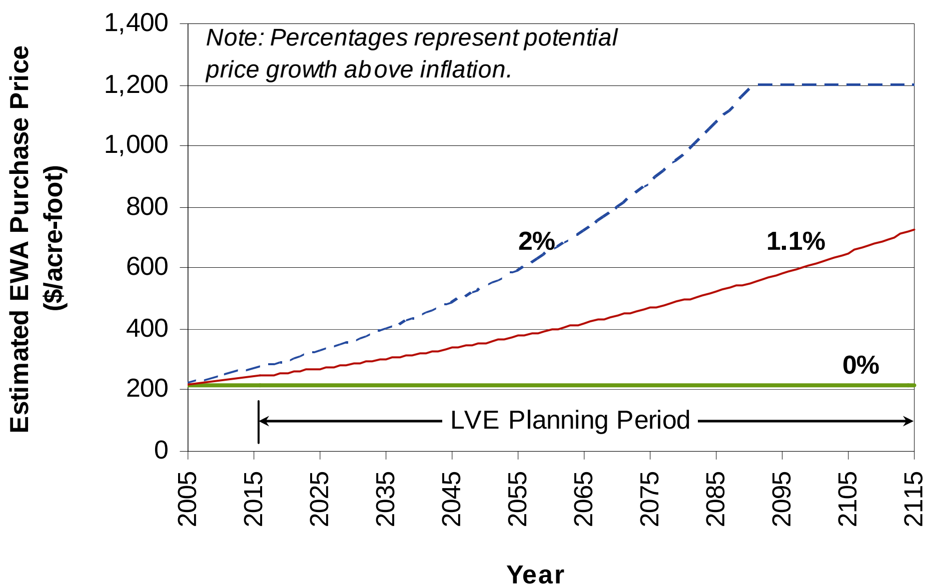

FIGURE 4.10 – PROJECTED EWA SPOT MARKET PURCHASE PRICE OVER LVE PLANNING PERIOD WITH $1,200 PER ACRE-FOOT PRICE CAP

The figures show that only the 2 percent price trend reached the $800 per acre-foot and $1,200 per acre-foot price caps. As described previously, each analysis uses an initial weighted average price of water in 2004 of $215 per acre-foot (2006 price levels), as shown in **Table 4.8**.

Estimated EWA Replacement Supply Benefits

Table 4.9 summarizes the net present value and equivalent annual benefit of the avoided costs of EWA spot market purchases for the assumed rates of future real price growth. For the 2 percent price trend, values assuming the $1,200 per acre-foot price cap are shown. These benefits were developed by applying the estimated spot market purchase prices to the estimated annual EWA deliveries for the alternative evaluated in this report (104,200 acre-feet per year, average), escalated at rates of 0 percent, 1.1 percent, and 2 percent. The 0 percent growth rate is presented as a low book end for the purpose of this initial economic evaluation, but this trend is unlikely to occur. A 4 percent growth rate was also examined as a high book end, but is not presented in the table because the lower growth rates resulted in positive net benefits. Future benefits were discounted to the base year (2016) using the current Federal discount rate of 5-1/8 percent. As shown, the average annual value of EWA replacement supplies for the alternative evaluated in the report could range from about $22.6 million to $44.5 million.

TABLE 4.9
VALUE OF EWA PURCHASES REPLACED BY THE ALTERNATIVE EVALUATED IN THIS REPORT UNDER POTENTIAL FUTURE PRICE GROWTH RATES

	2006 Prices ($ millions)		
	0 Percent Real Price Escalation	1.1 Percent Real Price Escalation	2 Percent Real Price Escalation
Net Present Value	$437.2	$626.2	$862.3
Equivalent Annual Value	$22.56	$32.31	$44.50

CHAPTER 5
PRELIMINARY PROJECT FEASIBILITY ASSESSMENT

This section presents the results of a preliminary economic evaluation for the alternative selected for analysis in this report. The results of the economic evaluation are presented in two ways, first, using a preliminary assessment of the net economic benefits, and second, as a benefit-cost measure. Each of the measures presented herein is preliminary in nature, and is not at the level of detail typically required of a feasibility-level economic analysis or for seeking Congressional authorization and appropriations.

To allow for the comparison of alternatives with different time frames and varying costs or benefits over time, benefits and costs are typically amortized over the project life to yield annualized benefits and costs. The two comparisons made in this preliminary assessment are summarized below:

$$\text{Net Benefits} = \text{Average Annual Benefits} - \text{Average Annual Costs}$$

$$\text{Benefit-Cost Ratio} = \frac{\text{Average Annual Benefits}}{\text{Average Annual Costs}}$$

Estimates are based on a 100-year project life cycle and concept-level engineering designs, costs, and benefit estimations, and are presented at 2006 price levels. The stream of annual benefits and costs has been adjusted (discounted) to the base year of 2016.

As described in **Chapter 2**, the alternative selected for analysis in this report includes the following major elements:

- Raise the existing Los Vaqueros Dam in-place to create a reservoir with a total capacity of 275 TAF
- Expand the existing Old River intake and pumping plant by 170 cfs to a total capacity of 420 cfs
- Construct a new 350 cfs pipeline from the expanded Old River intake to the existing Transfer Facility (paralleling the existing 320 cfs pipeline to provide total conveyance of 670 cfs from the Delta to the Transfer Facility)
- Replace the existing Transfer Facility balancing reservoir with a larger, 8 MG reservoir
- Construct a new 470 cfs pump station at the Transfer Facility and replace pumps in the existing 200 cfs transfer pump station, for a total transfer capacity of 670 cfs to the expanded reservoir
- Construct a new 670 cfs pipeline from the Transfer Facility to Los Vaqueros Reservoir

- Construct a new 175 cfs pump station and new pipeline to convey water from Los Vaqueros Reservoir to the SBA at the Dyer Canal

The average annual yield in terms of EWA replacement supplies is estimated as 104,200 acre-feet per year for this alternative, based on preliminary model simulations (see **Chapter 2** for modeling conditions). This alternative is used only for the purpose of preliminary economic analysis in this report to determine if a potentially feasible alternative exists under current plan formulation parameters. The following sections summarize and provide a comparison of net costs and benefits for this alternative.

ESTIMATED PROJECT BENEFITS

The following potential project benefits were included in this initial analysis: EWA replacement supplies, Bay Area emergency water supply, Bay Area water quality, and fishery protection benefits. Average annual benefits for the alternative selected in this report are summarized in **Table 5.1**.

TABLE 5.1
SUMMARY OF AVERAGE ANNUAL PROJECT BENEFITS

Project Purpose	Annual Value of Benefits 2006 Prices ($ millions)
EWA Replacement Supply	22.6 to 44.5
Water Supply Reliability	0.0
Emergency Water Supply	5.0
Water Quality	5.5
Fishery Protection	1.7
Total Annual Benefits	**34.8 to 56.7**

KEY: EWA = Environmental Water Account

The range in EWA benefits displayed in **Table 5.1** reflects a range of potential spot market price growth paths from 0 percent to 2 percent (above inflation), assuming a $1,200 price cap (representing the cost of desalinating brackish supplies). The fact that small differences in price growth patterns or price caps can result in large benefit differences underscores the potential risk of relying on spot markets to provide reliable water supplies over the longterm. Details regarding these calculations can be found in **Chapter 4.**

Although EWA benefit valuation was a primary focus of this report, a preliminary estimate of other potential project benefits was also made. Water supply reliability, water quality, and fishery benefit methods are described in **Chapter 4,** and preliminary estimates for these potential benefits are summarized briefly below.

Emergency Water Supply Benefits

The reservoir expansion alternative selected for analysis in this report was operated primarily to provide EWA replacement supplies. Although no yield was dedicated to improving Bay Area water supply reliability, the project would provide emergency supplies in the event of an earthquake or levee failure in the Delta. Consequently, the water supply reliability benefits calculated for the alternative are based solely on preliminary estimates of the value of these emergency supplies. Future analyses will evaluate the economic tradeoffs associated with supplying water for the EWA versus urban supply reliability purposes.

Emergency storage benefits are the value of supplies stored in Los Vaqueros Reservoir in the event of a major levee failure in the Delta that would significantly degrade water quality, or a major earthquake in the Bay Area that would disrupt the ability of Bay Area water agencies to import water into their service areas. With a connection from Los Vaqueros to the SBA, the expanded reservoir could deliver (either directly or by exchange) to nearly any Bay Area water agency. The amount of water available for emergency purposes is estimated as the average reservoir storage with the expanded reservoir, less the average storage without the expansion. On average, the expected available emergency storage supply is 143,400 acre-feet. For the purpose of this initial economic analysis, the value of this water during an emergency was conservatively estimated to be $1,700 per acre-foot (2006 price levels). Various estimates exist of the probability of levee failures and large earthquakes on the three major faults that cross the study area. Based on work by others, the combined probability of an earthquake or levee emergency occurring is estimated as once in every 50 years, or a 2 percent chance in any year. Using these values, the economic benefit of additional water stored in an expanded Los Vaqueros Reservoir is estimated to be about $5.0 million per year (2006 price levels). These estimates are preliminary and future analysis would be needed to refine the methodology and estimates for inclusion in a feasibility report.

Water Quality Benefits

Water quality benefits result from improvements to the water quality of municipal supplies. These improvements fall into three categories:

1. Lower consumer costs associated with changes in TDS and TH
2. Lower groundwater management costs through recharging the local groundwater basins with lower TDS water
3. Lower water treatment costs through delivering water with lower turbidity, TOC, and bromides

The alternative evaluated in this report would result in water quality improvement to SBA users; CCWD would not experience any improvements over future without-project conditions. Consumer-related water quality cost savings were estimated using methodologies developed by Sonnen (2002) for initial studies of the Los Vaqueros expansion. The economic benefit was estimated by subtracting the consumer costs for the without-project condition from the costs of the with-project condition. These cost savings were estimated for agencies receiving water from the SBA. The analysis estimated that 248,000 households receive treated water from the SBA. The analysis also assumed that CCWD would receive no water quality improvements from the expansion project. The estimated water quality benefits of the alternative evaluated in this report are summarized in **Table 5.2**.

TABLE 5.2
SUMMARY OF ESTIMATED WATER QUALITY BENEFITS

Benefit Type	Annual Benefits (2006 Prices)
Consumer Savings	$3.2 million
Groundwater Management	$2.3 million
Water Treatment Plant Savings[1]	Not estimated
Total Water Quality Benefits	**$5.5 million**

Notes:
1. The value of reduced costs at water treatment plants was not estimated in this initial economic evaluation.

Several categories of consumer costs savings were used to estimate the economic benefits:

- Reduced bottled water purchases (accounting for about $0.61 million per year in avoided costs)
- Longer life of household appliances, plumbing, and fixtures (accounting for about $2.05 million per year in avoided costs)
- Lower use of home water softeners (accounting for about $0.43 million per year in avoided costs)
- Reduced purchases of soaps and detergents (accounting for about $0.02 million per year in avoided costs)

These benefits accrue when water supplies with lower TDS and TH are delivered to households served by water treatment plants that receive water from the SBA. The benefits are equivalent to a savings of about $12.50 per household per year.

Economic benefits from lower groundwater basin management costs were estimated using the avoided cost approach. The with-project condition delivers lower TDS water for groundwater recharge in the SBA service area. Groundwater recharge occurs from two primary sources: active recharge via spreading basins, and passive recharge from outdoor irrigation of urban landscapes. The with-project condition reduced the average annual salt loading to the groundwater basins by 2,300 tons (TDS). To achieve the same reduction in salinity would require desalination of these supplies prior to recharge. The avoided cost of desalination is estimated to be $1,000 per ton TDS, resulting in an avoided treatment cost of $2.3 million annually. This value is equivalent to about $22 per acre-foot recharged.

Savings in water treatment plant operating costs were not estimated as part of this evaluation. CCWD is currently developing a detailed water quality model that will estimate the water quality parameters of interest in this benefit category. This model is expected to be available by the end of 2006, and available for use in subsequent feasibility analyses.

Fishery Benefits

Fishery benefits could potentially fall into the category of other direct benefits for the NED analysis. Water delivered to the SBA from Los Vaqueros Reservoir would be diverted from the Delta through modern, positive-barrier fish screens similar to the existing fish screens at CCWD's Old River intake and pumping station. Currently, water delivered to the SBA passes through Clifton Court Forebay, which does not have fish screens. The economic benefit of diverting water through a screened intake versus an unscreened intake could be valued in several ways. For the purpose of this initial economic analysis, two potential methods were considered:

- **Avoided cost of fish screens at Clifton Court –** The first method estimates the fishery benefit as the cost of providing a fish screen of equivalent size (170 cfs) and type at Clifton Court Forebay. The cost of installing new screens at Clifton Court Forebay has been estimated by others to range between $1.0 and $1.5 billion for an ultimate capacity of 10,500 cfs. This cost is roughly equivalent to between $95,000 and $143,000 per cfs screened. Over a 100-year project life, and using the same assumptions concerning replacement costs and O&M used in the construction cost estimate for the expansion alternative, this results in an annual avoided cost of between $1.3 and $1.9 million.
- **Valuation using CVPIA fishery mitigation charge –** This valuation approach is based on the fish and wildlife mitigation charge for CVP contractors, established by Congress through the CVPIA, to pay for fishery protection and other environmental projects. This charge is currently $16 per acre-foot for CVP M&I contractors. Applying this valuation to the average annual EWA supply of 104,200 acre-feet developed by the alternative under evaluation would result in an annual economic benefit of about $1.71 million.

For the purpose of this initial economic evaluation, the CVPIA mitigation charge valuation method resulting in an economic benefit of $1.67 million was used. Further analysis is needed to better define the nature of potential fishery benefits and the methods to value the benefits, if appropriate.

Lower Cost EWA Water Supply

The lower cost EWA water supply developed through this project will be a key part of the NED analysis. The P&G note that cost reduction benefits apply when the same level of output is attained at lower cost. This is the assumption of identifying whether LVE can provide a lower cost alternative to meeting current EWA objectives and accomplishments.

The benefit of the LVE project will be the avoided spot market water purchases, given that the net present value of the average annual costs of the project is less than the market. The annual spot market value used will depend on the year, ultimate price path projection, and appropriate market cap applied.

IMPLEMENTATION COSTS

Total implementation costs include construction cost, IDC, and annual O&M and replacement costs.

Construction Cost

Designs and costs are based primarily on the cost to construct the existing Los Vaqueros Project facilities, which were completed in 1997. The facility cost estimates use existing appraisal-level engineering and designs and unit cost data presented in the *Project Cost Estimate Methodology Technical Memorandum* (CALFED, 2004a). Unit costs were updated from 2002 to 2006 prices using the Engineering News Report Construction Cost Index (CCI) for the San Francisco Region. The total first cost includes 15 percent for unlisted items and an additional 25 percent contingency, per Reclamation guidance for appraisal-level cost estimates. To obtain an estimate of total implementation cost, 25 percent was added to the total field cost to account for engineering design, construction inspection, administrative, and legal costs. Lands and easements required for implementation and mitigation costs were not specifically calculated, but are believed to be represented within the unlisted items and contingencies. The cost estimates in this report are not intended to be at the feasibility-level required to request project authorization or appropriations for construction.

A construction period of 3 years is assumed for the 275 TAF reservoir and related facilities, based on preliminary engineering and construction scheduling. Construction would be completed by the end of 2015, and the project would be operational starting in 2016. This schedule is based on the following assumptions: (1) a ROD will be made in early 2009, with Congressional authorization and appropriations available to commence design work in 2010, and (2) funding and other limitations will not impact the implementation schedule. It is also assumed that all future without-project conditions are fully realized when the expanded reservoir becomes functional (i.e., the AIP would be in place).

Interest During Construction

IDC accounts for costs incurred during the construction period. Interest is computed using the project discount rate of 5-1/8 percent from the construction start date to the beginning of the period of analysis. IDC is applied to total field cost (including unlisted items and contingencies, but excluding engineering design, inspection, administrative, and legal costs). IDC was calculated based on 2006 construction dollars.

Annual Operation, Maintenance, and Replacement Costs

Annual O&M and replacement values were developed as percentages of facility field costs (including unlisted items and contingencies). The O&M percentages are based partially on industry averages but primarily on actual O&M costs incurred by CCWD for the existing Los Vaqueros Project. Replacements are assumed to occur every 40 years and are expressed as a percentage of total pump station and substation/transmission facility costs. Percentage of facility costs for annual operation (excluding power), maintenance, and replacement are summarized in **Table 5.3**.

TABLE 5.3
ANNUAL OPERATION, MAINTENANCE, AND REPLACEMENT

	Facility	% of Facility Cost
O&M (excluding power)	Dam	0.1%
	Intakes	1.0%
	Pipelines	0.5%
	Pump Stations	1.0%
	Power Supply Facilities	0.8%
Replacements (every 40 years)	Pump Stations and Substations	35%

KEY: O&M = operation and maintenance

A large portion of the annual operating costs of an expansion project would arise from the cost to pump water into the reservoir and deliver supplies to the SBA. The expansion project also has the potential to affect pumping at other Delta pumping facilities because of its interaction with the EWA and with CCWD water supply and quality operations. These effects may result in increased or decreased pumping at different times of the year at CCWD's Rock Slough, Old River, and AIP pump stations, as well as the SWP's Banks and South Bay pumping plants. Consequently, net energy costs were estimated as the difference in pumping costs between the with-project and without-project conditions at these facilities. An average rate of $0.10 per kilowatt-hour was used to estimate the cost of pumping.

Costs Not Included

Costs not included in this initial economic analysis include the following:

- Betterments that may be desired as part of a locally preferred plan are not included in the calculation of costs. This may include betterments associated with relocations or replacements (improvements beyond replacement-in-kind of facilities impacted by a project). Betterments or add-ons requested by a local sponsor may be included in a locally preferred plan.
- Costs related to lands and easements and mitigation were not directly calculated, but are believed to be represented within the appraisal-level provisions for unlisted items and contingencies.
- The opportunity cost of lands inundated by an expanded reservoir are not included. Watershed lands surrounding the existing reservoir are currently owned by CCWD, and future development of these lands is restricted to preserve reservoir water quality.
- Avoided costs related to O&M or replacement of existing facilities that would be replaced or abandoned as part of an expansion project are not considered in this analysis.
- O&M costs related to the AIP and Old River Pumping Plant (facilities that would exist at the time of project implementation/construction and operate in the future without-project condition) are not included as part of project costs.

- Costs related to potential degradation in CCWD's Delta water supplies during the 3-year construction period (while the reservoir would be drawn down) are not included. The combination of CCWD's existing Delta intakes with the proposed AIP would provide some flexibility in meeting CCWD's water quality goals during construction.

Summary of Implementation Costs

Project costs for the 275 TAF reservoir alternative evaluated in this report are summarized in **Table 5.4**.

TABLE 5.4
SUMMARY OF ESTIMATED PROJECT COSTS FOR SELECTED ALTERNATIVE

Type	Item	Cost[4]
Implementation Costs	Los Vaqueros Dam and Appurtenances	$139,426,000
	Delta Intake, Pumping, and Conveyance to Transfer Facility	$42,669,000
	Transfer Facility Pumping and Conveyance to Reservoir	$76,957,000
	Pumping and Conveyance from Reservoir to SBA	$48,783,000
	Total Field Cost	**$307,835,000**
	Unlisted Items (15%)	$46,176,000
	Subtotal	**$354,011,000**
	Contingency (25%)	$88,503,000
	Total First Cost	**$442,514,000**
	Indirect Costs[1] (25%)	$110,629,000
	Subtotal	**$553,143,000**
	Interest During Construction[2]	$43,746,000
	Total Implementation Cost	**$596,889,000**
Annual Operation, Maintenance, Repair, And Replacements	**Operation and Maintenance**	
	- Dam and Appurtenances	$211,200
	- Delta Intake	$82,500
	- Pipelines	$645,500
	- Pump Stations	$792,000
	- Substations and Transmission Lines	$61,500
	Subtotal	**$1,792,700**
	Net Power[3]	$1,518,000
	Replacements (annualized)	$235,400
	Total Annual OMR&R	**$3,546,100**
	Capital Value of OMR&R	**$70,353,000**
TOTAL COSTS	**Capital Value of All Costs**	**$667,242,000**
	Average Annual Cost over 100 Years	**$34,429,000**

KEY: SBA = South Bay Aqueduct OMR&R = operation, maintenance, repair and replacement

Notes:
1. *Indirect costs include engineering, design, inspection, administration, and legal costs.*
2. *Interest during construction calculated for a 3-year construction period.*
3. *Net power cost represents the difference between pumping costs in the with-project and without-project conditions.*
4. *All costs are presented at 2006 price levels.*

The unit cost of EWA replacement yield is the estimated average annual cost to develop the project divided by the estimated yield of the project. Estimated average annual EWA replacement yield for the alternative selected in this analysis is about 104,200 acre-feet per year, resulting in a unit cost of about $330 per acre-foot for this alternative.

COMPARISON OF BENEFITS AND COSTS

The total annual costs and benefits identified in this analysis are summarized in **Table 5.5**. Benefit estimation methods are described in greater detail in **Chapter 4**. EWA benefits are presented for three potential future spot market water price escalation trends: 0 percent, 1.1 percent, and 2 percent annually. As shown, the alternative evaluated in this initial economic analysis provides positive average annual net economic benefits between $0.37 million and $22.30 million and a ratio of average annual benefits to costs between 1.01 and 1.65, depending on the price escalation underlying the EWA benefits calculations.

The 0 percent growth rate is presented in **Table 5.5** as a low book end for the purpose of this initial economic evaluation, but this trend is unlikely to occur. A 4 percent growth rate was also examined as a high book end, but is not presented in the table because the lower growth rates resulted in positive net benefits.

TABLE 5.5
SUMMARY OF AVERAGE ANNUAL ECONOMIC EFFECTS

		2006 Price Levels ($ millions)[1]		
		0% Real Price Escalation	**1.1% Real Price Escalation**	**2% Real Price Escalation**
Costs	**Total Annual Costs[2]**	**(34.43)**	**(34.43)**	**(34.43)**
Benefits	EWA Replacement Supplies	22.56	32.31	44.49
	Water Supply Reliability	0.00	0.00	0.00
	Emergency Water Supply	5.00	5.00	5.00
	Bay Area Water Quality	5.53	5.53	5.53
	Fishery Benefits[3]	1.71	1.71	1.71
	Total Annual Benefits	**34.80**	**44.55**	**56.73**
Net Benefits	**Net of Annual Costs & Benefits**	**0.37**	**10.12**	**22.30**
	Ratio of Annual Benefits to Costs (B:C)	**1.01**	**1.29**	**1.65**
KEY:	EWA = Environmental Water Account			

Notes:
1. *Values reflect 2006 price levels with the exception of EWA benefits (which have been escalated based on a range of potential growth rates above inflation, then discounted back using the Federal discount rate of 5-1/8 percent). A $1,200 per acre-foot price cap was applied to EWA benefits (corresponding to the cost to desalinate brackish water).*
2. *Total annual costs include implementation (construction cost with unlisted items and contingencies, interest during construction, and engineering, administration, and legal costs), operation and maintenance, power, and major replacements.*
3. *Further analysis is needed to better define the nature of potential fishery benefits and the methods to value the benefits, if appropriate.*

Because net benefits are greater than zero and the benefit-cost ratio is greater than 1, this alternative would be considered economically feasible. This conclusion is preliminary, and may be revised after a more thorough evaluation of project benefits and costs for the feasibility study.

Sensitivity and Uncertainty

Uncertainty and variability are inherent in water resources planning, and the P&G provide guidance for evaluating risk and uncertainty in the formulation of alternative plans. Ideally, risk and uncertainty should be characterized by probability distributions based on well-established empirical data (such as hydrologic uncertainty). But the P&G recognize that many aspects of today's projects cannot be characterized in this manner. In this case, a range of likely outcomes may be described by using sensitivity analysis, the process of testing the sensitivity of an outcome to variation in key parameters. Analyses should attempt to characterize the sources and nature of uncertainty to determine how sensitive outcomes are to changes in assumptions.

For this initial economic analysis, key areas of uncertainty relate to the following:

- The rate of growth in water transfer prices, and the extent to which these prices may or may not reflect the opportunity cost of the water supply in other uses, is uncertain and requires further analysis.
- The continued presence of the EWA or similar program in the future is uncertain, including the level of Federal participation in such a program. To date, the EWA has predominantly benefited the SWP by maintaining reliable supplies to SWP contractors.
- Operations modeling results used in this initial economic analysis used the stand-alone CALSIM-II operations model. Future analyses using the integrated CALSIM-II model, under development by the CALFED Common Assumptions group, will allow assessment of how an expansion of Los Vaqueros might affect other Central Valley water management operations. This may lead to refinements in reservoir operations and adjustments in yield.
- Existing and potential future Delta pumping and export constraints (biological opinions, E/I ratio restrictions, future restoration actions, etc.) could affect ability to fill the expanded reservoir or increase the cost to achieve the same benefits. Adaptive management and operational flexibility should be assessed in future analyses.
- Water quality delivered to the SBA generally increases for the alternative selected for evaluation in this report. Future model runs will investigate operation methods to mitigate potential seasonal fluctuations in delivered water quality.
- The cost estimates used in the initial economic analysis are based on appraisal-level engineering and designs. Consequently, conservative factors were applied to account for unlisted items and contingencies. Detailed engineering and design work is needed to refine the cost estimates.
- Numerous factors exist that could potentially impact future water demands, supplies, and scarcity, and could affect operation of the State's water management system. All of these factors have the potential to influence prices on the water transfer spot market.

CHAPTER 6
PRELIMINARY COST ALLOCATION

This chapter describes the purpose and process for allocating project costs among purposes and cost-sharing partners. It provides background information, defines terms, and identifies potential methods for allocating costs.

BACKGROUND AND TERMINOLOGY

Cost allocations are made for Federal water resources projects to derive an equitable distribution of project costs among authorized project uses, or those purposes proposed for authorization, in accordance with existing law. This section presents possible approaches for allocating costs that are believed to follow the current administrative guidelines presented in the P&G and pertinent Reclamation guidance.

This initial analysis provides a preliminary indication of the cost implications of the approaches shown. It does not represent a detailed assessment of the economic effects of costs being borne by different Federal and non-Federal entities, and it does not identify potential non-Federal sponsor(s).

Three basic steps are associated with cost allocation and apportionment:

1. Identify costs to be allocated
2. Allocate costs to project purposes
3. Apportion costs to beneficiaries

Identifying Costs to Be Allocated

Costs to be allocated include construction costs, other costs (sunk costs), interest during construction (IDC), and annual operation, maintenance, and replacement costs.

- **Construction cost -** Construction costs include the cost to implement all elements of the project necessary to achieve the anticipated benefit. Calculation of construction costs is described in **Chapter 5**.
- **Other costs (sunk costs) –** Sunk costs include costs associated with planning, field investigations, land acquisition, and environmental compliance activities. These costs are often assigned to major project features or project purposes to facilitate allocation.
- **Interest during construction –** Absent an up-front cost-sharing payment, Reclamation requires that repayment for a project be initiated at the completion of construction. IDC accounts for the financial cost of the construction period between the time when construction begins and benefits are derived. IDC was calculated for the alternative evaluated in this report based on a 3-year construction period ending in 2015.

- **Annual operation, maintenance, and replacement costs –** O&M and replacement costs are the costs required to assure continued benefits over the life of the project.

It should be noted that cost allocation is a financial exercise rather than an economic evaluation. Consequently, project costs may be presented differently in a cost allocation than in an NED analysis.

Allocating Costs to Project Purposes

Once all project costs have been identified, they are allocated to the project purposes, as generalized in **Figure 6.1**. *Specific costs* are for project components that contribute to a single purpose; for example, the cost of recreation facilities around a multipurpose reservoir. *Separable costs* are the costs that are specifically necessary because a purpose is included in a multipurpose project. Separable costs include specific costs and may include a portion of joint costs. They are estimated as the reduction in financial costs that would result if a purpose were excluded from an alternative. Remaining *joint costs* are the costs remaining after specific and separable costs have been removed.

Methods for allocating joint costs generally fall into one of two categories: those that consider benefits, and those that do not. Methods that do not consider benefits may divide joint costs between beneficiaries equally, or based on their share of separable costs. Methods that are based on benefits divide joint costs among beneficiaries proportional to the benefits each receives. The separable costs-remaining benefits (SCRB) method allocates costs among beneficiaries proportional to the benefits remaining after separable costs are removed. Benefits are derived in the economic analysis. Other methods for allocating joint costs based on benefits include the alternative justifiable expenditure method, and the share of total benefits method.

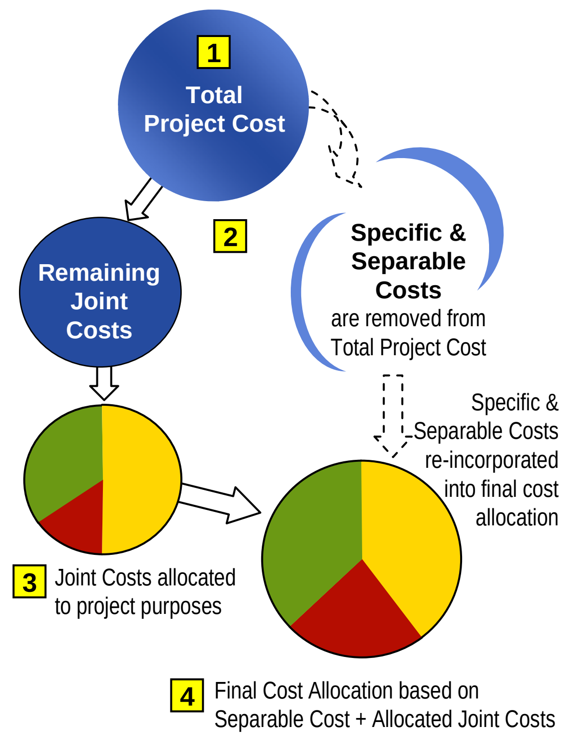

FIGURE 6.1 – ALLOCATION OF COSTS TO PROJECT PURPOSES

Apportioning Costs to Beneficiaries

The cost allocation process is designed so that costs associated with project purposes can be apportioned to beneficiaries for repayment. Once costs are allocated to appropriate purposes, they can be apportioned to the Federal Government and non-Federal sponsor(s) based on specific project authorization and/or established Federal cost-sharing laws and regulations.

Federal costs are designated as either reimbursable or non-reimbursable. Reimbursable costs are those that, through some form of up-front cost sharing, repayment, or other financial agreement, are repaid to the Government. Non-reimbursable costs are those borne entirely by the Federal Government. Based on existing legislation, costs allocated to water supply, fish and wildlife, ecosystem restoration, flood control, and hydropower purposes are either fully or partly reimbursable by project beneficiaries. Existing legislation that provides cost-sharing relationships for purposes that may be included in the LVE is summarized in **Table 6.1**.

TABLE 6.1
EXISTING AUTHORITIES FOR FEDERAL FINANCIAL PARTICIPATION IN MULTIPURPOSE WATER RESOURCES PROJECTS

Purpose	Pertinent Legislation[2]	Description
EWA Replacement Supply	Water Supply , Reliability, and Environmental Improvement Act of 2004 (PL 108-361)	PL 108-361 authorized Federal appropriations for the EWA for 6 years. However, the legislation does not address cost-sharing or repayment for projects related to the EWA.
	Federal Water Project Recreation Act of 1965 (PL 89-72), as amended	The EWA is an environmental program that supports the protection of at-risk Delta fish. A potential authority for Federal participation in fish and wildlife enhancement is provided by PL 89-72. The act provides Federal funding for up to 75% of the costs to plan, design, and construct (including IDC) fish and wildlife enhancement elements, with a minimum 25% non-Federal share due on completion of construction. Up to 50% of the separable construction costs for fish and wildlife enhancement may be deemed non-reimbursable. Up to 50% of O&M and replacement costs could be funded by the Federal Government.
M&I Water Supply	Reclamation Act of 1902, as amended	These acts provide for up-front Federal financing of M&I water supply purposes, with 100% repayment of capital costs (including IDC and interest over the repayment period); 100% of O&M costs are non-Federal.
Water Quality	No applicable Federal legislation specifically pertaining to water quality identified.	
Recreation[1]	Federal Water Project Recreation Act of 1965 (PL 89-72), as amended	PL 89-72 provides Federal cost-sharing of up to 50% for recreation elements, including planning, design, and IDC. Up to 50% of the separable costs for recreation elements may be deemed non-reimbursable. Up to 50% of O&M and replacement costs could be paid for with Federal funding.
KEY:	Delta = Sacramento–San Joaquin Delta EWA = Environmental Water Account IDC = interest during construction	M&I = municipal and industrial O&M = operation and maintenance PL = Public Law

Notes:
1. *Although recreation is currently not an objective of the LVE, potential exists for an expansion project to provide recreation benefits.*
2. *The CVPIA was not included in the table because integration with the CVP is not included in current formulation.*

POTENTIAL COST ALLOCATION METHODS

The method of cost allocation used must be consistent with the project being proposed. For the LVE, the proposed project will likely be described as a project to develop EWA replacement supplies and improve Bay Area water supply reliability while providing water quality benefits to Bay Area water users. For EWA replacement supplies, the beneficiaries would likely be Reclamation and DWR. At this time, Bay Area entities that would benefit from the project have not been identified, but may include CCWD and/or water agencies that receive SWP supplies from the SBA. In the future, beneficiaries will need to be known to properly allocate project costs. In addition, project ownership and operational responsibilities also have an influence on how costs are allocated in a Federal water resources project.

The likely allocation method to allocate joint costs to project purposes is the SCRB method. This would require calculation of the cost of alternative projects with each of the project purposes removed. Numerous methods exist that could potentially be used to subsequently apportion those costs to Federal and non-Federal project beneficiaries. Such methods are discussed below for each of the identified project purposes.

Costs Allocated to EWA Replacement Supply

Federal interest in the EWA program was established in legislation enacted in October 2004, which authorized Federal appropriations for the EWA until 2010. However, no laws exist governing how costs might be allocated among Federal and non-Federal partners for projects developing EWA replacement supplies. In the past, the State of California has provided the majority of funding for the existing EWA, and the majority of EWA water supplies have been used to compensate SWP users impacted by Delta pumping curtailments. Reclamation has relied primarily on CVPIA Section 3406 (b)(2) water supplies to avoid impacts related to pumping curtailments and other regulatory actions in the Delta. Over the 5 years that the EWA has been in operation, Reclamation has only financed two EWA purchases (both in 2002). With the limited amount of time the program has been in operation, and uncertainties regarding the future of the EWA and other environmental programs, it is uncertain how Reclamation might rely on the EWA for environmental water supplies in the future.

Numerous potential methods exist for estimating a potential Federal share of costs associated with EWA replacement supplies. These might include (1) dividing costs by a predetermined percentage between existing Federal and non-Federal EWA partners, (2) apportioning costs based on historical Federal versus non-Federal participation in the EWA, or (3) apportioning costs based on anticipated future Federal needs for environmental water supplies. The first method would require an agreement among the Federal and non-Federal entities that would be financing the EWA component of the project regarding their relative financial responsibilities. The second method would be based on historical Federal participation in the EWA, which is limited to the past 5 years and therefore may not be representative of Federal participation over the 100-year life of the project. The third method would require an assessment of CVP and other Federal environmental water supplies and demands over the project life, likely using computer simulations; a comparison of these supplies and demands could then identify any residual need for environmental water that could be met through a program such as the EWA. The volume of this unmet environmental water need that could be met by the proposed project would then be used to establish the Federal cost-share for EWA related elements.

EWA replacement supply costs allocated to the Federal Government might be considered partially or fully non-reimbursable. Federal costs expended to date on the EWA were borne entirely by the Federal Government.

Costs Allocated to Bay Area Water Supply Reliability

Federal authorization supporting Federal cost-sharing for water supply elements that may be applicable to the LVE is summarized in **Table 6.1**. The existing authorities shown in the table allow for reimbursement to the Federal Government of 100 percent of the costs for construction, IDC, and O&M elements related to the M&I water supply reliability component of a Federal project. Based on existing authorities, such a project would be owned by the Federal Government. It is unlikely that existing CVP cost allocation and cost-sharing procedures could be directly applied to an expansion project, as currently formulated.

Costs Allocated to Bay Area Water Quality

If facilities or operational changes are included in a multipurpose project specifically to improve water quality, the costs attributable to water quality would need to be determined (likely based on the SCRB method). Because water quality is strongly tied to water supply reliability (the quality of a water supply has a significant influence on its beneficial uses and subsequent ability to improve supply reliability), water quality components of a multipurpose project may be eligible for up-front Federal financing with 100 percent repayment, similar to water supply reliability components. However, there is no established Federal interest in Bay Area water quality would support cost-sharing of joint costs allocated to water quality at this time.

EXAMPLE COST ALLOCATION

The following provides a simplified example of how the cost of a Federal Los Vaqueros expansion project might be allocated to project purposes, using the alternative identified for evaluation in this report. A rigorous SCRB analysis was not performed, and the following example does not represent a typical feasibility-level cost allocation that would support Congressional decision-making. A more rigorous cost allocation would be required should a plan be recommended for implementation.

For the purpose of this initial analysis, the following simplifying assumptions were made in allocating project costs:

- Construction costs, sunk costs, O&M, and replacement costs were not allocated separately. Instead, total project cost (from **Table 5.4**) was used. This total includes the net present value of annual O&M, replacements, and power. A more thorough cost allocation would allocate these costs separately, typically to account for differences in cost-sharing of implementation costs versus O&M costs, for example.
- A simplified share of total benefits method was applied in the example cost allocation to allocate costs to project purposes. Costs were allocated to EWA replacement supply, emergency water supply, or water quality proportional to the benefits presented in **Table 5.5** for the 2 percent price escalation scenario. Fishery benefits were not allocated as part of this initial economic evaluation.

Table 6.2 summarizes costs to be allocated and allocation percentages based on these assumptions.

TABLE 6.2
EXAMPLE COST ALLOCATION
2006 Prices ($ millions)

Total Costs to Be Allocated (includes implementation cost and capital value of annual O&M and replacements)		**$ 667**
Costs Allocated to EWA Replacement Supply	81% of Net Benefits	540.3
Costs Allocated to Water Supply Reliability	0% of Net Benefits	0.0
Costs Allocated to Emergency Water Supply	9% of Net Benefits	60.0
Costs Allocated to Water Quality Improvement	10% of Net Benefits	66.7

KEY: EWA = Environmental Water Account O&M = operation and maintenance

CHAPTER 7
FINDINGS

This chapter summarizes the findings of this initial economic evaluation and presents recommendations for future studies related to the expansion of Los Vaqueros Reservoir.

SUMMARY OF FINDINGS

The alternative selected for analysis in this report would involve rebuilding the existing Los Vaqueros Dam in-place to create a reservoir with a total capacity of 275 TAF, in combination with a 170 cfs increase in Delta pumping and conveyance and construction of a 175 cfs delivery pipeline from the reservoir to the SBA. Based on the initial economic analysis, this alternative appears to be economically feasible, resulting in average annual positive net benefits between about $0.37 million and $22.30 million (annual), and with a ratio of average annual benefits to costs between about 1.01 and 1.65.

There appears to be Federal interest in the development of EWA replacement supplies. Assuming this Federal interest is confirmed, it is possible that some portion of the project could be financed by the Federal Government. While some Federal costs may be non-reimbursable, the majority of costs could be assumed to consist of both reimbursable Federal costs, and non-Federal costs. Additional work is required to complete the cost allocation.

The initial economic analysis presented in this report was performed at the concept level (pre-feasibility). The estimation of project costs is based on pre-feasibility level engineering and designs (developed from designs and costs to construct the original Los Vaqueros Project facilities, which were completed in 1997). The estimation of benefits is based on preliminary project yield and valuation estimates. Consequently, selection of this alternative for preliminary economic evaluation in this report does not represent the identification of a recommended or preferred alternative for display in a Feasibility Report or for consideration by Congress.

The alternative selected for analysis in this report would be operated primarily to provide EWA replacement supplies. Water supply reliability benefits were restricted to the emergency storage benefits that could be provided by the expanded reservoir in the event of a disruption in Bay Area water supplies (such as might result from an earthquake or levee failure). Similarly, no adjustments were made to facilities or sizes to improve water quality at the expense of EWA replacement supplies. Although the EWA replacement supply benefits alone appear to be sufficient to justify the cost of implementing the expansion project, future analyses should evaluate potential economic tradeoffs associated with operating the reservoir to provide Bay Area water supply reliability benefits as well. Although a 275 TAF reservoir was selected for analysis in this initial economic evaluation, future plan formulation efforts should continue to assess larger reservoir expansion options.

ALTERNATIVE FORMULATION OPTIONS

Although the alternative selected for analysis in this report appears to be economically feasible, ways may exist to reformulate alternatives for the LVE to expand the magnitude and categories of benefits. The formulation of alternatives is governed by the problems and opportunities, objectives, constraints, principles, and criteria specific to the LVE. The following text discusses examples of how LVE planning objectives, constraints, principles, and criteria might be changed to expand the range of potential benefits.

Project Objectives

The expansion of Los Vaqueros Reservoir has the potential to provide multiple benefits in a variety of resource areas. The current LVE study objectives were selected because they correspond to existing problems and opportunities in the study area (see **Chapter 2**). However, the LVE may be able to address additional problems and opportunities outside the study area. Several examples are summarized below.

- **Modify water supply reliability objective to include supply reliability for the CVP and/or SWP –** Currently, the water supply reliability objective of the LVE is directed toward Bay Area water agencies. However, surplus Delta flows stored in an expanded reservoir could provide supply reliability benefits to the CVP and/or SWP in a similar manner. CCWD's voters approved Measure N (see **Chapter 2**), which would prevent an expansion project from exporting water to Southern California; this may or may not limit the opportunity to integrate the project with the CVP or SWP.
- **Add flood control as an objective –** Water stored in an expanded Los Vaqueros Reservoir could allow existing multipurpose reservoirs, such as Oroville or Folsom, to encroach on their conservation (water supply) storage space during the flood season to hold back more flood flows. Water stored in Los Vaqueros could be used to replace any CVP or SWP storage space that could not be refilled after the flood season ends. CVP or SWP water stored in Los Vaqueros could be conveyed to Bethany Reservoir for delivery via the California Aqueduct.
- **Add recreation as an objective –** Recreation could be added as an objective of the LVE; however, little data exist to support the need for additional recreation in the study area. Additional analysis of regional recreation use and needs would be required to determine whether recreation should be added as an objective. In addition, CCWD has strict policies regarding water-based recreation to protect water quality in the reservoir.

Plan Formulation Constraints, Principles, and Criteria

Plan formulation constraints, principles, and criteria guide the formulation of alternatives. For the LVE, several of the constraints and criteria that significantly influence the formulation of alternative plans are related to CCWD's Principles of Participation and voter-approved Measure N. It is understood that Measure N precludes CCWD's participation in the study of projects that would increase the export of water to Southern California or involve the construction of a peripheral canal; this may limit the ability of a project to serve water users outside the Bay Area. The Principles of Participation also may effect watershed ownership and operations arrangements for the project. It may be possible to increase project benefits and/or justify the construction of a larger reservoir if benefits could be offered to a broader group of beneficiaries. These might include Central Valley CVP or SWP water users, or urban water users outside the Bay Area. However, additional analyses would be required to determine how these potential beneficiaries might participate in an expansion project and whether such a project would be economically feasible.

FUTURE STUDIES

This initial economic analysis indicates that feasibility-level studies for the LVE should continue, progressing toward the identification of a plan to be considered for implementation in a Draft Feasibility Report with accompanying environmental documentation.

Future plan formulation efforts will focus on refining, evaluating, and comparing alternative plans for display in the Feasibility Report. These efforts should include the following activities:

- Identify potential project participants and the financial responsibilities of Federal and non-Federal sponsors; specifically, determine how EWA costs could be shared between the Federal Government and non-Federal cost-sharing sponsor(s)
- Determine project ownership, and O&M arrangements
- Identify potential water rights issues associated with an expansion project
- Identify any additional elements or requirements of a locally preferred plan
- Identify a recommended alternative for display in the Feasibility Report

Future economic analyses will likely focus on confirming the valuation methodology and refining the estimate of project costs and benefits. Sensitivity analysis of key variables can provide an indication of how the economic analysis results could change given different assumptions. Based on preliminary estimates, it is recommended that future economic analyses include sensitivity analysis of the following variables:

- Inflation and potential changes in the real growth of water prices over time
- Key demand and supply factors influencing the price of water on the spot market
- Hydrologic variability

Future economic analyses should also evaluate the potential economic tradeoffs between formulating alternatives to provide EWA replacement supplies versus improving Bay Area water supply reliability. In addition, a more thorough estimate of other potential benefit categories and associated methods, including emergency water supply and fishery benefits, is required for feasibility.

Future operations analysis, engineering, and design work is needed to refine facility operations, configuration, size, and cost. These activities should include the following:

- Use the integrated CALSIM-II Common Assumptions Model Package to simulate alternative plans and refine operations for the recommended alternative
- Continue to evaluate both moderate (up to 275 TAF total capacity) and larger (up to 500 TAF total capacity) reservoir expansion opportunities
- Assess hydrodynamic impacts in the Delta, including Delta water quality
- Evaluate sensitivity of CALSIM-II modeling results to various input parameters
- Develop feasibility-level designs and costs for a recommended alternative; specifically, refine facility layouts and configurations, including a potential connection to the SBA

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GLOSSARY OF TERMS

Discount rate	Factor used to convert future monetary values to present values.
Joint costs	Costs that cannot be readily assigned to a single beneficiary or purpose, typically because they serve multiple users or purposes.
Net present value	The today of a stream of payments, receipts, or costs occurring over time, as discounted through the use of an interest rate.
Opportunity cost	The cost of forgoing certain opportunities or alternatives in favor of pursuing others.
Other direct benefits	Incidental direct benefits of a project over and above the direct outputs for which the plan is being formulated.
Willingness to pay	The expressed amount an individual would pay for a good or service. For goods or services sold in a market environment, this corresponds to the amount actually paid to obtain the goods or services. For nonmarket goods, it corresponds to the expressed amount an individual would be willing to pay to receive the stated benefits.

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ATTACHMENT 1
COST SUMMARY

275 TAF RESERVOIR WITH 670 CFS TOTAL DELTA INTAKE CAPACITY

		Size	Quantity	Unit	Unit Cost	Cost
DAM AND APPURTENANCES						
	Los Vaqueros Dam	275 TAF	1	LS	117,000,000	$117,000,000
	Dam Outlet Pipeline	132 in	3,000	LF	1,420	$4,260,000
	Balancing Reservoir		4,000,000	gal	0.66	$2,640,000
	Flow Control Station		1	LS	1,766,000	$1,766,000
	Power Transmission Lines		10	mile	276,000	$2,760,000
	Relocations		1	LS	11,000,000	$11,000,000
DELTA INTAKE AND CONVEYANCE FACILITIES - Delta to Transfer Facility						
Intake	Victoria Canal - AIP (assume existing)	250 cfs				
	Old River - Existing Intake	250 cfs				
	Victoria Canal - New Intake	0 cfs	1	LS	0	$0
	Old River - Expand Existing	170 cfs	1	LS	5,887,000	$5,887,000
	Total Delta Intake Capacity	**670 cfs**				
Delta-Transfer Pipelines	New Delta-Transfer Pipeline Capacity	350 cfs				
	1 Pipeline - 350cfs	96 in	34,700	LF	1,060	$36,782,000
TRANSFER PUMPING AND CONVEYANCE - Transfer Facility to Reservoir						
Transfer Pumping	New Transfer Pump Station	470 cfs	1	LS	36,324,000	$36,324,000
	New Transfer PS - Head (max H)	353 ft				
	New Transfer Substation		1	LS	1,778,000	$1,778,000
	Repl. Pumps at Existing Transfer PS	200 cfs	1	LS	5,743,000	$5,743,000
	Expanded Balancing Reservoir		8,000,000	gal	0.66	$5,280,000
Transfer-LV Pipeline(s)	New Transfer - LV Capacity	670 cfs				
	1 Pipeline - 670 cfs	132 in	19,600	LF	1,420	$27,832,000
DELIVERY FACILITIES - Reservoir to SBA (Dyer)						
LV Delivery Intertie	Size & Location	175 cfs	Dyer			
	LV-SBA (Dyer) Pipeline	66 in	43,800	LF	630	$27,594,000
LV Delivery Intertie	LV-SBA (Dyer) Pump Station	175 cfs	1	LS	20,241,000	$20,241,000
	LV-SBA PS - Head (max H)	445 ft				
	LV-SBA PS - Substation		1	LS	948,000	$948,000
TOTAL FIELD COST						**$307,835,000**
	Unlisteds	Appraisal Level	15%			$46,176,000
					Subtotal	**$354,011,000**
	Contingencies	Appraisal Level	25%			$88,503,000
TOTAL FIRST COST						**$442,514,000**
	Indirect Costs - Engineering, Design, Inspection, Admin, Legal				25%	$110,629,000
					Subtotal	**$553,143,000**

Interest During Construction (IDC) Duration: 3 years	Yearly Exp	Mid Yr	Prev Yr Exp	All Prev Interest	Interest-Bearing Amt	Compound IDC
Year 1	184	92	0	0	92	$5
Year 2	184	92	184	5	281	$14
Year 3	184	92	369	19	480	$25
					Subtotal IDC (millions)	**$44**

TOTAL IMPLEMENTATION COST	**(2006 price levels)**	**$596,889,000**

Note: All costs at 2006 price levels.

ANNUAL OPERATION, MAINTENANCE, AND REPLACEMNT COSTS FOR 275 TAF RESERVOIR WITH 670 CFS TOTAL DELTA PUMPING CAPACITY

ANNUAL OPERATION, MAINTENANCE, REPAIR, AND REPLACEMENTS (OMR&R)				
		Subtotal Facility Costs		
Operation & Maintenance	Dam & Appurtenances	$175,932,400	0.1%	$211,200
	Delta Intake(s)	$8,241,800	1.0%	$82,500
	Pipelines	$129,091,200	0.5%	$645,500
	Pump Stations	$79,191,000	1.0%	$792,000
	Substations & Transmission	$7,680,400	0.8%	$61,500
			Subtotal	**$1,792,700**
Power	Net increase over without-project conditions			**$1,518,000**
Replacements	Pumps, Substations (every 40 years)	$86,871,400	35%	$30,405,000
			Annualized	**$235,400**
			Total Annual OMR&R	**$3,546,100**
			Capital Value of OMR&R	**$70,353,000**

Note: All costs at 2006 price levels.

Notes related to preliminary cost estimate for alternative evaluated in this report:

1. Cost estimates were developed from appraisal-level engineering and designs. Further analysis is needed to refine facility designs, locations, and sizes.

2. Unit costs are based on the cost to construct existing Los Vaqueros Project facilities, which were completed in 1997. Unit costs were previously developed at 2002 price levels in the *Project Cost Estimate Methodology Technical Memorandum* (CALFED, 2004a), and were updated to 2006 price levels for the purpose of this initial economic evaluation using the Engineering New Record Construction Cost Index (CCI) for the San Francisco region.

3. Factors for unlisted items and contingencies were applied consistent with Reclamation design guidance for estimates prepared at the appraisal level.

4. Costs for lands, easements, and mitigation were not directly calculated, but are believed to be well represented within unlisted items and contingencies.

5. Interest during construction (IDC) was calculated for a 3-year construction period, based on preliminary construction scheduling for a 275 TAF reservoir.

6. Factors used to estimate operation, maintenance, and replacement costs are based on actual costs to operate and maintain the existing Los Vaqueros Project, per CCWD.

7. Net power cost was estimated as the difference in power cost between the with- and without-project conditions at affected Delta pumping stations (Old River, Alternative Intake Project, Rock Slough, SWP South Bay Pumping Plant, and SWP Banks Pumping Plant).

8. Total annual operation and maintenance, power, and replacement cost reflects discounting over the 100-year period of analysis using the Federal discount rate of 5-1/8 percent.

ITEMIZED COST FOR 275 TAF DAM

No.		Activity	Quantity	Unit		Unit Cost		Cost
1	**General Requirements and Mobilization**							
	1.1	Construction Administration	24	mo	$	155,000	$	3,720,000
	1.2	Survey, Field Engineering, & Quality Control	24	mo	$	100,000	$	2,400,000
	1.3	Submittals		LS			$	3,340,000
	1.4	Temporary Facilities & Mobilization		LS			$	3,520,000
						Subtotal	**$**	**13,000,000**
2	**Site Preparation**							
	2.1	Demolition		LS			$	240,000
	2.2	Abandon Exisiting Outlet Tunnel		LS			$	730,000
	2.3	Strip/Clear & Borrow Areas		LS			$	380,000
	2.4	Creek Diversion & Water Management		LS			$	970,000
	2.5	Pioneer Haul Roads		LS			$	3,660,000
	2.6	Erosion and Sediment Control		LS			$	260,000
						Subtotal	**$**	**6,000,000**
3	**Dam Foundation**							
	3.1	Excavation: Valley Floor	900,000	cyd	$	5.67	$	5,103,000
	3.2	Excavation: Abutments	160,000	cyd	$	3.00	$	480,000
	3.3	Prepare Foundation	30,000	syd	$	15.00	$	450,000
	3.5	2-Row Grout Curtain	40,000	sft	$	20.00	$	800,000
						Subtotal	**$**	**7,000,000**
4	**Embankment**							
	4.2	Gate Shaft	86,000	cyd	$	125.00	$	10,750,000
	4.3	Core	200,000	cyd	$	6.40	$	1,280,000
	4.4	Claystone Shell	3,900,000	cyd	$	7.25	$	28,275,000
	4.5	Filter and Drain	130,000	cyd	$	58.00	$	7,540,000
	4.6	Bedding	55,000	cyd	$	65.00	$	3,575,000
	4.7	Riprap (reuse)	60,000	cyd	$	24.00	$	1,440,000
	4.8	Riprap (import)	85,000	cyd	$	74.00	$	6,290,000
	4.9	Instrumentation and Data Management		LS			$	300,000
						Subtotal	**$**	**59,000,000**
5	**Hydraulic Structures**							
	5.1	Inlet Tunnel & Shaft (1,000 cfs)	2,400	ft	$	5,500	$	13,200,000
	5.2	Inlet & Gate Shaft Structure & Mechanical		LS			$	1,670,000
	5.3	Delta-LV and Transfer Pipelines (2 x 800 ft)	1,600	ft	$	1,000	$	1,600,000
	5.4	Outlet Tunnel (850 cfs)	1,750	LS	$	4,600	$	8,050,000
	5.5	Sloping Multiport Intake and Mechanical		LS			$	4,700,000
	5.6	Outlet Structure & Mechanical		LS			$	1,550,000
	5.7	Spillway		LS			$	1,000,000
						Subtotal	**$**	**32,000,000**
						TOTAL	**$**	**117,000,000**

KEY: cfs = cubic feet per second ft = feet mo = month

cyd = cubic yard LS = lump sum sft = square feet

Notes: All costs at 2006 price levels.

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