Casitas Municipal Water District
WATER RESOURCES COMMITTEE
Baggerly/Spandrio

June 5, 2020 – 10:00 A.M.

This meeting will be held via teleconference
To attend the meeting please call
(888) 788-0099 or (877) 853-5247
Enter Meeting ID 929 6098 2498#

Special Meeting Agenda

1. Roll Call
2. Public Comments
3. Board Comments.
4. Manager Comments.
5. Review of the Draft Comprehensive Water Resources Plan.

Right to be heard: Members of the public have a right to address the Board directly on any item of interest to the public which is within the subject matter jurisdiction of the Board. The request to be heard should be made immediately before the Board's consideration of the item. No action shall be taken on any item not appearing on the agenda unless the action is otherwise authorized by subdivision (b) of ¶54954.2 of the Government Code.
If you require special accommodations for attendance at or participation in this meeting, please notify our office in advance (805) 649-2251, ext. 113. (Govt. Code Sections 65954.1 and 54954.2(a). Please be advised that members of the Board of Directors of Casitas who are not members of this standing committee may attend the committee meeting referred to above only in the capacity of observers, and may not otherwise take part in the meeting. (Govt. Code Section 54952.2(c)(6)

CASITAS MUNICIPAL WATER DISTRICT
MEMORANDUM

TO: WATER RESOURCES COMMITTEE

FROM: MICHAEL FLOOD, GENERAL MANAGER

SUBJECT: COMPREHENSIVE WATER RESOURCES PLAN STATUS UPDATE

DATE: 06/02/20

RECOMMENDATION:

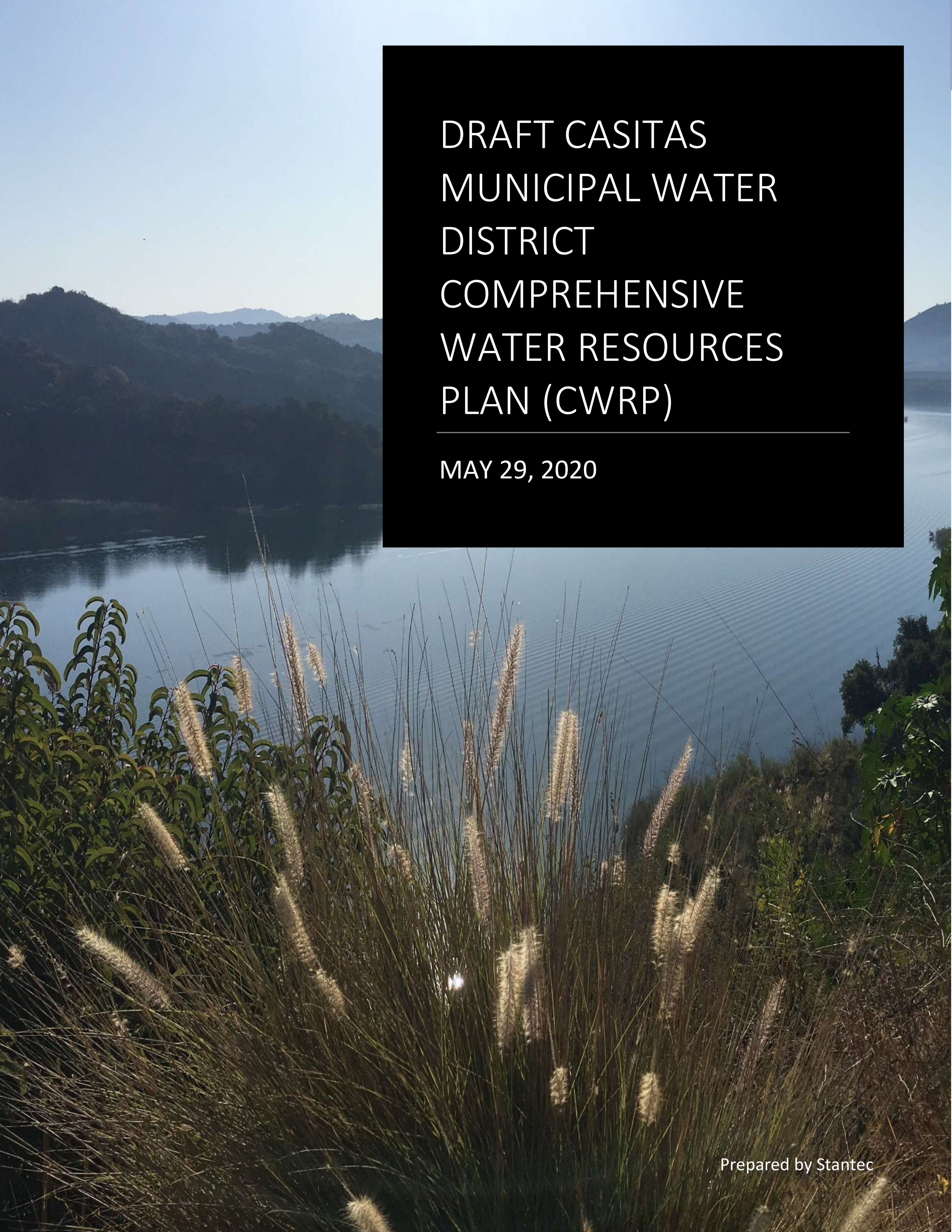
It is recommended the Water Resources Committee receive an update on the status of the Comprehensive Water Resources Plan.

BACKGROUND AND DISCUSSION:

The Board of Directors authorized a consulting services agreement with Stantec in January 2019 to prepare the Comprehensive Water Resources Plan (CWRP). Several public meetings have been held with the Water Resources Committee throughout the process, and an overview of the draft plan was presented at a Board Workshop held on February 8, 2020. Current work efforts are focused on preparing the draft report for public review.

On May 19, 2020, the Water Resources Committee discussed the draft report, and requested to review the appendices. The revised draft report and appendices are attached for discussion.

Staff is recommending the draft report and appendices be posted on the District's website in June 2020 with a 45-day public comment period. Due to COVID-19 social distancing requirements, public workshops related to the CWRP are not being scheduled at this time. In order to encourage public participation, staff is recommending postcards be mailed to all properties within District boundaries with information about the opportunity to comment.



DRAFT CASITAS MUNICIPAL WATER DISTRICT COMPREHENSIVE WATER RESOURCES PLAN (CWRP)

MAY 29, 2020

Prepared by Stantec

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Prepared by Autumn Glaeser

Reviewed by Chip Paulson

Approved by Chip Paulson

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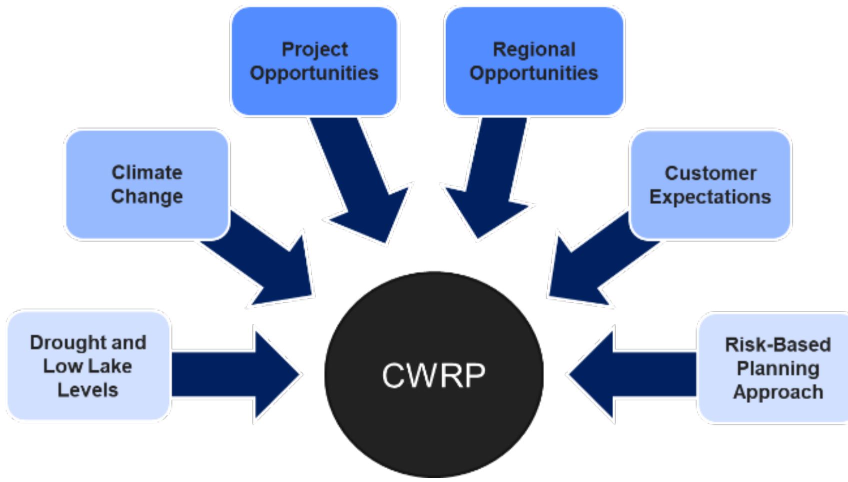
Abbreviations

AF	acre-foot/acre-feet
AFY	acre-foot per year/acre-feet per year
C	Conservation (Project Alternatives category)
Casitas or District	Casitas Municipal Water District
Calleguas	Calleguas Municipal Water District
CIMIS	California Irrigation Management Information System
DCF	Delta Conveyance Facility
CWRP	Comprehensive Water Resources Plan
GSWC	Golden State Water Company
GW	Groundwater (Project Alternatives category)
HOBO	Matilija Deep Aquifer, Horizontal Bore
MO	Maintenance and Operation (Project Alternatives category)
O&M	Operation and Maintenance
OBGMA	Ojai Basin Groundwater Management Agency
OVSD	Ojai Valley Sanitary District
SWP	State Water Project
UVRGA	Upper Ventura River Groundwater Agency
UWMP	Urban Water Management Plan
VRBO	Matilija Deep Aquifer, Vertical Bore
WEAP	Water Efficiency and Allocation Program

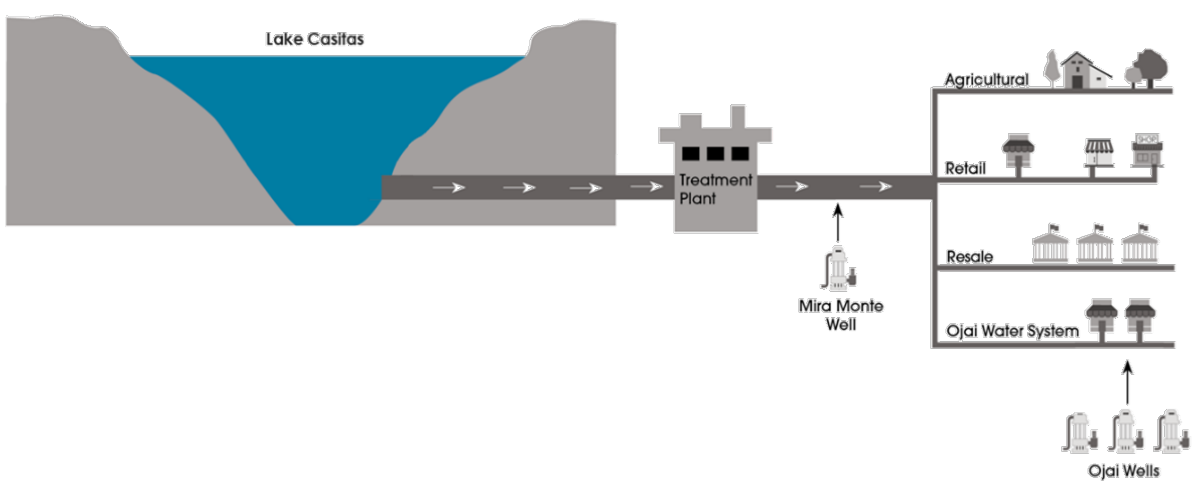
Executive Summary

THE CASITAS MUNICIPAL WATER DISRICT COMPREHENSIVE WATER RESOURCES PLAN (CWRP) presents a strategy for addressing current and future water supply challenges, risks, and opportunities to meet the needs of Casitas Municipal Water District (Casitas) customers. The CWRP is based on a review of a wide range of available options and strategies, and consists of an adaptive approach to providing a reliable and sustainable water supply for Casitas.

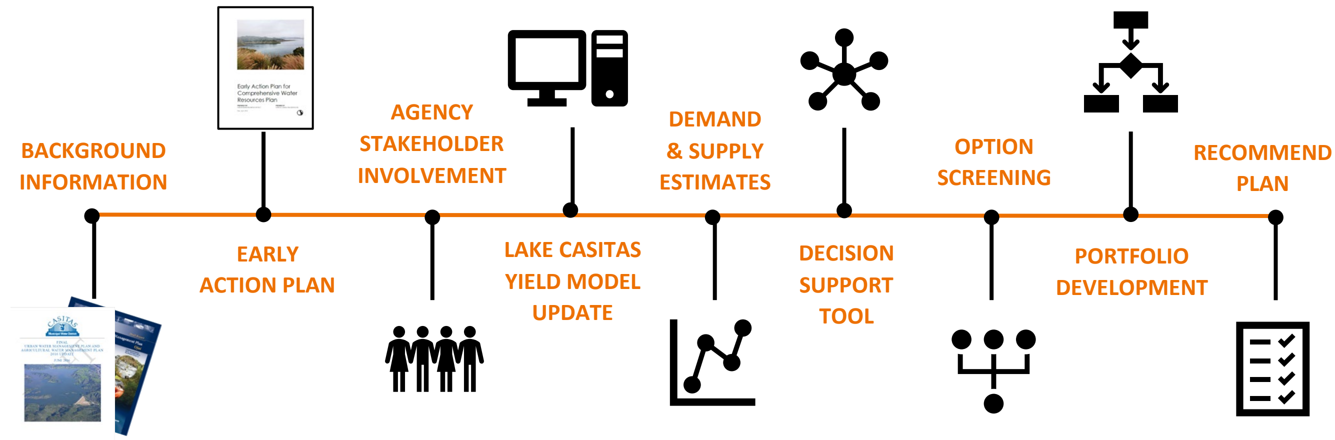
PROJECT DRIVERS. The CWRP was prepared in response to several important drivers based on recent events, anticipated future conditions, near-term opportunities, and customer expectations.



CASITAS MUNICIPAL WATER DISTRICT SYSTEM. Casitas serves water to four categories of customers: retail residential and commercial, agricultural, resale (i.e., through water delivery contracts), and Ojai Water System customers that were previously served by Golden State Water Company. The Casitas System is primarily supplied by Lake Casitas, and has one well (Mira Monte well in the Upper Ventura River Groundwater Basin). The Ojai System is supplied primarily by groundwater wells in the Ojai Groundwater Basin, and receives supplemental water from Lake Casitas via the Casitas System. These surface and groundwater resources are all dependent on rainfall and runoff in the Ventura River watershed.



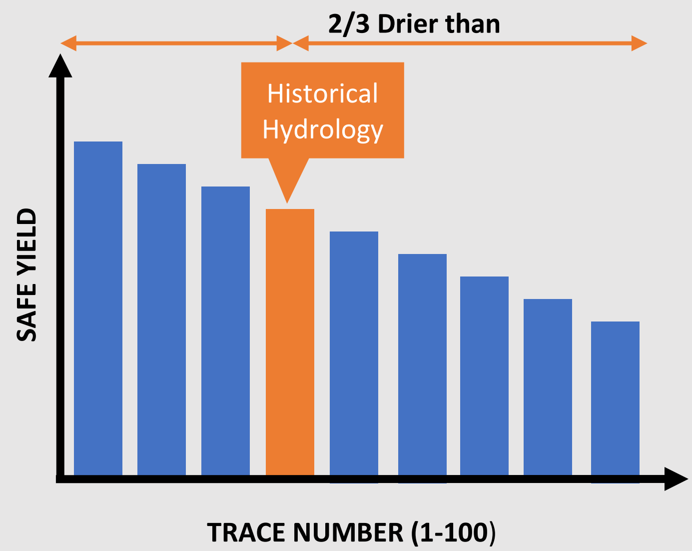
PROJECT APPROACH. The CWRP was developed using a systematic approach based on industry practices for risk-based planning, new and updated analytical tools, and stakeholder input. Stakeholder input was received through two stakeholder workshops, 12 Water Resources Committee meetings which were open to the public, and one Board workshop.



FUTURE DEMAND. Future 2040 water demand was estimated using a combination of past estimates and analysis of recent water use. Casitas System and Ojai Water System estimated demands are lower than previous estimates and reflect recent water use patterns from the last several years.

16,000 AFY	2,350 AFY
Casitas System 2040 Demand	Ojai Water System 2040 Demand

CLIMATE VARIABILITY. Operation of Lake Casitas was simulated for **100 future hydrologic conditions** (hydrologic traces) developed based on reshuffled historical hydrology and an adjustment for the impact of future climate change in Ventura County. The results showed there is a 67% chance that projected future hydrology will be drier than historical hydrology.



LAKE CASITAS MODELING. Lake Casitas is the primary source of supply for Casitas Municipal Water District. Yield estimates for Lake Casitas were developed using a computer model to simulates all inflows and outflows on a monthly time step for a 74-year period (1945-2018). Lake Casitas annual yield for water supply planning was based on the concept of safe demand. This is the largest base demand – i.e., the customer demand when the Lake is full – that could be met in every year when demand reductions are applied during periods of low lake levels in accordance with the Casitas Water Efficiency and Allocation Program. A minimum allowable lake storage level was set at 20,000 AF (8.5% of active storage) to provide a buffer against unforeseen emergency conditions.

AVAILABLE WATER SUPPLY. The safe demand from Lake Casitas was evaluated based on a minimum storage of 20,000 AF and a climate-adjusted risk-based hydrology approach. The safe demand that could be delivered for 95 of the 100 synthetic hydrologic traces is 10,660 AFY; this was adopted as the Lake Casitas yield for the CWRP. The Mira Monte Well capacity based on recent experience is 180 AFY. The available supply for the Ojai Water System is estimated to be 2,325 AFY (1,800 AFY from groundwater wells and an average of 525 AFY from the Casitas System).

Future Available Supply

10,660 AFY

Lake Casitas Safe Demand

180 AFY

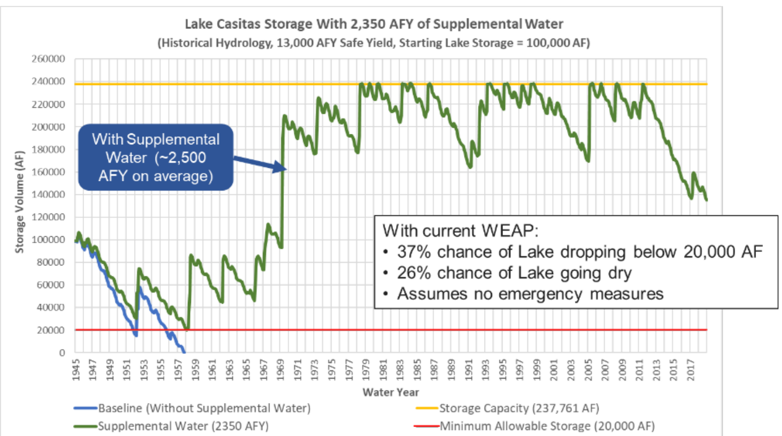
Mira Monte Well Capacity

2,325 AFY

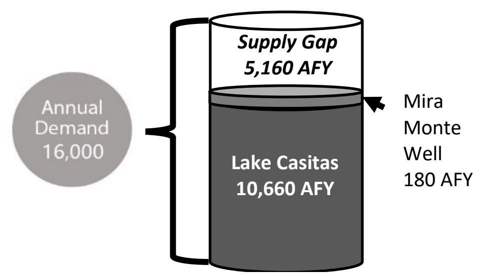
Ojai Water System Available Supply

FUTURE WATER SUPPLY GAPS. The **long-term supply gap** is the difference between estimated 2040 demand and available supply from all current sources. This gap is about 5,200 AFY for the Casitas System; there is no significant gap for the Ojai Water System.

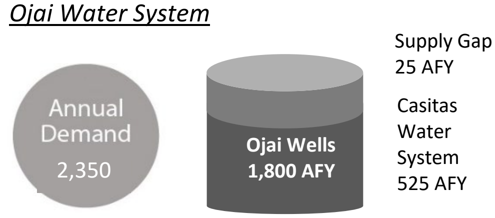
The **short-term supply gap** is based on mitigating the risk of Lake Casitas dropping to critically low levels as a result of extended drought. Modeling showed a supplemental supply of 2,500 AFY would adequately mitigate that risk if achieved within one to five years.

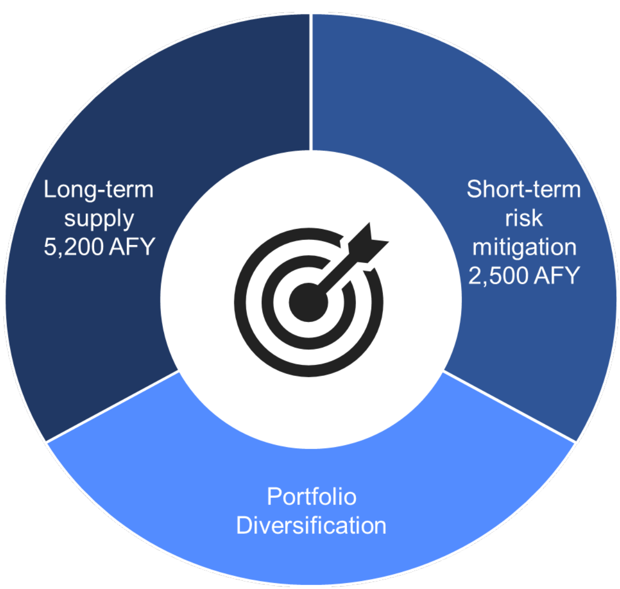


Casitas Water System



Ojai Water System

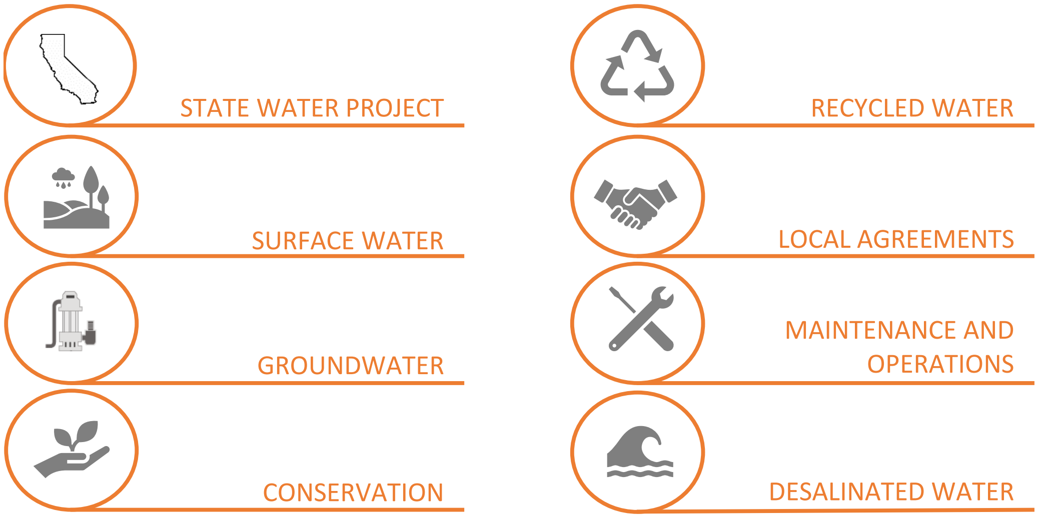




SUMMARY OF WATER NEEDS AND CWRP GOALS

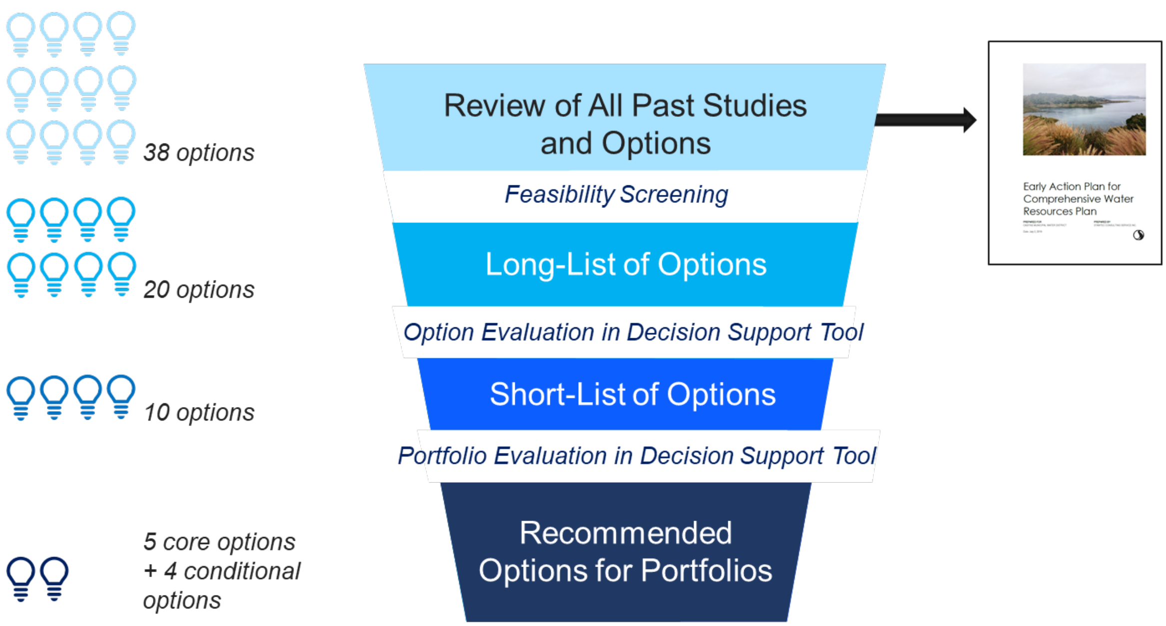
- Comparison of future water demand and future supply determined an average annual long-term water supply gap of 5,200 AFY.
- The current low storage level in Lake Casitas is a concern if the current drought continues; this can be mitigated by delivering 2,500 AFY of supplemental water to the Lake every year.
- All current Casitas supplies originate in the Ventura River watershed; diversifying the water portfolio with outside supplies will improve resilience and sustainability of the Casitas Water System.

WATER SUPPLY OPTIONS. A comprehensive range of structural/non-structural, surface/groundwater, and local/imported water options were considered to address future water supply needs.



WATER SUPPLY OPTIONS ANALYSIS. A thorough and deliberate process was used to evaluate potential water supply options to address the CWRP goals. Over **30 structural and non-structural projects** and programs were evaluated using a decision support tool based on **technical, economic, environmental, and social criteria**. The most feasible options were selected for further analysis and for combining into comprehensive water supply portfolios.

Over 30 projects were evaluated.



RECOMMENDED PLAN

The recommended plan consists of a coordinated set of planning policies, projects, and new and updated programs.

PLANNING POLICIES

- Supply and Demand Estimates
- Minimum Allowable Lake Storage
- Risk Based Planning

PORTFOLIO OF PROJECTS

- Local Options
- Supplemental Water Options
- Conditional Options

NEW AND UPDATED PROGRAMS

- Water Conservation Plan
- WEAP Policy Updates
- Supplemental Water Integration Plan

PLANNING POLICIES. Casitas has adopted new policies for water supply planning.

- CWRP supply and demand estimates will be used for **future planning**.
- The minimum operating volume in Lake Casitas during normal operations will be **20,000 acre-feet** (8.5% of active storage).
- Adequate average annual supply will be developed to **meet 95% of anticipated future hydrologic conditions**. Emergency measures will be implemented during more extreme conditions.

PORTFOLIO OF PROJECTS. The recommended portfolio of projects includes both local and supplemental water options. Two local projects will maximize yield from Ventura River water resources. Two regional interconnections to State Water Project infrastructure – one in Ventura and one in Santa Barbara County – will allow access to Casitas' current State Water Project contracted supply, as well as other supplemental water sources such as City of Santa Barbara desalinated water or in-lieu transfers with Ventura. Conditional options will be tracked in case one or more of the recommended projects cannot be implemented as planned. The capital cost of the recommended plan projects is **$155 million,** which would likely need to be funded by non-rate revenue sources such as bonds or grants. Local projects are recommended to be completed in 2 years, the Ventura-Santa Barbara Interconnection is recommended to be completed in 5 years, and the Casitas-Calleguas Interconnection and other supplemental water acquisitions are recommended to be completed in 10 years.

LOCAL, NEAR TERM, NO-REGRETS OPTIONS

1. GW 08 – Ojai Basin Well Rehabilitation and Replacement
2. MO 08 – Robles Fish Screen Improvements

PREFERRED SUPPLEMENTAL WATER OPTIONS

1. SWP 03 - Ventura-Santa Barbara Interconnection
2. SWP 04 – Casitas-Calleguas Interconnection
3. SWP 05/DW 01 Supplemental Water

CONDITIONAL OPTIONS – TRACK ONLY

1. C 01 – Demand Management 5%-10%
2. MO 01 – Watershed Management/Arundo Removal
3. GW 01 – Matilija Deep Formation Wells
4. SWP 05/DW 01 – Additional Supplemental Water Options

NEW AND UPDATED PROGRAMS. It is recommended that Casitas: (1) Develop a Water Conservation Plan to maintain current low customer water use. (2) Update the existing Water Efficiency and Allocation Program to include emergency operations and revised drought stages corresponding to lake levels. (3) Prepare a Supplemental Water Integration Plan to integrate State Water Project water and other supplemental sources into the Casitas Water System.

Section 1 Introduction

The Casitas Comprehensive Water Resources Plan (CWRP) presents a strategy for addressing current and future water supply challenges, risks and opportunities to meet the needs of all Casitas Municipal Water District customers. The CWRP considers water supply needs based on risks, threats and challenges, then develops water supply solutions based on individual options, broader strategies, and immediate opportunities (**Figure 1-1**). This report describes the approach used to develop the CWRP, and the elements of the recommended plan. The focus of the report is on justification for selection of the projects, programs and policies making up the recommended water supply strategy, and on outlining considerations in implementing the recommended actions. The majority of the documentation for the detailed technical studies that support the development of the plan (e.g., future demand estimates, water supply modeling, alternative evaluation) is presented in technical appendices to the CWRP Report.

Figure 1-1: *CWRP Links Water Supply Needs and Solutions*

1.1 The Casitas System

The CWRP is a plan for meeting future water needs for all customers of the District using all water supply resources currently available to the District as well as potential new sources. This includes customers and facilities of the Ojai Water System, which was acquired by the District from Golden State Water Company (GSWC) in 2017. Casitas serves water to the following four categories of customers.

- Agricultural customers
- Retail residential and commercial customers
- Resale customers (i.e., other water providers with whom Casitas has a water delivery contract)
- Ojai Water System customers

Current water supplies are provided by three local sources: Lake Casitas, Mira Monte Well, and the Ojai Wellfield. These surface and groundwater resources are all dependent on rainfall and runoff in the Ventura River watershed. Water from Lake Casitas is treated at the District water treatment plant and delivered to retail, agricultural and resale customers, as well as Ojai Water System customers. Water from the Mira Monte Well is blended with treated Lake Casitas Water. Water supplies from the Ojai

Wellfield can only be used within the Ojai Water System based on current Ojai Groundwater Basin regulations. **Figure 1-2**. is an overview of the Casitas system.

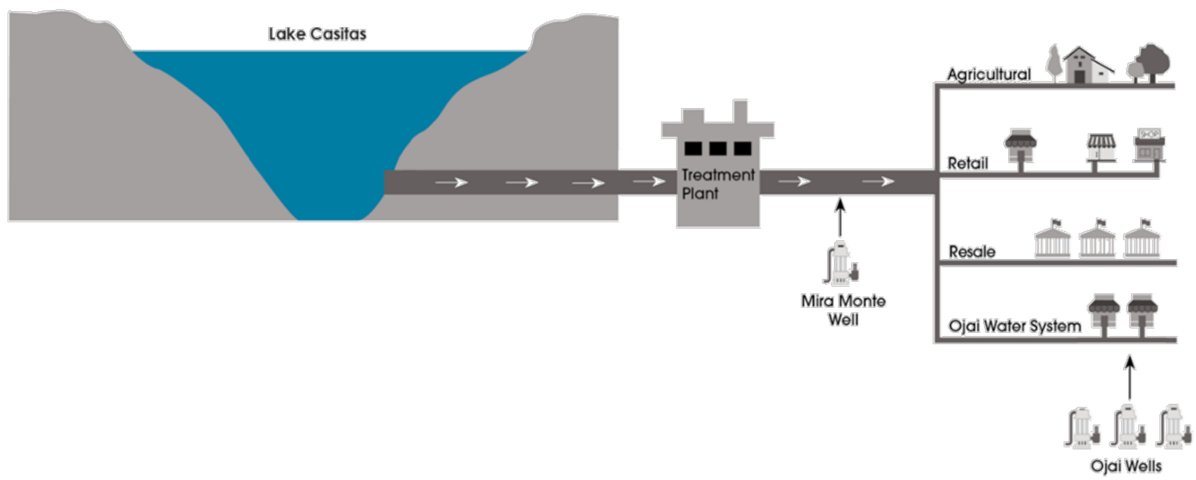


***Figure 1-2**. Casitas Water System Overview*

1.2 Project Objectives and Drivers

Casitas Municipal Water District developed this CWRP to identify, analyze, and prioritize strategies for providing a reliable water supply to meet the future water needs of Casitas' retail and contract (resale) customers. The objective was to lay out a strategic plan for addressing current and future water supply needs through a combination of effective policies, projects and programs with the support of the local community.

The CWRP was prepared in response to the recent extended drought in California, which resulted in historic low storage levels in Lake Casitas, the primary local water supply source. It was driven by concerns over supply reliability in the face of possible future climate change, and expectations of customers who had borne the brunt of several years of aggressive water use reductions. Casitas is facing important decisions on local projects and large, expensive regional projects, and needed a rational approach for assessing its options. In addition, the CWRP marks a new approach to water supply planning that embraces risk and uncertainty, including an updated analysis of the available yield from Lake Casitas that incorporates the impacts of future climate variability.

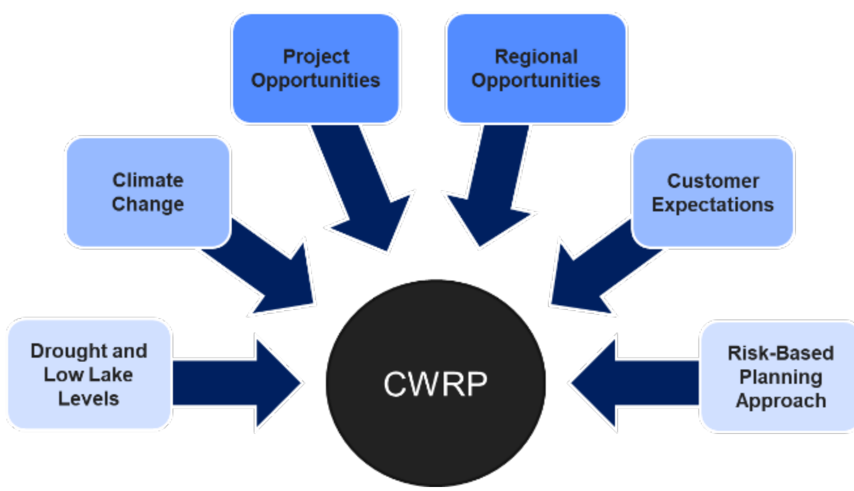


***Figure 1-3**: Drivers for Preparing the Comprehensive Water Resources Plan*

Figure 1-3 highlights the drivers for preparing the Comprehensive Water Resources Plan.

1.3 Overview of the CWRP Process

The process used to develop the CWRP was deliberate, rigorous, and transparent. It incorporated principles of risk-based water supply planning currently being adopted widely throughout the water resources planning and management industry (Water Research Foundation, 2016). The primary steps in the CWRP planning process (shown in **Figure 1-4**) are briefly described below.

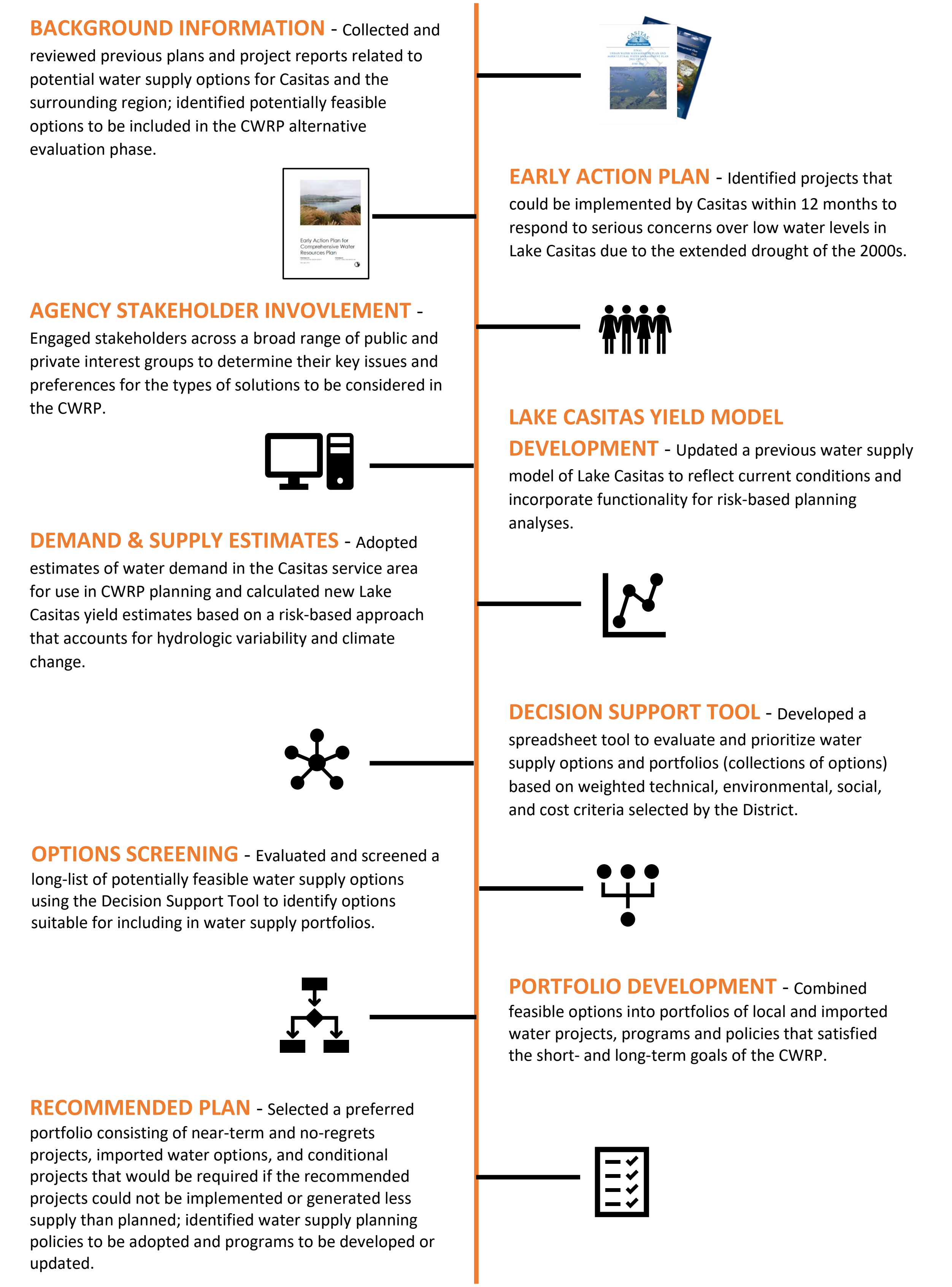


***Figure 1-4**: Overview of the CWRP Process*

Section 2 Stakeholder Involvement

As part of the CWRP, a stakeholder engagement program was created and implemented. Stakeholders included community members, local officials, water agencies (federal, state, and local), agricultural users, environmental groups, nongovernmental organizations, major water users, and other stakeholders to discuss the challenges and opportunities for water supply reliability within the region. The stakeholder involvement process and input are described in more detail in Appendix B Stakeholder Engagement Documentation Technical Memorandum.

A comprehensive key stakeholder database was created in collaboration with Casitas and local elected officials that represent the Casitas Water System service area. The stakeholder engagement strategy included a mixture of various digital and in-person engagement tactics with the following goals:

- **Facilitate stakeholder meetings** to gather input on community priorities for water supply projects
- **Build trust** in the engagement process among key stakeholders and the communities served by the District by providing regular and ongoing progress updates
- **Organize and document** the feedback received throughout the process

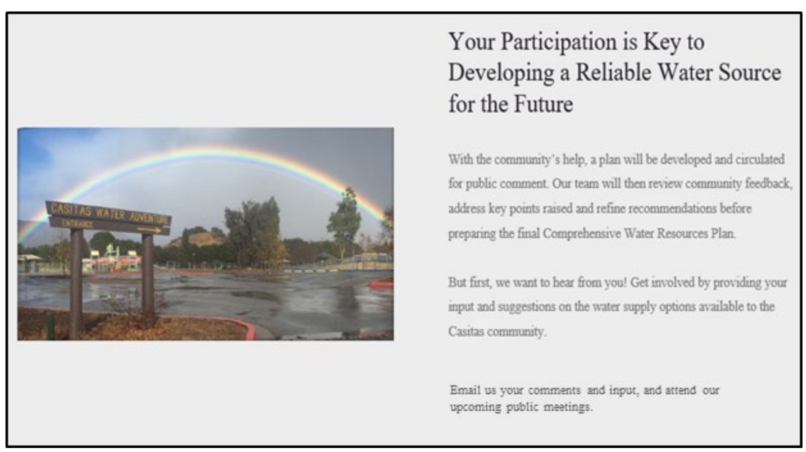
80 Stakeholders from **50 Organizations** were engaged.

Two stakeholder workshops were held in July 2019 in Oak View, CA. These workshops were used to engage stakeholders in a collaborative discussion around water supply concerns within the region. There were several recurring themes during these discussions which included the following:

- Importance of communication with elected officials
- Environmental concerns
- Identifying cost-effective solutions that work
- Impact of water shortages on residents and businesses
- Navigating a complex web of multiple water agencies
- Risks of reliance only on a local water source
- Importance of stable water price and sustainability

Key feedback regarding future water supplies and planning strategies included:

1. Diversify the Casitas Water supply portfolio.
2. Evaluate the State Water Project (SWP) alternatives since Casitas has an existing contract for SWP water, and has been paying for its share of the SWP costs since 1963.



A webpage example from Casitas' Microwebsite.

3. Implement regional solutions that could be mutually beneficial to other water providers in the region.

Monthly CWRP updates were provided to the Casitas Water Resources Committee (WRC), which consists of two Casitas Board members. These meetings were open to the public and were attended by Casitas staff and the CWRP consulting team. CWRP updates were provided at 12 WRC meetings over the course of the project. At these meetings the WRC provided project direction in a number of important areas, including alternatives to be studied, approaches to incorporating climate variability, alternative evaluation criteria, supply and demand estimates, and the recommended plan.

During preparation of the draft CWRP report a Board workshop was held to brief the entire Board on the study process and the draft recommendations. This meeting was open to the public.

Section 3 Demand Analysis

Future water demands were estimated for the Casitas Municipal Water District service area, which includes the Casitas Water System and the Ojai Water System. The CWRP water demand analysis is described in detail in Appendix C Water Demand Estimate for Casitas Municipal Water District Technical Memorandum.

The analysis treated the Casitas Water System separately from the Ojai Water System because the potential sources of supply to the two areas are different. Demands in areas served by the Casitas system are primarily met by water supplied by Lake Casitas, with a small supply from the Mira Monte Well located in the Upper Ventura River Groundwater Basin. Demands in the Ojai Water System are met primarily by Ojai Groundwater Basin wells and supplemented by Casitas Water System as needed.

In this report, water demand refers to water that must be delivered to the Casitas water treatment plant or produced by Ojai Groundwater Basin wells. It thus accounts for both the customer uses and losses in water delivery systems. This is termed “production” water demand as distinguished from “consumption” water demand which captures only customer use “at the tap” and not water delivery system losses. The connection between Casitas sources and demand centers is summarized in **Figure 3-1**.

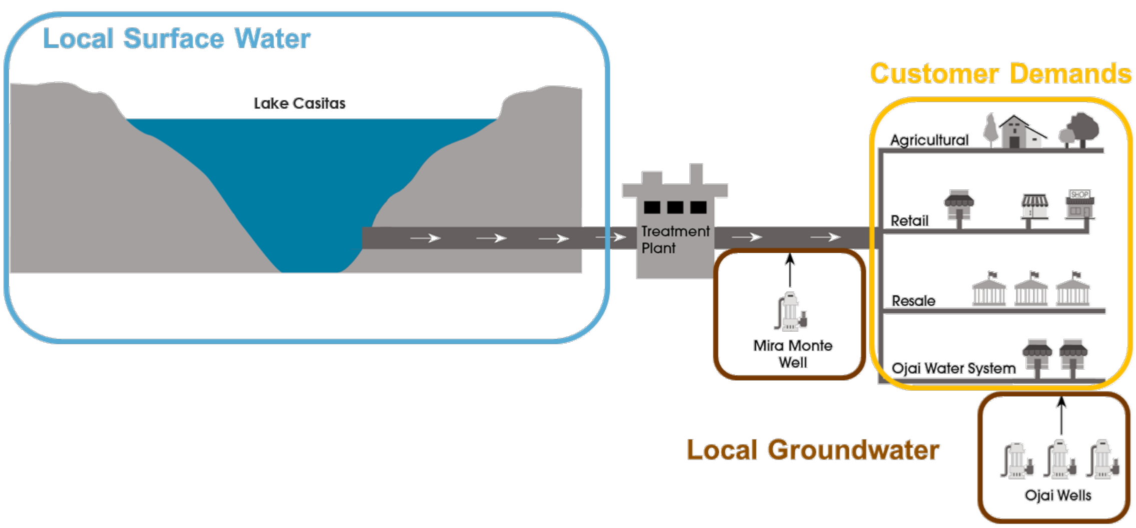


Figure 3-1: *Connection Between Casitas Sources and Demand Centers*

The CWRP was based on future water demands representing estimated conditions in 2040. For both the Casitas Water System and the Ojai Water System, future demands were estimated based on an average of the most recent published Urban Water Management Plan (UWMP) demand forecast and an extrapolation from recent historical demand data (**Figure 3-2**). This approach allowed for incorporation of the influence of the recent severe drought and corresponding long-term water use reductions by Casitas customers.

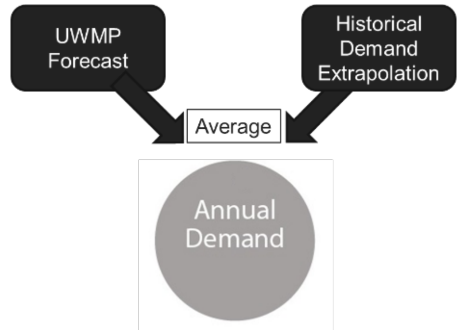
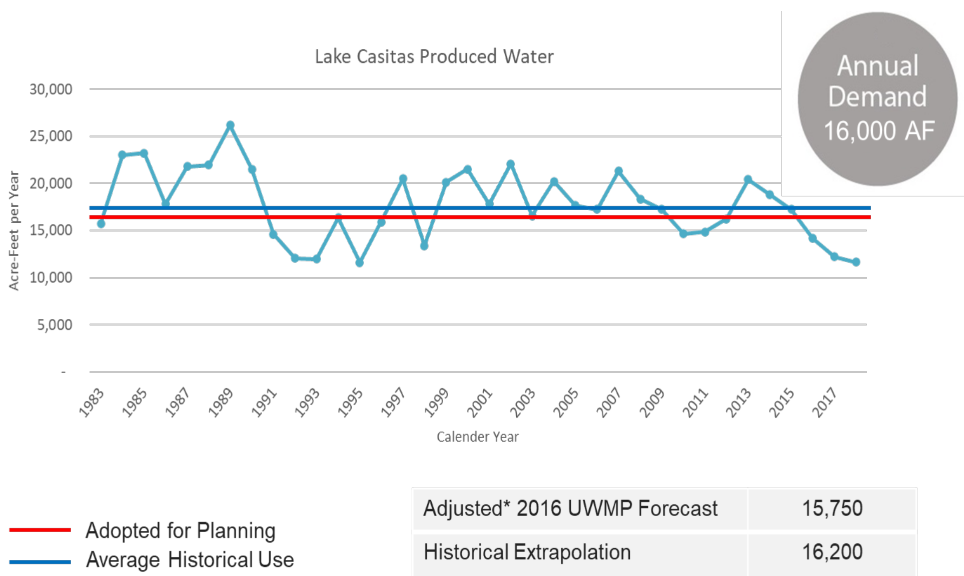


Figure 3-2: *Method for Estimating Future Demand for CWRP*

3.1 Casitas Water System Future Demands

The 2016 Casitas Municipal Water District Urban Water Management Plan (Casitas 2016) reported a 2020 water demand of 17,200 acre-feet per year (AFY) and a 2040 water demand estimate of 17,500 AFY for the Casitas Water System, including all residential, commercial, agricultural, and resale customers. This demand estimate was based on Ventura County population estimates, which forecasted essentially no growth in the Casitas service area over the planning period. Casitas water demand in the past five years has been considerably lower than 17,500 AFY, reflecting the willingness of Casitas customers to modify water use practices in response to the drought. Although some rebound in demand may occur in future years, much of the water savings are likely permanent due to structural changes such as conversion of turf to xeriscape landscaping and replacement of old fixtures and appliances with water-efficient fixtures and appliances. Casitas staff felt it was reasonable to assume a permanent savings of 10% from the 2016 UWMP forecast. Thus, the effective Casitas UWMP demand estimate used in the CWRP analysis was 15,750 AFY.



Adjusted* 2016 UWMP Forecast	15,750
Historical Extrapolation	16,200
Adopted for Planning	**16,000**

*2016 UWMP Forecast – 17,500 AFY

Source data compiled from Lake Casitas historical records

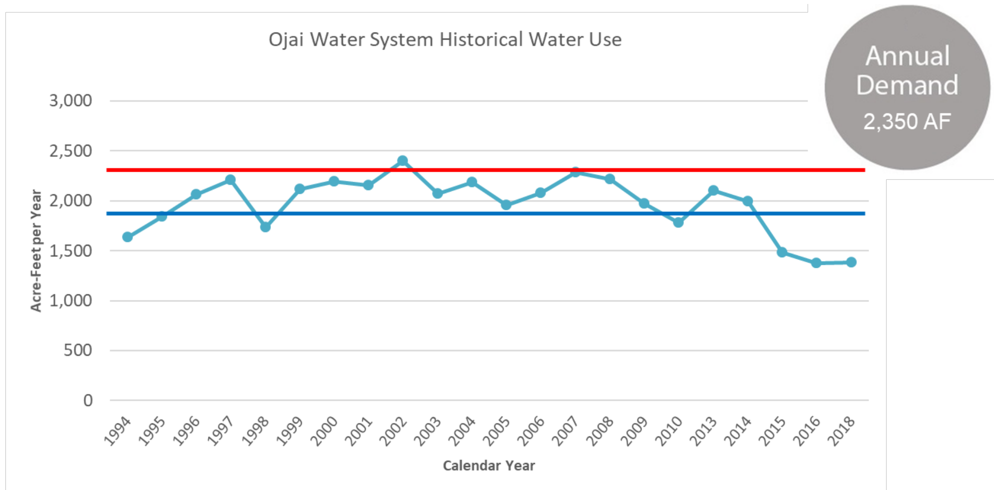
Figure 3-3: *Casitas System Historical Water Production and 2040 Water Demand Forecast*

Recent historical water use data was also analyzed as part of the water demand forecast approach. Data for produced water from Lake Casitas and the Mira Monte Well was averaged over the past 8 years. This average of 15,860 AFY was increased by 300 AFY based on the increase in the UWMP demand forecast between 2020 and 2040, resulting in a historical extrapolation of 16,160 AFY.

For purposes of the CWRP, the assumed 2040 demand was the average of the adjusted 2016 UWMP estimate and the historical extrapolation, which was rounded to 16,000 AFY (**Figure 3-3**). Because population is not expected to increase in the study area based on Ventura County growth studies, this water demand estimate should be valid for years past 2040.

3.2 Ojai Water System Future Demands

The most recent UWMP for the Ojai Water System is the 2010 Golden State Water Company UWMP. That report had a future water use estimate for 2035 of 2,570 AFY. This included effects of assumed population growth and reduction in per capita use due to conservation measures.



*Includes projected growth rate per 2010 UWMP

Adopted for Planning
Average Historical Use

2010 UWMP Forecast	2,570 AFY
Historical Extrapolation	2,140 AFY
Adopted for Planning	**2,350 AFY***

***Figure 3-4**: Ojai Water System Historical Water Production and 2040 Water Demand Forecast*

Historical water consumption in the Ojai Water System service area over the past 5 years has averaged 1,560 AFY. Adjusting for future growth assumed in the UWMP and water system losses, the 2040 water demand estimate based on extrapolation of recent historical data is 2,140 AFY.

The CWRP adopted the average of the UWMP estimate and the historical extrapolation, or 2,350 AFY. Because Ventura County forecasts little growth in Ojai Valley, the estimated demand of 2,350 AFY should be a valid estimate for future years beyond 2040 (**Figure 3-4**). The Ojai Water System demand includes demand met from Ojai Basin wells, which produced an average of 1,360 AFY over the past 8 years, and water purchased from Casitas.

3.3 CWRP Demand Summary

Future water demands adopted for CWRP planning are summarized in **Table 3-1**. When combining the Casitas Water System and Ojai Water System demands, it is necessary to account for the portion of Ojai Water System demands met from the Casitas Water System, so this volume of water is not double counted. On average Casitas has supplied 525 AFY to Ojai, which represents about 20% of Ojai's demand. Adjusting for this shared volume of water, the total estimated 2040 demand for the Casitas service area is 17,825 AFY.

Table 3-1: *Summary of Future Water Demands Adopted for CWRP*

DEMAND PARAMETER	CASITAS SYSTEM	OJAI WATER SYSTEM	TOTAL
UWMP 2040 Forecast (AFY)	15,750	2,570	-
Historical Extrapolation (AFY)	16,200	2,140	-
Adopted for CWRP (AFY)	16,000	2,350	18,350
Ojai Demand Included in Casitas Demand (AFY)	-	-	525
Net Casitas Municipal Water District Demand (AFY)	-	-	17,825

Section 4 Water Supply Analysis

This section describes the components of the analysis performed to estimate the long-term water supply available for the Casitas Water System and the Ojai Water System. The Casitas System water supply was estimated using a simulation model of Lake Casitas; the Ojai Water System supply was estimated based on past production of Ojai Groundwater Basin wells. A detailed description of the water supply and modeling analysis is provided in Appendix D Lake Casitas Water Supply Analysis Technical Memorandum.

4.1 Casitas System Water Supply Analysis

The analysis of available water supply to the portion of the Casitas service area served from Lake Casitas (called the Casitas System herein) was performed using the Lake Casitas Yield Model. Casitas developed the first version of this simulation model for Lake Casitas in 2004. This model was used by Casitas in the past to estimate the safe yield for Lake Casitas based on historical hydrology from 1945 to 2004.

The Lake Casitas Yield Model simulates lake inflows, outflows, and operations. The setting for the model is shown in **Figure 4-1.**. Key inputs are direct inflows to the lake from Coyote Creek and Santa Ana Creek, and diversions from the Ventura River at the Robles Diversion. Key outflows are water releases to meet water supply needs and evaporation. The model is a set of Excel spreadsheets, and is described in detail in the Casitas Water Supply and Use Report (Casitas, 2004).

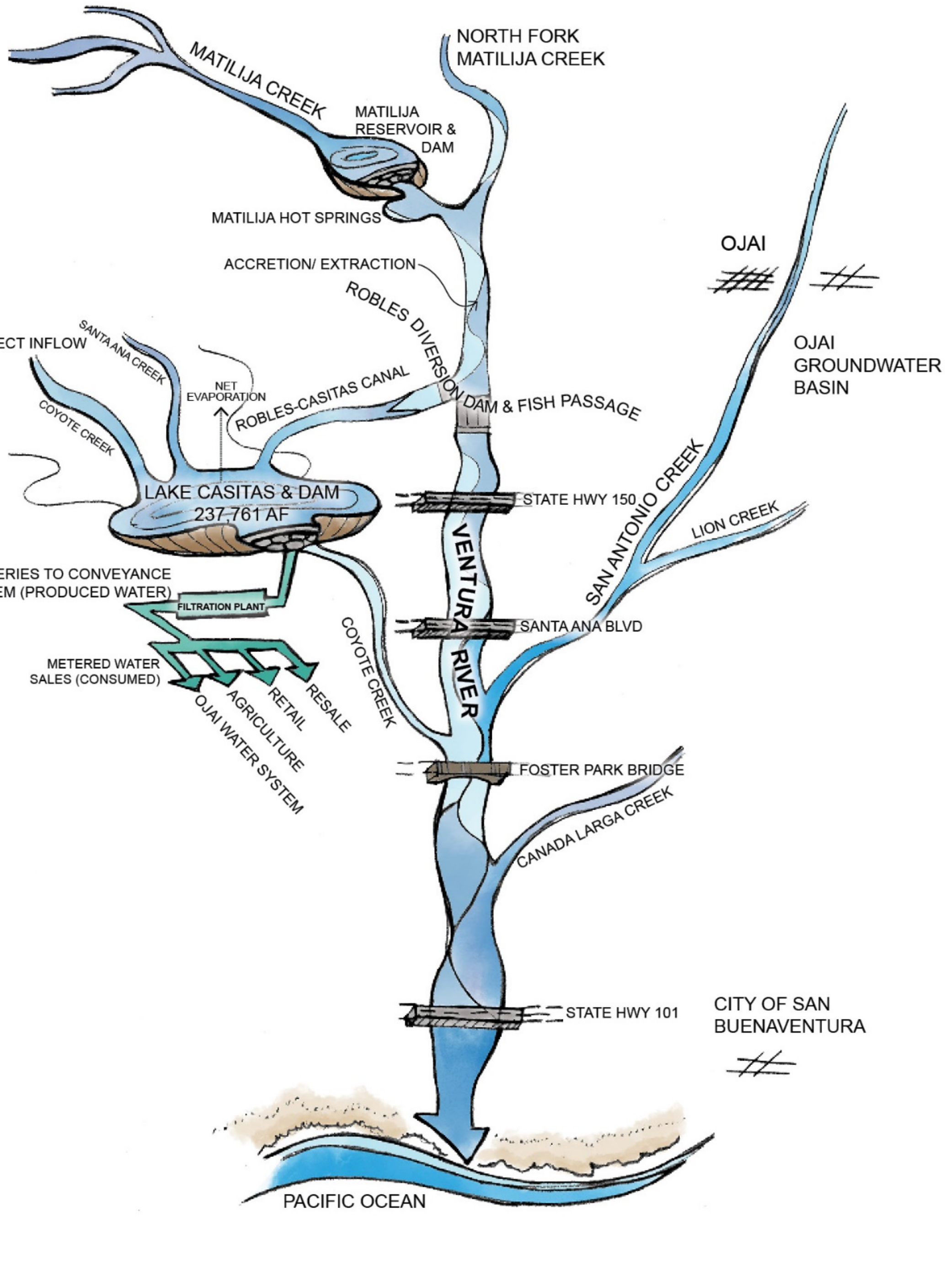


***Figure 4-1**. Schematic representation of Lake Casitas Yield Model setting*

4.1.1 Casitas Yield Model Update

The Lake Casitas Yield Model was updated for the CWRP (**Figure 4-2**) by making the following improvements:

- Extended the model to a 74-year period of record through 2018; this captured the recent California drought.
- Incorporated the 2003 Biological Opinion Operating Criteria for steelhead trout into the simulation of the Robles Diversion Structure; this reduced the volume of water diverted into Lake Casitas in the model during most conditions.
- Updated the Lake Casitas reservoir elevation-area-capacity table based on the recent 2017 bathymetric survey; this reduced the maximum capacity of the Lake from the original volume of 254,000 AF to 237,761 AF.

The updates to the Lake Casitas Yield Model reduced the estimated safe yield of the Lake from 20,540 AFY to 17,460 AFY. This is a significant reduction of 15% in the estimated safe yield just from updating the model.

The next step in the Lake Casitas yield analysis for the CWRP incorporated new planning policies adopted by the Casitas Board during the CWRP process. These policies and their effect on the Lake Casitas yield analysis are described in the following sections.

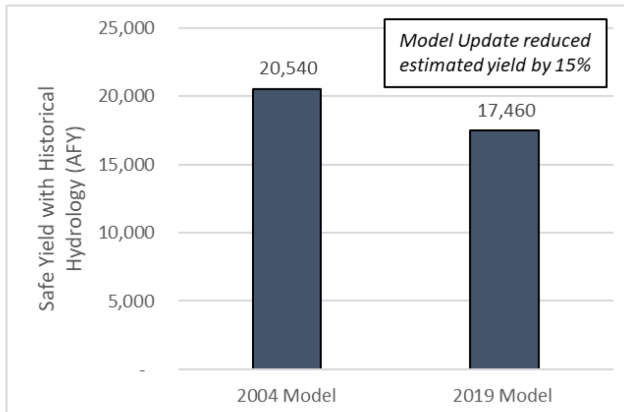


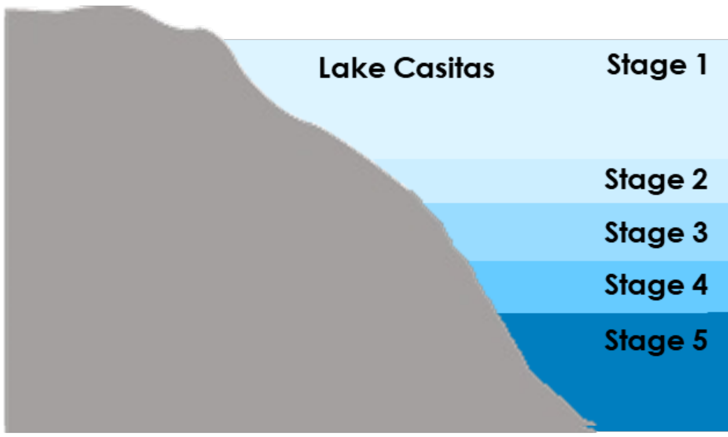
***Figure 4-2**: Impact of 2019 Updates on Lake Casitas Yield Model Safe Yield Estimates for Historical Hydrologic Data*

4.1.2 Incorporation of the WEAP Policy and the Concept of Safe Demand

SAFE YIELD – the **largest amount of water** that can be drawn from Lake Casitas every year in the period of record, without storage dropping below the minimum allowable storage level

SAFE DEMAND – the **largest amount of water** that can be drawn from Lake Casitas every year in the period of record **when demand is reduced based on Lake level according to the WEAP policy**, without storage dropping below the minimum allowable storage level

The Casitas Water Efficiency and Allocation Program (WEAP) was first developed in 1992 as a strategy for managing demand in response to periods of low supply from Lake Casitas. The most recent revision of the WEAP is dated May 2018. The WEAP establishes water use allocations for each Casitas customer based on either 80% of actual use in FY 1989-90 or actual use in FY 2012-13, whichever was less. When Casitas acquired the GSWC system, Ojai customers' allocations were based on estimates of structures and landscaped area on each parcel. The WEAP also defines five Lake Casitas storage stages and provides guidelines for setting lower allocations when storage volumes in Lake Casitas are below certain levels (**Figure 4-3**). The Casitas Board declares the WEAP stage based on lake storage, anticipated runoff in coming months, customer demands, and other factors.



Stage	Lake Storage (AF)	Lake Storage (% of Capacity)	Allocation Reduction (%)
Stage 1	237,761	100%	20%*
Stage 2	118,881	50%	20%
Stage 3	95,104	40%	30%
Stage 4	71,328	30%	40%
Stage 5	59,440	25%	50%
	950 AF	0%	

*Voluntary Reduction

Figure 4-3: *Lake Casitas WEAP Stages*

Because Board declarations of WEAP stages are intended to reduce customer demands, and because Casitas customers have responded positively to shortage declarations and reduced their water use in the past, the Lake Casitas yield analysis was changed to reflect reduced water demands consistent with the WEAP target demands at each lake stage. That is, as the lake level dropped during dry periods in the simulation, the total water demand was set to not exceed the target demand in the WEAP policy. The largest base demand – i.e., the demand when the Lake is full – that could be met in every year when the WEAP reductions are applied for low lake levels was referred to as the "safe demand". The safe demand was used in the CWRP to represent the long-term annual yield from Lake Casitas.

NEW SAFE DEMAND POLICY: Lake Casitas **long-term yield** is based on the concept of **safe demand**, in which customer demands are reduced in dry periods when lake levels are low, consistent with the current WEAP guidelines.

4.1.3 Minimum Allowable Storage Level in Lake Casitas

Past Lake Casitas yield estimates were based on simulations that allowed the Lake storage to be drawn down to the dead pool level, which is approximately 950 AF (0%). This provides no buffer for emergency conditions. As part of the CWRP, the Lake Casitas operation policy was changed to establish a minimum allowable storage level below which the Lake would not be drawn down during normal operations (**Figure 4-4**). The volume of water below the minimum allowable storage would be reserved for emergency conditions beyond the planning assumptions in the CWRP, e.g., more severe droughts or outages of critical infrastructure such as the Robles Diversion.

NEW MINIMUM ALLOWABLE STORAGE POLICY: Lake Casitas will be managed to maintain a **minimum allowable storage volume of 20,000 AF** in all periods of normal operation. A plan will be developed for emergency conditions when the Lake falls below 20,000 AF.

Casitas set the minimum allowable storage volume at 20,000 AF. Excluding the dead pool, this provides about 19,000 AF of emergency storage. This volume is equivalent to 1.1 years of future Casitas Water System demand, or 1.4 years of the WEAP Stage 5 demand. In all Lake simulations of safe yield or safe demand, the goal was to **maintain lake storage above 20,000 AF at all times**. Calculations of the water supply gap described later in this report were based on maintaining a minimum allowable storage of 20,000 AF.

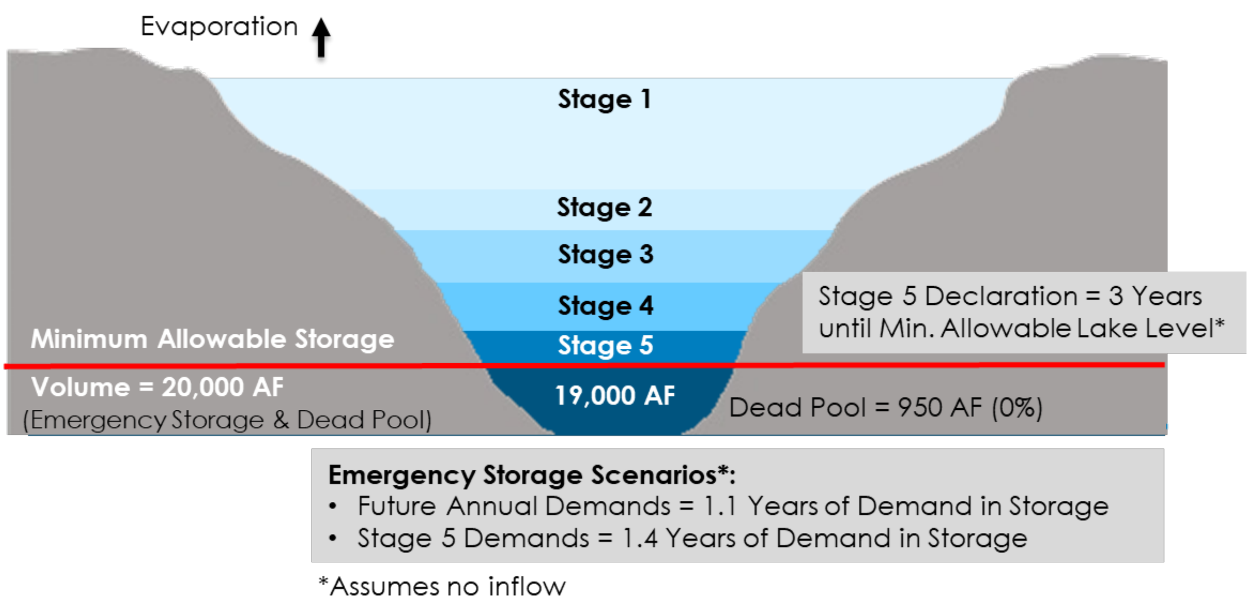


Figure 4-4: *Minimum Allowable Lake Level*

4.1.4 Climate Variability and Climate Change Analysis

Estimates of future Lake Casitas yield account for climate variability (annual variation in climate and streamflow based on historical records) and climate change (shift in temperature and precipitation due to global climate drivers).

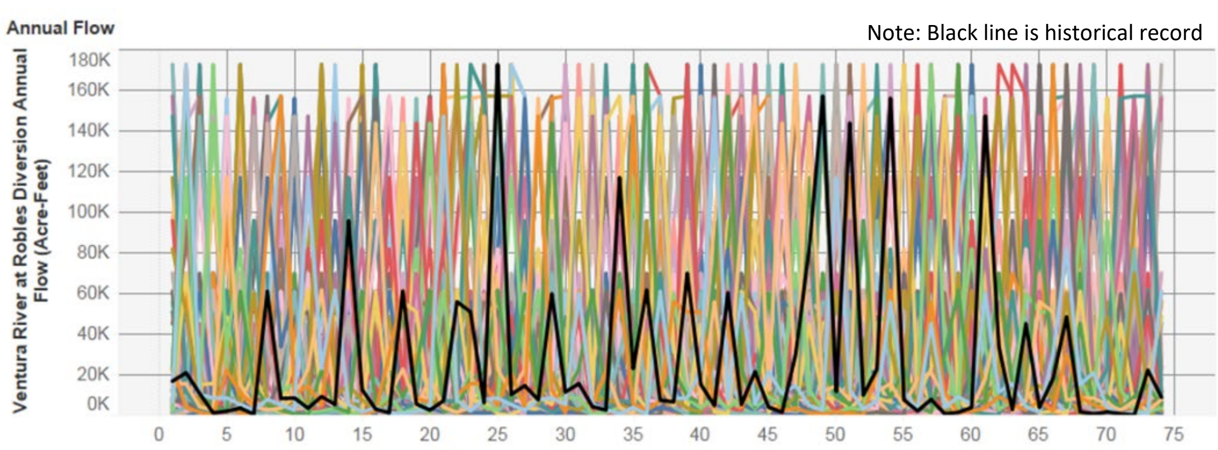


Figure 4-5: *Plot of 100 74-year Monthly Time Series for Ventura River Streamflow at Robles Diversion, Based on Historical Record*

Natural hydrologic variability was incorporated into the Lake Casitas yield analysis by generating one hundred 74-year hydrologic datasets (traces) derived from the historical dataset and having the same basic statistics (e.g., standard deviation and serial correlation of annual streamflows) as the historical record (**Figure 4-5**). Annual historical natural inflows to the lake and Ventura River streamflows at the Robles Diversion structure were reshuffled 100 times, maintaining the long-term serial correlation between annual streamflows. Monthly distribution of flows within each year was unchanged. The result was 100 hydrologic datasets that were used as input for the Lake Casitas Yield Model.

Downscaled climate change information for Ventura County (Western Regional Climate Center, 2019) was used to adjust Lake Casitas yield estimates for potential future changes in climate conditions (temperature and precipitation). Key findings for Ventura County climate change include:

- ***Increased*** average temperature
- ***Increased*** maximum temperatures by 3-5 degrees F
- ***Increased and/or decreased*** average annual precipitation
- ***Increased*** number of dry days (3-4 per year)
- ***Increased*** precipitation intensity; wettest 5% of days will contribute 10% more to annual precipitation
- ***Increased*** evapotranspiration by 2.5 to 6.5 inches/year, with highest increases in inland areas
- ***Decreased*** runoff production (conversion of rainfall to runoff)

Some potential climate change conditions could decrease Lake Casitas inflow and others could increase it. These effects were assumed to generally compensate for each other. Increased evaporation of six inches/year was found to reduce the Lake Casitas safe yield for historical inflow hydrology by 4.3 percent. This factor was applied to results of yield simulations to account for potential future climate change.

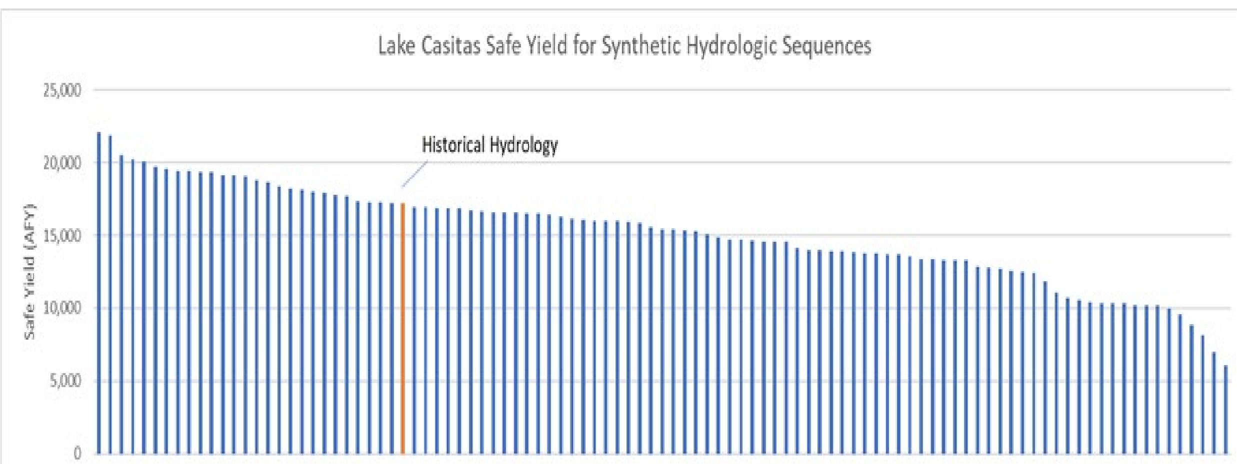


***Figure 4-6**: Lake Casitas Safe Yield for Synthetic Hydrologic Sequences*

Of the 100 synthetic hydrologic traces generated for the CWRP, about two-thirds result in lower Lake Casitas safe yield than the historical hydrology (**Figure 4-6**). This persistence toward drier conditions has a significant effect on the reliable yield the Lake could supply in the future.

4.1.5 Reliability Analysis

The 100 synthetic hydrology traces were used to develop safe demand estimates with different reliabilities. The 2019 Lake Casitas Yield Model was used to simulate the safe yield and safe demand (maximum annual withdrawal when demands are reduced according to WEAP policy) for each of the 100 traces. Results are shown in **Figure 4-7** and **Table 4-1**: Lake Casitas Safe Demand and indicate the percentage of potential future hydrologic conditions for which the given safe demand could be met.

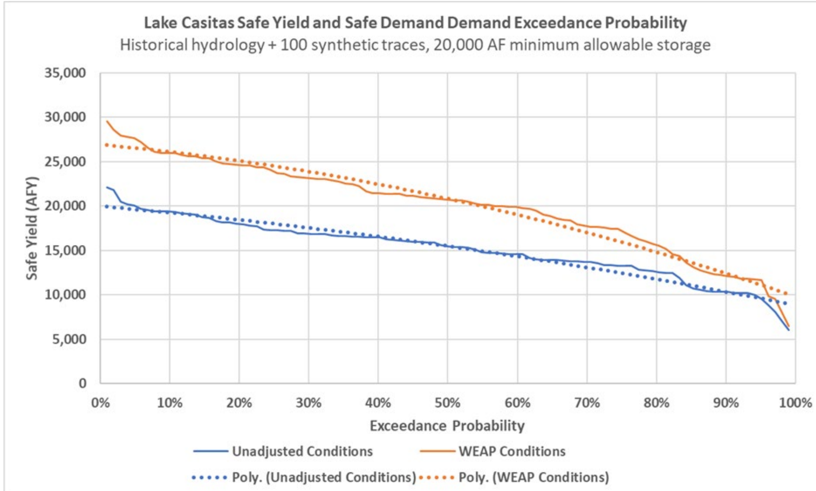


***Figure 4-7**: Lake Casitas Safe Demand Exceedance Probability Analysis (Safe yield shown in blue; safe demand shown in orange.)*

Casitas considered the reliability results and determined that developing supplies to produce safe demand to meet all future hydrologic conditions would be very expensive and unnecessary with the adopted minimum allowable storage in Lake Casitas of 20,000 AF. The Board selected a reliability of 95% to balance a conservative approach to water supply planning against prudent financial planning. When the climate change adjustment described previously was applied, the 95% reliable safe demand from Lake Casitas used for the CWRP was 10,660 AFY.

***Table 4-1**: Lake Casitas Safe Demand (AFY)*

RELIABILITY	SAFE DEMAND WITHOUT CLIMATE CHANGE ADJUSTMENT (AFY)	SAFE DEMAND WITH CLIMATE CHANGE ADJUSTMENT (AFY)
90%	12,420	11,890
95%	11,140	10,660
99%	10,090	9,650

Note: 100 hydrologic traces, application of WEAP demand reductions for low lake levels, minimum allowable storage of 20,000 AF

NEW RELIABILITY POLICY: Lake Casitas safe demand used for planning will be based on a **reliability of 95%**.

There is a 95% chance that in the future we will be able to support a base demand of 10,660 AFY from Lake Casitas under our current WEAP policy with our current supplies and a 20,000 AF minimum allowable storage pool.

4.2 Water Supply Needs Analysis

Future water supply needs were based on three factors:

1. The **water supply gap** (difference between future annual demand and available annual supply)
2. The **immediate risk of shortages** due to the current low storage volume in Lake Casitas after the extended California drought

3. The desire for a more **diversified water supply portfolio** to better prepare for future uncertainty

4.2.1 Water Supply Gap Analysis

The future water supply gap was estimated separately for the Casitas System and the Ojai water System.

Casitas Water System

The CWRP adopted an average annual demand for the Casitas system of 16,000 AFY (see Section 3, **Casitas Water System Future Demands**). The available annual supply is the sum of the Lake Casitas 95% reliable safe yield of 10,660 AFY and the Mira Monte Well[1] yield of 180 AFY. The Mira Monte Well is located in the Upper Ventura River Groundwater Basin, which is managed by the Upper Ventura River Groundwater Agency (UVRGA). The resulting long-term water supply gap for the Casitas system is 5,160 AFY (rounded to 5,200 AFY), as depicted in **Figure 4-8**.

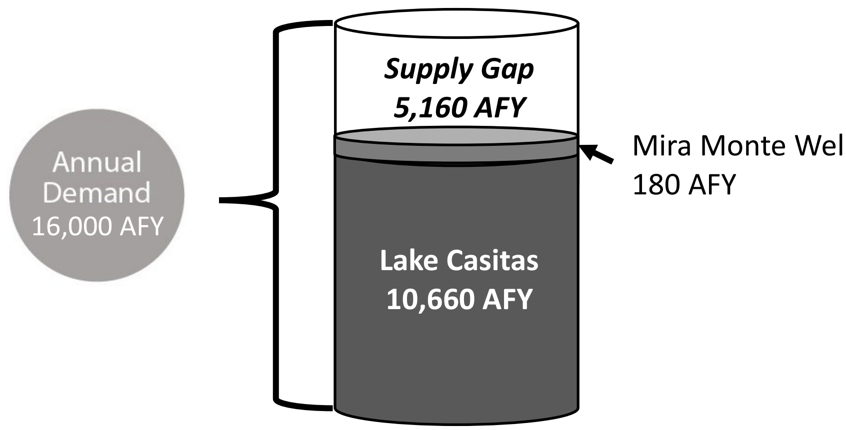
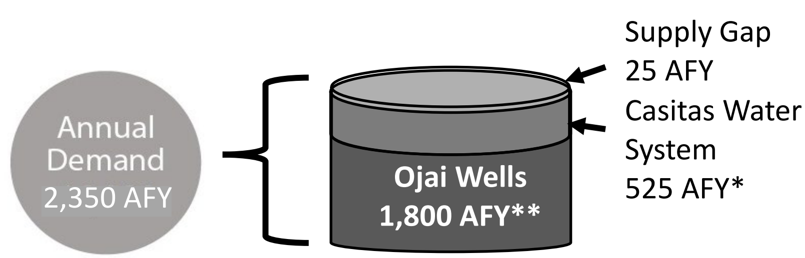


***Figure 4-8:** Casitas System Water Supply Gap*

Ojai Water System

The Ojai Water System average annual future demand for the CWRP is 2,350 AFY (see Section 3, **Ojai Water System Future Demands**). The available supply for the Ojai Water System is estimated to be 2,325 AFY (1,800 AFY from groundwater wells[2] and an average of 525 AFY from the Casitas System (based on historical deliveries)). The groundwater wells are in the Ojai Basin, which is managed by the Ojai Basin Groundwater Management Agency (OBGMA). The resulting gap of 25 AFY was assumed to be within the



*Typical historical value; included in demand on Lake Casitas System
** Assumed safe yield from current well system. Permitted production = 4,404 AFY.

***Figure 4-9**: Ojai Water System Water Supply Gap*

[1] The Mira Monte Well is located in the Upper Ventura River Groundwater Basin, which is managed by the Upper Ventura River Groundwater Agency (UVRGA).
[2] The Ojai system groundwater wells are in the Ojai Basin, which is managed by the Ojai Basin Groundwater Management Agency. Assumed safe yield is 1,800 AFY, and Casitas has a permitted capacity of up to 4,404 AFY.

accuracy of the supply and demand analyses, and could be met with a small additional delivery from the Casitas System if needed (**Figure 4-9**).

Table 4-2 summarizes the water supply gap in both the Casitas and Ojai Water Systems.

***Table 4-2**: Summary of Water Supply Gap Analysis*

WATER SYSTEM	AVERAGE ANNUAL FUTURE DEMAND (AFY)	AVERAGE ANNUAL SUPPLY (AFY)	ASSUMED WATER SUPPLY GAP (AFY)	COMMENTS
Casitas System	16,000	10,840	5,200	Rounded from 5,160
Ojai Water System	2,350	2,325	0	Negligible; could be met from Casitas System

4.2.2 Immediate Risk of Shortages

At the beginning of the CWRP study the Lake Casitas storage was about 78,000 AF, which triggered a Stage 3 declaration and caused concern for Casitas water managers and the community. Although the Lake had recovered to about 100,000 by late 2019, concern of future shortages remained if the drought were to continue.

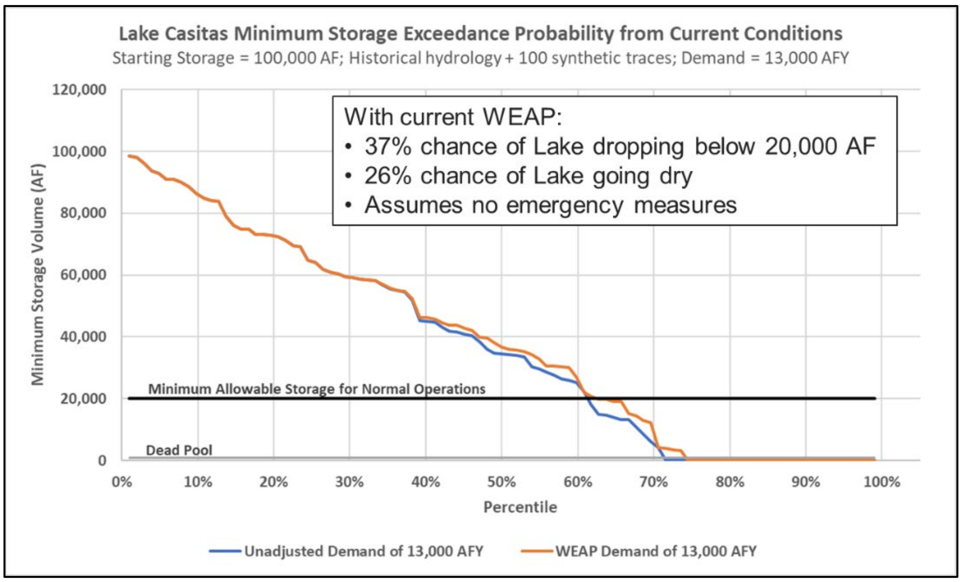


***Figure 4-10**: Exceedance Probability of Lake Casitas Minimum Storage Occurring At Least Once Over the Simulation Period for 100 Hydrologic Traces with Starting Lake Storage of 100,000 AF*

The risk of critically low Lake levels was investigated by simulating Lake Casitas operation for the 100 synthetic hydrologic traces and historical hydrology with a demand of 13,000 AFY. This demand is higher than the 2019 observed demand but lower than the long-term estimate of 16,000 AFY. The Lake Casitas risk shortage analysis is described in Appendix E Analysis of the Risk of Lake Casitas Being Drawn Down to the Minimum Pool Level Technical Memorandum. Thirty-seven percent (37%) of the 100 hydrologic traces caused the Lake to fall to the 20,000 AF minimum storage level, and 26% of the traces caused the Lake to fall to the dead pool level (**Figure 4-10**). This assumed no emergency measures would be taken.

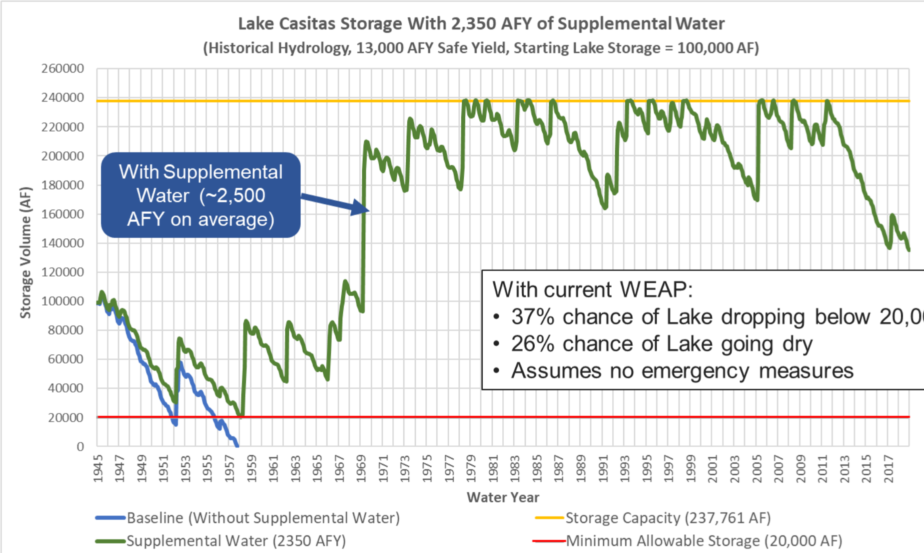


***Figure 4-11**: Plot of Lake Casitas Storage for Historical Hydrology with Addition of 2,500 AFY of Supplemental Water in Every Year*

This level of risk prompted development of a CWRP objective to take steps to secure a new water supply in the near term in the event the recent drought continues. Simulations with different constant annual volumes of supplemental water showed that 2,500 AFY provides reasonable protection against critically low Lake levels in the next decade (**Figure 4-11**). The CWRP goal was to add 2,500 AFY of new supply in 5 years.

4.2.3 Portfolio Diversification

All existing Casitas surface and groundwater supplies for both the Casitas System and Ojai Water System originate in the local Ventura River watershed. This places Casitas at risk from droughts or emergencies that affect the local watershed. A strategy to address this risk is to diversify the Casitas water supply portfolios. Diversification involves adding supplies from sources other than the local watershed, e.g., the State Water Project, desalinated seawater, water imported from an adjacent watershed (**Figure 4-12**). The CWRP adopted a goal of diversifying the Casitas water supply portfolio, since a desire for portfolio diversification was one of the main themes from the stakeholder engagement process.

BENEFITS OF WATER SUPPLY DIVERSIFICATION

- Improve reliability during shortage periods
- Provide flexibility in system operations
- Forge regional partnerships

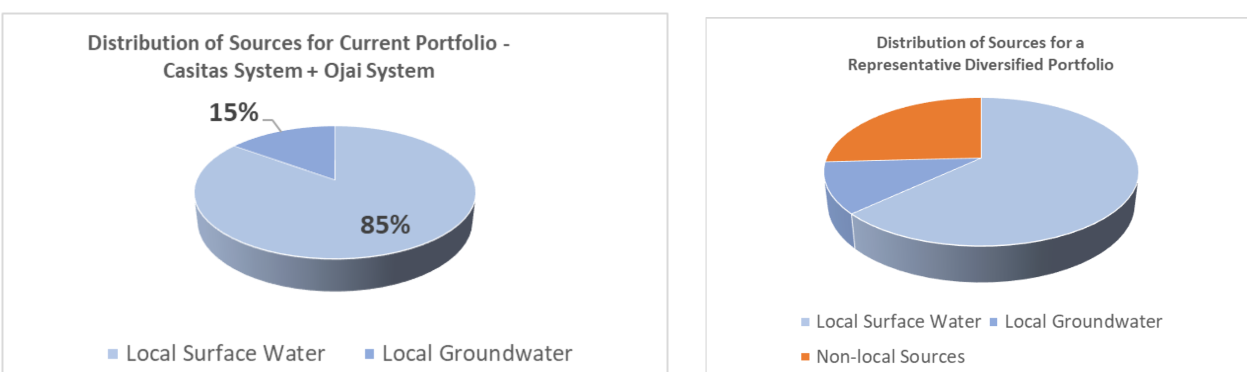


***Figure 4-12**: Conceptual Representation of a Diversified Portfolio*

4.2.4 Water Supply Planning Goals

As a result of the water needs assessment, the Board adopted goals for long-term water supply augmentation, short-term risk mitigation, and portfolio diversification (**Figure 4-13**). These goals were the basis for investigating potential water supply options and developing future water supply portfolios.

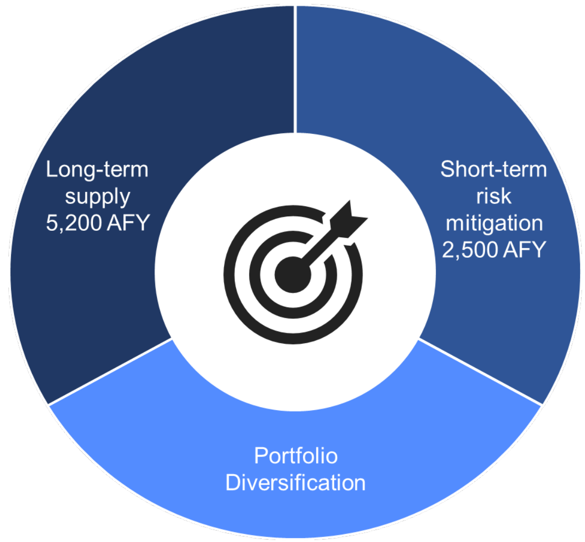


***Figure 4-13**: Summary of CWRP Planning Goals*

Section 5 Water Supply Options Analysis

Potential strategies to address the CWRP goals were developed by first identifying all potential supply options, then screening those to select the most feasible options, and finally combining those feasible options into portfolios that satisfied the CWRP goals. This section describes the process used to select feasible water supply options, which is depicted in **Figure 5-1**.

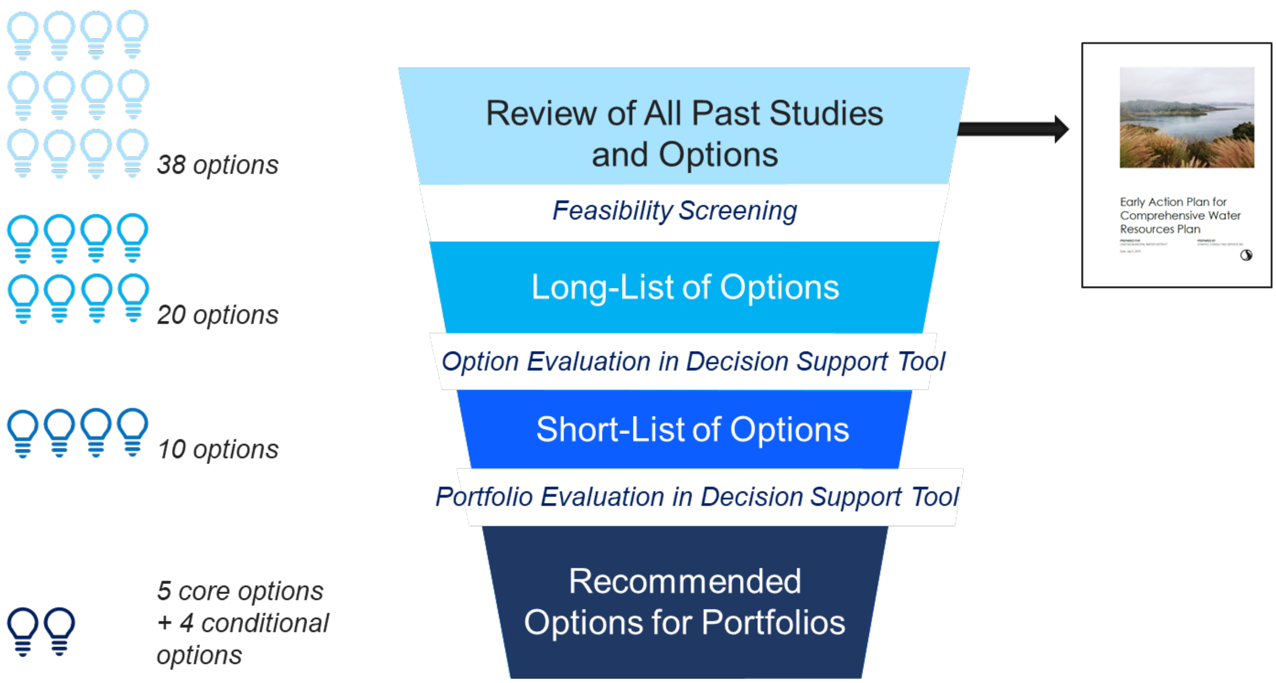


***Figure 5-1**: Water Supply Option Screening and Evaluation Process*

5.1 Water Supply Options Considered

An extensive list of water supply options was prepared by reviewing past water supply planning reports and identifying options considered previously. This included planning reports by Casitas and other agencies, including the recent Casitas Water Security Project analysis (WREA et al, 2016). This process is described in Appendix A Background Information Technical Memorandum. Other concepts were added by the project team, and a list of projects suitable for consideration in the CWRP was developed. This list is shown on the next page, with water supply options categorized based on the project type and water source.

STATE WATER PROJECT

SWP 01 Transfers via City of Ventura State Water Project Interconnect and Casitas-Ventura State Water Project Interconnection
SWP 02 Calleguas Emergency Interconnection with Casitas
SWP 03 Ventura-Santa Barbara Counties Interconnection
SWP 04 Casitas-Calleguas Interconnection
SWP 05 City of Ventura Supplemental Water or In-Lieu

RECYCLED WATER

RW 01 Recycled Water from Ojai Valley Sanitary District (OVSD)
RW 02 Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn
RW 03 Secondary Reclaimed Water to the Ojai Valley
RW 04 Tertiary Reclaimed Water to Rincon Orchards
RW 05 Spray Field in Canada Larga
SW 06 Ojai East Septic Collection, Package Treatment, Recharge

SURFACE WATER

SW 01 San Antonio Creek Spreading Basin Rehabilitation
SW 02 Debris Basin "Enhanced" Percolation
SW 03 Matilija Dam Groundwater/Surface Water
SW 04 Expansion of Robles Canal
SW 05 Construction of a New Dam Upstream of Lake Casitas
SW 06 Robles Forebay Restoration

LOCAL AGREEMENTS

LA 01 Ojai Basin Groundwater Management Agency (OBGMA) Co-operation Agreement (Inter-basin) with Upper Ventura River Groundwater Basin Sustainability Agency
LA 02 Conjunctive Use Agreement with OBGMA

GROUNDWATER

GW 01 Matilija Formation Deep Wells (VRBO, HOBO)
GW 02 Abandoned Wells and Inspection Program
GW 03 Data Collection and Storage
GW 04 Renovate Senior Canyon Mutual Water Company Horizontal Well
GW 05 Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed
GW 06 Ojai Basin Desalter Project
GW 07 Santa Ana Road Underground Stream
GW 08 Well Improvements in Ojai Groundwater Basin

MAINTENANCE AND OPERATIONS

MO 01 Environmental/Habitat Modification
MO 02 Ventura River Watershed Infrastructure Improvements
MO 03 Fire Hydrant and Dead-End Flush Re-Use
MO 04 Resale Water Company System Retrofit/Rehabilitation
MO 05 Casitas Leak Detection and Repair Program
MO 06 Sediment Removal at North End of Lake Casitas
MO 07 Pipeline from Matilija Chlorinator to Hot Springs
MO 08 Robles Diversion Fish Passage Improvements

WATER CONSERVATION

C 01 Conservation/Enhanced Demand Management Programs (5 percent)
C 02 Conservation/Enhanced Demand Management Programs (10 percent)

DESALINATED WATER

DW 01 Desalinated Water from City of Santa Barbara
DW 02 Casitas Desalinated Water Plant
DW 03 Ventura County Regional Desalinated Water Plant

5.2 Water Supply Options Screening

A Decision Support Tool was developed to allow Casitas to evaluate, compare and screen water supply options. The Decision Support Tool implements a multi-criteria weighted scoring approach to standardize the process for assessing options. Development and application of the Decision Support Tool for the CWRP are described in Appendix F Decision Support Tool Documentation Technical Memorandum.

Casitas staff and the Water Resources Committee selected the individual criteria and criteria weights for evaluating water supply options. Criteria were selected in technical, cost, environmental, and social categories. Different criteria weights were explored to test possible outcomes with different stakeholder group preferences (e.g., higher weights for environmental or cost criteria). In the weighting scheme adopted by Casitas the technical and cost categories were given the most importance (highest weights) in the multi-criteria scoring process. The evaluation criteria and the assigned weights are shown in **Table 5-1**.

Table 5-1: *Decision Support Tool Criteria and Weights for Evaluating Water Supply Options*

CRITERIA CATEGORY	INDIVIDUAL CRITERIA	CRITERIA WEIGHTS	CATEGORY WEIGHTS
Technical	Annual Yield	15%	30%
	Technical Feasibility	5%	
	Reliability	5%	
	Time to Implement	5%	
	Phased Construction	-	
Cost	Construction Cost	15%	30%
	O&M Cost	5%	
	Overall Cost Effectiveness	10%	
Environmental	Water Quality	10%	25%
	Permitting and Regulatory Constraints	8%	
	Energy Efficiency	7%	
Social	Casitas Control	5%	15%
	Stakeholder Support	5%	
	Regional and Ancillary Benefits	5%	

Each of the potentially feasible water supply options was evaluated using the Decision Support Tool. Results are shown in **Figure 5-2**, which ranks the options from most preferred (highest score) to least preferred (lowest score). The top 10 scoring options were selected for building portfolios. Since the feasibility of the Matilija Deep Wells option is not fully understood, this option was also included in further portfolio analysis. Selected water supply options are described in the following subsections.

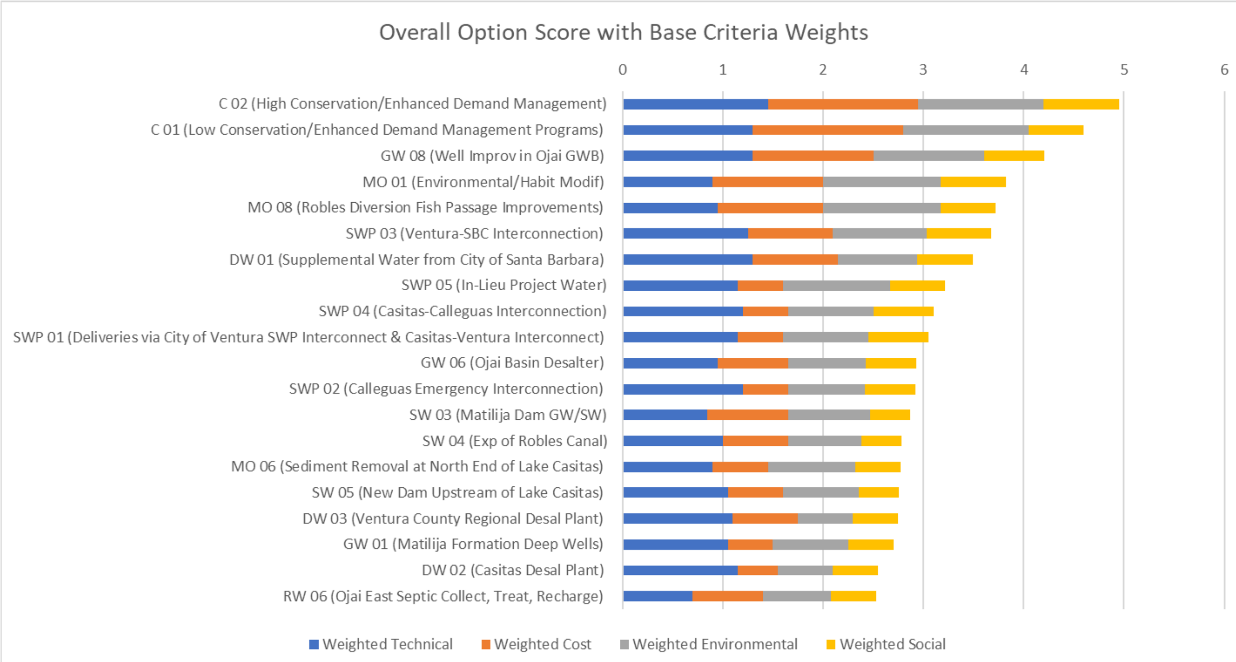


***Figure 5-2**: Decision Support Tool Scoring of Water Supply Options Using Base Weights Selected by Casitas*

Note: High scores denote best performance relative to the evaluation criteria

5.3 Local Water Supply Options

Water supply options to be used in forming portfolios were divided into two groups: Local Options that derive their supply from the Ventura River watershed, and Supplemental Water Options that derive their supply from outside the Ventura River watershed. The Local Options adopted for the CWRP portfolios are listed in **Table 5-2** in the order in which they were ranked in the Decision Support Tool. Detailed descriptions of the Local Options follow the table.

Table 5-2: Summary of Local Options Carried forward to Portfolio Analyses

LOCAL OPTION	BRIEF DESCRIPTION	ESTIMATED AVERAGE ANNUAL YIELD (AFY)	ESTIMATED CAPITAL COST
C 01 / C 02 - Enhanced Conservation/Demand Management	Conservation and demand management practices above and beyond those currently implemented by Casitas and its resale customers. Could include increased rebates, education and outreach, or other conservation incentives. Two levels: 5% savings (C 01) and 10% savings (C 02) compared to planned water use. Can be implemented immediately.	800 – 1,600	$80k - $170k (Grants may be available)
GW 08 - Ojai Basin Well Improvements	Rehabilitation or replacement of existing wells to recover original design yield. Can be implemented in one year.	500	$1.5M
MO 01 - Watershed Management (Arundo removal)	Casitas participation in regional efforts to manage watershed conditions upstream of Lake Casitas to increase runoff. Example: Arundo removal. Can be implemented immediately but benefits will not be realized for several years.	300	-
MO 08 - Robles Diversion Fish Screen Improvements	Improvements to Robles Diversion fish screen to allow more efficient operation and increased diversions to Lake Casitas. Can be implemented immediately.	350	$500K to $10M
GW 01 - Matilija Formation Deep Wells (VRBO, HOBO)	Wells to recover water from the Matilija Deep Aquifer. Horizontal Bore (HRBO) and Vertical Bore (VRBO) options have been considered. Pilot tests are needed to confirm well yields and long-term supply. Significant uncertainty around project feasibility.	Unknown – requires further study	Unknown – requires further study

C 01/C 02 – Conservation/Enhanced Demand Management Programs

Casitas has a long history of implementing conservation policies and demand management measures (DMMs). These policies and DMMs are remarkably effective in reducing water demand during drought periods. During the most recent drought, Casitas customers reduced their water use by about 40%, and over 9,000 AFY of water was saved in 2019 compared with pre-drought demands 2013. In response to the recent drought, Casitas implemented its Water Efficiency Allocation Program, and overuse penalties were implemented as part of the allocation program under the more severe stages of drought. As of April 2019, the State of California declared the drought over, but Casitas has remained in a Stage 3 declaration due to conditions in the local watershed.

Even in non-drought periods, Casitas has a long-standing commitment to water use efficiency. Casitas was a signatory to the Memorandum of Understanding with the California Urban Water Conservation Council, which is now known as the California Water Efficiency Partnership (CalWEP). Some of the programs implemented by the Casitas water conservation section include:

- Water surveys available to all customers
- Free water saving devices including low flow showerheads, faucet aerators, toilet flappers, shower timers, etc.
- Washing machine and toilet rebates through partnership with CalWEP
- Turf removal rebates (previous regional grant funded program)
- System water loss audits and leak detection and repair
- Smart Irrigation Controller rebates
- Agricultural and hobby farm rebates for implementing water efficiency recommendations
- California Irrigation Management Information System (CIMIS) stations
- Outreach using social media
- Water Conservation Demonstration Garden at District Headquarters
- Public education and community outreach through banners newsletters, bill inserts, workshops, tours, etc.
- Water waste investigations (and enforcement of adopted ordinance prohibiting waste of water)

The State has also adopted several initiatives to increase conservation such as the Water Conservation Act of 2009 and, more recently, the Making Conservation a Way of Life legislation passed in 2018. In accordance with State guidelines, Casitas prepares an Urban Water Management Plan every five years, which outlines demand management programs and demonstrates water use efficiency consistent with State policy.

While some of the water savings achieved during the recent drought are expected to be permanent, customers may return to previous behaviors as the pressure to conserve in direct response to an ongoing drought is relaxed. The CWRP assumes that demands will rebound but will remain 10 percent lower than previously planned UWMP demands (refer to **Section 3** for a description of planned long=term demands).

Option C 01/C 02 consists of implementing additional demand measures to drive average water use even lower on a long-term basis. For the CWRP, two levels of additional demand reduction were considered: 5% and 10% below the average annual demands of 16,000 AFY for the Casitas System and 2,350 AFY for the Ojai Valley System. **Figure 5-3** shows recent historical demands, the CWRP planned demand, and a 10% additional conservation scenario. Specific methods or programs to achieve these reductions have not been specified, but would be part of the Water Conservation Plan proposed as a CWRP recommended program. It is anticipated this program, in addition to measures targeting municipal uses, would include incentives to help promote agricultural water efficiency and ensure the Casitas resale entities continue to aggressively promote conservation among their customers.

The estimated cost of additional demand management was based on the cost of the current Casitas conservation program, which is about $170,000/year excluding salaries and other costs. Gaining an additional permanent 5% savings was assumed to require an increased spending of 50% ($85,000/year); additional permanent 10% savings was assumed to require additional spending of 100% ($170,000/year).

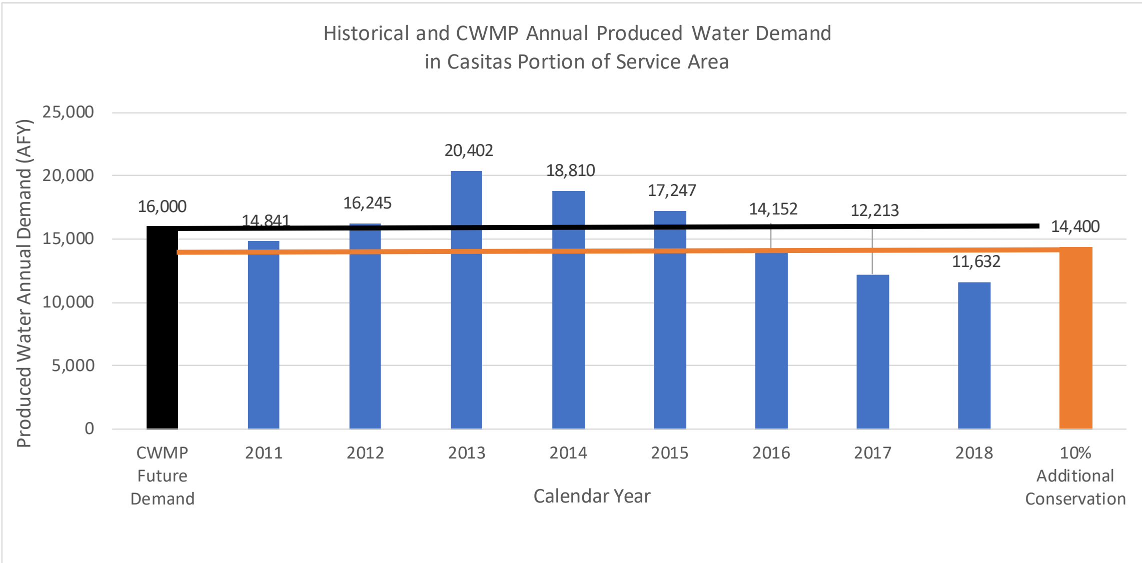


***Figure 5-3**: Historical and CWRP Annual Produced Water Demand in Casitas Service Area Compared to 10% Conservation Option*

GW 08 – Well Improvements in Ojai Groundwater Basin

Casitas acquired GSWC's Ojai Water System in June 2017. Included in the acquisition were six groundwater production wells consisting of the Mutual #4, Mutual #5, Mutual #6, San Antonio #3, San Antonio #4, and the Gorham well.

***Figure 5-4.** Ojai Wellfield Location*

Casitas operates these wells on two parcels located on either side of San Antonio Creek, south of Grand Avenue, as shown in **Figure 5-4.** The wells range in age from 6 to 47 years old and produce between 70 and 250 gallons per minute (gpm).

Since the acquisition of the wells from Golden State in 2017, Casitas has performed multiple studies on the wellfield with the intent of characterizing the condition of the wells, quantifying interference between the wells, and identifying projects that could be undertaken to improve the production and operation of the existing wells. These studies identified several projects specific to the Ojai Wellfield. Respective locations from the wells can be found in **Figure 5-4** (Figure 1 of the Ojai Well Assessment Report Pueblo Water Resources, 2018). The anticipated yield is approximately 500 AFY.

MO 01 – Environmental/Habitat Modifications

The Environmental/Habitat Modification project consists of activities to reduce the amount of a major water-consuming plant in the Casitas service area and contributing watershed, *Arundo donax* (*Arundo*). Turfgrass is also considered a major water consuming plant, but to a considerably lesser extent and is part of regular conservation measures. Therefore, this project focuses only on removal of *Arundo*.

Arundo is an invasive species with very high water consumption; the rate of water loss is estimated at approximately six times more than that of the native riparian vegetation. Estimates of *Arundo* water use vary between 1 and 48 AFY/acre, with a reasonable estimate of 24 AFY/acre water use (California Invasive Plant Council, 2011). *Arundo* removal and replacement with native riparian plants reduces evapotranspiration losses and results in net savings of approximately 20 AFY per acre of *Arundo* removed. This improves recharge to the groundwater basin as well as helps to keep the river alluvium more saturated.

Arundo removal and replacement with native species can vary in cost based on method of removal. Methods meeting all County requirements has a cost of approximately $20,000 per acre, and other methods could cost as much as $579,000 per acre (Ventura County Watershed Protection District, 2010; WREA & KG, 2016). However, *Arundo* removal is not permanent and ongoing management programs are required to control this invasive species. The Ventura River Watershed Council has included an Arundo-Free Watershed Campaign as one of their top six priority projects per the 2015 Ventura River Watershed Management Plan.

For purposes of the CWRP, this project was assumed to remove 45 acres of *Arundo* per year for an annual average water savings of 300 AFY. Actual increase in supply accruing to the Casitas system would be very difficult to document. If implemented as a water supply project, Casitas would not be responsible for managing *Arundo* removal activities. Casitas would participate with the Ventura County Watershed Protection District and other agencies involved in watershed management projects.

MO 08 – Robles Diversion Fish Passage Improvements

In order to augment the natural inflow to Lake Casitas, Casitas operates the Robles Diversion Dam along the Ventura River. The facility is shown in **Figure 5-5.**. The Robles Diversion Dam diverts water to the Robles Diversion Canal, which in turn feeds Lake Casitas. Due to the Biological Opinion from the National Marine Fisheries Service regarding the endangered steelhead trout, Casitas was required to install and operate a fish screen at the Robles Diversion Dam. After the installation of the fish screen in

Figure 5-5. *Robles Diversion Fish Screen (MKN Associates, 2019)*

2004, the Robles Diversion no longer could divert the maximum design flows into Lake Casitas due to restrictions in the Biological Opinion and due to frequent clogging and blockage of the fish screens by debris in the river, especially during high flows. The existing cleaning equipment cannot keep up with the debris loading, which limits the amount of water diverted into the Robles Diversion Canal. This is especially problematic after wildfires in the tributary watershed such as the recent Thomas Fire when the sediment and debris load significantly increased. The existing operations reduce the flow through the screens or shut the diversion down in order to perform manual cleaning, both of which significantly reduce the amount of flow diverted to the lake during storm runoff.

To optimize the operation of the Robles Diversion Dam and maximize the intake of the diversion structure into the Robles Diversion Canal, several alternatives were proposed in the Robles Diversion Fish Screen Alternatives Feasibility Study (MKN Associates, 2019):

- Improve the existing brush system.
- Replace the vertical wedge-wire screens with horizontal wedge-wire screens to improve cleaning efficiency
- Install a fixed manifold back-spray system to work in tandem with an improved brush system.
- Replace the existing fixed screen system with a traveling screen.
- Reduce the load on the existing screen system by suppling the fish ladder auxiliary flow separately from the screened v-channel flow. This is intended to be used in combination with Alternative 1.

The costs range from $30,000 to $12M depending on the alternative and selected components. Pilot studies are being performed to determine the preferred alternative. The CWRP assumes a cost of $3 million for a mid-range alternative.

The additional yield that would be captured after implementing Robles fish screen improvements was estimated by improving the efficiency of the Robles Diversion in the Lake Casitas Yield Model. Results indicated an improvement in average annual yield of 350 AFY based on a 10% increase in overall diversion efficiency (i.e., the percentage of legally available diversions that can be physically diverted from the Ventura River to Lake Casitas).

GW 01 – Matilija Formation Deep Wells

The Matilija Formation Deep Wells project consists of the construction of one or more deep water wells in the Matilija sandstone. This formation contains groundwater that recharged over very long time periods. The project includes the exploration of both horizontal (HOBO) and vertical (VRBO) wells and allows for drought-period production of groundwater directly to Casitas' water transmission system and/or the Robles Canal. Production capacity and long-term yield is currently unknown and would require a pilot project to estimate.

This is a potential resource with incomplete information on geologic characteristics, well feasibility, and other factors. Casitas contracted a team of professionals to provide a peer review of the feasibility of the proposed project. While findings were promising in some cases, further analysis is required. In addition, the District will need to understand the water rights associated with this water source and the impacts to the overlying landowners.

5.4 Supplemental Water Supply Options

Supplemental water supply options develop water from sources outside the Ventura River watershed. The primary supplemental water supply option is connection to the California State Water Project.

5.4.1 State Water Project Overview

According to the California Department of Water Resources (DWR), California's State Water Project (SWP) was constructed in the 1960s and 1970s to supply water to more than 27 million people and 750,000 acres of farmland. Planned, constructed, and operated by DWR, the SWP is one of the world's largest water, power, and conveyance systems. In the past decade it has conveyed an annual average of 2.9 million acre-feet of water. The SWP relies on a delivery system of reservoirs, aqueducts, power plants, and pumping plants that extend more than 700 miles (California Department of Water Resources, 2015). The SWP allows the movement of water from northern to southern California and the ability to exchange water with SWP contractors throughout the state. The SWP also provides flood control, power generation, recreation and environmental benefits to the State of California. The SWP primary water delivery facilities are shown in **Figure 5-6**.

In 1963, the Ventura County Flood Control District (VCFCD) contracted with the State of California for 20,000 AFY of water from the SWP. In 1971, the VCFCD assigned the administration of the Water Supply Contract to Casitas for the three agencies. Casitas' contractual share is 5,000 AFY, the City of Ventura has 10,000 AFY and United Water Conservation District (UWCD) has 5,000 AFY. To date the infrastructure is not in place to deliver the contractual share to Casitas and the City of Ventura. UWCD can access SWP through Lake Piru. Infrastructure requirements are being evaluated from agencies currently receiving SWP water from north and south of Ventura County.

To the north of Ventura County, the SWP serves Santa Barbara County through the Coastal Branch Aqueduct and a 42-mile long Central Coast Water Authority pipeline shown in **Figure 5-7** (California Department of Water Resources, 2012). This pipeline allows for the SWP to deliver water to Lake Cachuma for conveyance to South Santa Barbara County agencies via Tecolote Tunnel and the South Coast Conduit, which extend as far south as Carpinteria Reservoir. This allows for opportunities to be explored for delivering SWP to Casitas.

THE STATE WATER PROJECT

Figure 1-1 Names and Locations of Primary Water Delivery Facilities, December 31, 2012

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Figure 5-6 State Water Project Primary Water Delivery Facilities (California Department of Water Resources, 2015)

To the south of Ventura County, the Metropolitan Water District of Southern California (MWD) is a regional wholesaler that provides water to 26 member public agencies (The Metropolitan Water District of Southern California, 2020). MWD imports water from both the SWP and the Colorado River Aqueduct. Calleguas Municipal Water District (Calleguas) is a member agency of MWD and receives their SWP water through a complex delivery system. Water delivered to Calleguas is treated by MWD at the Joseph Jensen Filtration Plant in Granada Hills. Once SWP water reaches Calleguas via the East Portal Facility in Chatsworth, it is distributed through the potable water distribution system (Figure 5-8), stored in Lake Bard, or injected into the Fox Canyon aquifer. (Calleguas Municipal Water District, 2015).

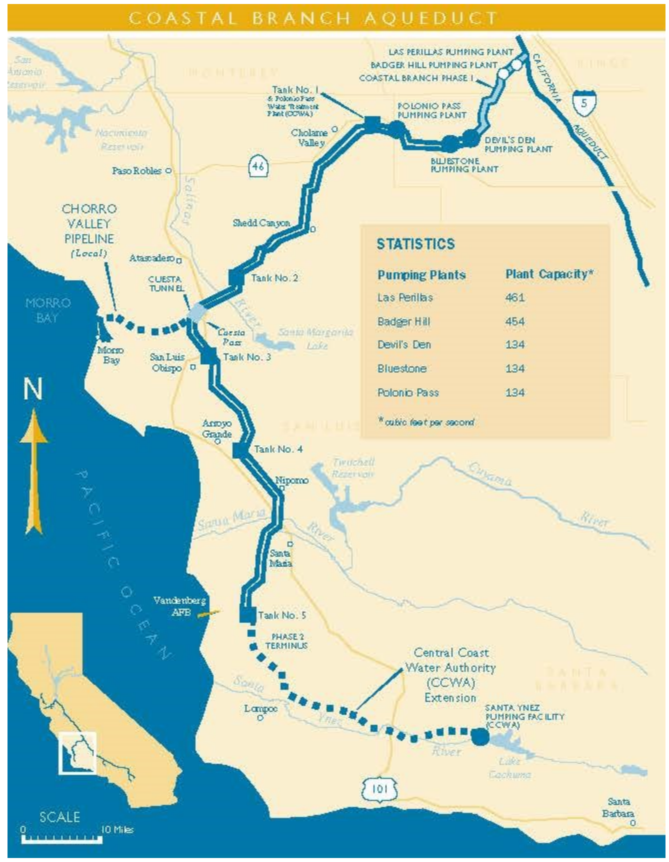

Figure 5-7 *State Water Project Coastal Branch Aqueduct (The Metropolitan Water District of Southern California, 2020)*

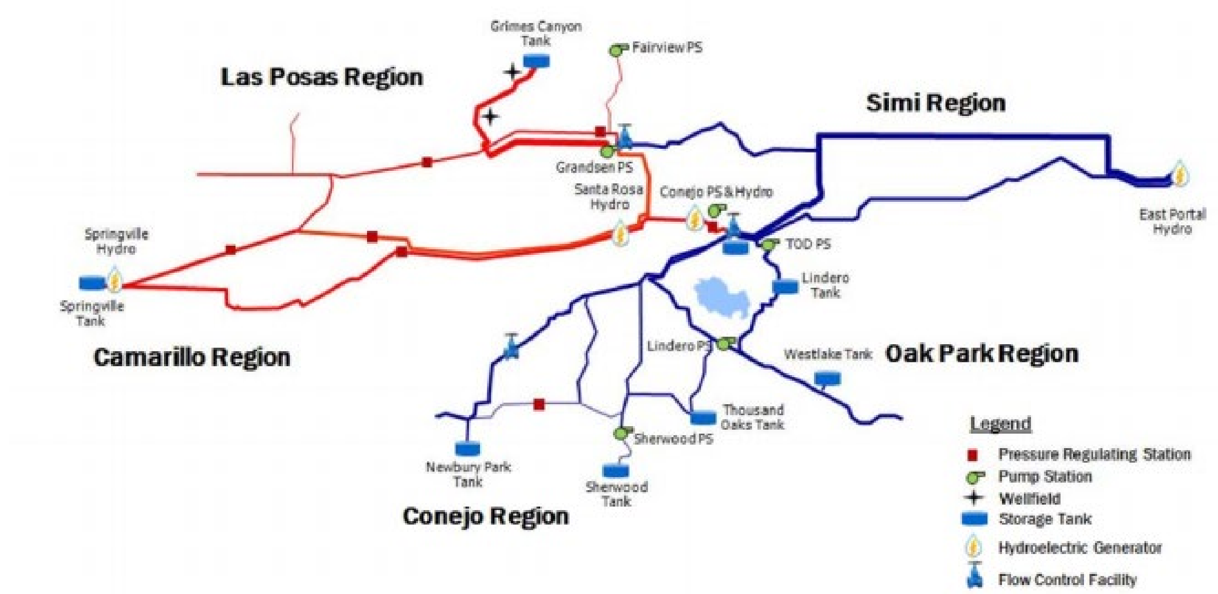

Figure 5-8 *Calleguas Municipal Water District Potable Water Distribution System (Calleguas Municipal Water District, 2015)*

5.4.2 Casitas State Water Project Options

While Casitas' water has historically come from local supplies, Casitas has contracted and paid the fixed contractual costs for the full allocation of 5,000 AFY of imported water from the SWP. The contracted amount of up to 5,000 AFY is referred to "Table A" water, which is a table in the contract referring to the maximum amount to be delivered. Imported water has not been supplied to Casitas due to lack of local conveyance infrastructure to deliver the water.

Supplemental Water Options include projects that give Casitas access to supplies from outside the Ventura River watershed. **Table 5-3** lists the Supplemental Water Options considered for the CWRP. They include connections to existing and proposed water infrastructure in either the Ventura area or Santa Barbara County to provide access to SWP water and other sources.

Average annual yields of State Water Project options were based on State Water Project system modeling performed by the State of California and the Casitas SWP Table A contract amount of up to 5,000 AFY. Due to hydrologic variability and complex operational criteria, the State has estimated the average long-term Table A yield to SWP contractors is 62% of the Table A amount (Department of Water Resources, 2018). This estimate of future reliability is slightly about the same as the historical Table A deliveries for 2000-2019 shown in

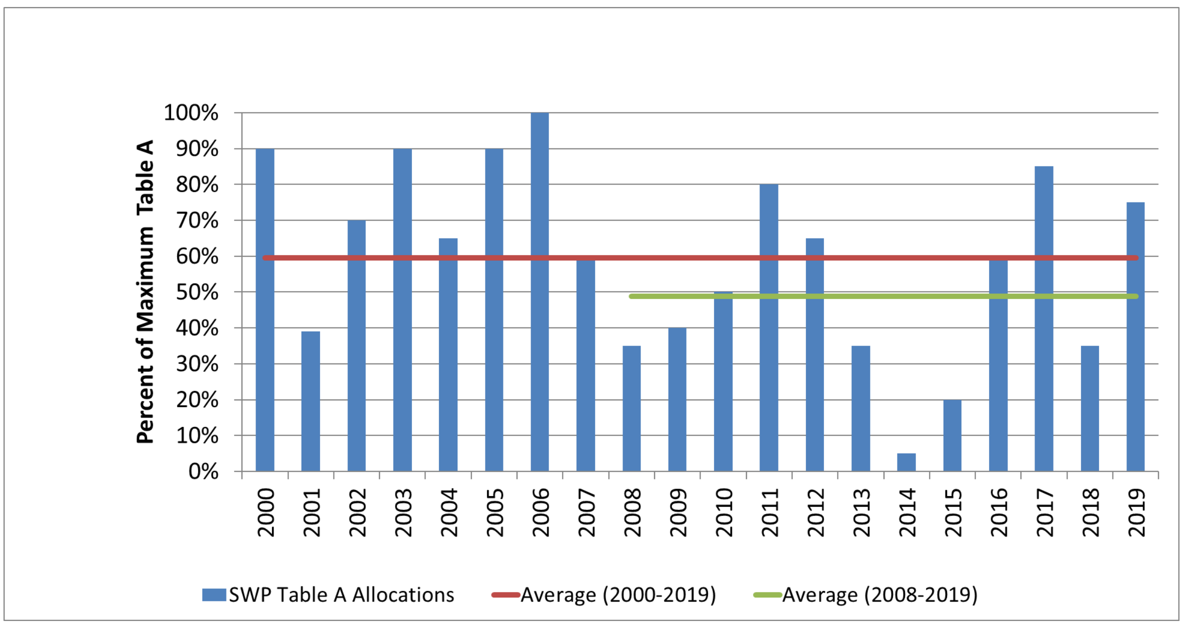

Figure *5-9*. The average allocation in the last ten years has been reduced due to extreme drought and environmental restrictions. For the Casitas Table A amount of 5,000 AFY, 62% reliability translates to a long-term average SWP yield of 3,100 AFY. These estimates assume the Delta Conveyance Facility (DCF) is completed as currently proposed. If the DCF is not completed, or if Casitas chooses not to participate in DCF funding, the long-term reliability of its State Water Project deliveries would be reduced to about 40% for an average annual yield to Casitas about 2,000 AFY.

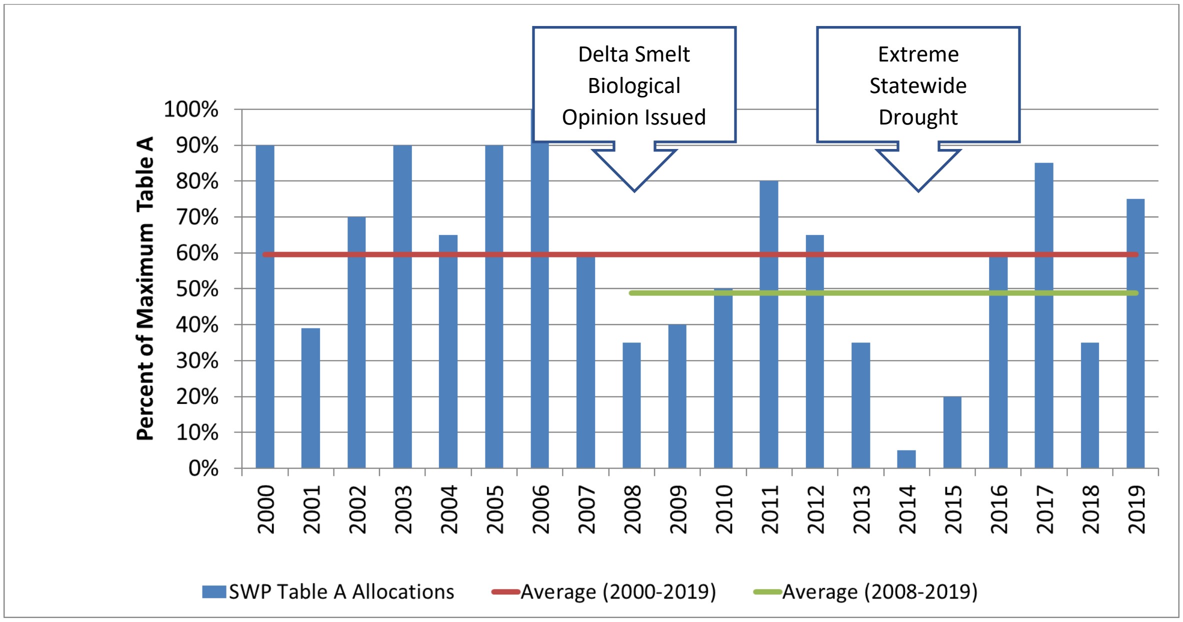

Figure 5-9*: Historical SWP Table A Deliveries, 2000-2019*

Table 5-3: Summary of Supplemental Water Options Carried Forward to Portfolio Analyses

SUPPLEMENTAL WATER OPTIONS	BRIEF DESCRIPTION	ESTIMATED CAPACITY (AFY)	ESTIMATED AVERAGE ANNUAL YIELD (AFY)	ESTIMATED CAPITAL COST
SWP 01 - Deliveries via City of Ventura SWP Interconnection and Casitas-Ventura SWP Interconnection	SWP water delivered from Calleguas Municipal Water District to the City of Ventura through a proposed 30-inch pipeline. The City of Ventura will make upgrades to their distribution system to allow State Water Project water to reach the west side of Ventura where Casitas will construct a 10 cfs pump station to distribute into the Casitas water system.	2,000	2,000	$33M
SWP 03 -Ventura-Santa Barbara Counties Interconnection	SWP water delivered from the Carpinteria Valley Water District to Casitas through a proposed 16-inch interconnection pipeline and two pump stations.	2,000	2,000	$14.5M
SWP 04 - Casitas-Calleguas Interconnection	SWP water delivered from Calleguas Municipal Water District through the City of Ventura through a proposed 36-inch pipeline to allow SWP water to reach the west side of Ventura where Casitas will construct a 30 cfs pump station to distribute into the Casitas water system.	5,000	3,100*	$136M
SWP 05 - City of Ventura Supplemental or In-Lieu Water	After the implementation of SWP 01 or parts of SWP 04, Casitas would have ability to use the infrastructure to access other supplemental water sources, such as in-lieu transfer of SWP water with the City of Ventura to offset their demands from Lake Casitas.	2,000	2,000	Cost for SWP 04 makes this option possible
DW 01 - Supplemental Water or Desalinated Water from City of Santa Barbara	After the implementation of SWP 03, Casitas would have the ability to use the infrastructure to access other supplemental water sources such as City of Santa Barbara desalinated water or other future supplemental sources.	2,000	2,000	Cost for SWP 03 makes this option possible

*Average annual yield limited to Casitas Table A allocation for State Water Project

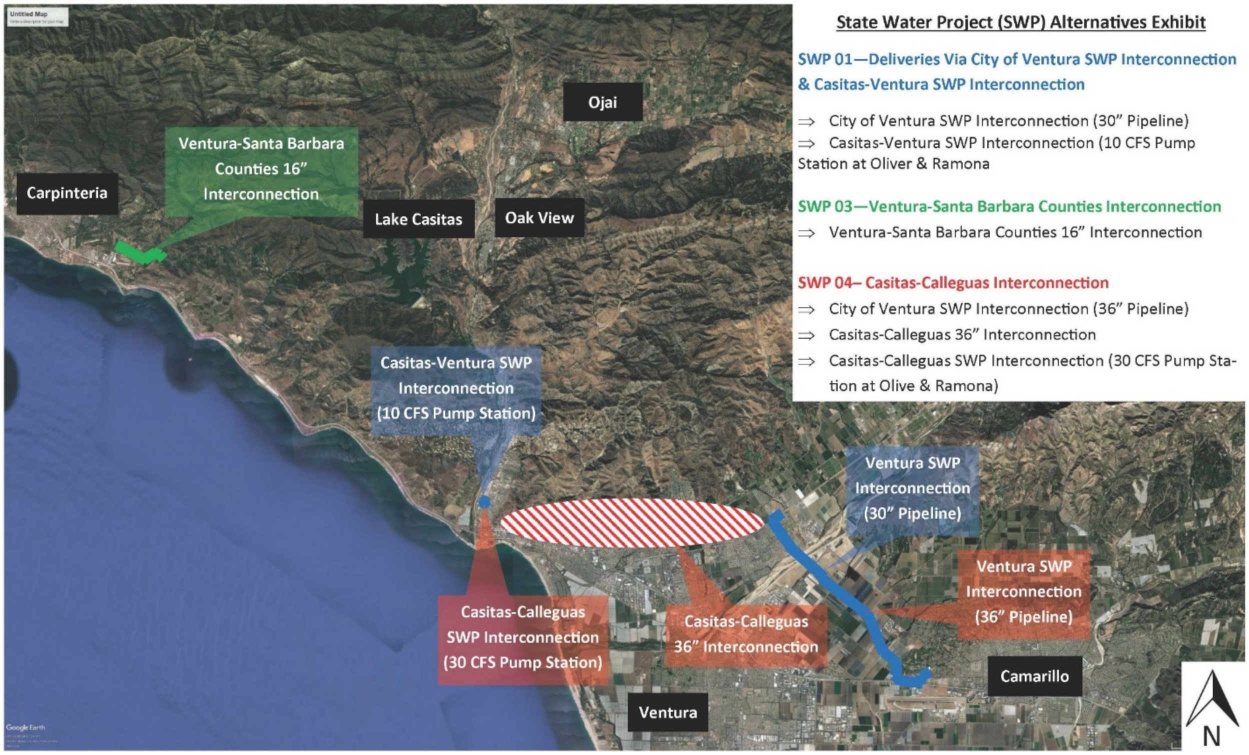

Figure 5-10 *Casitas State Water Project Interconnection Options*

SWP 01 – Deliveries Via City of Ventura State Water Project Interconnection & Casitas-Ventura State Water Project Interconnection

This State Water Project (SWP) option, referred to as the Deliveries via City of Ventura SWP Interconnection and Casitas-Ventura SWP Interconnection, involves the combination of two proposed projects (1) the City of Ventura SWP Interconnection and (2) the Casitas-Ventura SWP Interconnection. The first project involves the City of Ventura and other partner agencies including Casitas designing and constructing a 30-inch bi-directional pipeline to connect Calleguas Municipal Water District (Calleguas) and the City of Ventura. Casitas has shared in the cost of the City of Ventura's SWP Interconnection Alignment Study and Environmental Impact Report. The interconnection would allow for the delivery of SWP water to be wheeled through Calleguas and allow for in-lieu use of SWP water by the City of Ventura, which reduces their use of water from Lake Casitas. The City of Ventura would also upgrade their existing infrastructure to allow for the delivery of SWP water to reach the west side of their distribution system and ultimately to a proposed Casitas pump station and the second project. This second project involves Casitas constructing a 10 cubic feet per second (cfs) pump station at Olive Street and Ramona Street in the City of Ventura. In early 2019, Casitas retained an engineering firm to prepare the Casitas-Ventura SWP Interconnection Preliminary Design and investigate how to convey water from the west side of Ventura to connect to Casitas' transmission pipelines near Foster Park, to supplement water supply from Lake Casitas. The Casitas-Ventura SWP Interconnection would be dependent on the City of Ventura's SWP Interconnection Project being completed.

This project would give Casitas access to its SWP Table A allocation as well as Article 21 surplus water when available. The Department of Water Resources (2018) estimates a long-term average of a total of 50,000 AFY of Article 21 water would be available to SWP contractors. Because Article 21 water is not available in all years and the amount available to Casitas is uncertain, it is not considered a reliable source of water for the CWRP. Option SWP 01 would also allow Casitas to enter into contracts with the City of Ventura for future surplus water based on some of their future water projects.

SWP 03 – Ventura-Santa Barbara Counties Interconnection

This SWP option, referred to as the Ventura-Santa Barbara Counties Interconnection, involves a bi-directional potable water pipeline to connect with Carpinteria Valley Water District (CVWD) to allow for Casitas to receive SWP water via two proposed booster pump stations and minor treatment facilities. Preliminary design is complete and involves a high-capacity and high-pressure 8,000 linear feet pipeline to connect the transmission mains between the CVWD system and the Casitas water distribution system.

State Water would be delivered through facilities owned by various entities, including California DWR, Central Coast Water Authority, Bureau of Reclamation (Lake Cachuma and South Coast Conduit), City of Santa Barbara (treatment plant), and Carpinteria Valley Water District pipelines. Therefore, several wheeling agreements would be necessary.

The Casitas SWP Table A contract amount is 5,000 AFY. However, the SWP annual allocations are typically less due to hydrologic variability and complexity of operations. Analyses by the California Department of Water Resources (Department of Water Resources, 2018) estimate future long-term Table A deliveries to be 62% of the Table A contract amount. Operational modeling results provided in the report appendix for each State Water contractor show the Central Coast Branch SWP supplies have a long-term average of about 61% of the contracted Table A amount. This estimate assumed construction of the Delta Conveyance Facility (DCF), which would address some of the existing and future hydrologic and regulatory constraints to SWP operations. Infrastructure being contemplated for SWP 03 would be capable of delivering 2,000 AFY to Casitas (40% of Table A). For the CWRP the long-term average SWP yield from this connection was assumed to be 2,000 AFY.

This project would give Casitas access to its SWP Table A allocation as well as Article 21 surplus water when available. The Department of Water Resources (2018) estimates a long-term average of a total of 50,000 AFY of Article 21 water would be available to SWP contractors. Because Article 21 water is not available in all years and the amount available to Casitas is uncertain, it is not considered a reliable source of water for the CWRP. Option SWP 03 would also allow Casitas to enter into contracts with Santa Barbara County entities for surplus water or water produced from the Santa Barbara seawater desalination plant.

It is estimated the Ventura-Santa Barbara Counties Interconnection could be constructed in 3-5 years.

SWP 04 – Casitas-Calleguas Interconnection

This SWP option, referred to as the Casitas-Calleguas Interconnection, involves a bi-directional potable water pipeline through Ventura to connect with Calleguas Municipal Water District (Calleguas) to allow Casitas to receive SWP water via new booster pump stations and minor treatment facilities. In addition to delivering its SWP Table A allocation and Article 21 surplus water when available, the interconnection would create opportunities for Casitas to consider agreements with other water entities in the Ventura/Oxnard area for exchange or other cooperative water management strategies. The interconnection would also allow Calleguas to receive water from Lake Casitas during emergencies.

State Water would be delivered through facilities owned by various entities, including California DWR, Metropolitan Water District of Southern California, Calleguas, and the City of Ventura. Therefore, several agreements would be necessary.

The Casitas-Calleguas Interconnection makes use of Ventura's proposed SWP facilities, either as planned or through required upgrades to increase capacity. Thus, this option requires coordination and cost-sharing with Ventura to accomplish its SWP connection. Casitas is actively engaged in this project with Ventura at this time.

It is estimated the Casitas-Calleguas Interconnection would be constructed in a 5- to 10-year timeframe.

SWP 05/DW 01 – Supplemental Water

This alternative involves access to supplemental water from a variety of possible sources through SWP 03 and SWP 04 infrastructure. Planned pipeline capacity in connections to Ventura or Santa Barbara County would be sized for maximum deliveries of SWP water. In non-peak delivery months and in years when the State Water Table A allocation is less than the full contract amount, these pipelines would not be operated at capacity and could be used to convey water from other sources such as supplemental water purchases and water transfers. Examples of possible supplemental water sources that could be delivered using SWP connection infrastructure are briefly described below.

Article 21 Water from SWP. Article 21 supply is water that is surplus to the needs of the SWP under certain conditions and is made available for purchase by State Water Contractors. When available, this surplus supply is allocated to the requesting State Water Contractors using a calculation that is based on their respective Table A allocations. The Department of Water Resources (2018) indicates the long-term annual average of Article 21 water available for the SWP system is 50,000 AFY. Casitas could choose to purchase Article 21 water to supplement its Table A deliveries if needed and convey that water through the same SWP connection infrastructure.

In-lieu Water Transfers with Ventura. Casitas has shared in the cost of the City of Ventura's SWP Interconnection Alignment Study and Environmental Impact Report. The City of Ventura's Interconnection Project allows for in-lieu use of State Water by the City of Ventura, which reduces the use of water in Lake Casitas.

Santa Barbara Desalination and Other Regional Supplies. The City of Santa Barbara reactivated its desalination plant in late 2017. The Desalination Plant has a full build-out capacity of 10,000 AFY but is currently operating around 3,125 AFY. Desalinated water or other supplies conveyed through regional facilities could potentially be provided to the Casitas service area through the proposed Ventura-Santa Barbara Counties Interconnection facilities and reduce the demand on Lake Casitas.

These are just examples of possible supplemental water sources in addition to SWP supplies. Once the SWP delivery infrastructure is in place, Casitas will have the ability to explore several possible supplemental supply or water transfer opportunities. Some may become part of Casitas' annual water portfolio, while others may be viewed as short-term emergency supplies.

Section 6 Portfolio Development and Ranking

Water supply options were combined in different ways to meet the three CWRP objectives for long-term augmentation supply, short-term mitigation supply, and portfolio diversification. Three portfolio strategies were applied: Local Focus Portfolios that emphasized more Local Options; Diversification Portfolios that emphasized more Supplemental Water Options; and Balanced Portfolios that used a balanced blend of the other two strategies. As a sensitivity analysis, some portfolios were evaluated assuming the proposed Delta Conveyance Facility (DCF) Project is not constructed by the State of California. This assumption lowers both the yield and the cost of portfolios with supplemental water derived from State Water Project options. Because only a few Supplemental Water Options were available for portfolios, and only one could be implemented in time to meet the short-term mitigation objective (SWP 03 – Ventura-Santa Barbara Counties Connection), most portfolios were comprised of similar projects.

The Decision Support Tool was used to rank portfolios using the same criteria and weights as were used to rank water supply options. Portfolio scores were computed as the sum of the product of the score of each individual option in the portfolio multiplied by the fraction of the total portfolio yield provided by that option. Portfolio scoring and ranking is shown in **Figure 6-1**. Options included in the top portfolios were incorporated into the recommended long-term strategic water supply plan, described in **Section 7**.

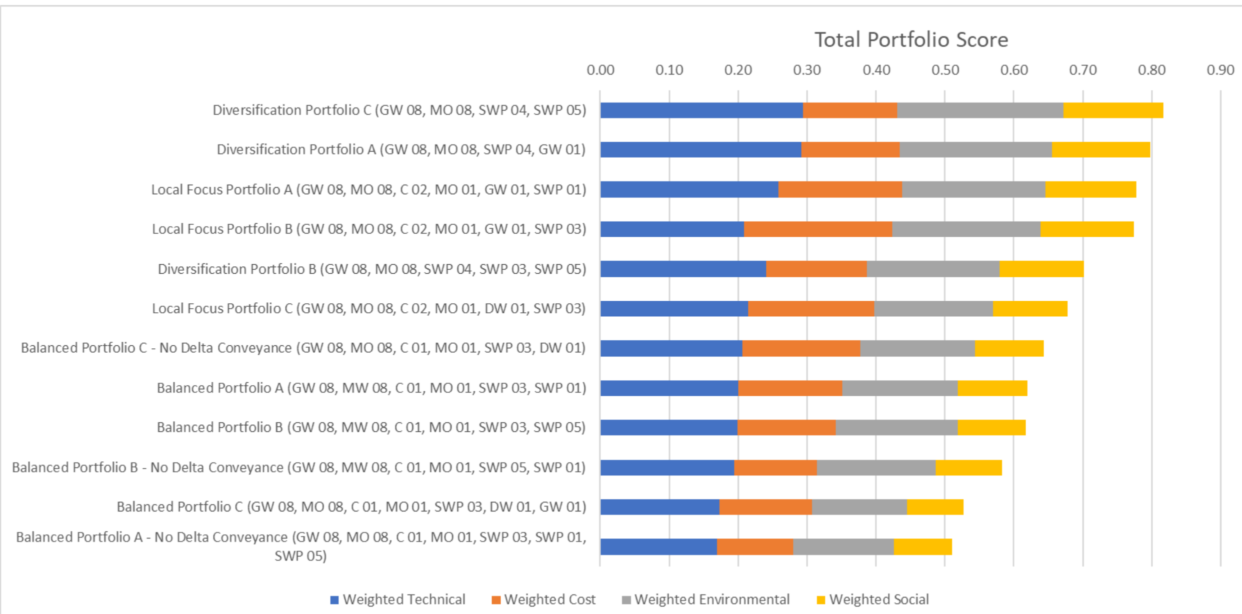

***Figure 6-1**: Decision Support Tool Scoring of Portfolios*

Section 7 Recommended Plan

The CWRP recommended plan consists of three types of components: new planning policies, a portfolio of new water supply projects, and new and updated programs. Each group of recommendations is described in this section.

PLANNING POLICIES

- Supply and Demand Estimates
- Minimum Allowable Lake Storage
- Risk Based Planning

PORTFOLIO OF PROJECTS

- Local Options
- Supplemental Water Options
- Conditional Options

NEW AND UPDATED PROGRAMS

- Water Conservation Plan
- WEAP Policy Update
- Supplemental Water Integration Plan

7.1 Planning Policies

The CWRP recommended plan includes several new policies that should become part of the District's approach to future water supply planning. These policies will assure Casitas has a robust risk-based approach to meeting future water supply and demand conditions. Recommended new policies are depicted in **Figure 7-1** and listed below. Adoption of these policies was assumed for development of the portfolio of projects included in the recommended plan and is recommended as the basis for future planning documents such as the 2020 Urban Water Management Plan and Casitas System Master Plan.

- **Future Annual Demand:** The Casitas System forecasted 2040 water demand is 16,000 AFY, reduced from the previous estimate of 17,500 AFY.
- **Future Hydrology:** The hydrology used for estimating Lake Casitas yield is 100 synthetic traces based on the statistics of the observed historical hydrology to incorporate uncertainty around future climate variability, rather than historical hydrology alone.
- **Safe Demand from Lake Casitas:** Lake Casitas yield for water supply planning is based on the concept of safe demand, in which Casitas System demand is reduced as Lake storage falls in accordance with the target demands in the WEAP policy. Previous plans were based on an estimate of safe yield, in which demands were assumed to be constant every year.
- **Reliability of Lake Casitas Supply:** The 95% reliable safe demand with an adjustment for climate change is adopted as the Lake Casitas yield for supply and water needs analyses. The 95% reliable safe demand for Lake Casitas is 10,660 AFY, compared to the previous safe yield (100% reliable) estimate of 20,440 AFY.
- **Minimum Allowable Storage:** The minimum storage volume allowed in Lake Casitas for non-emergency operations is 20,000 AF, rather than the dead pool storage of 950 AF.

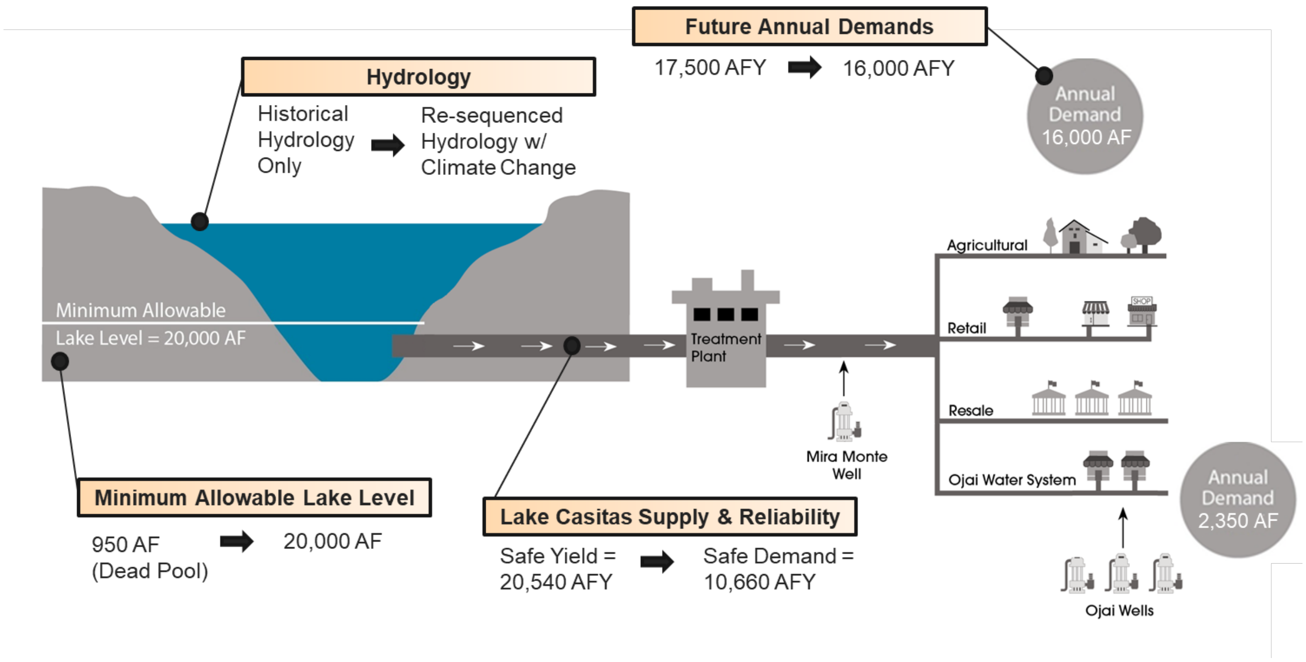

***Figure 7-1**: Graphical summary of new and revised planning policies*

7.2 Portfolio of Projects

The recommended portfolio of projects satisfies the goals of the CWRP. It is a best-fit blend of the portfolios evaluated in the previous section. It provides at least 5,200 AFY of long-term supply, at least 2,500 AFY of additional supply within 5 years to address immediate risk, and diversifies the Casitas portfolio (**Figure 7-2**).

Projects were classified in one of three categories.

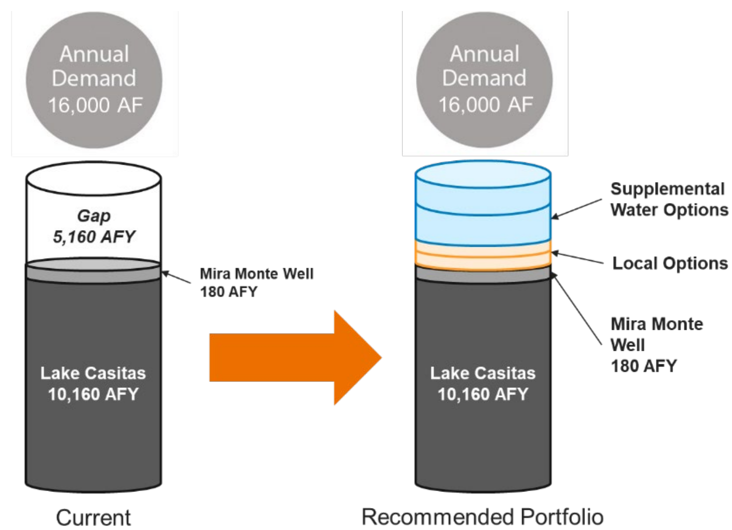

***Figure 7-2**: Summary of recommended portfolio components*

LOCAL NEAR-TERM, NO-REGRET OPTIONS are recommended for implementation as part of the plan

PREFERRED SUPPLEMENTAL WATER OPTIONS are recommended for implementation as part of the plan

CONDITIONAL OPTIONS should be tracked for possible implementation later if one or more of the recommended options cannot be implemented or produces less average annual yield than planned

7.2.1 Meet Long-Term Supply Gap of 5,200 AFY

The options from the top scoring portfolio "Diversification Portfolio C" (Section 6) are recommended for implementation. The options included in the top portfolio are:

- GW 08 – Ojai Basin Well Rehabilitation and Replacement (500 AFY average annual supply)
- MO 08 – Robles Fish Screen Improvements (350 AFY average annual supply)
- SWP 04 – Casitas-Calleguas Interconnection (up to 3,100 AFY average annual supply)
- SWP 05 – Supplemental Water (up to 1,250 AFY average annual supply)

Some SWP 04 facilities provide an opportunity to also implement SWP 01 (in-lieu deliveries). This could be considered for a phased implementation approach. However, SWP 04 cannot be implemented within 5 years so it does not help address the 2,500 AFY near-term goal.

7.2.2 Meet Short-Term Risk Mitigation of 2,500 AFY

While the options in the top portfolio meet the long-term goal of an additional 5,200 AFY of supply, the Casitas-Calleguas interconnection is expected to take 5-10 years to construct. In order to meet the CWRP goal of 2,500 AFY supply in the near term, Casitas should pursue implementation of the following options, which have a shorter implementation timeline:

- SWP 03 – Ventura-Santa Barbara Interconnection (3,100 AFY average annual supply when combined with SWP 04)
- DW 01 – Supplemental Water (1,250 AFY average annual supply when combined with SWP 05)

The Ventura-Santa Barbara Interconnection meets all three of the CWRP goals. By building interconnections to the north (Santa Barbara) and to the south (Calleguas), Casitas would have increased opportunities for regional partnerships, improved reliability during emergencies, and operational flexibility. Once SWP 03 is constructed, Casitas would have the opportunity for supplemental water (Option DW 01).

7.2.3 Portfolio Diversification

The recommended portfolio of projects meets the goal for diversifying the Casitas water supplies. Based on the average annual yield available from each source of supply, 26% of the future portfolio is comprised of non-Ventura River watershed sources, as shown in **Figure 7-3**.

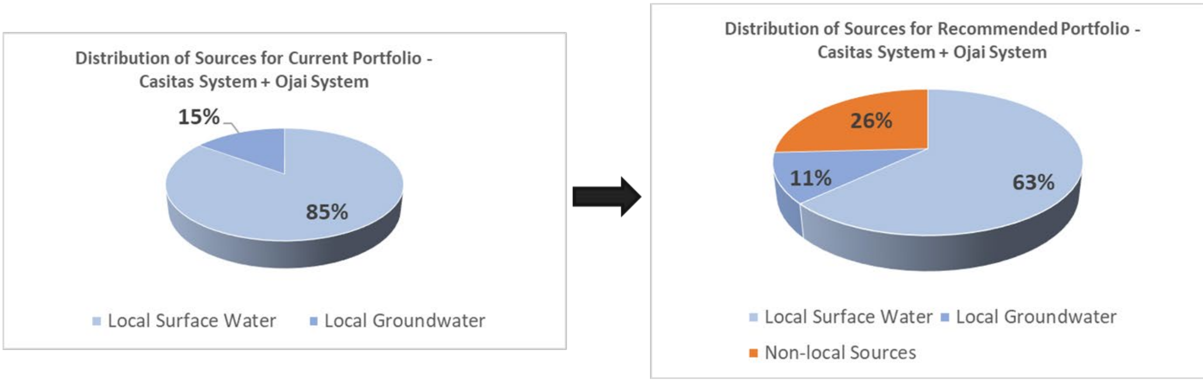

***Figure 7-3**: Conversion of Current All-Local Supply Portfolio to a Diversified Portfolio*

7.2.4 Adaptive Management with Conditional Options

Conditional options would be tracked and implemented only if one of the local or supplemental water options either could not be implemented as planned or delivered less average annual yield than planned. The following options were in the top 5 portfolios, and should be tracked and implemented as needed.

- Matilija Formation Deep Wells (VRBO or HOBO): Due to many uncertainties surrounding this option, it was included in the Conditional Options category until additional studies are performed to further define its feasibility.

- Watershed Management/*Arundo* Removal: Because the benefits of this option would be difficult to quantify for Casitas, this option is considered conditional. Other governmental and non-profit agencies are currently implementing *Arundo* removal in the Ventura River watershed, and Casitas could form partnerships and provide funding for enhanced programs implemented by others (e.g. Ventura County Watershed Protection District) that would prioritize watershed management efforts in the Lake Casitas watershed.

- Additional Demand Management: Because the CWRP planning policies already include a 10% demand reduction compared to the most recent UWMP, the long-term supply gap was addressed through developing new water supply projects and additional demand management was recommended as a conditional strategy. It is recommended that Casitas develop a Water Conservation Plan to evaluate the potential savings and cost effectiveness of various conservation measures.

- Additional Supplemental Water: The supplemental water option involves access to water through SWP 03 and SWP 04 infrastructure via in-lieu transfers from Ventura or other supplies such as desalinated water from the City of Santa Barbara. The recommended plan includes 1,250 AFY of supplemental water on an average annual basis to meet the requirement for 5,200 AFY of additional average annual supply. As a conditional option, Casitas could pursue more supplemental water as needed for droughts and emergencies.

In addition to monitoring performance of the recommended local and supplemental water options, tracking of these conditional options may include activities such as performing preliminary feasibility studies, revisiting cost estimates, or exploring interagency partnerships.

7.2.5 Summary of Recommended Portfolio

Figure 7-4 summarizes the Local Options, Supplemental Water Options, and Conditional Options comprising the CWRP recommended portfolio.

Local, near term, no-regrets options

1. **GW 08** - Ojai Basin Well Rehabilitation and Replacement (500 AFY)
2. **MO 08** - Robles Fish Screen Improvements (350 AFY)

Preferred supplemental water options

1. **SWP 03** – Ventura-Santa Barbara Interconnection*
2. **SWP 04** – Casitas-Calleguas Interconnection*
3. **SWP 05/DW 01** Supplemental Water (1,250 AFY)

Conditional options – track only

1. **C 01** – Demand Management: 5%-10% (800-1,600 AFY)
2. **MO 01** – Watershed Management/Arundo Removal (300 AFY)
3. **GW 01** – Matilija Deep Formation Wells (Unknown)
4. **SWP 05/DW 01** – Supplemental Water Options (up to 4,000 AFY)

*Combined average annual yield of SWP 03 and SWP 04 is 3,100 AFY

***Figure 7-4**: Water Supply Options in the Recommended Portfolio*

Figure 7-5 depicts how the options in the recommended portfolio align with the three CWRP goals. Only option SWP 03 Ventura – Santa Barbara County Interconnection addresses all three CWRP goals.

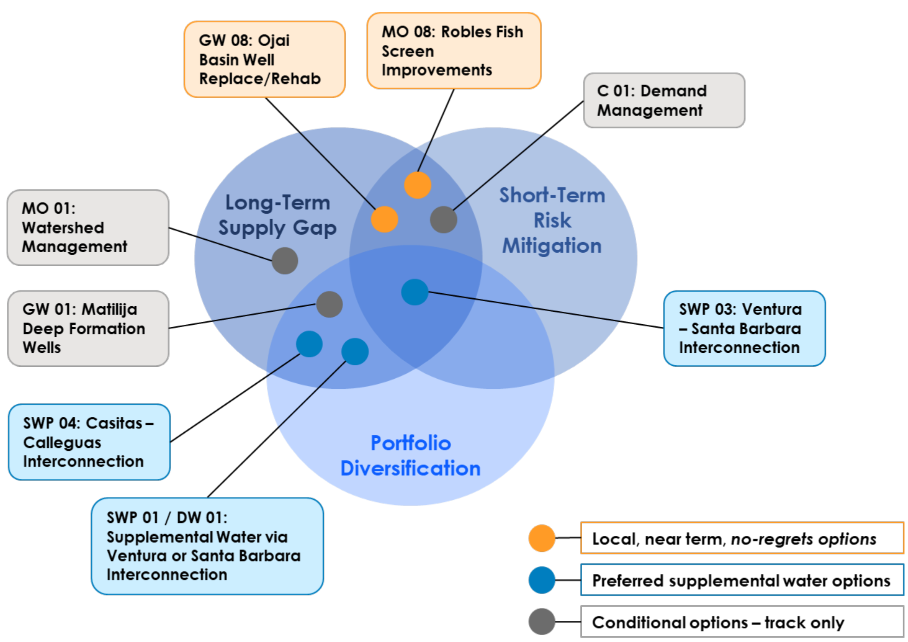

***Figure 7-5**: Correlation between Recommended Options and CWRP Goals*

7.2.6 Verification of Recommended Portfolio

The recommended portfolio was tested in the Lake Casitas Yield Model by simulating additional yield from the recommended projects come online in the following years:

- Ojai well rehabilitation – Year 1

- Robles fish screen improvements – Year 1
- Ventura-Santa Barbara County Interconnection – Year 5
- Casitas-Calleguas Interconnection with additional supplemental water – Year 10

Figure 7-6 shows the performance of the Lake with historical hydrology, and **Figure 7-7** shows the performance of the Lake with dry hydrologic trace from among the 100 synthetic traces. In both cases Lake Casitas would have gone dry without the additional water projects, and with the projects the Lake can be effectively maintained above the minimum allowable storage level of 20,000 AF.

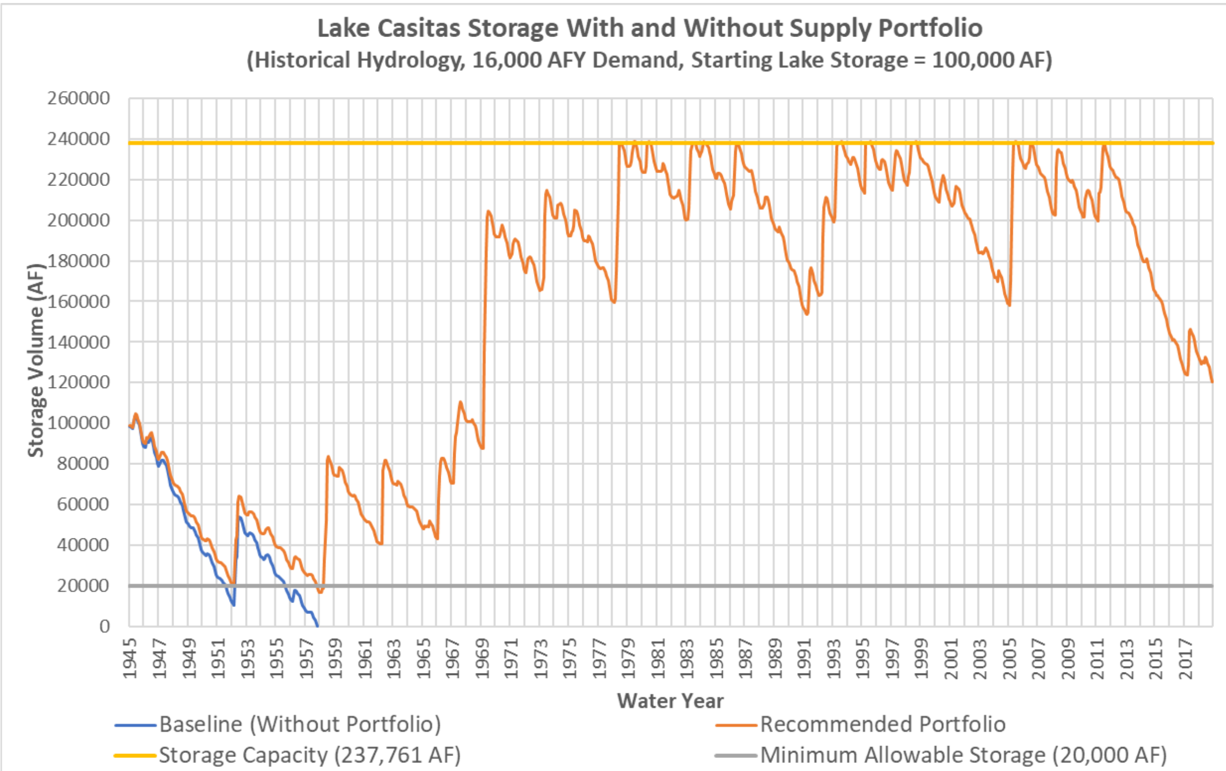

Figure 7-6 *Lake Casitas Storage Volume for Historical Hydrology with and without Recommended Portfolio Projects*

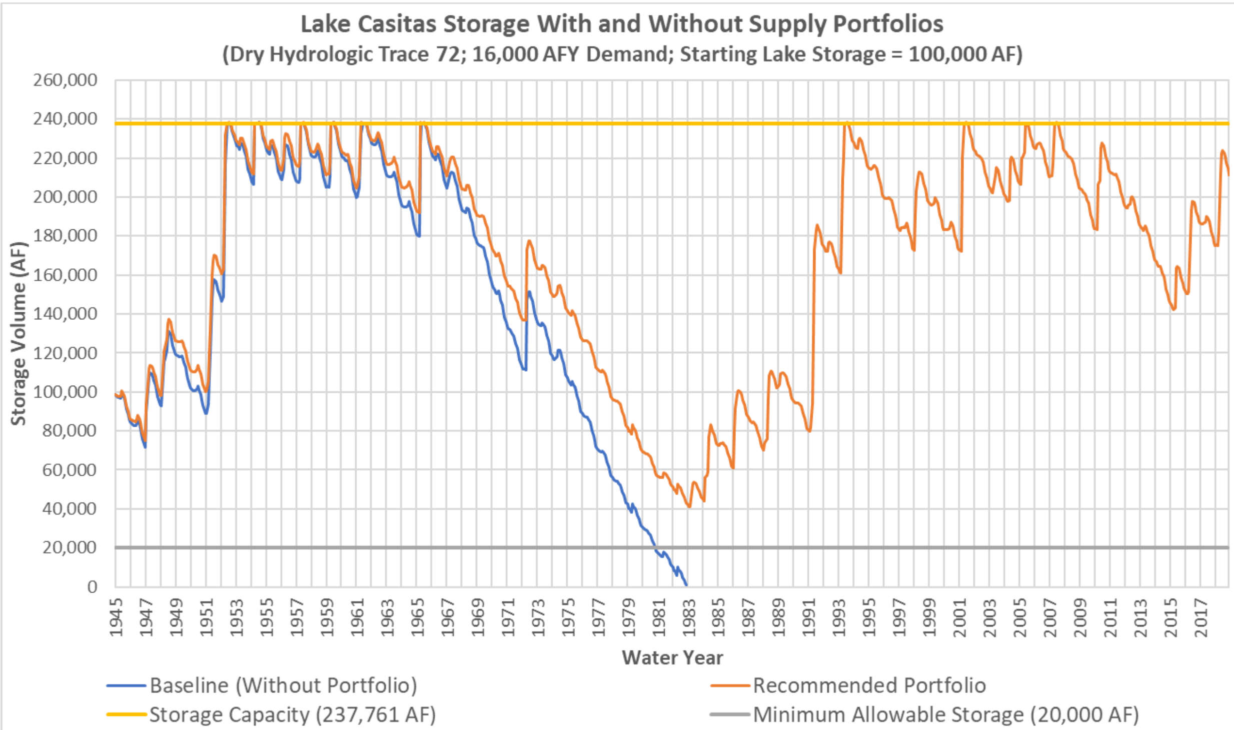

***Figure 7-7**: Lake Casitas Storage Volume for Dry Hydrologic Trace 72 with and without Recommended Portfolio Projects*

7.3 New and Updated Programs

The recommended plan includes developing and implementing new or updated programs in three important areas:

- Updated Water Conservation Plan
- Updated Water Efficiency and Allocation Program
- New Supplemental Water Integration Program

These programs are described in the following sections.

7.3.1 Water Conservation Plan

It is recommended Casitas develop a Water Conservation Plan, which would be a planning document to:

1. Evaluate existing and potential future ongoing conservation measures (e.g. various rebate programs could be evaluated for cost effectiveness),
2. Assure conservation programs are consistent with State requirements such as Making Conservation a Way of Life legislation, and
3. Outline demand strategies (such as the WEAP) to be employed in response to potential future supply shortages during droughts or emergencies.

The Water Conservation Plan should identify demand management measures that would provide for the CWRP planned demand (which was reduced from previous planned UWMP demands), as well as the conditional option for additional 5-10% conservation on average. Development of the Water

Conservation Plan should be coordinated closely with the planned 2020 update to the Casitas Urban Water Management Plan.

7.3.2 Updated Water Efficiency and Allocation Program

The Water Efficiency and Allocation Program establishes water use allocations for each Casitas customer and provides guidelines for setting lower allocations when storage volumes in Lake Casitas are below certain levels. Based on the new policies recommended in the CWRP, Casitas should update the WEAP to:

- Improve clarity in how allocations are set and when and how reduced allocations are triggered;
- Be more conservative in specifying when stages are declared and management actions are triggered; and
- Align WEAP allocations and target allocation reductions with current customer use patterns.

Because of the current low Lake Casitas storage volume, adopting an interim revised WEAP may be prudent while a more comprehensive update with its associated policies is being developed. Considerations for interim and permanent updates to the WEAP are briefly described below. Updating the WEAP is a separate programmatic action from this CWRP.

Factors to be included in the Updated Water Efficiency and Allocation Program

- Interim policies to address near-term risk of low Lake levels
- Review of water allocation in light of current water use rates
- Determine acceptable frequency of being in each WEAP stage
- Adopt management strategies for periods of critically low Lake levels

Interim WEAP Policies

Lake Casitas is currently less than half full (around 100,000 AF in January 2020) and is at risk of being drawn down to critical levels if the next few years are dry or have below normal runoff. A strategy for managing this risk is to adopt interim guidelines for setting Lake Casitas stages that are more conservative than the current WEAP stages. In simple terms this could involve “shifting the stages up” such that Stages 2-5 would be declared at higher lake storage levels. “Shifting the levels up” on an interim basis would provide a more conservative lake management framework until the lake recovers or a permanent WEAP update can be adopted.

The current WEAP does not have provisions for management actions to be taken when the lake is well below 25% full. Stage 5 applies when lake storage is between 25% full (59,440 AF) and dead pool (950 AF). Casitas managers would benefit from having interim policies in place in case the lake falls to critical levels below 59,440 AF to minimize the risk of the lake falling to the CWRP minimum allowable storage level of 20,000 AF.

Permanent WEAP Update

An update of the WEAP could involve the following steps.

- **Consider establishing new water allocations based on current use rates***.* Customer use in the Casitas service area changed dramatically as a result of the recent California drought. While some of these changes may not be permanent, others may be permanent due to structural changes (e.g., removal of turfgrass and replacement with xeriscape). Water allocations should be benchmarked to current use patterns in the Casitas service area.

- **Determine acceptable frequency of being in different WEAP stages**. The "other side of the coin" of having conservative lake storage stages in the WEAP policy is that the Board would be declaring Stage 2 or greater conditions with greater frequency. Customers have a limit to their tolerance for being asked to conserve. Casitas will need to gauge public perception on this topic when the WEAP is updated.
- **Adopt management practices for critically low Lake Casitas storage periods.** Additional demand management strategies are necessary for Board and Staff to manage the system during critical periods when the lake is below 25% full. In addition, emergency strategies for demand management or supply augmentation should be defined during extreme dry periods more severe than conditions assumed for the CWRP when lake storage falls below the minimum allowable storage volume of 20,000 AF.

7.3.3 Supplemental Water Integration Plan

Prior to delivery of water to the Casitas system from new outside sources, a "Supplemental Water Integration Plan" should be prepared. This plan should lay out the technical, operational, and financial aspects of introducing new water sources to the Casitas service area. The following components should be included in this plan.

Factors to be included in the Supplemental Water Integration Plan

- Criteria for importing supplemental water
- Integration of different water quality
- Preliminary infrastructure designs and costs
- Operation plan with new interconnections
- Financial plan and rate study

Criteria for importing supplemental water. Simulations of the Lake Casitas system with the recommended portfolio conducted for the CWRP include taking supplemental water from connections to Ventura and/or Santa Barbara State Water Project facilities in every year of operation. However, when Lake Casitas is already full or close to full, supplemental water would not be needed. There may be other situations in which State Water Project water or other supplemental supplies would not be purchased by Casitas. Because these resources are significantly more expensive than any local sources, they should be imported judiciously. Therefore, an operational plan is needed to specify the criteria (e.g., Lake Casitas storage, recent and anticipated Lake inflows, current system demands, anticipated yields from other supply sources) under which imported water would be purchased through the Ventura or Santa Barbara SWP connections. The plan should also define criteria for the distribution of SWP and supplemental water purchases from each connection after both are implemented (that is, how much SWP water to take through the Ventura connection, how much SWP water to take through the Santa Barbara connection, etc.).

Integration of different quality water. Water delivered through SWP connections, whether from Casitas' SWP allocation or other supplemental sources, would be different quality than water currently used by Casitas from Lake Casitas and the local groundwater basin. Because these supplies are treated water, it is assumed they would be delivered to the Casitas distribution system rather than to Lake Casitas. An assessment is needed of the potential effects of new supplies on the Casitas distribution system and characteristics of water delivered to Casitas customers.

Preliminary infrastructure designs and costs. Preliminary designs are needed for infrastructure required to accomplish the proposed connections to Ventura and Santa Barbara SWP facilities. Some of those preliminary designs are completed or are currently in progress; other components still need to be evaluated. Preliminary designs should be used to support refined cost estimates for required facilities.

Financial plan and rate study. An outline is needed for the recommended financial strategy to support construction and operation of the proposed SWP connections. Capital and Operation and Maintenance (O&M) costs should be considered. O&M costs differ between the Ventura and Santa Barbara connections due to different pumping requirements and different lengths of conveyance. In addition, the cost of SWP water is higher through the Santa Barbara connection (about $2,500/AF) than the Ventura connection (about $1,200 to $1,500/AF) because different SWP facilities are involved. Ultimately a new rate study is needed to allocate costs of the SWP connections and supplemental water supplies to Casitas' retail (municipal and industrial), agricultural and resale customers.

7.4 Stakeholder Feedback Addressed in the Plan

The CWRP recommended plan addresses the key stakeholder issues raised during the outreach process, and also addresses many of the secondary issues identified in stakeholder meetings. The key and secondary stakeholder issues and how they are addressed in the recommended plan are summarized in **Table 7-1**.

***Table 7-1**: Stakeholder Issues Proposed Resolutions per the CWRP*

Stakeholder Issue	How Issue is Addressed in the Plan
Key Issues	
Diversify the Casitas water supply portfolio	The recommended plan includes 26% of non-local supply on an average annual basis.
Evaluate State Water Project alternatives	Five SWP options were considered in the CWRP studies, and two were included in the recommended plan.
Implement regional solutions that could be mutually beneficial to other water providers	The recommended plan includes interconnections with Ventura and Santa Barbara County, which provide Casitas access to its SWP water and also create possibilities for water trades and acquisition of supplemental water supplies from regional entities.
Secondary Issues	
Environmental concerns	The Robles fish passage improvement project will maintain environmental flows in the Ventura River while improving the ability of Casitas to make its legally allowed diversions. The conditional watershed management/Arundo removal project would help manage the spread of invasive species in the Ventura River watershed.
Water price	Local options are cost effective but do not provide much additional supply. Supplemental water options are more expensive, and include cost of infrastructure as well as cost of water. Cost of water can be managed by only taking supplemental supplies when needed. Casitas will be performing a separate rate study to assess the impact of planned improvements on costs and rates.

Stakeholder Issue	How Issue is Addressed in the Plan
Key Issues	
Water sustainability	The recommended plan substantially improves the sustainability of Casitas' supply portfolio by stretching local supplies and adding supplemental supplies from multiple sources.

Section 8 Implementation of Recommended Plan

The CWRP includes an overall implementation schedule to assist Casitas in implementing the plan recommendations. The implementation schedule is phased over the next ten years and described in more detail in this section.

8.1 Cost Estimates for Recommended Water Supply Options

Table 8-1 lists the estimated capital costs of all project options in the recommended portfolio. Capital cost estimates were based on previous planning information developed by Casitas, supplemented by additional conceptual cost studies performed for the CWRP. This is described in more detail in Appendix A Background Information Technical Memorandum and Appendix G Water Supply Options Selected for Additional Analysis. These costs would likely need to be funded by non-rate revenue such as bonds or grants. Refer to Appendix H for potential funding options. It is recommended Casitas perform a rate study to evaluate impacts of projected operational costs.

***Table 8-1**: Capital Costs of Project Options in the Recommended Portfolio*

Project Option	Approximate Capital Cost	Long Term Average Annual Yield (AFY)
GW 08 – Well Improvements in Ojai Groundwater Basin	$1,500,000	500
MO 08 – Robles Diversion Fish Passage	$3,000,000	350
SWP 03 – Ventura-Santa Barbara Counties Interconnection	$14,500,000	2,000*
SWP 04 – Casitas – Calleguas Interconnection	$136,000,000	3,100*
SWP 05/DW 01 Supplemental Water (via SWP Connections)	Included in State Water Project alternatives	1,250
Total Portfolio	**$155,000,000**	**5,200**

*SWP average annual supply with DCF from Casitas Table A allocation for all SWP connections is 3,100 AFY

8.2 Phased Portfolio Implementation

Projects in the recommended portfolios can be phased based on the minimum anticipated time required for permitting, design and construction. Proposed project phasing is described below.

- Year 1-2 – Ojai well rehabilitation and minor Robles fish screen improvements not needing permitting

- Year 2-5 – Ventura-Santa Barbara County Interconnection and complete Robles fish screen improvements needing permitting
- Year 5-10 – Casitas-Calleguas Interconnection and additional supplemental water

With the current low storage volume in Lake Casitas the District should adopt this aggressive implementation schedule. If the next several years are wet years and the Lake recovers, the Interconnection projects could be implemented on a more extended schedule.

Table 8-2 summarizes the overall implementation timeline for the policies, projects and programs in the recommended plan. Key activities are described for the first 2 years, the first 5 years, and the first 10 years of the plan. Because key projects are regional and involve coordination with other water agencies, activities associated with those projects may need to shifted earlier or later to align with the needs of the other agencies. In addition, unique opportunities may arise that would cause implementation priorities to shift.

***Table 8-2**: Overall Implementation Timeline for Recommended Plan*

Timeframe	Policy Implementation	Project Implementation	Program Implementation
2020-2022	• If Lake Casitas level does not recover, adopt Interim WEAP Policy • Use new demand and supply forecasts in UWMP update • Adopt 20,000 AF minimum allowable storage for Lake management	• Complete Ojai Basin well rehabilitation and replacement • Complete minor Robles Diversion fish screen improvements not needed permitting • Coordinate with Ventura and Santa Barbara County on interconnections • Design and permitting of Ventura-Santa Barbara Interconnection	• Update WEAP based on new policies • Prepare Water Conservation Plan
2022-2025		• Complete final Robles Diversion fish screen improvements needing permitting • Complete Ventura-Santa Barbara County Interconnection by 2026 • Participate in Ventura SWP connection • Perform pilot testing for Matilija Formation Deep Well alternatives (Conditional Option)	• Prepare Supplemental Water Integration Plan • Explore options for in-lieu trades with Ventura SWP water (Conditional Option)
2026-2030		• Design and permitting of Casitas portions of Casitas-Calleguas Interconnection • Complete Casitas-Calleguas Interconnection by 2030 • Implement watershed management project or other options if other projects do not provide planned yield (Conditional Option) • Enter into contracts for supplemental water from Ventura and/or Santa Barbara County if not already done	• Implement additional demand management measures if other projects do not provide planned yield (Conditional Option)

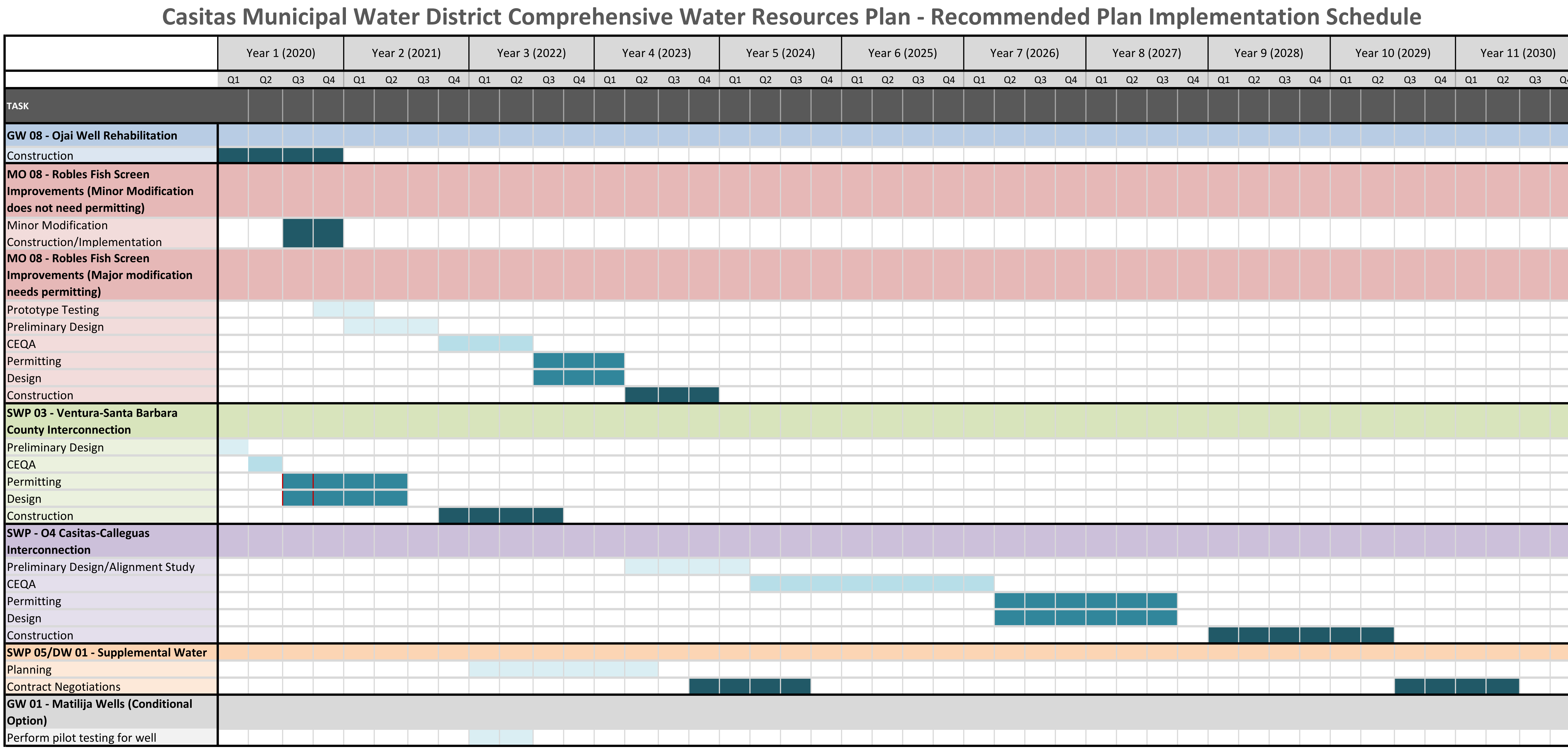

Figure 8-1 Recommended Plan Implementation Schedule

Planning, permitting, and design of major water projects can require many years, particularly when state and federal environmental permits or coordination are involved. Thus, these activities need to be started early to assure the projects are online when needed. The SWP options involve obtaining outside funding in the form of bonds or loans for construction; however, planning, permitting and design can be initiated early so the projects are 'shovel-ready' for construction when funds become available.

Figure 8-1 is a conceptual schedule for the anticipated timing of planning/permitting, design and construction for the water supply options in the recommended plan. Conditional Options are included because due diligence will be required on those options in case they are needed in the future.

Some of the recommended water supply options have unique implementation challenges. These are briefly highlighted below.

GW 08 – Well Improvements in Ojai Groundwater Basin – No unique challenges affect implementation of this water supply option. Casitas was making progress on the planned groundwater well improvements as the CWRP was being prepared, and is on track to complete the planned improvements within the next two years.

MO 08 – Robles Diversion Fish Passage Modifications – Minor improvements to improve the existing brush/screen system of the Robles diversion structure to optimize the operation of the Robles Diversion Dam can be accomplished within current regulatory approvals and are scheduled to be completed by 2021. The more comprehensive modification alternative cleaning system will require more time for prototyping, regulatory agency coordination, design and implementation.

SWP 03 – Ventura-Santa Barbara Counties Interconnection – Casitas is coordinating with CVWD on design and permitting of the interconnection to allow delivery of State Water and other supplemental water. No significant permitting challenges are anticipated for this option. Casitas is currently planning to pursue bonds to finance construction of SWP 03 and SWP 04, the two SWP interconnections. Implementation will be dependent on securing those bonds.

SWP 04 – Casitas-Calleguas Interconnection - This is the major new facility in the CWRP, and by far the most expensive water supply option. This alternative involves Casitas designing and constructing a crosstown interconnection pipeline to connect the Ventura State Water Project Interconnection pipeline to the Casitas-Ventura State Water Project Interconnection pump station. The proposed interconnection pipeline would be sized to allow for Casitas to receive their full allocation of 5,000 AF each year. Casitas will begin with an alternative study to determine potential alignments for this project.

SWP 05/DW 01 – Supplemental Water via SWP Interconnections – The timing of deliveries of supplemental water is dependent on completion of the proposed SWP interconnection infrastructure, either to Ventura or to Santa Barbara County (SWP 04 or SWP 03). However, coordination with those entities on terms of water supply agreements could take several months or years and should begin well before the facilities are scheduled to be online. Of particular importance will be agreement on schedules of when supplemental water deliveries could be requested by Casitas, the source water comprising those deliveries (as that may affect the quality of water delivered to Casitas), and pricing structures.

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Appendix A Background Information Technical Memorandum

Casitas Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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Prepared by Stephanie Soldo

Reviewed by Autumn Glaeser

Approved by Chip Paulson

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Executive Summary

E.S.-1.1 Introduction

Casitas Municipal Water District (Casitas) is preparing a Comprehensive Water Resources Plan (CWRP) to chart the course for assuring future water reliability. The CWRP will present a long-term plan for implementing strategic water projects and is the next stage in a long history of water supply planning and management on the part of Casitas.

This Background Information Technical Memorandum (TM) is a deliverable for Task 2 for the CWRP contract. It summarizes the review of previous water supply and demand estimates for the Casitas service area, water supply options previously considered by Casitas and other water agencies in the Casitas region, and the current status of water security projects actively being pursued by Casitas. The TM discusses the advantages and disadvantages of the options as described in the previous studies and evaluates whether they are viable options to consider as part of the CWRP evaluation.

ES-1.1.1 Historical Safe Yield of Lake Casitas

Lake Casitas was constructed by the U.S. Bureau of Reclamation (Reclamation) in 1959 as a source of supplemental municipal and irrigation water for the region. Lake Casitas is the primary source of water supply for Casitas Municipal Water District and will remain the cornerstone of Casitas' water supply portfolio in the future as outlined by the CWRP. The lake first filled completely in 1978 and last spilled in 1998.

The annual safe yield (largest yield that can be delivered in every year) of Lake Casitas has been estimated several times in the past 50 years as conditions have changed. The current estimate is 20,540 acre-feet per year (AFY).

ES-1.1.2 Water Supply and Demand

The current firm water supply available to Casitas is estimated in the most recent Urban Water Management Plan (UWMP, 2016) to be 20,840 AFY (20,540 AFY from Lake Casitas and 300 AFY from the

Mira Monte well). This does not include the yield of the Ojai Basin wells acquired from Golden State Water Company in 2017, which has an estimated average safe yield of 5,000 AFY (Ojai GWMP, 2018).

The 2016 UWMP estimates the future demand in the Casitas service area to be 17,200 AFY in 2020 and 17,500 AFY in 2040.

If these future supply and demand estimates hold true, Casitas has an average annual surplus of 3,340 AFY. However, as the last drought has shown, extended dry periods caused by climate variability or climate change can severely stress the Casitas water supply system and threaten its ability to meet future demands.

ES-1.1.3 Water Supply Projects from Background Documents

Casitas has prepared various water supply option studies over the years since the construction of Lake Casitas. **Figure ES-0-1** shows a timeline of significant events since the construction of Lake Casitas in comparison to the lake levels and rainfall. Many of the historical studies were prepared as the lake levels dropped or as demands reached values above the published safe yield. The options proposed in those studies had a wide range of benefits, and the projects that resulted in the largest supply of water also came with a significant capital cost. An example is the many options for connecting to the State Water Project. As Lake Casitas filled up during wet periods, the urgency of implementing expensive water supply alternatives waned and Casitas maintained a conservative approach to financial commitments.

This Background Information TM presents a summary of the water supply project options studied by Casitas over the years and recommends which projects should be carried forward and evaluated in the current CWRP. The TM breaks the projects into the following categories:

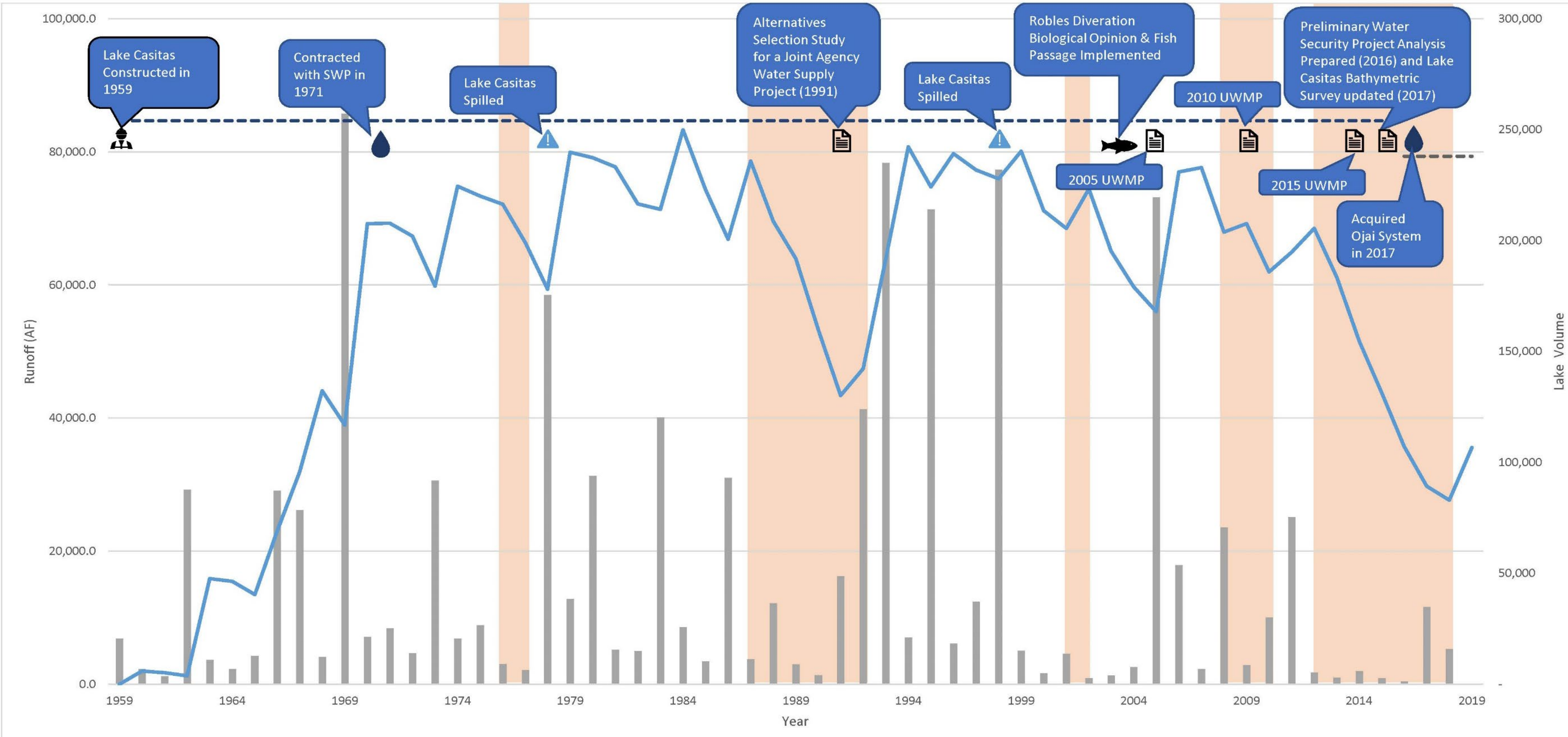
- State Water
- Surface Water
- Groundwater
- Recycled Water
- Local Agreement
- Maintenance and Operation
- Conservation
- Desalinated Water

Table ES-1 lists the water supply projects reviewed in this TM. It provides key data for each project if available, including cost and annual yield. It also indicates whether the project is a current Water Security Project as identified by Casitas, an Early Action Plan project as identified in this CWRP, and if the project is recommended for inclusion in the CWRP option analysis. Many of the projects were only described conceptually in past reports, and there was little specific data available.

E.S.-1.2 Conclusions

Casitas has considered a wide range of water supply enhancement projects in the past 50 years. These have included large capital projects such as improvements to the Robles Diversion Canal and a connection to the State Water Project; small capital projects including improvements to wellfields and recycled water options; and non-structural projects such as water conservation and agreements with resale customers and regional agencies.

Because Lake Casitas and groundwater wells were a reliable source of supply under historical hydrologic conditions and demand management measures were effective, Casitas was not required to implement any of the major, expensive and complex water supply projects considered to date. However, risks to water supply reliability posed by future climate variability, environmental threats such as wildfires, and future demand require a more robust water supply portfolio. The supply projects identified in this TM for consideration in the CWRP option analysis offer a broad array of options for evaluation and comparison.



LEGEND

Lake Casitas Full Capacity

Drought Period

Figure ES-0-1. Casitas Water Supply Timeline

Table ES-0-1. Water Supply Project Options Summary

Option No.	Project	Estimated Capital Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
SWP	**State Water Project Options**						
SWP 01	Deliveries via City of Ventura State Water Project Interconnection and Casitas-Ventura State Water Project Interconnection	Unit Capital Cost = $1,710/AFY[1] Capital cost = $1,645/AFY[1] *(Unit Capital Cost = $1,560/AFY)*[2] *(Capital cost = $1,500/AFY)*[2]	3,100 AFY[12]	✓	✗ (included as a No Regrets option)	Design Phase Preliminary Design Phase	✓
SWP 02	Calleguas Emergency Interconnection with Casitas	Not Available	Not Available	✓	✗ (included as a No Regrets option)	Pre-Planning Phase	✓
SWP 03	Ventura-Santa Barbara Counties Interconnection	Capital Cost = $14,500,000[12]	2,000 AFY[12]	✓	✗ (included as a No Regrets option)	Preliminary Design Phase	✓
SWP 04	Calleguas - Ventura Interconnection	Capital Cost = $136,000,000[12]	3,100 AFY[12]	✓	✗	Planning Phase	✓
SWP 05	City of Ventura Supplemental or In-Lieu Water	Capital Costs are part of SWP 01 or SWP 04	2,000 AFY[12]	✓	✗	Planning Phase	✓
SW	**Surface Water Project Options**						
SW 01	San Antonio Creek Spreading Basin Rehabilitation (*Not a Casitas facility*)	Not Available	Not Available	✗	✓	This groundwater recharge facility is not currently operating due to accumulation of ash and silt from the Thomas Fire.	✗
SW 02	Debris Basin "Enhanced" Percolation	Not Available	Assumed minimal[2]	✗	✗	Debris basin "enhanced" percolation practices are currently utilized	✗
SW 03	Matilija Dam Groundwater/Surface Water	Not Available	500 AF (available every two years)[2]	✗	✗	Not currently being pursued by Casitas.	✓
SW 04	Expansion of Robles Canal	Unit Capital Cost =$1,305/AFY[1] (*Unit Capital Cost = $556/AFY*)[2] (Capital Cost = Not Available)	Not Available (Canal capacity to increase up to 1,700 cfs)[2]	✗	✗	Not currently being pursued by Casitas.	✓
SW 05	Construction of a New Dam Upstream of Lake Casitas	Unit Capital Costs Range from $2,210/AFY to $2,530/AFY[1] (Unit Capital Cost = $941 – $1,078/AFY)[2] (Capital Cost = Not Available)	Ranges from 2,600 AFY to 4,300 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✓

Option No.	Project	Estimated Capital Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
SW 06	Robles Forebay Restoration	Capital Cost = $850,000[12]	Not Available	✓	✓	Casitas anticipates releasing the plans and specifications by May 2019 to be awarded for construction in July 2019.	✗
GW	**Groundwater Project Options**						
GW 01	Matilija Formation Deep Wells	Capital Cost = $6.2M/well *(Capital Cost = $5.6 M/well for drilling & construction O&M = $10,000/year)*[2]	Yield is unknown	✓	✗	HOBO: Awaiting approval from the US Forest Service. VRBO: Casitas has selected a team to perform a peer review of the feasibility of this project.	✓
GW 02	Abandoned Wells and Inspection Program	Not Available	No additional yield	✗	✗	The is not a project in which Casitas is active.	✗
GW 03	Data Collection and Storage (Additional Depth-discrete Monitoring Wells and Additional Data Loggers)	Not Available	No additional yield	✗	✗	The is not a project in which Casitas is active.	✗
GW 04	Renovate Senior Canyon Mutual Water Company Horizontal Well	Unit Capital Cost = $460/AFY[1] Capital Cost = $147,000[1] *(Unit Capital cost = $419/AFY)*[2] *(Capital cost = $134,000)*[2]	Reduction of supply from Lake Casitas of approx. 320 AFY[2]	✗	✗	The is not a project in which Casitas is active.	✗
GW 05	Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed	Not Available	No additional yield	✗	✗	Not currently being pursued by Casitas.	✗
GW 06	Ojai Basin Desalter Project	Unit Capital Cost = $8,286/AFY[1] Capital Cost = $2.9M[1] *(Unit Capital Cost = $7,429/AFY)*[2] *(Capital Cost = $2.6M)*[2]	350 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✓
GW 07	Santa Ana Road Underground Stream	Not Available	Not available	✗	✗	Discounted as a potential new water source for Casitas.	✗
GW 08	Well Improvements in Ojai Groundwater Basin	Unit Capital Cost = $3,000/AFY Capital Cost = $ 1.5M[5]	500 AFY[5]	✓	✓	Casitas is currently underway for well improvements in the Ojai Basin	✓

Option No.	Project	Estimated Capital Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
RW	**Recycled Water Project Options**						
RW 01	Recycled Water from Ojai Valley Sanitary District (OVSD)	Not Available[3]	Not Available	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗
RW 02	Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn	Unit Capital Cost = $63,514/AFY[1] Capital Cost = $4.7M[1] *(Unit Capital Cost = $27,027/AFY)*[2] *(Capital Cost = $2,000,000* *O&M = $150,000/year)*[2]	74 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✗
RW 03	Secondary Reclaimed Water to the Ojai Valley	Unit Capital Cost = $21,563/AFY[1] Capital Cost = $48.3M[1] *(Unit Capital Cost = $9,286/AFY)*[2] *(Capital Cost = $20.8M)*[2]	2,240 AFY[2]	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗
RW 04	Tertiary Reclaimed Water to Rincon Orchards	Unit Capital Cost = $10,508/AFY[1] Capital Cost = $20.7M[1] *(Unit Capital Cost = $4,517/AF)* *(Capital Cost = $8.9M)*[2]	1,970 AFY[2]	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗
RW 05	Spray Fields in Canada Larga	Unit Capital Cost = $11,160/AFY[1] Capital Cost = $25.0M[1] *(Unit Capital Cost = $4,777/AFY)* *(Capital Cost = $10.7M)*[6]	2,240 AFY[6]	✗	✗	Not currently being pursued by Casitas.	✗
RW 06	Ojai East Septic Collection, Package Treatment, Recharge	Unit Capital Cost = $345,714/AFY[1] Capital Cost = $12.1M[1] *((Unit Capital Cost = $314,286/AFY)*[2] *(Capital Cost = $11M* *Annual O&M = $100,000)*[2]	35 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✓
LA	**Local Agreement Options**						
LA 01	Ojai Basin Groundwater Management Agency Co-operation Agreement (Inter-basin) with Upper Ventura River Groundwater Basin Sustainability Agency	Not Available	Not Available	✗	✗	In Progress.	✗
LA 02	Conjunctive Use Agreement with OBGMA	Not Available	Not Available	✗	✗	OBGMA is developing a draft agreement.	✗

Option No.	Project	Estimated Capital Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
MO	**Maintenance and Operation Project Options**						
MO 01	Environmental/Habitat Modifications	Capital Cost = Arundo removal ~$20,000/acre[2]	20 AFY/acre[2,8]	✗	✗	Casitas offers rebates for direct customers for certain environmental/habitat modifications.	✓
MO 02	Ventura River Watershed Infrastructure Improvements	Various per annual fiscal year budget	Not Available	✗	✗	These projects are projects and or programs proposed by Ventura River Watershed Management Plan. Casitas participates as necessary for projects directly involving Casitas.	✗
MO 03	Fire Hydrant and Dead-End Flush Re-Use	Not Available	0.3 AFY[2]	✗	✗	Not enough to represent new water for Casitas.	✗
MO 04	Resale Water Company System Retrofit/Rehabilitation	Various per annual fiscal year budget	650 AFY[9]	✗	✗	Casitas has assisted Senior Canyon Mutual Water Company to improve reliability of groundwater resources.	✗
MO 05	Casitas Leak Detection and Repair Program	Variable costs	Not Available	✗	✗	Program in progress.	✗
MO 06	Sediment Removal at North End of Lake Casitas	Not Available	Not Available	✗	✗	Not implemented, environmental and financial feasibility and justification assessment is needed.	✓
MO 07	Pipeline from Matilija Chlorinator to Hot Springs	Unit Capital Cost = $125,000/AFY[1] Capital Cost = $1.2M[1] *(Unit Capital Cost = $116,667/AFY)*[2] *(Capital Cost = $1,120,000)*[2]	9.6 AFY[2]	✗	✗	This project is currently scheduled for implementation by Casitas in 2020-2022.	✗
MO 08	Robles Diversion Fish Passage Improvements	Capital Cost = Various alternatives ranging from $4M to $12M	Annual yield values have not been determined	✓	✓	Initial stages is being implemented this summer. Pilot study beginning winter 2019	✓
C	**Conservation Project Options**						
C 01	Conservation/Enhanced Demand Management Programs (5 percent reduction)	Not Available	Reduced demand; Estimate not available	✓	✓	Ongoing	✓
C 02	Conservation/Enhanced Demand Management Programs (10 percent reduction)	Not Available	Reduced demand; Estimate not available	✓	✓	Ongoing	✓
DW	**Desalinated Water Project Options**						
DW 01	Desalinated Water from City of Santa Barbara	Not Available	Not Available	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓
DW 02	Casitas Desalinated Water Plant	Not Available	1,121 AFY[10]	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓

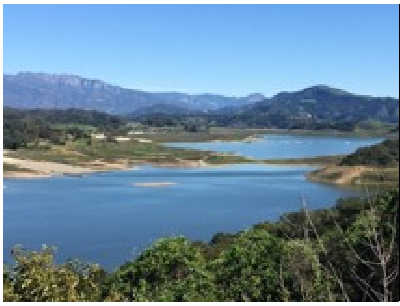
Option No.	Project	Estimated Capital Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
DW 03	Ventura County Regional Desalinated Water Plant	Not Available	Not Available	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓

[1] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[3] To comply with the Nutrient TMDL, OVSD estimates that it will have to spend $10-15 million over the next 7 years
[4] Original 1991 estimate (Boyle, 1991)
[5] 2019 estimate (Pueblo, 2018)
[6] Original 1992 estimate (Boyle, 1992)
[7] Casitas anticipates providing around 10 AFY to CVWD but considers this water part of the Casitas annual customer demand and not a transfer. The 2005 UWMP states Casitas could purchase 500 AF from CVWD and an emergency water exchange agreement remains in place.
[8] 20 AFY/acre of arundo removal estimated to recharge groundwater
[9] Assuming a 10 percent reduction in estaimted annual supply to resale customers. (UWMP, 2016)
[10] Estimate per 2005 UWMP. However, the 2016 Final UWMP states no feasibility study has been done, production rate is unknown
[11] Includes annual budget in Casitas' ten-year plan.
[12] Provided by Casitas.

Abbreviations

AF	acre-foot
AFY	acre-foot per year
AWMP	Agricultural Water Management Plan
Casitas	Casitas Municipal Water District
Calleguas	Calleguas Municipal Water District
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CVWD	Carpinteria Valley Water District
CWRP	Comprehensive Water Resources Plan
DDMW	depth discrete monitoring well
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ETO	Evapotranspiration (crop)
gpm	gallons per minute
GSP	Groundwater Sustainability Plan
GSWC	Golden State Water Company
G/Y	gallons per year
mg/l	milligrams per liter
MOU	Memorandum of Understanding
MWD	Metropolitan Water District of Southern California
NEPA	National Environmental Policy Act
OBGMA	Ojai Basin Groundwater Management Agency

O&M	Operation and Maintenance
OVSD	Ojai Valley Sanitary District
Reclamation	U.S. Bureau of Reclamation
RWQCB	Regional Water Quality Control Board
SACSGRP	San Antonio Creek Spreading Grounds Rehabilitation Program
SMC	Senior Canyon Mutual Water Company
SWP	State Water Project
TDS	total dissolved solids
TM	Background Information Technical Memorandum
USACE	U.S. Army Corps of Engineers
UVRB	Upper Ventura River Basin
UVRGA	Upper Ventura River Groundwater Basin Sustainability Agency
UWCD	United Water Conservation District
UWMP	Urban Water Management Plan
VCFCD	Ventura County Flood Control District
VCWPD	Ventura County Watershed Protection District
VRWC	Ventura River Watershed Council
VRWMP	Ventura River Watershed Management Plan



Introduction

1.0 Introduction

This Background Information Technical Memorandum (TM) is a deliverable for Task 2 for the Casitas Municipal Water District (Casitas) Comprehensive Water Resources Plan (CWRP) contract. It summarizes the review of previous water supply and demand estimates for the Casitas service area, water supply options previously considered by Casitas and other water agencies in the Casitas region, and the current status of water security projects actively being pursued by Casitas. The TM discusses the advantages and disadvantages of the options as described in the previous studies and evaluates whether they are viable options to consider as part of the CWRP evaluation. In addition to narrative summaries, the information is presented in a format that can be presented to the general public as an informational tool. The TM recommends options to be evaluated further in Task 3, which will involve a comparative evaluation and screening of water supply options and recommendations for projects to be included in the CWRP.

The summary of previous supply and demand estimates and water supply project options was based on a review of published reports provided by Casitas and collected from other agencies. Key references are listed below, organized by the primary region they address. A number of older reports are not listed because they are no longer relevant, or their findings were superseded by subsequent reports.

- Casitas
    - Final Urban Water Management Plan and Agricultural Water Management Plan, Casitas Municipal Water District, 2016
    - 2016 Reconnaissance Level Preliminary Water Security Project Analysis/CMWD Preliminary Water Security Project Analysis
    - Preliminary Water Security Project Analysis, Casitas Municipal Water District, 2016
    - 2010 Urban Water Management Plan, Casitas Municipal Water District, 2010
    - 2005 Urban Water Management Plan, Casitas Municipal Water District, 2005

- City or County of Ventura
    - 2015 Urban Water Management Plan for City of Ventura, Kennedy/Jenks Consultants, 2016
    - Water Shortage Event Contingency Plan, Ventura Water, 2015

- Ventura River Watershed Management Plan, Ventura River Watershed Coordinator, 2015
- San Antonio Creek Spreading Grounds Rehabilitation Project Component Report, Ventura County Watershed Protection District, 2014
- Ventura County Water Management Plan, 1994
- Water Supply and Demand Status Report, 1989
- Feasibility of Importing State Water Project Water into Ventura County - Executive Summary, James M. Montgomery, Consulting Engineers, Inc., 1987

- Ojai Valley
    - A Cooperative Regional Approach to Improving Ventura County's Water Supply Reliability, Richard H. Hajas for Ojai Valley Water Advisory Group, 2018
    - Groundwater Management Plan, Ojai Valley Groundwater Basin Management Agency, 2018
    - Treatment Plant Effluent Considerations, Ojai Valley Sanitation District, 2018
    - Urban Water Management Plan, Kennedy/Jenks Consultants, 2010
    - 2010 Urban Water Management Plan Ojai, Golden State Water Company, 2010
    - Ojai Valley Sanitary District Reclaimed Water Feasibility/Marketing Study, 1992

Historical Safe Yield of Lake Casitas

2.0 Historical Safe Yield of Lake Casitas

Lake Casitas was constructed by the U.S. Bureau of Reclamation (Reclamation) in 1959 as a source of supplemental municipal and irrigation water for the region. Lake Casitas is the primary source of water supply for Casitas Municipal Water District and will remain the cornerstone of Casitas' water supply portfolio in the future as outlined by the CWRP.

Lake Casitas currently has a capacity of 237,760 acre-feet (AF). The original capacity was 254,000 AF, but the capacity was reduced by sediment accumulation. In 1959, Reclamation estimated a safe yield of 27,800 acre-feet per year (AFY) for Lake Casitas when integrated with the operation of Lake Matilija. The safe yield is defined as the largest amount of water that can be withdrawn in every of year of operation assuming the reservoir is drawn down to the dead pool level during the critical drought period. It is a common water supply metric used for planning by water agencies because it is a conservative estimate of the yield available with a 100 percent reliability.

The estimate of the Lake Casitas safe yield was revised several times in the past 50 years. In 1968, Reclamation reduced its safe yield estimate for Lake Casitas from 27,800 AFY to 20,350 AFY. This change was prompted by several changes in circumstances including a new critical drought period, a larger evaporation rate determined by operations at the time of the study, and a significant reduction in Lake Matilija storage capacity.

A follow up study was completed by Casitas in 1988, identified as Study Number D-20 (MBK, 1989), which reevaluated the safe yield and developed a new estimate of 21,500 AFY. This evaluation differed from the 1968 study by eliminating Lake Matilija storage altogether and decreasing the evaporation rate based on historical documentation.

Finally, in 2004 a Lake Casitas reservoir operation model was developed by Casitas and was used to revise the safe yield estimate based on changes to operation of the Robles Diversion and the assumption that Lake Matilija is removed. The resulting safe yield estimate was 20,540 AFY based on operations during a 21-year drought period from 1944-1965.

Table 2-2-1 summarizes the past safe yield estimates for Lake Casitas. The most recent estimate of 20,540 AFY is currently used by Casitas for water supply planning. As part of this CWRP project, the Lake

Casitas safe yield will be re-evaluated based on the hydrology of the recent drought, new operating rules for the Robles Diversion during severe dry years, and the potential effects of climate change.

Table 2-2-1. Historical Lake Casitas Safe Yield Values

Source of Safe Yield Estimate (Reporting Year)	Lake Casitas Safe Yield (AFY)
1959 Operating Criteria with Integrated Matilija (1959) (Supply and Demand Memo, 1989)	27,800
1959 Operating Criteria with Integrated Matilija (1968) (Supply and Demand Memo, 1989)	20,350
D-20 Study without Integrated Matilija (20-year drought) (1988) (Supply and Demand Memo, 1989)	21,500
Robles BO Operating Criteria without Integrated Matilija (21-year drought) (2004) (UWMP, 2005)	20,540

Historical Water Supply and Demand Data

3.0 Historical Water Supply and Demand Data

3.1 Casitas Service Area Water Supply

The main supply for Casitas is surface water captured in Lake Casitas with a small percentage supplied from local groundwater. **Table 3-1** lists the water produced by Casitas from its surface and groundwater sources from 2011 to 2018. During this timeframe the annual water produced varied by up to 28 percent, demonstrating the high variability experienced by precipitation-dependent systems in Ventura County watersheds. Both surface water and groundwater supplies were less than the long-term average annual yield estimates of 20,540 AFY and 300 AFY, respectively, in each year during this time period. The Ojai Groundwater Basin is included in the produced water totals for 2017 and 2018 after Casitas acquired the Ojai Water System from Golden State Water Company (GSWC) in 2017.

For future water supply planning, Casitas has adopted the long-term average surface and groundwater yield estimates as shown in **Table 3-2** (UWMP, 2016). **Table 3-2** does not include the estimated annual yield from wells supplying the Ojai Water system.

Table 3-1. Casitas Produced Water (2011-2018 calendar year)

Water Supply Sources	2011	2012	2013	2014	2015	2016	2017	2018
Local surface water (Lake Casitas)[1,]	14,841	16,244	20,402	18,811	17,246	14,151	12,214	11,633
Local groundwater (Mira Monte Well)[2,3]	67	232	173	42	54	35	164	151
Ojai Groundwater Basin4	N/A	N/A	N/A	N/A	N/A	N/A	1,381	1,381
TOTAL	**14,908**	**16,476**	**20,575**	**18,853**	**17,300**	**14,186**	**13,759**	**13,165**

Table 3-2. Projected Water Supplies 2020-2040 (UWMP, 2016)

Water Supply Sources (1)	2020	2025	2030	2035	2040
Local surface water (Lake Casitas)	20,540	20,540	20,540	20,540	20,540
Local groundwater (Mira Monte Well)	300	300	300	300	300
TOTAL	**20,840**	**20,840**	**20,840**	**20,840**	**20,840**
Notes: Sources, CMWD, 2016. All values in AF, rounded. Fiscal Years.					

3.2 Casitas Service Area Water Demands

Figure 3-1. shows the Casitas service area in western Ventura County. The service area includes the City of Ojai, small communities between Ventura and Ojai, and coastal areas.

1 (Casitas Municipal Water District)
2 (UWMP, 2016). All values in AF, rounded.
3 CMWD Large Water System 2016, 2017, and 2018 Annual Report

4 Ojai Water System Large Water System 2017 and 2018 Annual Report

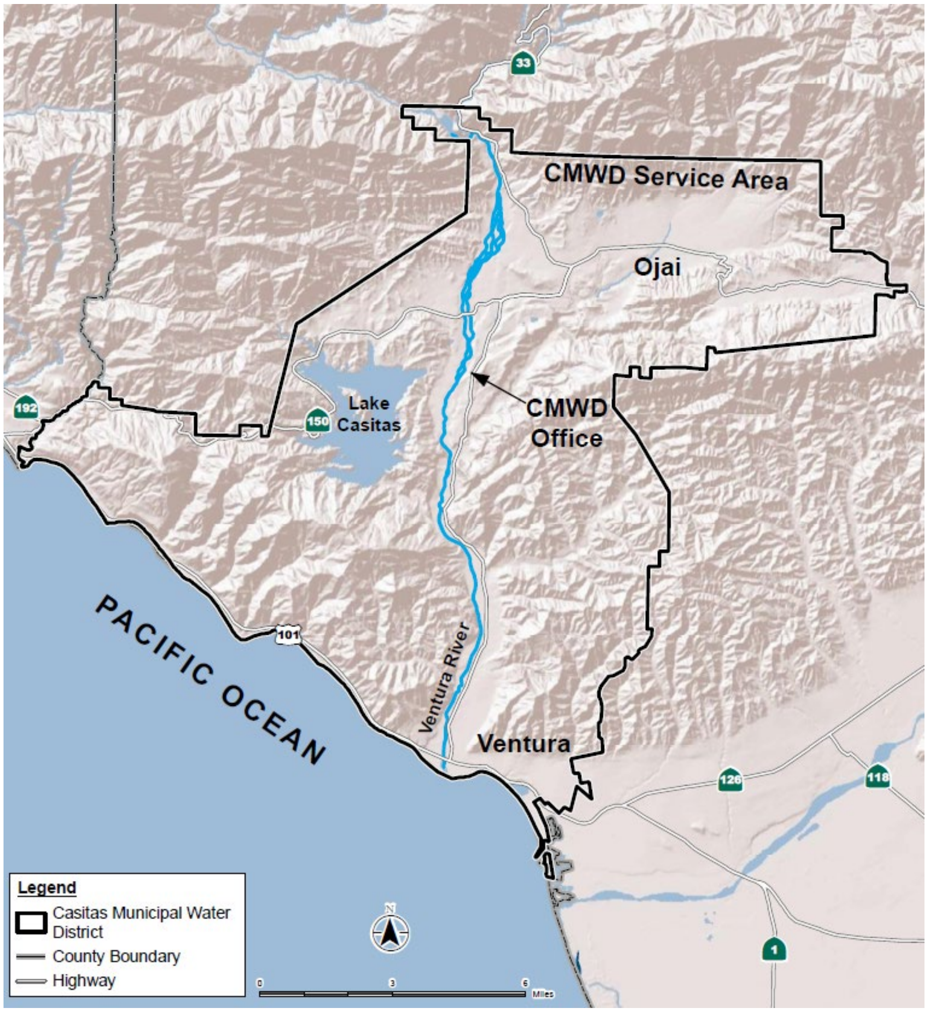


Figure 3-1. Casitas Service Water Area

Casitas serves a population of approximately 70,000 through over 6,000 service connections. Casitas serves three main water customer sectors: municipal and commercial (retail customers), agricultural, and resale (i.e., other water providers that deliver Casitas water to their own customers). **Figure 3-2 s**hows the 2018 customer distribution.

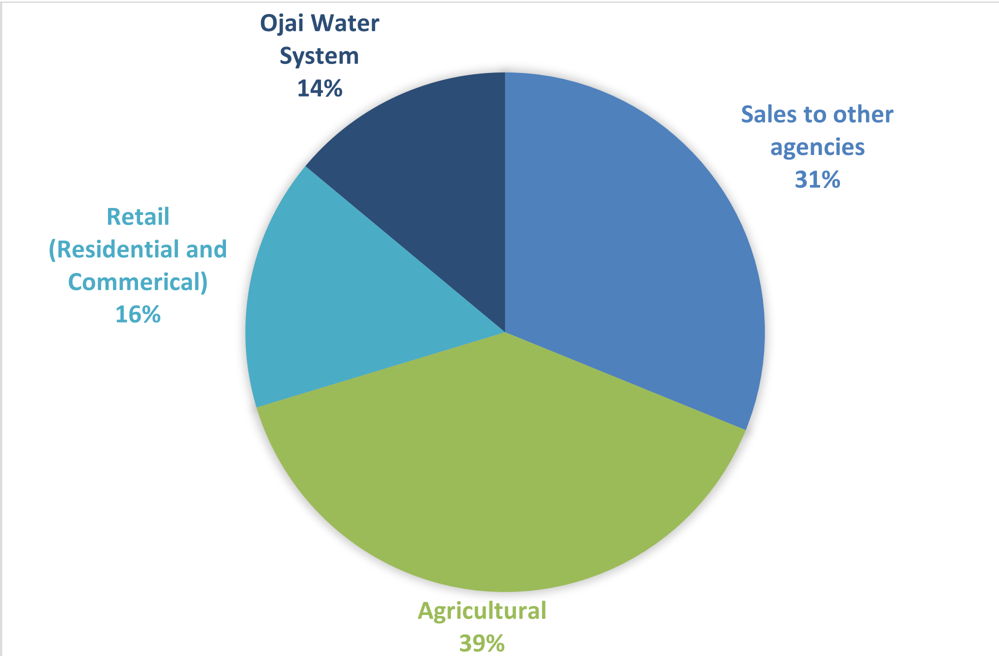


Figure 3-2 – 2018 Casitas Customer Distribution

Figure 3-3 shows the forecasted demands from various studies from 1987 to 2016. The historical trend of Casitas water demand projection was steadily increasing from the1960s to the 1990s. The demands were growing primarily due to new agricultural lands being put into production. By 1990, the total demand on Lake Casitas began to exceed the safe yield of the lake. (Boyle, 1991) As a result of the growing demands which were exceeding the safe yield and the drought during this time, Casitas declared a water shortage emergency which helped to bring demands within safe yield limits. By 2005, the projected demands were significantly lower than demands in the 1990s. Several factors may be responsible for the change in demand pattern, including a wet period in the 1990s that caused Lake Casitas to spill in 1998; a water conservation ethic that became more prominent in the Western United States beginning in the 2000s; and customer response to drought conservation measures during an extended dry period in the 2010s. In addition, water quality issues that occurred during the 1990’s reduced the amount of water the City of Ventura used significantly below their minimum 6,000 acre-feet contracted value in the mid-1990s. **Figure 3-4** shows Lake Casitas produced water (AF) between 1983 to 2018.

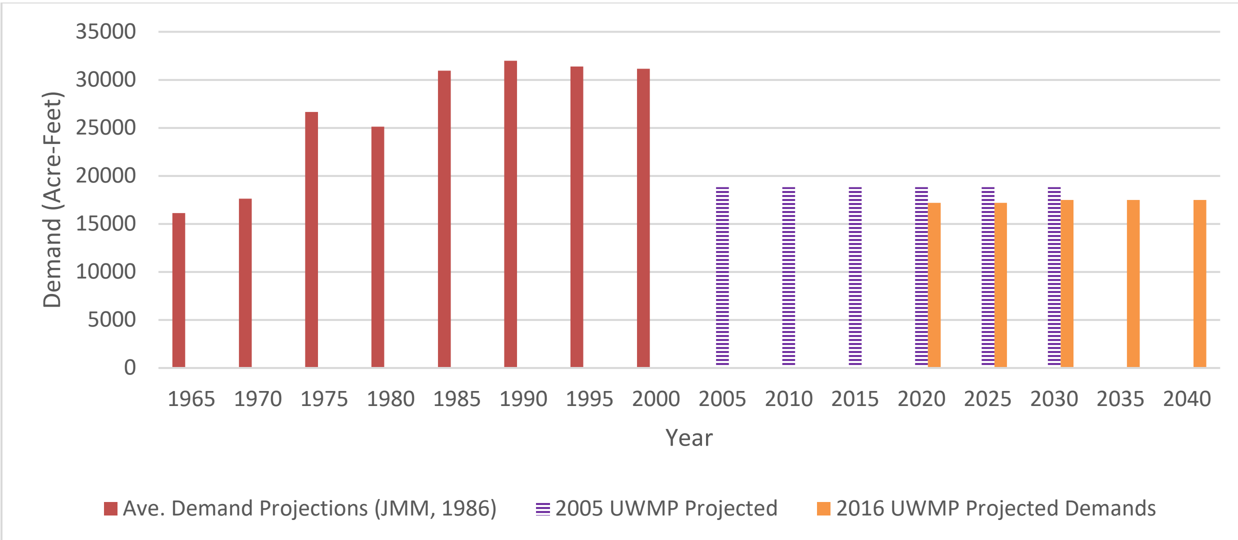


Figure 3-3. Comparison of Forecasted Demand Projections

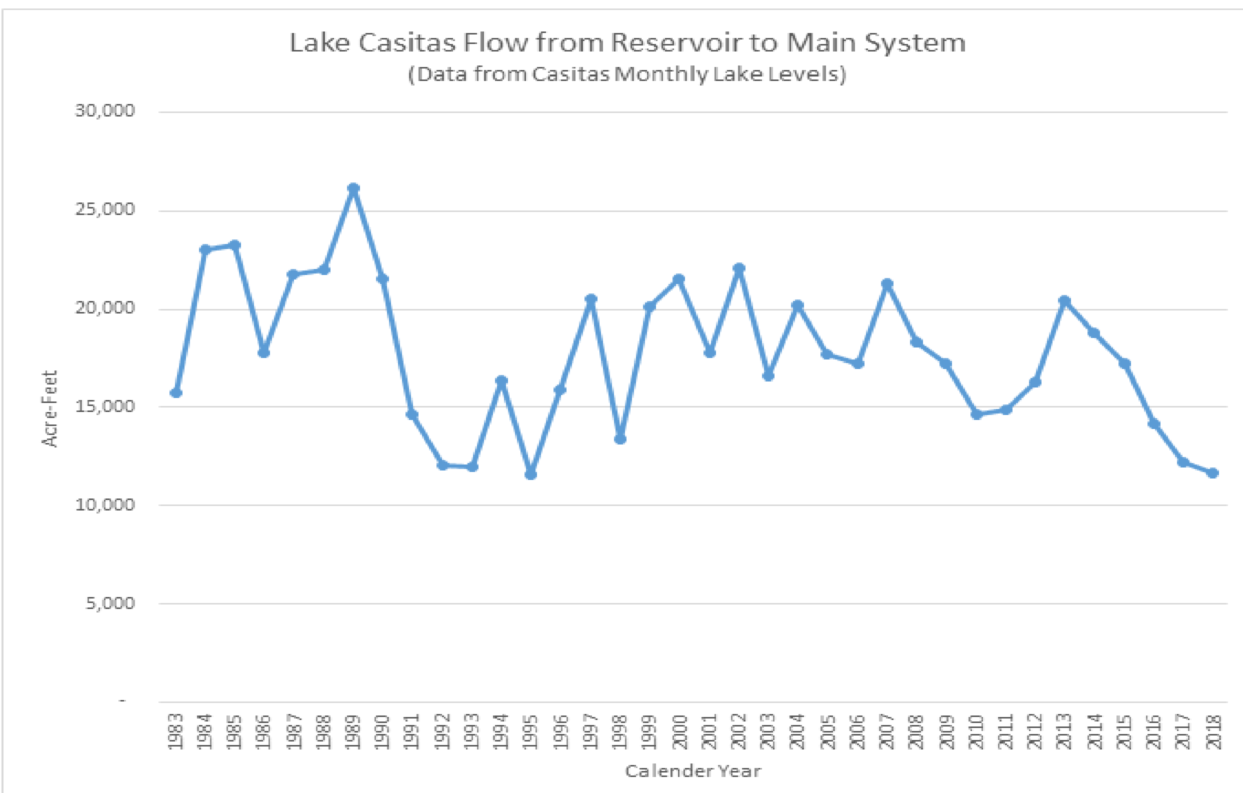


Figure 3-4. Lake Casitas Produced Water (1983-2018 Calendar Years)

Table 3-3 shows potable water use sales for Casitas between 2000 and 2015 and is evidence of the declining water use in the Casitas service area in recent years.

Table 3-4 shows the most recent potable water use between 2016 and 2018, including the Ojai Water System which was purchased from Golden State Water Company (GSWC) in 2017.

Table 3-3. Past Potable Water Uses 2000-2015 (UWMP, 2016)

Category (1)	2000	2005	2010	2015
Sales to other agencies	7,186	7,118	6,482	6,192
Agricultural sales (2)	9,115	8,939	6,398	8,048
Retail sales (2)	3,088	2,821	2,427	2,507
TOTAL	19,389	18,877	15,307	16,747
Notes: Source, CMWD, 2016. All values in AF, rounded. Data does not include water losses. Direct sales to CMWD customers.				

Table 3-4. 2016-2018 Potable Water Deliveries[5,6]

Category	2016	2017	2018
Sales to other agencies	3,926	2,742	3,284
Agricultural	6,973	6,404	4,552
Retail	1,836	2,974	3,136
Ojai Water System	0	513	1,792
TOTAL	**12,735**	**12,633**	**12,764**

The general reduction in per capita water use over the past two decades has resulted in lower water demand forecasts in recent studies compared to forecasts developed prior to 1990. **Table 3-5** shows the projected demands from 2020 to 2040 from the 2016 UWMP, which are currently used by Casitas for water supply planning. This projection assumes population in the Casitas retail service area remains relatively constant based on the Ventura County population forecast. It also assumes agricultural water demand is unchanged and there is a small increase in current deliveries to resale customers. The Ojai Water System was not included in the projections in the 2016 UWMP, though it is expected to be included in the next UWMP update.

[5] CMWD Consumption Report 2016-2017, 2017-2018, 2018-2019
[6] Ojai Large Water System 2017 and 2018 Annual Report to the Drinking Water Program

Table 3-5. Projected Casitas Water Demands (UWMP, 2016)

Category (1)	2020	2025	2030	2035	2040
Sales to other agencies	6,200	6,200	6,500	6,500	6,500
Agricultural sales (2)	8,000	8,000	8,000	8,000	8,000
Retail sales (2)	3,000	3,000	3,000	3,000	3,000
TOTAL	17,200	17,200	17,500	17,500	17,500

Notes:
Source, CMWD, 2016. All values in AF, rounded. Data does not include water losses.
Direct sales to CMWD customers.

Water Supply Projects from Background Documents

4.0 Water Supply Projects from Background Documents

Casitas has a long history of considering improvements to its water supply portfolio. This section summarizes the water supply projects evaluated in the past by Casitas and other regional water agencies in Ventura County. It highlights the advantages and disadvantages of water supply options considered in the past and recommends whether those options should be considered for evaluation in the CWRP option analysis.

Projects are categorized as:

- State Water Project
- Surface Water
- Groundwater
- Recycled Water
- Local Agreement
- Maintenance and Operation
- Conservation
- Desalinated Water

Each section below begins with a description of each water supply option in the respective category, followed by a table summarizing the options. Each table lists project cost (capital cost and/or unit cost per acre-ft of annual yield) and estimated yield if available. Many projects were not described in detail in previous reports and specific information on cost and yield was not available. The tables also indicate whether each project is a current Casitas Water Security project or CWRP Early Action Plan project and specifies if each project is recommended for the CWRP option evaluation task.

4.1 State Water Project (SWP) Options

4.1.1 Introduction

In 1963, the Ventura County Flood Control District (VCFCD) contracted with the State of California for 20,000 acre-feet per year of water from the State Water Project (SWP). In 1971, the VCFCD assigned the administration of the Water Supply Contract to Casitas. Casitas' allocation is 5,000 acre-feet, the City of Ventura has 10,000 acre-feet and United Water Conservation District (UWCD) has 5,000 acre-feet (JMM). Historically, there has not been a practical way to deliver the allocation to these entities; no State Water Project water has been delivered to Casitas or the City of Ventura due to lack of connecting infrastructure. UWCD has been able to since connect into the SWP.

In 1987 the "Feasibility of Importing State Water Project Water into Ventura County" report was prepared by James M. Montgomery, Consulting Engineers Inc. (JMM) to evaluate alternatives for accessing State Water Project water for Casitas, City of Ventura, and United Water Conservation District. Following the completion of the 1987 feasibility study and a subsequent 1988 study, "Evaluation of Alternatives Involving a Castaic Lake Delivery Point" was prepared by JMM in 1988 due to the interest of Castaic Lake Water Agency and Metropolitan Water District of Southern California (MWD). Various alternatives were developed, and further study was recommended.

In 1991, Casitas, City of Ventura, and UWCD contracted with Boyle Engineering Corporation to prepare an Alternatives Selection Study for a Joint Agency Water Supply Project to review the previous reports and select the alternatives that met the joint agencies needs and goals. This study referenced a program level Environmental Impact Report (EIR) planned for the selected alternatives. Per the Alternatives Selection Study, the alternatives shown in **Table 4-1** went through a screening process and were selected to be studied in a programmatic EIR. Cost per yield values are shown, but no capital costs were provided in the historical documents.

Table 4-1. Alternatives Selected for the Program EIR (Boyle)

Alternative	Description	Cost/AF
Alt. 1A	Pipeline from Castaic to Ventura with a Joint Agency treatment plant	$1,022 (1991)
Alt. 1B	Treated water pipeline from Castaic Lake Water Agency to Ventura	$872 (1991)
Alt. 2A	Pipeline from Castaic to Upper Ojai with a Joint Agency Treatment Plant	$1,117 (1991)

Alt. 2B	Treated water pipeline from Castaic Lake Water Agency to Upper Ojai	$959 (1991)
Alt. 3	SWP water received at Lake Piru with delivery by flow down the Santa Clara River and/or a pipeline, with desalination treatment.	$1,199 (1991)
Alt. 4	Seawater desalination plant	$2,038 (1991)
Alt. 5	No project alternative	N/A

Other ideas were considered such as "wheeling" State Water Project water from MWD through Calleguas and the City of Oxnard, but this was deemed unacceptable without Casitas being annexed to MWD's service area.

4.1.2 SWP 01 – Deliveries via City of Ventura State Water Project Interconnection and Casitas-Ventura State Water Project Interconnection

4.1.2.1 Project Description

Between 2014 and 2016, wheeling without annexation was reconsidered by Calleguas and deemed acceptable. As a result, the City of Ventura's State Water Interconnection Project (with Calleguas) was determined as a viable option to study. The estimated cost is $1,560/AFY (after approximately $1,500/AF of capital expenses). (WREA & KG, 2016)

Casitas has shared in the cost of the City of Ventura's State Water Interconnection Alignment Study and Environmental Impact Report. This project would allow for in-lieu use of water by the City of Ventura, which reduces the use of water in Lake Casitas.

In early 2019, Casitas retained an engineering firm to prepare the Casitas-Ventura State Water Project Interconnection Preliminary Design and investigate how to convey water from the west side of Ventura to connect to Casitas' transmission pipelines near Foster Park, eventually extending to Lake Casitas (see **Figure 4-1**). The Casitas-Ventura State Water Project Interconnection would be dependent on the City of Ventura's State Water Interconnection Project being completed.

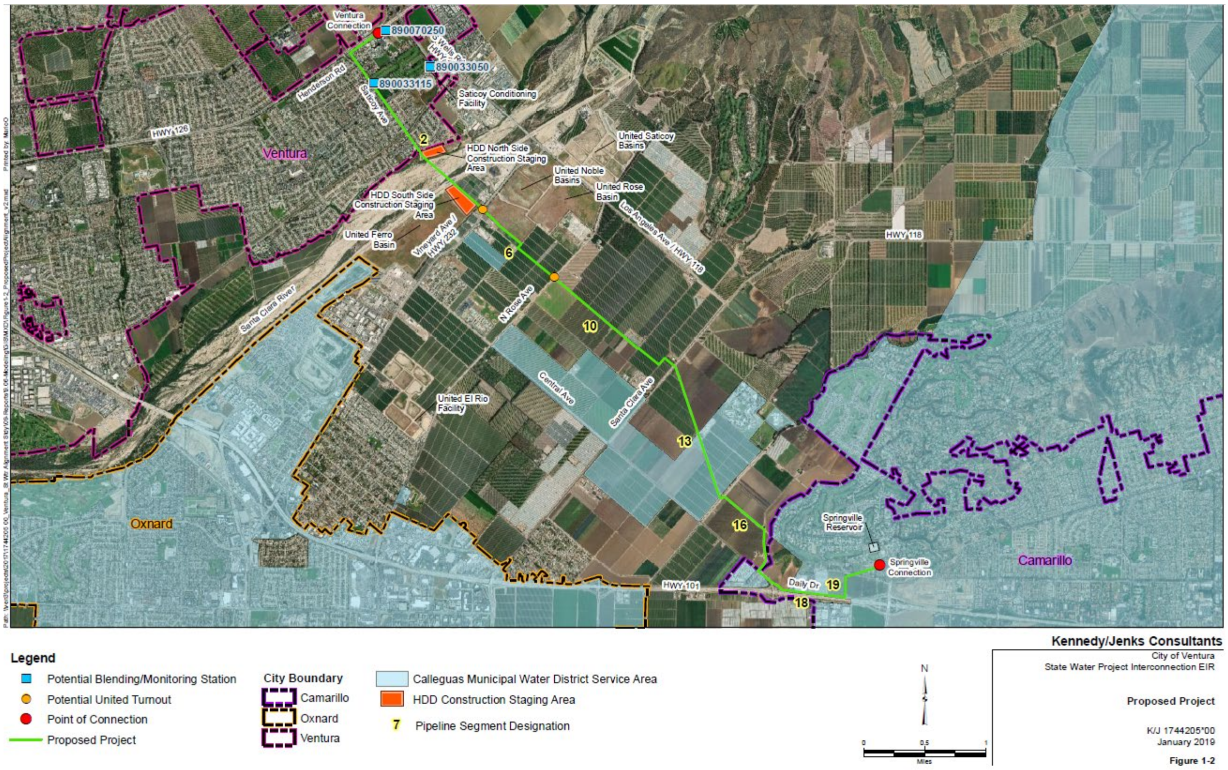


Figure 4-1 City of Ventura State Water Interconnection Project Proposed Alignment (Kennedy/Jenks Consultants, 2018)

Table 4-2 lists the advantages and disadvantages of Deliveries via City of Ventura State Water Project Interconnection and Casitas-Ventura State Water Project Interconnection.

Table 4-2. Advantages and Disadvantages of Deliveries via City of Ventura State Water Project Interconnection and Casitas-Ventura State Water Project Interconnection

Advantages	Disadvantages
• Uses the 3,100 AFY allocation currently owned by Casitas. • Reduces demand on Lake Casitas. • Benefits multiple agencies and spreads costs to other beneficiaries. • Diversifies Casitas' water portfolio by accessing water supplies originating outside Ventura County. • Represents the culmination of decades of planning and past investments. • Can be used if SWP Article 21 becomes available.	• Casitas is dependent on other agencies committing funds and constructing infrastructure. • Currently a three to five-year timeframe for implementation, which is relatively short for a project of this magnitude but might not meet immediate demands in the near term. • The reliability of SWP water has come into question recently as a result of the extended California drought. • Preliminary costs are very high.

4.1.2.2 Current Status

The City of Ventura is the lead agency for this project. Casitas has participated and is a partner in this project. The Draft EIR recently completed the 45-day review and comment period. The EIR document will be used as a decision-making tool for local, state, and federal agencies in considering this project. Simultaneously, Casitas has contracted with Kennedy Jenks for the Casitas-Ventura State Water Project Interconnection Preliminary Design for the infrastructure to convey water from West Ventura to Lake Casitas. The Casitas-Ventura State Water Project Interconnection project is dependent on the City of Ventura State Water Interconnection Project moving forward.

4.1.2.3 Recommendations Summary

Casitas and other neighboring water providers in Ventura County made significant investments in the past to investigate feasible methods of accessing their State Water Project allocations. Many alternatives were considered over the past 50 years, and recommendations in past studies were superseded by more current thinking. This SWP option currently appears to have merit and is in the environmental/permitting phase and the preliminary design phase of evaluation by Casitas and other entities in the region. Therefore, the CWRP includes this option in the list of water supply options considered in the option evaluation process.

4.1.3 SWP 02 – Calleguas Emergency Interconnection with Casitas

4.1.3.1 Project Description

Simultaneously, a second option is being evaluated at a pre-planning level. It is part of Calleguas Municipal Water District’s (Calleguas) Water Supply Alternatives Study and would include a bi-directional pipeline to deliver State Water Project water to Lake Casitas during normal operations and deliver Lake Casitas water to Calleguas during emergencies. This option, referred to as the Calleguas Emergency Interconnection with Casitas, would allow for a direct connection between Calleguas Municipal Water District (Calleguas) and Casitas.

Table 4-3 lists the advantages and disadvantages of Calleguas Emergency Interconnection with Casitas.

Table 4-3. Advantages and Disadvantages of Calleguas Emergency Interconnection with Casitas

Advantages	Disadvantages
• Benefits multiple agencies and spreads costs to other beneficiaries. • Diversifies Casitas' water portfolio by accessing water supplies originating outside Ventura County. • Can be used to purchase SWP Article 21 water when it becomes available. • Allows for regional emergency storage.	• Casitas is dependent on other agencies committing funds and constructing infrastructure. • Currently a three to five-year timeframe for implementation, which is relatively short for a project of this magnitude but might not meet immediate demands in the near term. • The reliability of SWP water has come into question recently as a result of the extended California drought. • Preliminary costs are very high.

4.1.3.2 Current Status

Calleguas is in the process of studying various alternatives. The Inter-Tie with Casitas is one of those alternatives to allow for storing SWP water in Lake Casitas for emergencies.

4.1.3.3 Recommendations Summary

This SWP option is in the pre-planning phase of evaluation by Casitas and other entities in the region. Therefore, the CWRP includes this option in the list of water supply options considered in the option evaluation process.

4.1.4 SWP 03 – Ventura-Santa Barbara Counties Interconnection

4.1.4.1 Project Description

A third SWP option, referred to as the Ventura-Santa Barbara Counties Interconnection, involves exploring an existing emergency transfer agreement with Carpinteria Valley Water District to improve the existing connection with the Casitas water system and allow for Casitas to receive SWP water from the Central Coast Branch. This is a new idea as of early 2019 and preliminary design is currently underway with an expected completion of July 2019.

Table 4-4 lists the advantages and disadvantages of the Ventura-Santa Barbara Counties Interconnection.

Table 4-4. Advantages and Disadvantages of Ventura-Santa Barbara Counties Interconnection

Advantages	Disadvantages
• Diversifies Casitas' water portfolio by accessing water supplies from the Central Coast Branch. • Can be used if SWP Article 21 becomes available. • Reduces demand on Lake Casitas.	• Currently a three to five-year timeframe for implementation, which is relatively short for a project of this magnitude but might not meet immediate demands in the near term.

• Casitas has more control over infrastructure and implementation.	• The reliability of SWP water has come into question recently as a result of the extended California drought.

4.1.4.2 Current Status

Casitas recently retained consultants to perform preliminary design and environmental/permitting services to support a grant application for this project.

4.1.4.3 Recommendations Summary

This SWP option is in the preliminary design phase of evaluation by Casitas and other entities in the region. Therefore, the CWRP includes this option in the list of water supply options considered in the option evaluation process.

4.1.5 SWP 04 – Casitas-Calleguas Interconnection

The fourth SWP option, referred to as the Casitas-Calleguas Interconnection, involves a bi-directional potable water pipeline through Ventura to connect with Calleguas Municipal Water District (Calleguas) to allow Casitas to receive SWP water via new booster pump stations and minor treatment facilities. In addition to delivering its SWP Table A allocation and Article 21 surplus water when available, the interconnection would create opportunities for Casitas to consider agreements with other water entities in the Ventura/Oxnard area for exchange or other cooperative water management strategies. The interconnection would also allow Calleguas to receive water from Lake Casitas during emergencies.

State Water would be delivered through facilities owned by various entities, including California DWR, Metropolitan Water District of Southern California, Calleguas, and the City of Ventura. Therefore, several agreements would be necessary.

The Casitas-Calleguas Interconnection makes use of Ventura's proposed SWP facilities, either as planned or through required upgrades to increase capacity. Thus, this option requires coordination and cost-sharing with Ventura to accomplish its SWP connection. Casitas is actively engaged in this project with Ventura at this time.

It is estimated the Casitas-Calleguas Interconnection would be constructed in a 5- to 10-year timeframe.

Table 4-5 lists the advantages and disadvantages of the Ventura-Santa Barbara Counties Interconnection.

Table 4-5. Advantages and Disadvantages of Casitas-Calleguas Interconnection

Advantages	Disadvantages
• Uses the 3,100 AFY allocation currently owned by Casitas. • Reduces demand on Lake Casitas.	• Currently a10-year timeframe for implementation, which will not meet immediate demands in the near term.

• Benefits multiple agencies and spreads costs to other beneficiaries. • Diversifies Casitas' water portfolio by accessing water supplies originating outside Ventura County. • Represents the culmination of decades of planning and past investments. • Other supplemental water options become available	• The reliability of SWP water has come into question recently as a result of the extended California drought. • Preliminary costs are very high.

4.1.5.1 Current Status

Casitas is exploring funding options and is in the pre-planning stages for this project.

4.1.5.2 Recommendations Summary

This SWP option is in the pre-planning phase of evaluation by Casitas. Therefore, the CWRP includes this option in the list of water supply options considered in the option evaluation process.

4.1.6 SWP 05 – Supplemental or In-Lieu Water from Ventura

This option involves access to supplemental water from a variety of possible sources through SWP 01 and SWP 04 infrastructure. Planned pipeline capacity in a connection in Ventura County would be sized for maximum deliveries of SWP water. In non-peak delivery months and in years when the State Water Table A allocation is less than the full contract amount, this pipeline would not be operated at capacity and could be used to convey water from other sources such as supplemental water purchases and water transfers. Examples of possible supplemental water sources that could be delivered using SWP connection infrastructure are briefly described below.

Article 21 Water from SWP. Article 21 supply is water that is surplus to the needs of the SWP under certain conditions and is made available for purchase by State Water Contractors. When available, this surplus supply is allocated to the requesting State Water Contractors using a calculation that is based on their respective Table A allocations. The Department of Water Resources (2018) indicates the long-term annual average of Article 21 water available for the SWP system is 50,000 AFY. Casitas could choose to purchase Article 21 water to supplement its Table A deliveries if needed and convey that water through the same SWP connection infrastructure.

In-lieu Water Transfers with Ventura. Casitas has shared in the cost of the City of Ventura's SWP Interconnection Alignment Study and Environmental Impact Report. The City of Ventura's Interconnection Project allows for in-lieu use of State Water by the City of Ventura, which reduces the use of water in Lake Casitas.

Table 4-6 lists the advantages and disadvantages of the Ventura-Santa Barbara Counties Interconnection.

Table 4-6. Advantages and Disadvantages of Supplemental or In-Lieu Water from Ventura

Advantages	Disadvantages
• Uses the 3,100 AFY allocation currently owned by Casitas. • Reduces demand on Lake Casitas. • Benefits multiple agencies and spreads costs to other beneficiaries. • Diversifies Casitas' water portfolio by accessing water supplies originating outside Ventura County. • Represents the culmination of decades of planning and past investments. • Other supplemental water options become available	• Currently a10-year timeframe for implementation, which will not meet immediate demands in the near term. • The reliability of SWP water has come into question recently as a result of the extended California drought. • Preliminary costs are very high.

4.1.6.1 Current Status

Casitas is exploring funding options and is in the pre-planning and preliminary design stages for other SWP that would construct the infrastructure needed for this option.

4.1.6.2 Recommendations Summary

This SWP option is dependent on other SWP options. Therefore, the CWRP includes this option in the list of water supply options considered in the option evaluation process as an additional option paired with the other SWP infrastructure options.

4.1.7 State Water Project Options Summary Table

Table 4-7 below summarizes all state water project alternatives reviewed in this document and significant criteria associated with each.

Table 4-7. Active State Water Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
SWP 01	Deliveries via City of Ventura State Water Project Interconnection and Casitas-Ventura State Water Project Interconnection	\$1,710/AFY[1] Capital cost = \$1,645/AFY[1] (\$1,560/AFY)[2] (Capital cost = \$1,500/AFY)[2]	3,100 AFY[12]	✓	✗ (included as a No Regrets option)	Design Phase Preliminary Design Phase	✓
SWP 02	Calleguas Emergency Interconnection with Casitas	Not Available	Not Available	✓	✗ (included as a No Regrets option)	Pre-Planning Phase	✓
SWP 03	Ventura-Santa Barbara Counties Interconnection	Capital Cost = \$14,500,000[12]	2,000 AFY[12]	✓	✗ (included as a No Regrets option)	Preliminary Design Phase	✓
SWP 04	Calleguas - Ventura Interconnection	Capital Cost = \$136,000,000[12]	3,100 AFY[12]	✓	✗	Pre-Planning Phase	✓
SWP 05	City of Ventura Supplemental or In-Lieu Water	Capital Costs is part of SWP 01 or SWP 04	3,100 AFY[12]	✓	✗	Planning Phase	✓

[1] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[12] Provided by Casitas.

4.2 Surface Water Project (SW) Options

4.2.1 Introduction

Surface water currently serves as the main source of supply to Lake Casitas. Improving existing surface water facilities (and/or constructing new projects) could therefore optimize Casitas' overall yield. The alternatives listed below in **Table 4-8** describe six surface water projects explored historically, the current status of each, and recommendations moving forward.

Table 4-8. Surface Water Project Options

Option No.	Project
SW 01	San Antonio Creek Spreading Basin Rehabilitation (*Not a Casitas facility*)
SW 02	Debris Basin "Enhanced" Percolation
SW 03	Matilija Dam Groundwater/Surface Water
SW 04	Expansion of Robles Canal
SW 05	Construction of a New Dam
SW 06	Robles Forebay Restoration

4.2.2 Options

4.2.2.1 SW 01 – San Antonio Creek Recharge Basin Rehabilitation

Project Description

The San Antonio Creek Recharge Basin Rehabilitation Project is meant to increase groundwater storage and recharge in the Ojai Basin by rebuilding the abandoned diversion works, rehabilitating the existing spreading ground basins, and constructing aquifer recharge wells adjacent to San Antonio Creek. The primary purpose of the project is to capture 25 cubic feet per second (cfs) of surface flow from San Antonio Creek to recharge groundwater in the Ojai Basin. (Ojai Basin Groundwater Management Agency, 2018)

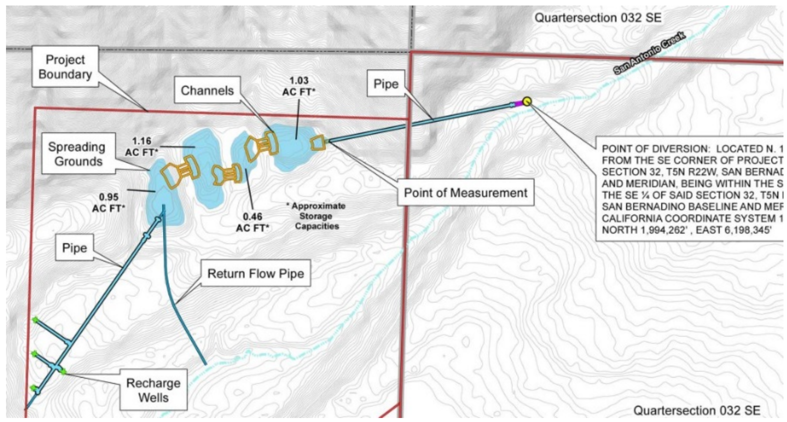


Figure 4-2. San Antonio Creek Spreading Grounds ((OBGMA, n.d.)

Based on the available information at the time of this report, further study is required to determine pertinent information for evaluation in the CWRP. **Table 4-9** lists the advantages and disadvantages of this project.

Table 4-9. Advantages and Disadvantages of San Antonio Creek Recharge Basin Rehabilitation Project

Advantages	Disadvantages
• Would recharge the Ojai Basin and offset the demand on Lake Casitas. • Was highly successful until the Wheeler Fire in 1985.	• Regular maintenance needed to mitigate debris from Thomas Fire burned area. • Outside of Casitas jurisdiction. • Ojai Basin Groundwater Management Agency would be responsible for project implementation.

Current Status

This groundwater recharge facility is not currently operating due to accumulation of ash and silt from the Thomas Fire. The facility could be rehabilitated to function as originally designed to recharge the eastern portion of the Ojai Basin. Casitas should continue participating with Ventura County Watershed Protection District, which is responsible for this facility.

Recommendations Summary

Recent plans and decisions by other regional water entities have recommended pursuing his project. Casitas is not involved in this project but could indirectly benefit from this facility operating. At this it is not recommended this project be included in the CWRP list of options for evaluation since it is not a Casitas project and would be implemented by the County of Ventura.

4.2.2.2 SW 02 – Debris Basin “Enhanced” Percolation

Project Description

This project enhances percolation of storm runoff into local groundwater aquifers by changing management practices at existing debris basins. There are three existing debris basins in the Ventura River Watershed which may aid in recharging the groundwater basin. Percolation could be enhanced by scarifying the bottom of the basins with a spring-tooth or ripper after accumulated debris is removed during normal maintenance activities. With proper debris basin maintenance, there should be no significant difference in recharge from cleanout to cleanout. (WREA & KG, 2016)

Based on the available information at the time of this report, further study is required to determine pertinent information for evaluation if carried forward into the CWRP. **Table 4-10** lists the advantages and disadvantages of this project.

Table 4-10. Advantages and Disadvantages of Debris Basin “Enhanced” Percolation

Advantages	Disadvantages
• Improves benefits from existing infrastructure in the watershed. • Minimal additional operation and maintenance expense. • Costs would not be borne by Casitas. • Provides benefits to any groundwater users in the aquifers in which enhanced percolation would occur.	• Project is not in Casitas’ control. • Water supply benefits are very minimal.

Current Status

Debris basin "enhanced" percolation practices are currently being followed by Ventura County Watershed Protection District (VCWPD). Casitas has concluded there is little if any benefit to doing more, so this option is not currently being pursued. (WREA & KG, 2016)

Recommendations Summary

This project was identified by Casitas in the 2016 Water Security Analysis, but there was no recommendation to implement it. Since debris basin “enhanced” percolation practices are being followed presently, there may be little if any water supply benefit associated with this option. Therefore, it is recommended this option not be carried forward to the CWRP option evaluation process.

4.2.2.3 SW 03 – Matilija Dam Groundwater/Surface Water

Project Description

The Matilija Dam Groundwater/Surface Water project involves collecting and transmitting water to Lake Casitas that currently exists in the shallow sediments in and near Matilija Lake and in the ponding area behind the dam. Matilija Dam no longer functions as it was designed due to the buildup of sediment and loss of water storage availability. The dam has been notched a few times and at present, water spills over the dam and flows into the Upper Ventura River groundwater basin and is used by several retail purveyors and private parties as a supply source downstream. Additionally, it helps support the diverse habitat along the river in the vicinity of Matilija Lake (WREA & KG, 2016). In 2015, the Ventura County Watershed Protection District (VCWPD) hired AECOM and Stillwater Sciences to evaluate a range of dam removal concepts. At this time, the Matilija Dam removal, Sediment Transport, and Robles Diversion Mitigation Project are in the pre-planning stages.

It is estimated there is approximately 500 AF in surface and subsurface storage behind the dam which could be piped directly to the Robles Diversion, then directed into the Robles Diversion Canal to be stored in Lake Casitas. While this water may be accessible for short-term use, it is estimated if the entire 500 AF were extracted, it would take approximately two years for that amount to be available again during dry periods. Additionally, there are several issues with its extraction, including dam stability, hydro-compaction of sediment materials, and water quality, as well as the fact that the water in subsurface storage helps to maintain Matilija Lake ‘full’ and promotes spills over the modified dam in accordance with the current operating strategy.

Table 4-11 lists the advantages and disadvantages of this project.

Table 4-11 Advantages and Disadvantages of Matilija Dam Groundwater/Surface Water Project

Advantages	Disadvantages
• Would supplement the supply to Lake Casitas. • Provides 250 AFY of new yield for Casitas (500 AF every two years). • Retains a small water supply benefit from the reconfigured Matilija Dam and Lake.	• Extracting the stored water behind the dam would take an estimated 2 years to re-collect. • Issues with its extraction include dam stability, hydro-compaction of sediment materials and water quality. • Subsurface storage water helps to maintain the Lake ‘full’ and promotes spills consistent with the current management plan. • Groundwater and surface water in Matilija Lake helps support the diverse habitat on the local portion of the River. • The proposed removal of Matilija Dam could orphan facilities constructed for this project at a later date.

Current Status

Although identified as a 2016 Water Security Project, this option is not currently being pursued by Casitas.

Recommendations Summary

The groundwater and surface water resources of Matilija Lake and the sediments therein were discounted as a significant 'new' potential water source for Casitas in the 2016 Water Security evaluation and thus were not recommended for further consideration (WREA & KG, 2016). If Matilija Dam is eventually removed in accordance with past studies, this project would become ineffective and its associated constructed infrastructure would have to be abandoned or repurposed. Despite these shortcomings, the Matilija Dam Groundwater/Surface Water Project will be carried forward into the CWRP project evaluation so it can be compared to other supply options currently available to Casitas.

4.2.2.4 SW 04 – Expansion of Robles Canal

Project Description

The Robles Canal is part of Reclamation's Ventura River water supply project and diverts water from the Ventura River to Lake Casitas. The present capacity of the Robles diversion canal is 500 cfs. Expansion of the Robles Canal was considered by Reclamation in 1968. The proposed project enlarges the existing canal and headworks capacity to 2,200 cfs, thereby allowing greater diversions to Lake Casitas during high flow periods. The estimated unit cost for the additional delivered water is $556/AFY (Boyle, 1991).

Expansion of the Robles Canal requires approvals and permits from Reclamation and environmental regulatory agencies. The 2003 Biological Opinion related to operation of the Robles Diversion to accommodate fish habitat objectives may reduce estimated project yield and complicate future permitting requirements.

Table 4-12 lists the advantages and disadvantages of this project.

Table 4-12. Advantages and Disadvantages of Expansion of Robles Canal

Advantages	Disadvantages
• Supplements the supply to Lake Casitas. • Increases the yield available from the current Robles Diversion project. • If future climate is characterized by fewer storms but larger severe events, having greater diversion capacity would mitigate the potential for reduced yield from the Ventura River due to fewer storms reaching the threshold for making diversions.	• Is not considered a new supply source. • Actual yield is dependent on water rights and permitted operations. • Increases sedimentation in Lake Casitas and the canal. • Requires approvals from Reclamation and challenging environmental permits.

Current Status

This is not an active project.

Recommendations Summary

This project was a preferred alternative in the 1968 Reclamation Report but was not selected as a preferred alternative in the 1991 Boyle Alternative Selection Study. Based on the limited information provided in previous studies, it is recommended this alternative be carried forward to the CWRP alternative evaluation process.

4.2.2.5 SW 05 – Construction of a New Dam Upstream of Lake Casitas

Project Description

The 1991 Alternatives Selection Study for a Joint Agency Water Supply Project prepared by Boyle Engineering Corporation includes five project alternatives for new dam and reservoir construction considered in the 1968 Bureau of Reclamation Report. These five projects were proposed as viable alternatives in anticipation of the Matilija Dam silting over time and losing its role in aiding supply to Lake Casitas. The projects are listed and described below.

SW 05A – New Matilija Dam and Reservoir

The New Matilija Dam and Reservoir project is a dam on Matilija Creek about 700 feet downstream from the current Matilija Dam. It would provide a 50,000 AF reservoir, with water delivered to Lake Casitas via the existing Robles-Casitas diversion canal. Features of the project include a diversion dam on the North Fork of Matilija Creek (about three miles upstream of its confluence with Matilija Creek), with a 1,000 cfs second diversion canal from this north fork diversion to the new reservoir. Estimated annual yield is 4,300 AFY, and estimated cost is $941/AFY of additional delivered water. (Boyle, 1991)

SW 05B – Nordhoff Dam and Reservoir on the Ventura River near Friend's Ranch

The Nordhoff Dam and Reservoir project is a dam about a quarter mile upstream from the Robles Diversion dam (near Friend's Ranch) providing a 33,000 AF storage reservoir. Similar to the New Matilija Dam, water would be delivered to Lake Casitas via the existing Robles-Casitas diversion canal. Estimated annual yield is 3,600 AFY, and estimated cost is $969/AFY of additional delivered water. (Boyle, 1991)

SW 05C – Murietta Dam and Reservoir on Matilija Creek

The Murietta Dam and Reservoir is approximately three miles upstream from the current Matilija Dam and would provide a 25,000 AF storage reservoir. Water would be delivered to Lake Casitas first by controlled releases into Matilija Creek, and then by diversion at the existing Robles-Casitas diversion canal. Estimated annual yield is 2,600 AFY, and estimated cost is $1,078/AFY of additional delivered water. (Boyle, 1991)

SW 05D – Upper San Antonio Creek Dam and Reservoir

The Upper San Antonio Creek Dam and Reservoir includes a dam on the San Antonio Creek about three miles upstream from the confluence of the San Antonio Creek and the Ventura River. Similar to the New Matilija dam, it would provide a 50,000 AF storage reservoir. Due to water treatment requirements, a pipeline would need to be constructed from the dam to a treatment plant before entering Lake Casitas. Estimated annual yield is 4,000 AFY, and estimated cost is $1,074/AFY of additional delivered water. (Boyle, 1991)

SW 05F – Lower San Antonio Creek Dam and Reservoir

The Lower San Antonio Creek Dam and Reservoir includes a dam on the San Antonio Creek about one mile upstream from the confluence of the San Antonio Creek and the Ventura River. It would provide a 32,000 AF storage reservoir. Due to water treatment requirements, a pipeline would need to be constructed from the dam to a treatment plant before entering Lake Casitas. Estimated annual yield is 3,000 AFY, and estimated cost is $1,074/AFY of additional delivered water. (Boyle, 1991)

Table 4-13 lists the advantages and disadvantages of the five New Dam alternatives considered in 1991.

Table 4-13. Advantages and Disadvantages of Construction of New Dam Upstream of Lake Casitas Project

Advantages	Disadvantages
• Estimated additional average annual yield ranges from 2,600 AFY to 4,300 AFY (not including what would be reduced due to water rights). • The known water quality for all alternatives is good. • The operational simplicity is good for all alternatives (except for the Upper San Antonio Creek Dam and Reservoir, which only has adequate operational simplicity).	• Estimated cost ranges from $2,210/AFY[7] to $2,530/AFY[8]. • Most alternatives do not provide a backup supply. • The institutional feasibility is poor for most alternatives, due to community impacts and environmental concerns. • Would cause possible flooding to nearby roads and structures.

Current Status

Not an active project.

Recommendations Summary

Any of these dam construction projects would need to be evaluated with detailed engineering and environmental reports to determine feasibility. Based on the limited information provided in previous studies contrasted with the potentially significant new yield compared to other supply options, it is recommended this option be carried forward to the CWRP option evaluation process.

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[7] 2019 dollars based on RSMeans Historical Cost Index
[8] 2019 dollars based on RSMeans Historical Cost Index

4.2.2.6 SW 06 – Robles Forebay Restoration Project

Project Description

As part of the Robles Diversion, the forebay was constructed in the late 1950's with the Lake Casitas construction. The Robles forebay is located upstream of the Robles Diversion and the 2004 Fish Passage facility and upstream of the timber cut-off wall in the Ventura River, see **Figure 4-3**.

Per the 2003 Biological Opinion, the Robles Diversion forebay is an important part of the diversion activities and is required to fill to an elevation of 764.5 feet above mean sea level prior to any diversions. Inflows into the Robles Diversion forebay are not constant and therefore operations change as needed per the 2003 Biological Opinion.

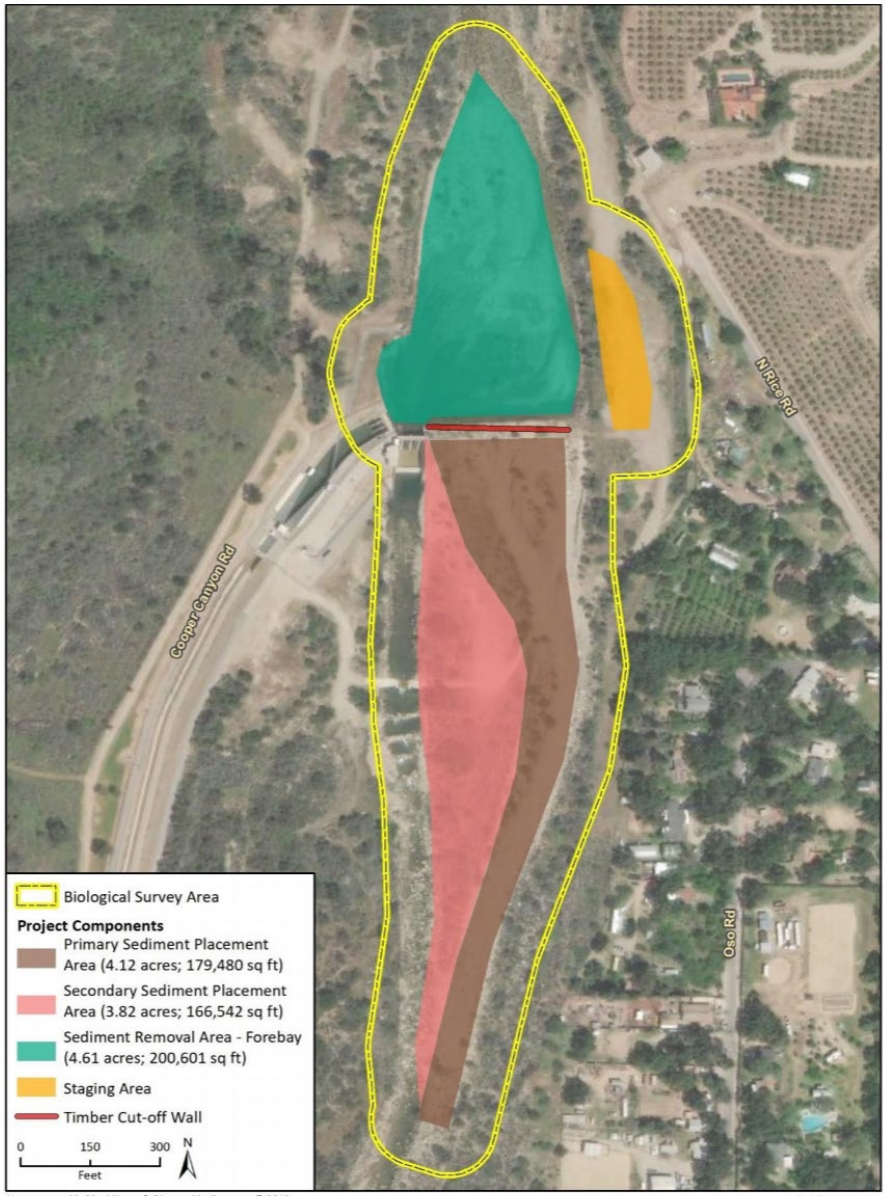


Figure 4-3 Robles Forebay Restoration Area (Rincon Consultants, 2019)

The sedimentation loading following the Thomas Fire has inundated the forebay and therefore decreased the available capacity. (Rincon Consultants, 2019) According to the 2003 Biological Opinion, maintenance of the forebay may be required and will require the use of heavy equipment and disturbance within the channel. Therefore, this work can take place during the dry season to avoid potential impacts to the steelhead. This project includes the removal an estimated 80,000 to 100,000 cubic yards of sediment. (Rincon Consultants, 2019)

Table 4-14. Advantages and Disadvantages of Robles Forebay Restoration Project

Advantages	Disadvantages
Improves effectiveness of existing Robles Diversion. Does not involve construction of new capital projects. Once obtained, permits are valid for five years and sediment can be removed annually.	Significant ongoing maintenance will be required to keep the Forebay operational at the design conditions. Requires a large volume of sediment disposal. Work in the Ventura River will involve significant permitting challenges.

Current Status

Casitas anticipates releasing the plans and specifications by May 2019 to be awarded for construction in July 2019. Annual sediment removals will be budgeted as part of regular operations and maintenance program.

Recommendations Summary

It is recommended this option remains a maintenance project and should be performed at regular intervals. This project is important in the overall effectiveness of the diversion. As a result, this project is not recommended to be carried forward to the CWRP option evaluation process.

4.2.3 Summary

Table 4-15 below summarizes the surface water project options reviewed in this document and significant criteria associated with each. Three of the six options are being recommended for evaluation in the CWRP as potential long-term water supply options.

Table 4-15. Summary of Surface Water Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
SW 01	San Antonio Creek Spreading Basin Rehabilitation (*Not a Casitas facility*)	Not Available	Not Available	✗	✓	This groundwater recharge facility is not currently operating due to accumulation of	✗

						ash and silt from the Thomas Fire.	
SW 02	Debris Basin “Enhanced” Percolation	Not Available	Assumed minimal[2]	✗	✗	Debris basin "enhanced" percolation practices are currently utilized	✗
SW 03	Matilija Dam Groundwater/ Surface Water	Not Available	500 AF (available every two years)[2]	✗	✗	Not currently being pursued by Casitas.	✓
SW 04	Expansion of Robles Canal	Unit Capital Cost =$1,305/AFY[1] (*Unit Capital Cost = $556/AFY*)[4] (Capital Cost = Not Available)	Not Available (Canal capacity to increase up to 1,700 cfs)[4]	✗	✗	Not currently being pursued by Casitas.	✓
SW 05	Construction of a New Dam Upstream of Lake Casitas	Unit Capital Costs Range from $2,210/AFY to $2,530/AFY[1] (Unit Capital Cost = $941 – $1,078/AFY)[4] (Capital Cost = Not Available)	Ranges from 2,600 AFY to 4,300 AFY[4]	✗	✗	Not currently being pursued by Casitas.	✓
SW 06	Robles Forebay Restoration	Capital Cost = $850,000[11]	Not Available	✓	✓	Casitas anticipates project to be awarded for construction in July 2019.	✗

[1] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[6] Original 1992 estimate (Boyle, 1992)
[11] Includes annual budget in Casitas’ ten-year plan.

4.3 Groundwater Project (GW) Options

4.3.1 Introduction

New or rehabilitated groundwater project possibilities in the Ojai region have been explored to either provide new water sources for Casitas or to maximize the efficiency of existing facilities. In addition, data collection, continuous groundwater level monitoring and well inspection programs were considered as tools to gauge the overall health of Ojai groundwater. The alternatives reviewed are listed below in **Table 4-16**. This section includes a project description, current project status, and recommendations moving forward.

Table 4-16 – Groundwater Projects

Option No.	Project
GW 01	Matilija Formation Deep Wells
GW 02	Abandoned Wells and Inspection Program
GW 03	Data Collection and Storage (Additional Depth-discrete Monitoring Wells and Additional Data Loggers)
GW 04	Renovate Senior Canyon Mutual Water Company Horizontal Well
GW 05	Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed
GW 06	Ojai Basin Desalter Project
GW 07	Santa Ana Road Underground Stream
GW 08	Well Improvements in Ojai Groundwater Basin

4.3.2 Options Project Descriptions

4.3.2.1 GW 01 – Matilija Formation Deep Wells

Project Description

The Matilija Formation Deep Wells project consists of the construction of one or more deep water wells in the Matilija sandstone. This formation contains groundwater that recharged over very long time periods. The project includes the exploration of both horizontal and vertical wells and allows for drought-period production of groundwater directly to Casitas' water transmission system and/or the Robles Canal. The production estimate is currently unknown and would require a pilot project to estimate the yield. This is an untapped resource with no known well details. Further analysis is required to determine when Casitas would rely on this water supply and what drought stage would initiate the production. In addition, the District will need to understand the water rights associated with this water source and the impacts to the landowners. Based on initial evaluation, the anticipated capital cost of the project is $5.6 million per well for drilling and construction. The number of wells is undetermined currently. The project implementation period is estimated to be 5 years including design.

The potential locations for the horizontal bore being considered are located on U.S. Forest Service land. Casitas has requested permission from the U.S. Forest Service to allow the installation of stream monitoring gauges to assess the viability of the project. Casitas has not received a response from the U.S. Forest Service.

Casitas is also considering installing a pilot vertical deep bore (VRBO) to gauge water quality and quantity in the Matilija formation. The VRBO well site is located on property owned by Casitas, west of the Robles Diversion facility. Preliminary design and CEQA compliance are underway and are expected to be complete by December 2019.

Table 4-17 lists the advantages and disadvantages of this project.

Table 4-17. Advantages and Disadvantages of Matilija Formation Deep Wells

Advantages	Disadvantages
• The water quality is not expected to be a concern. • Anticipated to be recharged during extended wet periods. • Cost is reasonable for return (estimated $696/AFY (WREA & KG, 2016)). • Diversifies Casitas' water portfolio by adding supply from an entirely new source.	• Yield is unknown. • Five years to implement. • Project is used only when drought triggers are met • Wells are shut down during wet periods to allow for replenishment. • USDA FS 299 permit, further evaluation of California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) compliance to determine level of effort. • Water rights may need to be evaluated.

Current Status

Casitas is awaiting approval from the US Forest Service on its FS299 permit application to install stream monitoring gauges for the HOBO (Casitas Water Security, n.d.).

Casitas has awarded a contract to a team of professionals to provide a peer review of the feasibility of the proposed project. The project is currently on hold pending further funding for a pilot study.

Recommendations Summary

The Matilija Horizontal Bores Project was on the Casitas 2016 Water Security Project list, and it continues to be investigated. The project would only be used during drought periods, so would be considered a source of emergency supply. The project develops previously untapped groundwater resources so provides an opportunity for Casitas to diversify its water portfolio. Although this could be an expensive intermittent supply, it is recommended this option be carried forward to the CWRP option evaluation process.

4.3.2.2 GW 02 – Abandoned Wells and Inspection Program

Project Description

The County of Ventura has an existing program to address abandoned wells as part of the water well ordinance. (Ojai Basin Groundwater Management Agency, 2018) OBGMA is recommending this to the County. This project involves evaluating all abandoned wells within the Ojai Basin to determine if they can be converted to monitoring wells, rehabilitated, or properly destroyed. This will mitigate losses to the regional water supply and potential hazards to the quality of the groundwater and will make the most efficient use of the existing well systems (Ojai Basin Groundwater Management Agency, 2018).

Table 4-18 lists the advantages and disadvantages of this project.

Table 4-18. Advantages and Disadvantages of Abandoned Wells and Inspection Program

Advantages	Disadvantages
• Rehabilitating abandoned wells could help protect water quality and quantity. • Maximizes benefits from existing wellfield infrastructure.	• Project is not within Casitas' jurisdiction since the County of Ventura oversees the water well ordinance. • Project may not create a new supply if wells become monitoring wells.

Current Status

The County of Ventura is responsible for well permitting and has an established program to address abandoned wells, but a special program in the Ojai Basin has not been established. At this time Casitas has not been involved with this option.

Recommendations Summary

OBGMA recommends the County move forward with this program because it allows them to review proposed well modifications prior to changes in conditions. Some of the abandoned wells may be ideal candidates to convert to depth-discrete monitoring wells or other monitoring uses, as agreeable with the property owners, county, city, or funding agencies (Ojai Basin Groundwater Management Agency, 2018). However, this type of conversion would not be a benefit to the Casitas water supply. Although this project may have benefits for improved groundwater basin management and aquifer assessments, it is recommended this option not be carried forward to the CWRP water supply option evaluation process.

4.3.2.3 GW 03 – Data Collection and Storage (Additional Depth-discrete Monitoring Wells and Additional Data Loggers)

Project Description

OBGMA plans to expand upon the efforts of Ventura County to routinely collect information on water levels and quality for wells in the Ojai Basin. This proposed project will expand the system of six existing monitored wells to ten monitored wells.

A depth discrete monitoring well DDMW near the south side of the basin would provide information on deep water salinity, production zone use and storage, and shallow zone storage and discharge to surface water and habitats. One such well is planned in the Hansen Well Drilling yard, near the OBGMA offices. This would be a partner effort between the City of Ojai, the OBGMA, the county, private constituents, and a funding agency (Ojai Basin Groundwater Management Agency, 2018).

Additional loggers in new wells, especially depth-discrete monitoring wells, and a near discharge point shallow well, are planned. Water level, temperature, and conductivity are parameters that can be monitored via this network, and telemetry systems should be included in future settings to minimize time demands of data collection efforts.

Table 4-19 lists the advantages and disadvantages of this project

Table 4-19. Advantages and Disadvantages of Data Collection and Storage Project

Advantages	Disadvantages
• Provides information on deep water salinity, production zone and storage • Provides information on deep water salinity, production zone and storage • Provides information on shallow zone storage and discharge to surface water and habitats. • Minimizes time demands on collection efforts.	• Only provides data does not conserve or increase supply.

Current Status

This is not a project in which Casitas is actively involved.

Recommendations Summary

Although data collection provides an overview on the health of the Ojai Basin, it would not directly increase Casitas' water supply. Therefore, it is not recommended to be included in the CWRP water supply option evaluation process.

4.3.2.4 GW 04 – Renovate Senior Canyon Mutual Water Company Horizontal Well

Project Description

Senior Canyon Mutual Water Company (SCM) owns a 3,000 ft long horizontal well or tunnel constructed in 1929 that initially was the main supply for the SCM system. The horizontal well has supplied water virtually on an uninterrupted basis. Records from 30 years ago show the tunnel occasionally produced in excess of 400 gallons per minute (gpm). With the recent extended drought the flow rate has been reduced to approximately 50 gpm. SCM has three metered connections to Casitas initially installed as emergency backup and auxiliary supply to the horizontal well system.

As the drought progressed and the flow from the tunnel decreased, SCM has used Casitas water almost exclusively. Periodic inspections revealed substantial debris on the tunnel floor, calcification scale on the tunnel walls and a major rock fall at approximately 2200 feet from the entrance. Dr. James Scott, a Mining Engineer who had been involved in the tunnels in Santa Barbara, visited the site in 1994 (when presumably the flow was approximately 200 gpm). He reported the condition of the tunnel had a direct impact on the tunnel yield, and it may be possible to double flow quantities from the tunnel if improved.

Assuming Dr. Scott is correct, during normal years, the increase of 200 gpm would result in a theoretical "production" of approximately 320 AFY. This would reduce the demand on the Casitas system by an equivalent amount. Casitas assisted SCM with design plans and applying for a grant. Anticipated capital cost of the project is $134,000. The project implementation time is estimated at one year (WREA & KG, 2016).

Table 4-20 lists the advantages and disadvantages of this project.

Table 4-20. Advantages and Disadvantages of Renovate Senior Canyon Mutual Water Company Horizontal Well

Advantages	Disadvantages
• Project may be exempt from CEQA but will depend on final improvements. • Reduces SCMWC demand from Lake Casitas. • Benefits SCMWC and improves their main source of water.	• New yield from renovation is uncertain. • Tunnel conditions could be worse than documented in 1994.

• The project completion time is estimated to be only one year. • Reasonable cost for return (estimated $419/AFY (WREA & KG, 2016))	

Current Status

This project was included in the preliminary Water Security Project list. Casitas in conjunction with Senior Canyon Mutual Water Company, received a grant for this project through the Ventura County Watershed Coalition for Proposition 50 regional grant funds. The grant will be used to improve the reliability of Senior Canyon Mutual Water Company's horizontal well so they would rely less on Casitas' surface water supply. This project will improve conjunctive use of local groundwater and surface water supplies (UWMP, 2016).

Recommendations Summary

The previous investigation in 1994 recommended rehabilitation of the horizontal well included cleaning, descaling, partial sealing, additional lateral drilling, and the potential of a separate bore. The project would benefit SCM first, which reduces demand on Lake Casitas water (WREA & KG, 2016). This project would indirectly benefit Lake Casitas but is not a project within Casitas' control. It is not recommended this project be included in the list of options to be evaluated in the CWRP.

4.3.2.5 GW 05 – Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed

Project Description

This project allows for continuous groundwater level and quality monitoring in the Ventura River Watershed by installing new monitoring instruments in the basin's wells. It was proposed by the Ventura River Watershed Council to advance the intent of Resiliency Through Infrastructure Campaign (Ventura River Watershed Coordinator, 2015).

Table 4-21 lists the advantages and disadvantages of this project.

Table 4-21. Advantages and Disadvantages of Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed

Advantages	Disadvantages
Improved data for well system improves operations and maximize safe groundwater production.	Benefits to average annual yield have not been estimated.

Improved monitoring capabilities could be required to support future conjunctive use or aquifer storage and recovery programs.	Casitas may have limited influence over how the monitoring data is used to manage groundwater resources.

Current Status

Casitas is not actively involved in this project.

Recommendations Summary

This project would improve data available for groundwater basin management in aquifers serving the Casitas service area but would not substantially improve water supplies available to Casitas. This project is outside of Casitas' control, and is not recommended for further evaluation in the CWRP. (Ventura River Watershed Coordinator, 2015)

4.3.2.6 GW 06 – Ojai Basin Desalter Project

Project Description

This project conceptually targets otherwise unusable high chloride water from the lowest aquifers in the Ojai Basin to allow for its potable use and allow for recharge water to replace the poorest quality water over time.

Casitas would own and operate the desalter project infrastructure. Delivering the water acquired from the Ojai Desalter Project requires installation of a membrane treatment system, and connection to the existing Casitas Ojai transmission system, as well as targeting a well (existing or new) to supply the high chloride water. Additionally, the brine from the treatment process would be delivered to the existing Ojai Valley Sanitary District (OVSD) collector lines in the project area. Production for the Ojai Basin Desalter Project is estimated to range from 300 to 400 AFY. Estimated maximum flow rate to be used in conceptual facility design is approximately 200 gpm.

Produced water prior to treatment is expected to be sodium-chloride in character, with total dissolved solids (TDS) in the near brackish state (around 2,000 milligrams per liter, or mg/l, TDS). Desalting would result in water quality of 500 mg/l TDS added to the distribution system. Anticipated cost of the Ojai Desalter Project ranges from $2.6 million to $2.9 million, depending on whether an existing well can be used or if a new well has to be drilled. The time required from conception to completion if allowed to progress without delay is estimated at one year if a Categorical Exemption is available for CEQA compliance and an existing well can be used. Additional time may be required if a new well or wells are to be constructed.

By using existing wells for sources that may not be usable untreated, treating the water through a reverse osmosis desalination facility, and discharging the brine to the OVSD, the produced water could be used to augment the municipal and/or agricultural supply of the valley. Because the extracted water could be replaced naturally with fresher water from shallower aquifers or recharge, a long-term benefit would be the desalination of the lower aquifers and increase in usable groundwater from the basin. (Richard H. Hajas, 2018)

Table 4-22 lists the advantages and disadvantages of this project.

Table 4-22. Ojai Basin Desalter Project

Advantages	Disadvantages
• May use existing wells. • Estimated production of 300-400 AFY.	• Requires reverse osmosis desalination facility. • About five times the cost of the State Water Project Transfer/Inter-tie (at $7,429/AFY (WREA & KG, 2016))

Current Status

Not currently being pursued by Casitas.

Recommendations Summary

This project was recommended by Casitas for its 2016 Water Security Project list. It makes additional water usable to Casitas, offsets potential 'undesirable results' of groundwater extraction during droughts and may be able to use existing well infrastructure. It would provide an estimated additional 300-400 AFY. (WREA & KG, 2016)

A more detailed feasibility study is recommended; partners such as Casitas, the City of Ojai, the Ojai Water Conservation District, and OVSD could all contribute and benefit from such a project. (Ojai GWMP) It is recommended this project be considered in the CWRP evaluation of water supply options.

4.3.2.7 GW 07 – Santa Ana Road Underground Stream

Project Description

Based largely on anecdotal information, the Santa Ana Road "underground stream" is a term given to a portion of subsurface water draining into the Upper Ventura River groundwater basin near Oak View. This water has been indicated by observations of a relatively shallow and stable water level in a local, lightly-used groundwater well.

This water is likely of limited utility due to low production capacity if stressed. High and consistent water levels reported in the past are likely a result of low use and bedrock/alluvium morphology rather than a significant resource that may be available to Casitas.

Water flowing into the Upper Ventura River Basin (UVRB) via the local creeks and streams, including subsurface flow like the ‘Underground Stream’, would be subject to management or allocation under the UVRB groundwater sustainability plan (GSP). Any additional withdrawal may be subject to review per the tenets of the GSP and/or challenge by downstream users.

Table 4-23 lists the advantages and disadvantages of this project.

Table 4-23. Advantages and Disadvantages of Santa Ana Road Underground Stream

Advantages	Disadvantages
• New source of local supply.	• Subject to management by outside agencies. • Reliability and yield are unproven.

Current Status

This was a lower tier project per the *2016 Preliminary Water Security Project Analysis*. It has since been discounted as a potential new water source for Casitas.

Recommendations Summary

The Santa Ana Road 'Underground Stream' has been discounted as a potential new water source for Casitas and is not recommended for evaluation in the CWRP.

4.3.2.8 **GW 08 – Well Improvements in Ojai Groundwater Basin**

Project Description

Casitas acquired GSWC's Ojai Water System in June 2017. Included in the acquisition were six existing groundwater production wells consisting of the Mutual #4, Mutual #5, Mutual #6, San Antonio #3, San Antonio #4, and the Gorman well. Along with the wells, Casitas also acquired equipment and appurtenances associated with the wells, including pumping equipment, controls, and pipelines.

Casitas operates these wells on two parcels located on either side of San Antonio Creek, south of Grand Avenue. The eastern parcel is approximately 4 acres and the western parcel is approximately 5.7 acres. The distance between wells ranges from 230 to 892 feet, and they range in age from 6 to 47 years old. The wells produce between 70 and 250 gallons per minute (gpm).

Since the acquisition of the wells from Golden State in 2017, Casitas has performed multiple studies on the wellfield with the intent of characterizing the condition of the wells, quantifying interference between the wells, and identifying projects that could be undertaken to improve the production and operation of the existing wells. These studies include the Ojai Wellfield Assessment Report (May 2018), the Ojai Wellfield Interference Assessment (November 2018), and the Groundwater Supply Augmentation Assessment: Analysis of Alternatives (January 2019). All studies were completed by Pueblo Water Resources, Inc. (Pueblo). These studies identified several projects specific to the Ojai Wellfield. Respective locations from the wells can be found in Figure 4-4., per the Pueblo Ojai Well Assessment Report. The projects that can be implemented within a 12-month time period were included in the Early Action Plan (EAP). The remaining project was a new well replacing Mutual #4 at Grand Avenue Wellfield. This project is estimated at $1.5M and $1.25M, which is budged for fiscal years 2018-2019 and 2019-2020. The anticipated yield is approximately 500 AFY.

Figure 4-4. Ojai Wellfield Location Map (Pueblo, 2018)

Table 4-24 lists the advantages and disadvantages of this project.

Table 4-24. Advantages and Disadvantages of Well Improvements in Ojai Groundwater Basin

Advantages	Disadvantages
• Improvements may produce additional yield from existing production wells. • Rehabilitation costs are relatively low in comparison to drilling a new well. • Maximizes efficiency of existing capital facilities.	• Loss of production during construction.

Current Status

Casitas recently awarded a construction contract to Legend Well & Pump for rehabilitation of Gorham Well #1 and is working on plans and specifications for rehabilitation of San Antonio Well #4. Casitas is also in the design phase for a well replacement for fiscal year 2019-2020.

Recommendations Summary

This project was a recommended to be included in the Early Action Plan and it is recommended the long-term groundwater projects be included in the list of options to be evaluated in the CWRP.

4.3.3 Summary

Table 4-25 below summarizes all groundwater project options reviewed in this document and significant criteria associated with each.

Table 4-25. Summary of Groundwater Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
GW 01	Matilija Formation Deep Wells	Capital Cost = $6.2M/well[1] *(Capital Cost = $5.6 M/well for drilling & construction* *O&M = $10,000/year)*[2]	Yield is unknown	✓	✗	HOBO: Awaiting approval from the US Forest Service. VRBO: Casitas has selected a team to perform a peer review of the feasibility of this project.	✓
GW 02	Abandoned Wells and Inspection Program	Not Available	No additional yield	✗	✗	The is not a project in which Casitas is active.	✗
GW 03	Data Collection and Storage (Additional Depth-discrete Monitoring Wells and Additional Data Loggers)	Not Available	No additional yield	✗	✗	The is not a project in which Casitas is active.	✗
GW 04	Renovate Senior Canyon Mutual Water Company Horizontal Well	Unit Capital Cost = $460/AFY[1] Capital Cost = $147,000[1] *(Unit Capital cost = $419/AFY)*[2]	Reduction of supply from Lake Casitas of approx. 320 AFY[2]	✗	✗	The is not a project in which Casitas is active.	✗

		(Capital cost = $134,000)[2]					
GW 05	Continuous Groundwater Level and Quality Monitoring in Ventura River Watershed	Not Available	No additional yield	✗	✗	Not currently being pursued by Casitas.	✗
GW 06	Ojai Basin Desalter Project	Unit Capital Cost = $8,286/AFY[1] Capital Cost = $2.9M[1] *(Unit Capital Cost = $7,429/AFY)*[2] *(Capital Cost = $2.6M)*[2]	350 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✓
GW 07	Santa Ana Road Underground Stream	Not Available	Not available	✗	✗	Discounted as a potential new water source for Casitas.	✗
GW 08	Well Improvements in Ojai Groundwater Basin	Unit Capital Cost = $3,000/AFY Capital Cost = $ 1.5M[5]	500 AFY[5]	✓	✓	Casitas is currently underway for well improvements in the Ojai Basin	✓

[1] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[5] 2019 estimate (Pueblo, 2018)

4.4 Recycled Water Project (RW) Options

4.4.1 Introduction

Incorporating recycled water to Casitas' portfolio has proven more challenging than other supply options, largely because OVSD does not own the rights to its effluent or any treated wastewater and therefore cannot enter into agreements with Casitas or other agencies. However, an option to bypass this water right issue has been considered, where a packaged wastewater treatment plant in east Ojai Valley would draw from sewage currently disposed in septic systems.

The alternatives listed below in **Table 4-26** describe six recycled projects explored historically, the current status of each, and recommendations moving forward.

Table 4-26 Recycled Water Project Options

Alternative No.	Project
RW 01	Recycled Water from Ojai Valley Sanitary District (OVSD)
RW 02	Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn
RW 03	Secondary Reclaimed Water to the Ojai Valley
RW 04	Tertiary Reclaimed Water to Rincon Orchards
RW 05	Spray Fields in Canada Larga
RW 06	Ojai East Septic Collection, Package Treatment, Recharge

4.4.2 Option Project Descriptions

4.4.2.1 RW 01 – Recycled Water from Ojai Valley Sanitary District (OVSD)

Project Description

This project would utilize OVSD Treatment Plant effluent to either increase the supply of the Ventura River (which in turn supplies Lake Casitas), or it would use recycled water to irrigate crops, parks, and golf courses in the Casitas service area. It could also provide water for industrial processes, power plants, fire-fighting, and other similar non-potable uses. (UWMP, 2016)

There are several obstacles for implementing a recycled water project using OVSD effluent. Most importantly, OVSD does not own the rights to its effluent or any treated wastewater and thus cannot enter into agreements with Casitas or other agencies to provide recycled water. The wastewater treatment plant is on City of Ventura land with a lease that gives Ventura the first right of use. (Ojai Valley Sanitation District, 2018) Treated wastewater must currently be discharged to the Ventura River for environmental purposes. Repurposing this water for municipal or agricultural use would require permitting from multiple regulatory agencies and compliance with CEQA.

Treating wastewater for non-potable municipal and agricultural uses would involve a cost for providing additional treatment beyond what the wastewater treatment plant is already required to provide. Even with additional treatment there may be public concerns over use of treated wastewater for municipal or agricultural use.

Table 4-27 lists the advantages and disadvantages of this project.

Table 4-27. Advantages and Disadvantages of Recycled Water from Ojai Valley Sanitary District Project

Advantages	Disadvantages
• Offsets the demand of Lake Casitas water and reduce use of local groundwater supplies. • Reuses existing supplies. • Consistent with current integrated water planning and "One Water" concepts being adopted by progressive water utilities.	• Water rights issues (OVSD does not own the rights to its effluent). • May not be permittable due to downstream environmental flow requirements. • Wastewater treatment process would have to be upgraded to meet non-potable water use standards. • Public may oppose use of treated wastewater for some non-potable municipal and agricultural uses.

Current Status

The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.

Recommendations Summary

This project is not considered a viable alternative per the *2016 UWMP* due to the issues discussed above. OVSD prepared a board memorandum stating their concerns regarding providing recycled water. Thus, despite the obvious benefits of using locally available recycled water for non-potable uses, this project must be eliminated from consideration in the CWRP options analysis.

4.4.2.2 RW 02 – Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn

Project Description

This project involves constructing a Scalping Plant on an OVSD collector main to allow for wastewater reuse at Ojai Valley Inn Golf Course. The project is comprised of a new package wastewater treatment plant ("scalping plant") along with appurtenances such as manholes, cleanouts, siphons and lift stations to deliver treated wastewater to the Ojai Valley Inn Golf Course irrigation system. The "scalped" wastewater from the OVSD collector main would be directed to the package treatment plant, ideally located at a low point in the selected area. (WREA & KG)

The treatment plant would need to be sited in an area of easy access near the Ojai Valley Inn water service on a parcel that Casitas may need to acquire. The "scalped" influent would be treated by means of a centralized redundant extended aeration system including anoxic chambers and clarification followed by membrane filtration and disinfection to meet tertiary standards. A sludge processing system would be included to decant the brine/sludge, reducing volume and decreasing water loss. (Alternatively, the brine could be returned to the collector main.) The treated effluent would then be piped to the Ojai Valley Inn irrigation system. OVSD staff have stated as much as 100,000 gallons per day could be "scalped" from the nearby collection main. Since treated wastewater storage is not contemplated, the "production" would be limited to what can be used daily. If the rainfall evapotranspiration (ETO) deficit is positive 8 months of the year, the project would reduce demand from the Casitas potable water system by approximately 74 AFY. (WREA & KG) By installing an injection well, the discharge during the other four months of the year (37 AFY) can be recharged to the groundwater basin.

The quality of treated wastewater must meet or exceed the standards adopted in the Ojai Groundwater Basin Plan. Lowering levels of nitrate and chloride to the required concentrations could be a challenge for a package plant wastewater treatment system. This project would also trigger the CEQA process, and an EIR would likely be required.

Anticipated capital cost of the project is $2.0 million, and operation costs are estimated to be approximately $150,000 per year. Project duration for implementation is estimated at 4 years. (WREA & KG, 2016)

Table 4-28 lists the advantages and disadvantages of this project.

Table 4-28. Advantages and Disadvantages of Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn Project

Advantages	Disadvantages
• Reliable, no apparent water rights issues. • Additional supply can be generated very near the point of use. • Efficiently reuses existing supplies. • Consistent with current integrated water planning and “One Water” concepts being adopted by progressive water utilities.	• High cost for small benefit.

Current Status

Not currently being pursued by Casitas.

Recommendations Summary

This was a lower tier project per the *2016 Preliminary Water Security Project Analysis* and should be included in the CWRP.

4.4.2.3 RW 03 – Secondary Reclaimed Water to Ojai Valley Irrigators

Project Description

Secondary treated reclaimed water from the OVSD wastewater treatment plant would be distributed to the Ojai Valley to irrigate citrus groves and two golf courses. To use the secondary effluent, farmers would need to convert their orchards to furrow irrigation. Although almost all orchards in the Ojai Valley now use drip irrigation to minimize water use, many of those orchards formerly used furrow irrigation and could be converted back. (Boyle, 1992) If reclaimed water rates are reasonable, farmers may be willing to convert their orchards back to furrow irrigation.

The water allocation program implemented by Casitas and the Ojai Basin Groundwater Management Agency may provide incentives for the use of reclaimed water. All of the reclaimed water from the OVSD treatment plant would be used if about a fourth of the orchards in East Ojai were connected to the reclaimed water system.

This project has the same legal constraints related to use of OVSD wastewater effluent as described for the Recycled Water Project (RW 01). To compensate for downstream environmental flow obligations associated with the current wastewater effluent discharge, it may be feasible for Casitas to release some Lake Casitas water into the Ventura River near the wastewater treatment plant to meet environmental demands of the river. The amount released would be lower than the reductions in water demand because it would only represent the non-consumptive portion of M&I water use; this would result in a net increase in water supplies available to Casitas' customers. However, this does not address the City of Ventura's claim on OVSD wastewater effluent. (Boyle, 1992)

Table 4-29 lists the advantages and disadvantages of this project.

Table 4-29. Advantages and Disadvantages of Secondary Reclaimed Water to the Ojai Valley Project

Advantages	Disadvantages
• Uses water to irrigate citrus groves and two golf courses, offsetting the demand on Casitas supply. • Efficiently reuses existing supplies. • Consistent with current integrated water planning and "One Water" concepts being adopted by progressive water utilities.	• Requires farmers using drip irrigation to convert back to furrow irrigation. • Water rights issues (OVSD does not own the rights to its effluent). • May not be permittable due to downstream environmental flow requirements.

Current Status

The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.

Recommendations Summary

This project is not considered a viable option due to the issues discussed above. OVSD prepared a board memorandum stating their concerns regarding providing recycled water. Thus, despite the obvious benefits of using locally available recycled water for non-potable uses, this project must be eliminated from consideration in the CWRP options analysis.

4.4.2.4 RW 04 – Tertiary Reclaimed Water to Rincon Orchards

Project Description

This project is similar to the previously discussed Recycled Water Project and Secondary Reclaimed Water Project in that OVSD wastewater effluent would be provided for non-potable water uses. In this project tertiary treated reclaimed water for OVSD would be distributed to orchards on the Rincon west of Lake Casitas, which are supplied by Casitas, in an aim to offset demands on Lake Casitas. (Boyle, 1992)

This project has the same regulatory and environmental constraints as the previously discussed reclaimed water projects.

Table 4-30 lists the advantages and disadvantages of this project.

Table 4-30. Advantages and Disadvantages of Tertiary Reclaimed Water to Rincon Orchards Project

Advantages	Disadvantages
• Reduces the use of Lake Casitas' water. • Efficiently reuses existing supplies. • Consistent with current integrated water planning and "One Water" concepts being adopted by progressive water utilities.	• In summer months, potable water from Casitas would be required. • Water rights issues (OVSD does not own the rights to its effluent). • May not be permittable due to downstream environmental flow requirements.

Current Status

The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.

Recommendations Summary

This project is not considered a viable option. OVSD prepared a board memorandum detailing their concerns regarding providing recycled water. Thus, despite the obvious benefits of using locally available recycled water for non-potable uses, this project must be eliminated from consideration in the CWRP options analysis.

4.4.2.5 RW 05 – Spray Fields in Canada Larga

Project Description

Fodder crops in the Canada Larga area are planned to be irrigated with secondary treated wastewater effluent from the OVSD. To date, this project has not been implemented.

There is not enough irrigable acreage of fodder crops in Canada Larga to use all the available effluent, so this project would establish “spray fields” to utilize the excess water. A “spray field” is an irrigation practice in which more water is applied to a field than would be consumed by the crops, ultimately aiming to recharge the groundwater basin. With the hilly topography of the area, it is likely some of the percolated water would emerge from the ground and flow into the Canada Larga Creek, which flows into the Ventura River. This water could then be picked up at the Robles Diversion and stored in Lake Casitas for use by Casitas (Boyle, 1992)

To verify the feasibility of spray fields concept in this area, pilot studies are needed to determine percolation rates, whether percolated groundwater would emerge into Canada Larga Creek, and the quality of the emergent water. Studies are needed to verify the project would meet State health regulations governing recharge of reclaimed water, including blending with other sources, depth to groundwater, retention time, and distance to potable water wells. The Regional Water Quality Control Board would have to permit the project. (Boyle, 1992)

Table 4-31 lists the advantages and disadvantages of this project.

Table 4-31. Advantages and Disadvantages of Spray Fields in Canada Larga

Advantages	Disadvantages
• The Ventura River would gain an additional source without any reclaimed water directly discharged to a surface water body.	• Feasibility is unknown without further studies of hydrogeology and water quality. • Benefits to Casitas would be minor. • High capital cost $10,721,000 in 1992. (Boyle, 1992) • Water rights issues (OVSD does not own the rights to its effluent). • May not be permittable due to downstream environmental flow requirements.

Current Status

Not currently being pursued by Casitas.

Recommendations Summary

This project is not considered a viable alternative. OVSD prepared a board memorandum stating their concerns regarding providing recycled water. Thus, despite the obvious benefits of using locally available recycled water for non-potable uses, this project must be eliminated from consideration in the CWRP alternatives analysis.

4.4.2.6 RW 06 – Ojai East Septic Recharge

Project Description

The Ojai East Septic Recharge project includes the installation of a package wastewater treatment plant in east Ojai Valley and a network of sewer collection mains and laterals to collect sewage that is currently being disposed in septic systems. The influent is treated by means of a centralized redundant extended aeration system including anoxic chambers and clarification followed by membrane filtration and disinfection to meet tertiary standards. The treated effluent is then piped to the lower pond in the San Antonio Creek Spreading Grounds (SACSGRP) to help recharge the Ojai Groundwater Basin. Production is estimated to be approximately 70 AFY. Current conditions may allow upwards of 35 AFY to recharge with 35 AFY taken up cumulatively by local trees and plants at individual sites. The project would provide the ancillary benefit of replacing septic systems with a centralized treatment system, which could improve local groundwater quality.

Anticipated capital cost of the project is $11 million, and operation costs would be approximately $100,000 per year. This is very expensive for 35-70 AFY of new supply. East Ojai is very rocky, and, as a result, cost for the sewer pipeline installation is anticipated to be very high. Project duration is estimated at 8 years from initiation of design to completion of construction.

Table 4-32 lists the advantages and disadvantages of this project.

Table 4-32. Advantages and Disadvantages of Ojai East Septic Recharge Project

Advantages	Disadvantages
• Increases recharge to Ojai Basin. • Uses existing recharge facilities. • Replaces septic systems with a centralized treatment system, which improves groundwater quality.	• Expensive capital and variable costs • Minimal supply created (35 AFY). • Estimated 8-year timeline from initial design to completed construction. • Triggers the CEQA process and multiple regulatory permits.

Current Status

This project was on the 2016 Water Security Project list but has not been studied further and is not currently being pursued by Casitas.

Recommendations Summary

This project was a part of the 2016 Water Security Project list. It is recommended that this project be included in the CWRP list of alternatives for evaluation.

4.4.3 Summary

Table 4-33 below summarizes all recycled water project options reviewed in this document and significant criteria associated with each.

Table 4-33. Summary of Recycled Water Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
RW 01	Recycled Water from Ojai Valley Sanitary District (OVSD)	Not Available[3]	Not Available	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗
RW 02	Scalping Plant on OVSD Collector Main for Re-Use at Ojai Valley Inn	Unit Capital Cost = $63,514/AFY[1] Capital Cost = $4.7M[1] *(Unit Capital Cost = $27,027/AFY)*[6] *(Capital Cost = $2,000,000* *O&M = $150,000/year)*[6]	74 AFY[1]	✗	✗	Not currently being pursued by Casitas.	✗
RW 03	Secondary Reclaimed Water to the Ojai Valley	Unit Capital Cost = $21,563/AFY[1] Capital Cost = $48.3M[1] *(Unit Capital Cost = $9,286/AFY)* *(Capital Cost = $20.8M)*[6]	2,240 AFY[6]	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗

RW 04	Tertiary Reclaimed Water to Rincon Orchards	Unit Capital Cost = $10,508/AFY[1] Capital Cost = $20.7M[1] *(Unit Capital Cost = $4,517/AF)* *(Capital Cost = $8.9M)[6]*	1,970 AFY[6]	✗	✗	The project is not in active status. OVSD prepared a board memorandum detailing their concerns and potential constraints for them to begin providing recycled water.	✗
RW 05	Spray Fields in Canada Larga	Unit Capital Cost = $11,160/AFY[1] Capital Cost = $25.0M[1] *(Unit Capital Cost = $4,777/AFY)* *(Capital Cost = $10.7M)[6]*	2,240 AFY[6]	✗	✗	Not currently being pursued by Casitas.	✗
RW 06	Ojai East Septic Collection, Package Treatment, Recharge	Unit Capital Cost = $345,714/AFY[1] Capital Cost = $12.1M[1] *((Unit Capital Cost = $314,286/AFY)[2]* *(Capital Cost = $11M* *Annual O&M = $100,000)[2]*	35 AFY[2]	✗	✗	Not currently being pursued by Casitas.	✓

[1] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[3] To comply with the Nutrient TMDL, OVSD estimates that it will have to spend $10-15 million over the next 7 years
[6] Original 1992 estimate (Boyle, 1992)

4.5 Local Agreement (LA) Options

4.5.1 Introduction

Agreements with local cities, purveyors, and agencies that were outdated and/or didn't optimize Casitas' water usage capabilities were considered for revision or development. The options listed below describe three local agreements explored historically, the current status of each, and recommendations moving forward.

4.5.2 Option Project Descriptions

4.5.2.1 LA 01 – OBGMA Co-operation Agreement (Inter-basin) with Upper Ventura River Groundwater Basin Sustainability Agency

Project Description

This project is part of the OBGMA overall Groundwater Management Plan whereby the OBGMA works with other stakeholders in the Ventura River Watershed to effectively understand and manage the drainage area that includes Ojai. Such a project is also included in the suite of tasks applied for by the Watersheds Coalition of Ventura County, under the Ventura River Watershed Management Plan (VRWMP). The UVRGA will develop its GSP and the OBGMA would review and provide comment as well as collaborate on linking projects. Of special concern is the shared boundary on the western side of the Ojai Basin and the discharge to San Antonio Creek from the Ojai Basin. Both agencies are implementing detailed studies to measure outflow and inflow via this waterway. (Ojai Basin Groundwater Management Agency, 2018)

Table 4-34 lists the advantages and disadvantages of this project.

Table 4-34. Advantages and Disadvantages of OBGMA Co-operation Agreement with UVRGA

Advantages	Disadvantages
• Promotes interagency cooperation to improve efficiency of overall water resources management in the Casitas region.	• Casitas is not a party to the agreement and does not control how it is carried out. • Water supply benefits to Casitas are highly uncertain.

Current Status

The agreement is outside of Casitas' control and is between OBGMA and UVRGA.

Recommendations Summary

It is recommended that Casitas continues to track this agreements progress and understand any potential benefits but this project is not recommended to be a part of the CWRP for long term water supply.

4.5.2.2 LA 02 – Conjunctive Use Agreement with OBGMA

Project Description

OBGMA has proposed developing a conjunctive use agreement with Casitas by which the agencies would work together to create an agreement for optimizing the water storage capacities in both Lake Casitas and the Ojai groundwater basin. Criteria are proposed for tying pumping rates of OBMGA groundwater to Lake Casitas' storage during dry periods when lake levels are low. Benefits to Casitas' water supply have not been estimated. These criteria do not necessarily increase the long-term yield of Casitas' supplies but would manage them better during droughts when both surface water and local groundwater are decreased.

Currently, a significant amount of surface water from Lake Casitas evaporates every year, reducing the supply available for Casitas customers. If Casitas and OBGMA could develop a plan for storage of more surface water in the Ojai Basin groundwater aquifer as part of the Conjunctive Use Agreement, it would improve overall yield for the combined surface water and groundwater resources by reducing losses.

Table 4-35 lists the advantages and disadvantages of this project.

Table 4-35. Advantages and Disadvantages of Conjunctive Use Agreement with OBGMA

Advantages	Disadvantages
• Improved efficiency of conjunctive groundwater and surface water management. • Possibility to increase overall yield by reducing evaporation losses from Lake Casitas.	• Casitas must rely on OBGMA for managing the groundwater portion of a conjunctive use program.

Current Status

The OBGMA is the lead agency to develop the conjunctive use agreement. At this time a draft has been prepared and is in the review process with stakeholders. Additional investigation may be warranted into options for increasing surface water recharge in lieu of storage in Lake Casitas to reduce evaporation losses.

Recommendations Summary

Casitas supports the conjunctive use plan and prefers that OBGMA lead and fund the effort. It is not recommended this project be included in the CWRP list of options for evaluation as it is not a Casitas project.

4.5.3 Summary

Table 4-36 below summarizes all local agreement options reviewed in this document and significant criteria associated with each.

Table 4-36. Summary of Local Agreement Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
LA 01	OBGMA Co-operation Agreement (Inter-basin) with Upper Ventura River Groundwater Basin Sustainability Agency	Not Available	Not Available	✗	✗	In Progress	✗
LA 02	Conjunctive Use Agreement with OBGMA	Not Available	Not Available	✗	✗	OBGMA is developing a draft agreement	✗

4.6 Maintenance and Operation Project (MO) Options

4.6.1 Introduction

Though maintenance and operation projects do not provide new sources of supply, they can prevent unnecessary losses and/or capture water otherwise lost due to inefficient systems. Several maintenance and operation projects have been considered by Casitas throughout the years. The options listed below describe eight projects explored historically, the current status of each, and recommendations moving forward.

4.6.2 Option Project Descriptions

4.6.2.1 MO 01 – Environmental/Habitat Modifications

Project Description

The Environmental/Habitat Modification project consists of activities to reduce the amount of a major water consuming plant in the Casitas service area and contributing watershed, *Arundo donax* (*Arundo*). Turfgrass is also considered a major water consuming plant, but to a considerably lesser extent and is part of regular conservation measures. Therefore, this project focuses only on removal of *Arundo*.

Arundo is an invasive species with very high water consumption; the rate of water loss is estimated at approximately six times more than that of the native riparian vegetation. Estimates of *Arundo* water use vary between 1 and 48 AFY/acre, with a reasonable estimate of 24 AFY/acre water use (California Invasive Plant Council, 2011). *Arundo* removal and replacement with native riparian plants would reduce evapotranspiration losses and result in net savings of approximately 20 AFY per acre of *Arundo* removed. This would improve recharge to the groundwater basin as well as help keep the river alluvium more saturated.

Arundo removal and replacement with native species can vary in cost based on method of removal. Methods meeting all County requirements has a cost of approximately $20,000 per acre, and other methods could cost as much as $579,000 per acre (Ventura County Watershed Protection District, 2010; WREA & KG, 2016). However, *Arundo* removal is not permanent and ongoing management programs are required to control this invasive species.

The Ventura River Watershed Council has included an Arundo-Free Watershed Campaign as one of their top six priority projects per the 2015 Ventura River Watershed Management Plan (Ventura River Watershed Coordinator, 2015). In 2015, it was estimated that over 180 acres of land in the Ventura River watershed were covered with *Arundo*, after 270 acres of *Arundo* were already removed.

Table 4-37 lists the advantages and disadvantages of this project.

Table 4-37. Advantages and Disadvantages of Environmental/Habitat Modifications

Advantages	Disadvantages
• No water rights or legal issues • Does not trigger environmental permitting requirements.	• Arundo control requires continuous effort and expense. • Benefits of controlling Arundo and other non-native, high water consuming vegetation are difficult to document.

Current Status

Casitas has previously offered grant-funded rebates to direct customers for turfgrass removal.

Recommendations Summary

The Environmental/Habitat Modifications Project was a lower tier project in the *2016 Preliminary Water Security Project Analysis*. It is recommended to include this project in the CWRP to further investigate its potential benefits.

4.6.2.2 MO 02 – Ventura River Watershed Infrastructure Improvements

Project Description

This project is a collection of general infrastructure improvements to mitigate water losses or to optimize operational efficiency of current water systems. Individual projects included in this category include the Existing Water Supply Infrastructure Reliability Improvements, the Contingency Water Storage Project, and the Ventura Water – Casitas Conduit Intertie. These projects are briefly described below.

- Existing Water Supply Infrastructure Reliability Improvements: Replace or retrofit aging or threatened water supply tanks, wells, pipes, and other conveyance and storage equipment to reduce water losses, ensure supply reliability, and bring infrastructure up to earthquake standards. (Ventura River Watershed Coordinator, 2015)
- Contingency Water Storage Project: Install decentralized contingency water storage. (Ventura River Watershed Coordinator, 2015)
- Ventura Water - Casitas Conduit Intertie: Install a new 5.5-mile pipeline from Lake Casitas to the City of Ventura, and a pump station, to provide Casitas with a backup for potential water service delivery interruption to the Rincon area and to improve the City of Ventura's water supply reliability and system operational abilities. (Ventura River Watershed Coordinator, 2015)

Table 4-38 lists the advantages and disadvantages of this project.

Table 4-38. Advantages and Disadvantages of Ventura River Watershed Infrastructure Improvements Project

Advantages	Disadvantages
• Ensures supply reliability and overall system operational abilities. • Maximizes efficiency of existing system components. • Delays the need for additional new water supply projects.	• Actual benefits in terms of reduced losses or more efficient water management may be difficult to quantify. • Benefits may be realized infrequently when emergency systems or alternate supplies are needed.

Current Status

These projects are projects and or programs proposed by Ventura River Watershed Management Plan. Casitas participates as necessary for projects directly involving Casitas.

Recommendations Summary

These projects are not recommended to be a part of the CWRP plan.

4.6.2.3 MO 03 – Fire Hydrant and Dead-End Flush Re-Use

Project Description

The Fire Hydrant and Dead-End Flush Water Re-Use project is based on the concept of capturing the flush water generated from maintenance of fire hydrants and dead-end water distribution lines and using it for irrigation. Casitas completes fire hydrant and dead-end flushing on an as-needed basis, whenever the chlorine residual drops below a pre-determined level or when other water quality issues are present. A large diameter hose and 5,000-gallon truck could be utilized to capture and temporarily store the water and then deliver it to a prearranged user. Casitas records show that approximately 0.3 AFY of water is lost to flushing. Although it is a good practice not to "waste" water, the re-use of flush water does not represent a major source of "new" water for Casitas. No project cost information available at this time. (WREA & KG, 2016)

Table 4-39 lists the advantages and disadvantages of this project.

Table 4-39. Advantages and Disadvantages of Fire Hydrant and Dead-End Flush Re-Use Option

Advantages	Disadvantages
• Captured flush water could be used for irrigation, reducing demand for new supplies. • Demonstrates Casitas' commitment to using best practices to reduce lost water to the greatest extent practical.	• The re-use of flush water would recover only about 0.3 AFY and does not represent a major source of "new" water for Casitas.

Current Status

This is an active annual maintenance project.

Recommendations Summary

Re-use of fire hydrant and dead-end flushing water is a lower tier project in the *2016 Preliminary Water Security Project Analysis*. It is recommended that Casitas employ this practice to the extent practical, but the benefits are too small for this project to be considered in the CWRP comparison of new supply options.

4.6.2.4 MO 04 – Resale Water Company System Retrofit/Rehabilitation

Project Description

In this project, Casitas would assist resale agencies to retrofit or rehabilitate their systems to rely less on Casitas supplies. For example, Casitas has assisted Senior Canyon Mutual Water Company to improve the reliability of its groundwater resources. (UWMP, 2016) As shown in **Table 3-5**, resale customers are expected to have a demand of 6,500 AFY in 2040, or about 37 percent of Casitas' total demand. If retrofit and rehabilitation projects could generate a reduction in losses or improvement in reliability of 10 percent, the benefit to Casitas would be 650 AFY in supply that could be used for other customers.

Table 4-40 lists the advantages and disadvantages of this project.

Table 4-40. Advantages and Disadvantages of Resale Water Company System Retrofit/Rehabilitation

Advantages	Disadvantages
• Improves efficiency of existing infrastructure. • Requires minimal permitting.	• Casitas would have to rely on other water entities to make the desired system improvements.

Current Status

Casitas is not actively assisting another agency at this time.

Recommendations Summary

This project is not recommended to be a part of the CWRP.

4.6.2.5 MO 05 – Leak Detection and Repair Program

Project Description

Per the 2010 UWMP, a much more aggressive leak detection and repair program was implemented by Casitas as a recommendation from the 2005 UWMP. This program was effective in reducing losses in the Casitas water distribution system and extending the benefits of existing water supplies. This project would continue that practice and expand it if practical. No estimate of water savings was provided in previous documents.

Table 3-5 shows the 2040 Casitas retail and agricultural demand is estimated to be 11,000 AFY. If minimal gains of 2 percent can be achieved by a more aggressive leak detection and repair program, the savings would be 220 AFY.

Table 4-41 lists the advantages and disadvantages of this project.

Table 4-41. Advantages and Disadvantages of Leak Detection and Repair Program

Advantages	Disadvantages
• A leak detection and repair program has already been implemented by Casitas. • Lower water losses each year would stretch the benefits of existing water supplies. • Maximizes efficiency of existing infrastructure.	• Because Casitas already has a strong leak detection and repair program, the additional savings may be minimal. • Marginal cost of saved water may be high if straightforward leak detection and repair projects have already been completed.

Current Status

A leak detection and repair program is currently in progress. This project would expand the current program.

Recommendations Summary

This should be considered an on-going maintenance and operations project; it is not recommended for inclusion in the CWRP option evaluation.

4.6.2.6 MO 06 – Sediment Removal at North End of Lake Casitas

Project Description

This project was identified in the 2005, 2010, and 2016 UWMP and would involve excavating the north end of Lake Casitas during low water level periods to increase the reservoir storage volume. Excavating a portion of the reservoir pool area would recover some of the storage volume lost due to sediment accumulation since the dam was constructed in 1959.

This option involves extensive permits and approvals from Reclamation and environmental regulatory agencies. Further study is required to estimate the additional storage created, cost estimates, and other planning level details.

Table 4-42 lists the advantages and disadvantages of this project.

Table 4-42. Advantages and Disadvantages of Sediment Removal at North End of Lake Casitas Project

Advantages	Disadvantages
• Improves benefits of existing reservoir by recovering some of the original storage volume lost to sedimentation. • Contributes new storage without constructing a new reservoir.	• Extensive permitting requirements. • Created storage will eventually be lost again due to future sedimentation.

Current Status

Although suggested as a potential project, this project has not been implemented due to environmental and financial feasibility concerns.

Recommendations Summary

Due to the difficulty of creating additional storage volume by constructing new reservoirs in the current permitting and political environment, it is recommended this option be included in the CWRP option evaluation process.

4.6.2.7 MO 07 – Pipeline from Matilija Chlorinator to Hot Springs

Project Description

This project involves replacing a portion (approximately 9,800 feet) of the existing 27-inch Matilija Conduit with smaller pipes. Currently, this pipe is oversized for the demands served by the pipeline which is causing water quality issues. The relative low velocity in the pipe during normal operations requires frequent flushing. Casitas’ staff has stated the pipe is occasionally flushed once per week due to low chlorine residual levels.

Replacement options may include a new 12-inch and 8-inch pipe. It is assumed the replacement pipeline would be installed generally along the same alignment as the existing pipe with the possibility of using the existing pipe for slip-lining, especially for the Ventura River crossing. According to Casitas' records, flushing the Matilija conduit in the area requires approximately 12 AFY which is discharged into the groundwater basin.

By changing to smaller pipe and assuming the same flushing frequency and time, based solely on pipe diameters, the total flush volume "saved" would be approximately 9.6 AFY. This water would remain in Lake Casitas. The volume would probably be greater since the number of flushes would likely be lower due to the smaller pipe having fewer water quality issues. Anticipated capital cost of the project is $1.13 million. (WREA & KG, 2016)

Table 4-43 lists the advantages and disadvantages of this project.

Table 4-43. Advantages and Disadvantages of Pipeline from Matilija Chlorinator to Hot Springs

Advantages	Disadvantages
• Saves approximately 9.6 AFY by requiring less flushing. • Maximizes benefits of existing infrastructure.	• Expensive on a unit cost basis ($116,802/AFY (WREA & KG, 2016)) • Current flushing water percolates to the Upper Ventura River Basin, so some of it already returns as usable supply.

4.6.2.8 Current Status

This project is currently scheduled for implementation by Casitas in 2020-2022.

Recommendations Summary

This is primarily a maintenance project rather than a water supply project. Because of its low yield and high unit cost, it is not recommended for inclusion in the CWRP option evaluation study.

4.6.2.9 MO 08 – Robles Diversion Fish Passage Improvements

Project Description

Figure 4-5. Robles Diversion Fish Screen (MKN Associates, 2019)

In order to augment the natural inflow to Lake Casitas, Casitas operates the Robles Diversion Dam along the Ventura River. The Robles Diversion Dam diverts water to the Robles Diversion Canal, which in turn feeds Lake Casitas. Due to the Biological Opinion from the National Marine Fisheries Service (2003) regarding the endangered steelhead trout, Casitas was required to install and operate a fish screen at the Robles Diversion Dam. After the installation of the fish screen in 2004, the Robles Diversion no longer could divert the maximum design flows into Lake Casitas due to frequent clogging and blockage of the fish screens by debris in the river, especially during high flows. The existing cleaning equipment cannot keep up with the debris loading, which limits the amount of water diverted into the Robles Diversion Canal. This is especially problematic after wildfires in the tributary watershed such as the most recent Thomas Fire when the sediment and debris load significantly increased. The existing operations reduce the flow through the screens or shut the diversion down in order to perform manual cleaning, both of which significantly reduce the amount of flow diverted to the lake during storm runoff.

To optimize the operation of the Robles Diversion Dam and maximize the intake of the diversion structure into the Robles Diversion Canal, the following alternatives were proposed per the Robles Diversion Fish Screen Alternatives Feasibility Study (MKN Associates, 2019):

1. Improve the existing brush system.
2. Install a fixed manifold back-spray system to work in tandem with an improved brush system.
3. Replace the existing fixed screen system with a traveling screen.
4. Reduce the load on the existing screen system by suppling the fish ladder auxiliary flow separately from the screened v-channel flow. This is intended to be used in combination with Alternative 1.

The costs range from $30,000 to $12M depending on the alternative and selected components. The Study did not include an evaluation of the additional yield that would be captured after implementing these project alternatives.

Table 4-44 lists the advantages and disadvantages of this project.

Table 4-44. Advantages and Disadvantages of Robles Diversion Fish Passage Improvements

Advantages	Disadvantages
• Most alternatives would improve the performance of the diversion and have little potential to create negative biological or other impacts. • Alternative 1 can be implemented immediately. • Maximizes benefits of the existing diversion system.	• Significant infrastructure costs and time to implement associated with Alternatives 2-4.

Current Status

Casitas has completed the feasibility study and will be implementing Alternative 1 by summer 2019. Casitas is moving forward with a pilot program in winter 2019 to determine which of the other three alternatives should be constructed in 2020.

Recommendations Summary

The existing fish passage screen is susceptible to clogging with debris. Improving operation of the cleaning system will increase the flows diverted from the Ventura River to Lake Casitas. Given the significance of this project, it is recommended this project be included in the CWRP list of options for evaluation.

4.6.3 Summary

Table 4-45 below summarizes all maintenance and operation project alternatives reviewed in this document and significant criteria associated with each.

Table 4-45. Summary of Maintenance and Operation Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
MO 01	Environmental /Habitat Modifications	(Capital Cost = Arundo removal ~$20,000/acre)[2]	20 AFY/acre[2,8]	✗	✗	Casitas offers rebates for direct customers for certain environmental/ha	✓

						bitat modifications.	
MO 02	Ventura River Watershed Infrastructure Improvements	Various per annual fiscal year budget	Not Available	✗	✗	These projects are projects and or programs proposed by Ventura River Watershed Management Plan. Casitas participates as necessary for projects directly involving Casitas.	✗
MO 03	Fire Hydrant and Dead-End Flush Re-Use	Not Available	0.3 AFY[2]	✗	✗	Not enough to represent new water for Casitas.	✗
MO 04	Resale Water Company System Retrofit/Rehabilitation	Various per annual fiscal year budget	650 AFY[9]	✗	✗	Casitas has assisted Senior Canyon Mutual Water Company to improve reliability of groundwater resources.	✗
MO 05	Casitas Leak Detection and Repair Program	Variable costs	Not Available	✗	✗	Program in progress.	✗
MO 06	Sediment Removal at North End of Lake Casitas	Not Available	Not Available	✗	✗	Not implemented, environmental and financial feasibility and justification assessment is needed.	✓
MO 07	Pipeline from Matilija Chlorinator to Hot Springs	Unit Capital Cost = $125,000/AFY[1] Capital Cost = $1.2M[1]	9.6 AFY[2]	✗	✗	This project is currently scheduled for implementation by Casitas in 2020-2022.	✗

		(Unit Capital Cost = $116,667/AFY)[2] *(Capital Cost = $1,120,000)*[2]					
MO 08	Robles Diversion Fish Passage Improvements	Various alternatives ranging from $4M to $12M of capital costs	Annual yield values have not been determined	✓	✓	Initial stages is being implemented this summer. Pilot study beginning winter 2019	✓

[1.] 2019 dollars based on RSMeans Historical Cost Index (RSMeans, n.d.)
[2] Original 2016 Estimate (WREA & KG, 2016)
[8] 20 AFY/acre of arundo removal estimated to recharge groundwater
[9] Assuming a 10 percent reduction in estaimted annual supply to resale customers. (UWMP, 2016)

4.7 Conservation Project Options (C)

4.7.1 Introduction

The conservation project options listed below is described in terms of what conservation measures have been explored historically, the current status of the project options, and recommendations moving forward. Both conservation options are the same program but would vary with how much reduction is planned.

4.7.2 Option Project Descriptions

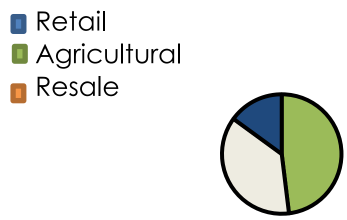
4.7.2.1 C 01/02 – Conservation/Enhanced Demand Management Programs (5%/10%)

Project Description

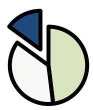
Casitas has a long history of implementing conservation policies and demand management measures (DMMs). These policies and DMMs have been remarkably effective in reducing water demand during drought periods. During the most recent drought, Casitas customers maintained steady conservation numbers. While Casitas rates remained the same, overuse penalties were implemented as part of the allocation program under the more severe stages of drought. As of April 2019, the State of California declared the drought over, but Casitas customers are reminded daily of the water shortage when looking at the low Lake Casitas levels.

Casitas has a comprehensive water conservation program directed toward its different classes of customers. The following sections discuss the three main customer types retail, agricultural, and resale.

Casitas water is provided to three main sectors:



Retail Customers



One of the key measures of the comprehensive water conservation program is establishment of a water allocation for each customer under the WEAP. Other conservation programs and measures include:

Public education and outreach (newsletters, billing statement messages, website, social media) - Example per **Figure 4-6**

- Customer water survey
- Free water conservation devices
- Rebate for direct customer turf replacement program (other rebates could include high efficiency washing machines, high efficiency toilets, smart irrigation controllers)
- Staff assistance (Public Affairs – Resource Manager, Water Conservation Specialist, Water Conservation Analyst, Water Conservation Technician)

Casitas' municipal customers responded to mandatory and voluntary demand management measures implemented during the recent drought by reducing overall consumption by 40 percent (per Casitas' Water Security website). This remarkable reduction in water use was driven by a combination of structural change (e.g., plumbing fixture replacement and turf replacement) and behavioral change (e.g., watering before 10:00 AM and after 6:00 PM, taking shorter showers). While much of the per capita water savings achieved during this period are expected to be permanent, customers may return to previous behaviors as the pressure to conserve in direct response to an ongoing drought is relaxed. However, Casitas' allocation program may promote continued conservation efforts and limit the water bounce back effect.

Casitas' water conservation staff should explore strategies for retaining as much of the recent per capita water use reduction as possible such that they become permanent savings. As extensive policies and conservation measures have already been implemented, maintaining gains in water conservation beyond the set allocation limits will likely be achieved through voluntary public programs. In general, Casitas should continue to promote its existing public programs to encourage participation for those who have not been engaged already. Casitas has a robust conservation program and it is recommended they continue with the following practices:

- Aggressive public education and outreach programs, with emphasis on thanking customers for their actions in the past and "maintaining the gains" already achieved.

- Rebate programs if they still appear to be effective.

- Promotion of the water survey program. This program is offered to single-family and multi-family residential customers, for direct retail customers, and for wholesale agency customers. Casitas' direct survey program includes an evaluation of all indoor and outdoor water use. The survey program includes an inspection of water appliances, leak checks for toilets and faucets, and a landscape inspection for irrigation efficiency and plant type. After completion of the survey, a customer is provided with a summary report on the improvements that can be completed both inside and outside of the home to assist water use efficiency. The report also indicates water and dollar savings that could be achieved, along with a summary of rebate opportunities provided by Casitas. Completion of the water survey program for all customers receiving supply from Casitas, who have not already done so, would help in reducing any extraneous water usage.

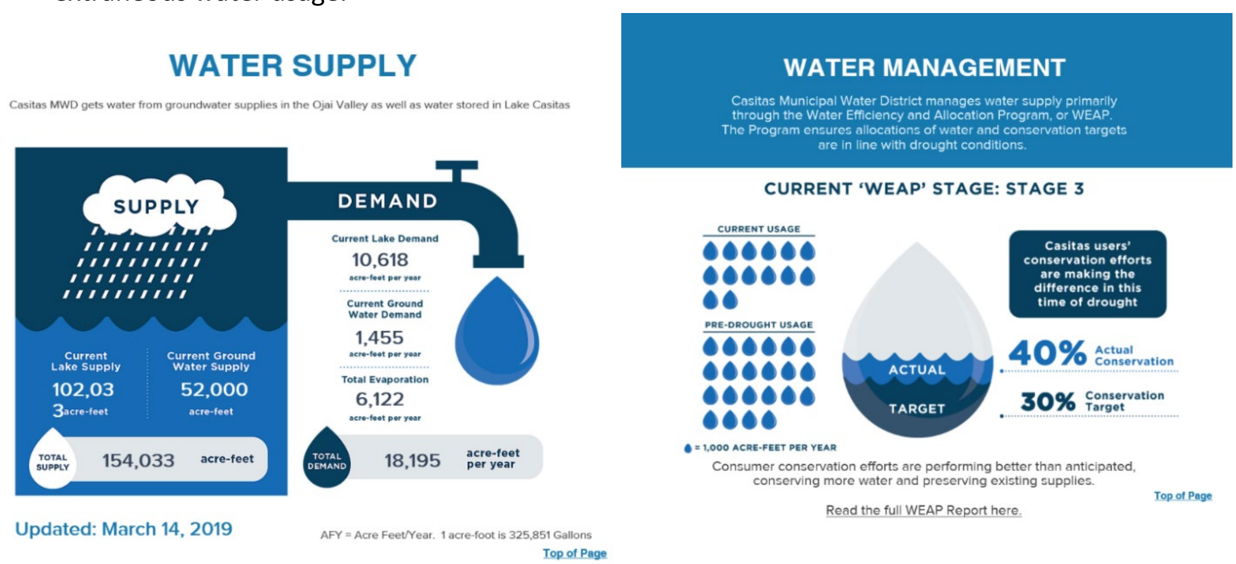


Figure 4-6. Examples of Water Supply and Water Management Public Outreach from Casitas' Website

Casitas should identify and target any structural changes that have not yet been implemented with respect to residential, direct retail, or wholesale agency customers, as these changes will not be susceptible to the "bounce back" that can typically occur in post-drought conditions. Promotion of voluntary programs and public messaging to not fall back into pre-drought habits can be used to maintain behavioral changes that have been achieved.

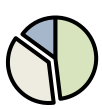
Agricultural Customers

Water savings were achieved through improving efficiency and use in agricultural water consumption. Per the 2015 UWMP, local agricultural water demand is historically the highest water demand among Casitas customer categories. This agricultural water demand also fluctuates dramatically from year to year. Agricultural customers tend to have a higher water demand from Casitas during years of low annual rainfall, as primary groundwater sources are quickly depleted, and surface water supplies are used. Although Casitas does not meet the requirements of an agricultural water supplier, it voluntarily provided elements of an Agricultural Water Management Plan (AWMP) in its 2015 UWMP.

The AWMP Act requires agricultural water supplies to address Efficient Water Management Practices (EWMP) with two separate classifications, one for critical activities and another for conditional activities. Casitas has implemented the critical EWMPs as required, which include accurate measurement of water deliveries to individual farming operations and adopting a pricing structure for agricultural water customers based at least partially on the quantity of water delivered. However, a focus on adoption of more conditional activities could assist in helping achieve additional water savings. Per the 2015 UWMP, conditional activities must be implemented by agricultural water suppliers if they are locally cost-effective and technically feasible. Examples of conditional activities offered by Casitas include:

- Real-Time Crop Irrigation Information – Casitas provides a link to the Soule Park Golf Course weather station, and additional irrigation information is made available to local farmers upon request.
- Provide Water Delivery Information to Water Users – Casitas provides water usage reports to water users upon request
- On-Farm Evaluations – Casitas contracts with the Ventura County Resource Conservation District's mobile laboratory for irrigation evaluation. Farmers are provided with free irrigation system audits/evaluations which include recommendations for BMPs. Per the 2015 UWMP, a potential future element of this program could provide financial incentives to farmers who choose to implement recommendations made as part of the irrigation system audit/evaluation.

Resale Customers



Per the 2015 UWMP, roughly one-third of Casitas' water is sold to entities (such as the City of Ventura) who resell water to their customers. Casitas' conservation programs account for water use among these resale customers as well as their retail customers.

Casitas' WEAP policies address resale customers by:

- establishing an annual water allocation each year;
- setting an objective of parity between the resale agency customers and Casitas customers in applying similar overall water use restrictions and financial penalties in each WEAP stage; and
- establishing a requirement to implement water conservation measures in accordance with the State's or California Urban Water Conservation Council's best management practices, responsibly maintain water system metering and pipeline systems to reduce water losses, and when necessary or when asked to do so, implement water demand reduction measures similar to or more restrictive than those imposed by Casitas.

Customers of resale entities may be less inclined to maintain water conserving practices if their water providers are not as aggressive as Casitas in promoting the importance of water conservation to long-term water security. Part of Casitas' post-drought water conservation strategy should include a component for ensuring its resale partners continue to implement best practices in water conservation as a condition of their water service contracts.

Table 4-46 lists the advantages and disadvantages of this project.

Table 4-46. Advantages and Disadvantages of Conservation/Enhanced Demand Management Programs

Advantages	Disadvantages
• Conservation efforts would reduce the demand on Lake Casitas. • Casitas has a strong conservation program to build on. • Conservation has been effective in the past and would be part of any future water supply plan.	• Casitas' customers may experience "conservation fatigue". • Benefits of additional conservation measures are difficult to predict. • Agricultural conservation measures are dependent on farmers; new measures in orchards could only be done when orchards are being replaced.

Current Status

Ongoing - several programs already in use but could be evaluated and updated as necessary.

Recommendations Summary

Casitas should continue to promote the existing conservation programs available to all municipal, agricultural, and resale customers and should develop a strategic plan for customer outreach and conservation program modifications after the current drought. Casitas currently provides, and should continue to provide, incentives to help promote on-farm evaluations and ensure its resale entities continue to aggressively promote post-drought conservation among their customers. It is recommended this project be included in the CWRP list of options for evaluation.

4.7.3 Summary

Table 4-47 below summarizes all conservation project options reviewed in this document and significant criteria associated with each.

Table 4-47. Summary of Conservation Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
C 01	Conservation/ Enhanced Demand Management Programs (5%)	Not Available	No additional yield	✓	✓	Ongoing	✓
C 02	Conservation/ Enhanced Demand Management Programs (10%)	Not Available	No additional yield	✓	✓	Ongoing	✓

4.8 Desalinated Water Project (DW) Options

4.8.1 Introduction

Casitas' proximity to the Pacific Ocean has offered potential to add desalinated water to its portfolio, either by utilizing current desalinated water plants, or by constructing a new one. The options listed below describe three desalinated water projects explored historically, the current status of each, and recommendations moving forward.

4.8.2 Option Project Descriptions

4.8.2.1 DW 01 – Desalinated Water from City of Santa Barbara

Project Description

The City of Santa Barbara reactivated their desalination plant in late 2017. The Desalination Plant as a full build-out capacity of 10,000 AFY but is currently operating around 3,125 AFY. The City of Santa Barbara is out to bid for the construction of a 24-inch water main to allow the distribution of desalinated water throughout the entire City water system including the South Coast Conduit that supplies Montecito Water District and CVWD. Desalinated water could be potentially be provided to the Casitas service area and reduce the demand on Lake Casitas. If Casitas proceeds with infrastructure for the SWP to connect into the CVWD system, these new facilities could be utilized to also receive desalinated water to help offset the reliance on Lake Casitas.

Table 4-48 lists the advantages and disadvantages of this project.

Table 4-48. Advantages and Disadvantages of Desalinated Water from Santa Barbara

Advantages	Disadvantages
• Reduces demand on Lake Casitas water. • Santa Barbara desalination plant is an existing facility so infrastructure investment and permitting are complete.	• For Casitas use, significant pumping would be required to deliver desalinated water to a large number of M&I customers. • The desalination plant is operated by the City of Santa Barbara; Casitas would not have control over operation and maintenance.

Current Status

None of the desalination options are currently being pursued by Casitas.

Recommendations Summary

It is recommended this project be included in the CWRP list of options for evaluation.

4.8.3 DW 02 – Casitas Desalinated Water Plant

4.8.3.1 Project Description

Proximity to the Pacific Ocean provides an opportunity for the Casitas to consider development of desalinated water supplies to supplement surface water supplies and to provide potential increased system reliability, most notably for coastal communities within the Casitas service area. For Casitas to move forward with a desalination project, a public consensus is needed, followed by a feasibility study to determine whether the project will have a positive cost-benefit result. (UWMP, 2005) Capital and operating costs of desalination plants are high, and most communities with desalination plants treat water as an emergency supply.

Table 4-49 lists the advantages and disadvantages of this project.

Table 4-49. Advantages and Disadvantages of Casitas Desalinated Water Plant

Advantages	Disadvantages
• Reduces demand on Lake Casitas water. • Provides an additional water supply with minimal reliability concerns.	• Desalination plant is required within a reasonable proximity of Casitas customers. • Significant pumping is required to deliver desalinated water to a large number of M&I customers. • Desalination plants are expensive to operate.

	• Permitting and CEQA compliance may take years to complete.

Current Status

None of the desalination options are currently being pursued by Casitas.

Recommendations Summary

It is recommended this project be included in the CWRP list of options for evaluation.

4.8.4 DW 03 – Ventura County Regional Desalinated Water Plant

4.8.4.1 Project Description

Ventura County formed a Desalination Task Force which started meeting in 1991. The task force was to assess the possibility of developing a desalination facility in the County and stay up to date on other desalination projects within California including the neighboring Santa Barbara County. At the time, the task force determined a desalination project should remain a future possibility; this decision was made after a year with significant rainfall which replenished the local supplies and reduced the urgency for developing countywide facilities, so this project was put on hold. (Ventura County Resource Management Agency & Ventura County Public Works Agency, 1994) Capital and operating costs of desalination plants are high, and most communities that have desalination plants treat water from them as an emergency supply.

Table 4-50 lists the advantages and disadvantages of this project.

Table 4-50. Advantages and Disadvantages of Ventura County Regional Desalinated Water Plant

Advantages	Disadvantages
• Reduces demand on Lake Casitas water. • Provides an additional water supply with minimal reliability concerns. • Adds a new water supply for the coastal communities.	• Impactful to the environment. • Outside of Casitas' control. • Desalination plants are expensive to operate. • Permitting and CEQA compliance may take years to complete.

Current Status

None of the desalination options are currently being pursued by Casitas.

Recommendations Summary

It is recommended this project be included in the CWRP list of options for evaluation.

4.8.5 Desalinated Water Project Options Summary Table

Table 4-51 below summarizes all desalinated water project options reviewed in this document and significant criteria associated with each.

Table 4-51. Summary of Desalinated Water Project Options

Option No.	Project	Cost	Estimated Annual Yield	Current Water Security Project	Early Action Plan Project	Current Status	Viable for CWRP Option
DW 01	Desalinated Water from City of Santa Barbara	Not Available	Not Available	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓
DW 02	Casitas Desalinated Water Plant	Not Available	1,121 AFY[10]	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓
DW 03	Ventura County Regional Desalinated Water Plant	Not Available	Not Available	✗	✗	None of the desalination options are currently being pursued by Casitas.	✓

[10]Estimate per 2005 UWMP. However, the 2016 Final UWMP states no feasibility study has been done, so production rate is unknown

Conclusions

5.0 Conclusions

Casitas has considered a wide range of water supply enhancement projects in the past 50 years. These have included large capital projects such as improvements to the Robles Diversion Canal and a connection to the State Water Project; small capital projects including improvements to wellfields and recycled water options; and non-structural projects such as water conservation and agreements with resale customers and regional agencies.

Because Lake Casitas and groundwater wells were a reliable source of supply under historical hydrologic conditions and demand management measures were effective, Casitas was not required to implement any of the major, expensive and complex water supply projects considered to date. However, risks to water supply reliability posed by future climate variability, environmental threats such as wildfires, and future demand require a more robust water supply portfolio.

The supply projects identified in this TM for consideration in the CWRP option analysis offer a broad array of options for evaluation and comparison. These are listed in **Table 5-1**.

Table 5-1. Recommended CWRP Long List of Water Supply Options List

Option. No.	Option Description
SWP	**State Water Project**
SWP 01	Deliveries via City of Ventura SWP Interconnect and Casitas-Ventura SWP Interconnection
SWP 02	Calleguas Emergency Interconnection with Casitas
SWP 03	Ventura-Santa Barbara Counties Interconnection
SWP 04	Casitas-Calleguas Interconnection
SWP 05	City of Ventura Supplemental Water or In-Lieu Water
SW	**Surface Water**
SW 03	Matilija Dam Groundwater/Surface Water
SW 04	Expansion of Robles Canal

Option. No.	Option Description
SW 05	Construction of a New Dam Upstream of Lake Casitas
GW	**Groundwater**
GW 01	Matilija Formation Deep Wells
GW 06	Ojai Basin Desalter Project
GW 08	Well Improvements in Ojai Groundwater Basin
RW	**Recycled Water**
RW 06	Ojai East Septic Collection, Package Treatment, Recharge
MO	**Maintenance and Operations**
MO 01	Environmental/Habitat Modifications
MO 06	Sediment Removal at North End of Lake Casitas
MO 08	Robles Diversion Fish Passage Improvements
C	**Conservation**
C 01	Conservation/Enhanced Demand Management Programs (5%)
C 02	Conservation/Enhanced Demand Management Programs (10%)
DW	**Desalinated Water**
DW 01	Desalinated Water from City of Santa Barbara
DW 02	Casitas Desalinated Water Plant
DW 03	Ventura County Regional Desalinated Water Plant

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Appendix B Stakeholder Engagement Documentation Technical Memorandum

Casitas Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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Approved by Chip Paulson

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1.0 Introduction

Casitas Municipal Water District (Casitas) prepared a Comprehensive Water Resources Plan (CWRP) to define a practical and defensible strategy for addressing current and future water supply needs. One of the important objectives of the CWRP planning process was to incorporate input from Casitas' stakeholders. For purposes of this project, stakeholders include community groups, public agencies, elected officials, and Casitas customers that could be affected by or that could influence the CWRP recommendations.

This Technical Memorandum summarizes the methods used for stakeholder engagement and the findings that were incorporated into the CWRP.

2.0 Stakeholder Engagement

2.1 Stakeholder Engagement Plan

Stantec and subconsultant Consensus prepared a Stakeholder Engagement Plan to outline the objectives and methods to be used in gathering input from key Casitas stakeholders. The philosophy of the stakeholder engagement process for this project was to inform and gather input from key stakeholders; decision making during the study and selecting the recommended plan were the responsibility of Casitas staff and Board members.

The Stakeholder Engagement Plan laid out the following objectives.

- Facilitate stakeholder meetings to gather input on community priorities for water supply projects.
- Build trust in the engagement process among key stakeholders and the communities served by the District by providing regular and ongoing progress updates.
- Organize and document the feedback received throughout the process.

In order to achieve the objectives, the following activities took place:

- Prepared a key stakeholder database
- Created a micro-website for communication
- Conducted local elected official briefings
- Hosted two key stakeholder workshops
- Presented project progress at monthly Casitas Water Resources Committee meetings

At the present time (April 2020) two public meetings are planned at which the general public will have an opportunity to comment on the CWRP recommendations.

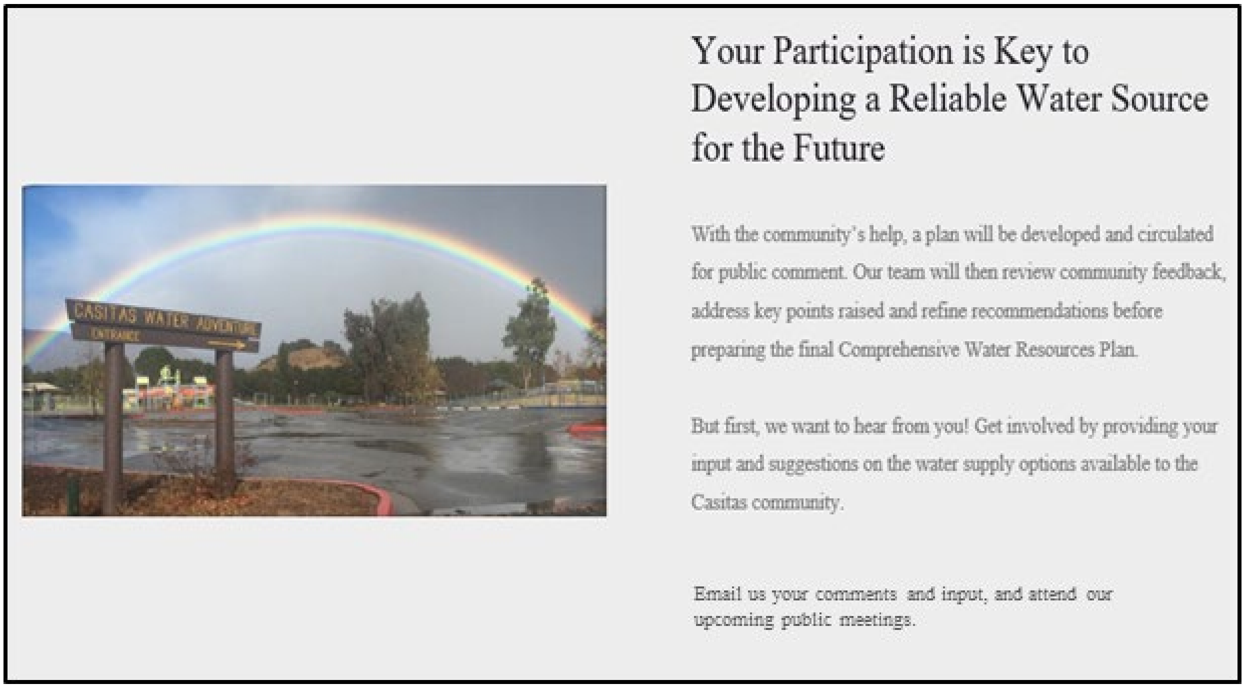

Figure 2-1 Casitas Micro-Website

2.2 Casitas Stakeholder Database

A comprehensive stakeholder database was created in collaboration with Casitas staff and local elected officials that represents the various interests in and around the Casitas service area. The stakeholder database includes local, state and federal government agencies; water districts and other special districts; regulatory agencies; environmental groups; and special interest groups representing Casitas customers. Table 2-1 is the comprehensive stakeholder list developed through the CWRP process.

Table 2-1 – Casitas Stakeholder Database

U.S. Army Corps of Engineers	https://www.spk.usace.army.mil/
Association of Water Agencies of Ventura County	https://www.awavc.org/
California Association of Mutual Water Companies	https://calmutuals.org/about-mutuals/
California Department of Fish & Wildlife	https://www.wildlife.ca.gov/
California Division of Drinking Water	https://www.waterboards.ca.gov/drinking_water/programs/
Calleguas Municipal Water District	http://www.calleguas.com/
Carpinteria Valley Water District	http://www.cvwd.net/
Center for Regenerative Agriculture	https://www.ojaicra.org/

City of Ojai City Council	http://ojaicity.org/city-council/
City of Ventura City Council	https://www.cityofventura.ca.gov/712/City-Council
Climate First: Replacing Oil and Gas	https://www.cfrog.org/
Environmental Coalition of Ventura County	https://www.facebook.com/pages/Environmental-Coalition-of-Ventura-County/154369081266266
Farm Bureau of Ventura County	http://www.farmbureauvc.com/
Friends of Ventura River	http://friendsofventurariver.org/
Major Water Users in Casitas service area	Various
Meiners Oaks District	http://meinersoakswater.com/
National Marine Fisheries Service	https://www.fisheries.noaa.gov/
Ojai Basin Groundwater Management Angency	http://obgma.com/
Ojai FLOW	http://ojaiflow.com/
Ojai Valley Chamber of Commerce	https://www.ojaichamber.org/
Ojai Valley Green Coalition	https://ojaivalleygreencoalition.com/
Ojai Valley Inn	https://www.ojaivalleyinn.com/
Ojai Valley Land Conservancy	https://ovlc.org/
Ojai Valley Sanitary District	http://www.ojaisan.org/
Ojai Valley Unified School District	https://www.ojaiusd.org/
Ojai Valley Water Advisory Group	http://www.ovwag.org/
Ojai Water Conservation District	https://owcd.org/
Santa Barbara Channelkeeper	https://www.sbck.org/
State Water Resources Control Board	https://www.waterboards.ca.gov/
Surfrider	https://www.surfrider.org/
United Water Conservation District	https://www.unitedwater.org/
US Bureau of Reclamation	https://www.usbr.gov/
US Forest Service	https://www.fs.fed.us/
Ventura Chamber of Commerce	http://venturachamber.com/
Ventura County Parks Department	https://www.ventura.org/parks-department/
Ventura County Resource Conservation District	http://www.vcrcd.org/
Ventura County Watershed Protection District	https://www.vcpublicworks.org/wpd/
Ventura Land Trust	https://www.venturalandtrust.org/
Ventura River Water District	http://venturariverwd.com/

2.3 Local Elected Offical Briefings

Casitas conducted a series of elected official briefings at the outset of the outreach process to notify elected officials of the project, allow for questions, augment the key stakeholder list, and collect feedback. These meetings include briefings with the following elected officials:

- Councilmember Ryan Blatz, City of Ojai
- Mayor Johnny Johnston, City of Ojai
- Councilmember Erik Nasarenko, City of Ventura
- Councilmember Cheryl Heitmann, City of Ventura
- Mayor Matt LaVere, City of Ventura
- Assemblymember Monique Limón, District 37
- Congresswoman Julia Brownley, District 26

2.4 Key Stakeholder Workshops

Casitas coordinated two key stakeholder workshops to provide stakeholders with the opportunity to learn about the CWRP and solicit feedback on several key topics including identification of potential water sources, approaches to strengthening existing water infrastructure, and strategies for conserving existing resources. The key stakeholder workshops were hosted in a charrette format in which attendees were divided into two to three groups consisting of participants with diverse backgrounds. Both of the key stakeholder workshops were held in July 2019. A total of 80 stakeholders from 58 organizations were engaged during these workshops.

Workshop participants brainstormed a wide range of issues, challenges and potential solutions associated with current conditions and future water planning strategies in the Casitas service area. These topics were organized into the following recurring themes.

- Navigating a complex web of multiple water agencies
- Risk of reliance on a local water source
- Identifying cost-effective solutions that work
- Environmental concerns
- Impacts on residents and businesses
- Water price and sustainability
- The importance of communication with elected officials

Specific input received from workshop participants in each of these key theme areas is summarized in Table 2-2.

Table 2-2 - Summary of Key Input from Stakeholder Workshops

Navigating a Complex Web of Multiple Water Agencies	
Challenges	**Potential Solutions**
• The challenge of navigating multiple (and in some cases overlapping) water agencies that are reliant on a single source of water. • Identifying a mutual framework that allows various water agencies to work collaboratively • Effectively using a singular source of water controlled by multiple interests • Navigating a solution that will work for federal, local, and state officials and stakeholders	• Any successful solution must involve some work at the regional level in order to deal with the complicated existing web of water agencies • Explore a State Water Project connection • A holistic approach: One Valley, One Water Supply • Support for an integrated regional plan • Include drop-dead dates into the plan – when we need water resources from outside of our region • Moratorium on building to avoid increasing water reliance
Risk of Reliance on a Single Water Source	
Challenges	**Potential Solutions**
• Too much reliance on local water sources and a clear need for a water source outside of the Casitas area • Threat of increased rationing and inconsistent water supply for residents and businesses	• Any successful solution must be an amalgamation of multiple potential solutions including obtaining water from additional sources. • Seek a more diversified water supply • Pursue more water from Ventura River via lawsuit or otherwise • Fully explore State Water Project connection possibility
Identifying Cost-Effective Solutions That Work	
Challenges	**Potential Solutions**
• The challenge of introducing cost-effective solutions that work • Desalination as an example of good idea that is considered too expensive • Identifying new solutions while optimizing existing ones	• An effective solution will both diversify and optimize existing and new water supplies • Lake is wasted sitting empty; we can rent space in Lake Casitas to other entities • Article 21: surplus water made available by the State • Ensure correct hydrology at/around Lake Casitas • Seasonal pumping • The potential for Arundo removal using a rebate program • Local desalination plants • 30-year revenue bonds as potential funding opportunity. • Trained beavers

Environmental Concerns	
Challenges	**Potential Solutions**
• The difficulty in quantifying the "safe yield" of the entire Ojai Valley • Growing environmental uncertainty due to climate change and other factors • Impact of rationing on fire protection	• Continued rationing: Casitas should evaluate how Stage 3 was weathered and consider continued/increased rationing as needed • Determine Ojai Valley's "safe yield" for future consideration • Look into the flood control hard channel bottoms and what we could gain with recharge if those were removed • Irrigated orchards are the best line of fire defense, yet we are making it a challenge for them to survive by not supplying sufficient water. We need to adapt accordingly • Harden water demand but allow for some growth • Re-allocate water to in-stream uses
Impacts on Individuals and Businesses	
Challenges	**Potential Solutions**
• The economics of rationing, with the current boom-and-bust approach, is hurting local businesses and agricultural users in particular • Climate of uncertainty: Orchards (and some other agricultural user sources of income) are reliant on a consistent water supply, and we are making it a challenge for them to survive economically and physically by not supplying consistently sufficient water	• Perform rate review: water rates don't push conservation; rates are backwards and penalize the smallest user vs. the largest user • Look into alternatives other than rationing
Water Price and Sustainability	
Challenges	**Potential Solutions**
• Water is sold too cheaply, and the supply is unsustainable because Casitas Municipal Water District is the defacto backup • Optics: The Lake looks dry, even when it is not • Difficulty in identifying the real problem: is it inefficient storage or a natural water deficit?	• We need to have a regional base to reduce costs on large infrastructure expenditures • Increase the price of local water • • Improve quality of local water infrastructure • Revisit fees to account for large vs. small users
Communicating with Elected Officials	
Challenges	**Potential Solutions**
• The challenge of communicating these issues to elected officials who lack proper context in an effective manner • Concern over failed communication with past agency directors	• Bring in leadership/champion to represent Casitas Municipal Water District to elected officials • Convince officials to better understand boom-and-bust cycles and forward legislation that addresses the actual issue proactively rather than constantly playing catch-up

2.5 Project Updates to Casitas Board

Monthly CWRP updates were provided to the Casitas Water Resources Committee (WRC), which consists of two Casitas Board members. These meetings were open to the public and were attended by Casitas staff and the Stantec consulting team. CWRP updates were provided at 12 WRC meetings over the course of the project. At these meetings the WRC provided project direction in a number of important areas, including alternatives to be studied, approaches to incorporating climate variability, alternative evaluation criteria, supply and demand estimates, and the recommended plan.

During preparation of the draft CWRP report a Board workshop was held to brief the entire Board on the study process and the draft recommendations. This meeting was open to the public.

3.0 Stakeholder Input in CWRP

The CWRP incorporated input from the stakeholder process regarding key issues to be addressed and water supply solutions to be considered. Stakeholder feedback was integrated with technical study results and Casitas staff knowledge to inform project decisions.

For example, each water supply option was evaluated using the decision support tool created as part of the CWRP study. The decision support tool includes a social impact criterion that was scored based on stakeholder and community values.

Casitas plans to conduct two public meetings to present the draft CWRP report and receive feedback on the proposed recommendations. That feedback will be incorporated into the final CWRP report.

Appendix C Water Demand Estimate for Casitas Municipal Water District Technical Memorandum

Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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Prepared by Chip Paulson

Reviewed by Autumn Glaeser

Approved by Autumn Glaeser

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1.0 Introduction

This technical memorandum (TM) describes the estimation of future water demands for use in the Comprehensive Water Resources Plan (CWRP) for Casitas Municipal Water District (Casitas). The TM documents the methods used to estimate water demands for customers served by Casitas, and presents the results for future water demands adopted for water supply planning purposes. The analysis is based on data provided by Casitas and information gathered from previous reports.

The Background Information TM prepared previously for the CWRP provides background on Casitas' municipal and agricultural retail customers and resale (contract) customers. That information is not repeated here. The emphasis of this TM is on developing appropriate projections of future water use for the entire Casitas system.

The following terms are used in this TM.

- Water consumption – Water consumed by end-user customers; also water required at the water meter to satisfy customer demands; often estimated based on billed water use.
- Water production – Water that must be produced by Casitas from its raw water sources and water treatment facilities to satisfy customers demands, accounting for distribution system losses and other unaccounted for water.

2.0 Historical Water Demands

Over 98% of water used by Casitas to serve its retail, agricultural, and resale customers was drawn from Lake Casitas. The remainder was provided by Mira Monte Well with a capacity of 300 acre-feet/year (AFY). Figure 2-1 shows the total annual water deliveries from Lake Casitas from 1983 to 2018. The historical trend of Casitas water demand was steadily increasing from the1960s to the 1990s. The demands were growing primarily due to new agricultural lands being put into production. By 1990, the total demand on Lake Casitas began to exceed the estimated safe yield of the lake at that time. As a result of the growing demands which were exceeding the safe yield and the drought during this time, Casitas declared a water shortage emergency which led to implementation of conservation measures and helped to bring demands within safe yield limits. By 2005, the projected demands were significantly lower than demands in the 1990s. Several factors may be responsible for the change in demand pattern, including a wet period in the 1990s that caused Lake Casitas to spill in 1998; a water conservation ethic that became more prominent in the Western United States beginning in the 2000s; and customer response to drought conservation measures including adoption of a water use allocation program during an extended dry period in the 2010s. In addition, water quality issues that occurred during the 1990's reduced the amount of water the City of Ventura used significantly below their maximum 6,000 acre-feet (AF) contracted value in the mid-1990s. In 2017, Casitas acquired the Ojai Water System from Golden State Water Company. The Ojai Water System receives approximately 20 percent of it's annual demand from Casitas while the remainder of the demand is supplied by the Ojai Groundwater Basin wells.

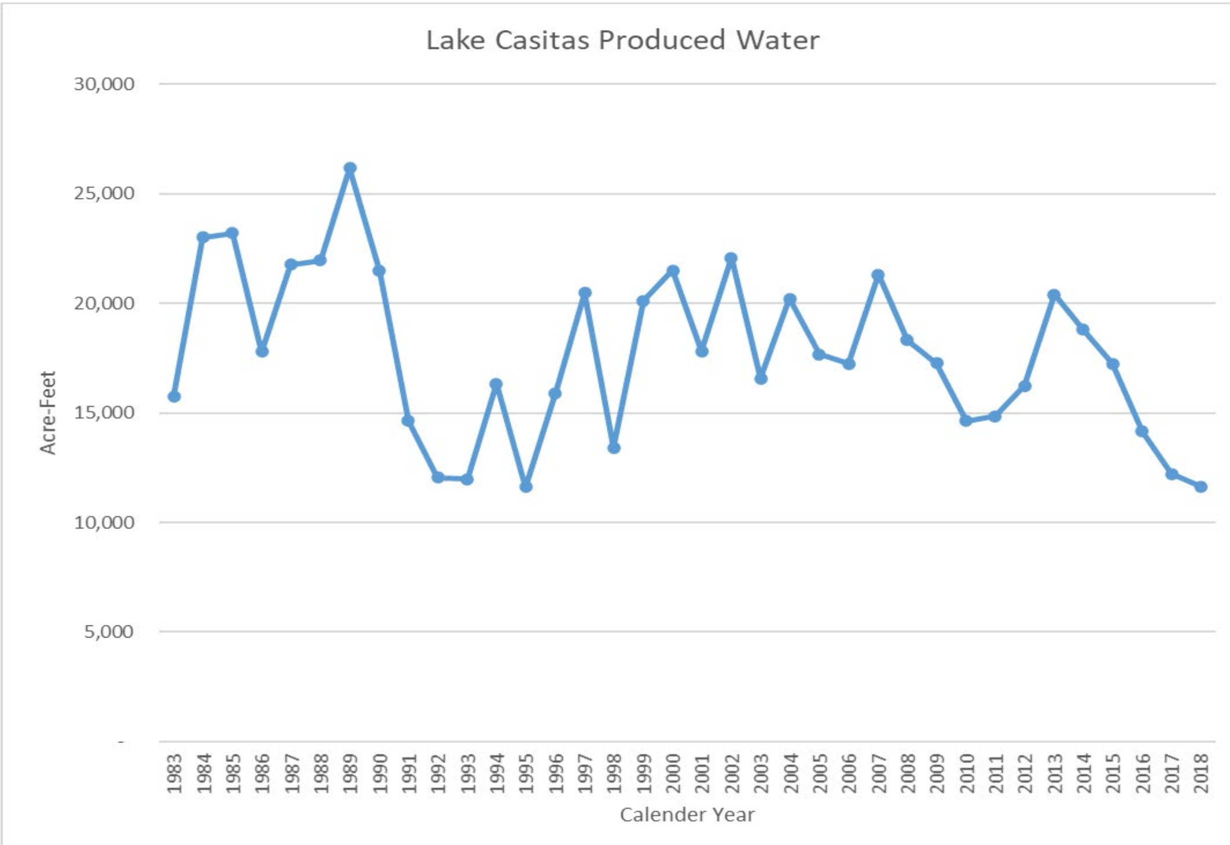

Figure 2-1. Annual Produced Water from Lake Casitas, 1975-2018 (Casitas Municipal Water District)

Table 2-1 shows potable water use sales (i.e., water consumption) for Casitas between 2000 and 2015 as reported in the 2016 Urban Water Management Plan (UWMP), and is evidence of the declining water use in the Casitas service area in recent years. These values exclude the Ojai Water System, and represent water provided from Lake Casitas and the Casitas Mira Monte Well. **Figure 2-2** shows the average percentage of deliveries to the three main customer categories over this period. **Table 2-2** shows the most recent potable water use between 2016 and 2018.

Table 2-1. Past Potable Water Uses 2000-2015 (UWMP, 2016)

Category (1)	2000	2005	2010	2015
Sales to other agencies (includes sales to Ojai Water System)	7,186	7,118	6,482	6,192
Agricultural sales (2)	9,115	8,939	6,398	8,048
Retail sales (2)	3,088	2,821	2,427	2,507
TOTAL	**19,389**	**18,877**	**15,307**	**16,747**

Notes:

(1) Source, CMWD, 2016. All values in AF, rounded. Data does not include water losses.

(2) Direct sales to CMWD customers.

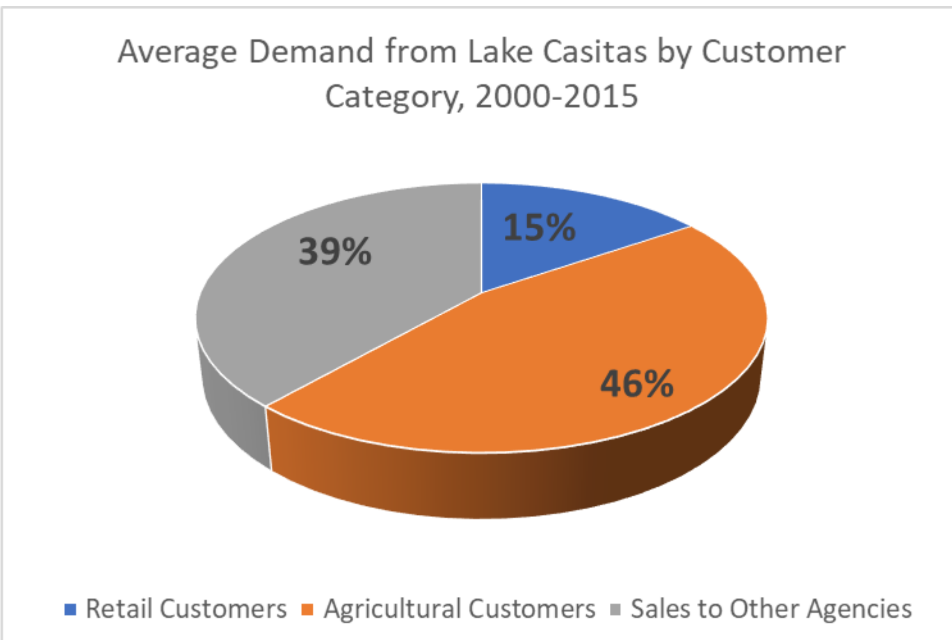

Figure 2-2 Average Demand from Lake Casitas by Customer Category, 2000-2015

Table 2-2. 2016-2018 Water Consumption

Category	2016 (1)	2017 (1)	2018 (1)
Sales to other agencies (includes resale to Ojai Water System)	3,926	2,742	3,284
Agricultural	6,973	6,404	4,552
Retail	1,836	2,974	3,136
Total	**12,735**	**12,120**	**10,980**
CMWD Water Consumption Subtotal	12,735	12,120	9,600
OJAI Water Consumption Subtotal	(2)	(2)	1,380
TOTAL	**12,735**	**12,120**	**12,764**

(1) Casitas Municipal Water District Consumption Report Water Sales FY 2015-2016, 2016-2017,2017-2018 and 2018-2019
(2) Not CMWD responsibility prior to 2017

The 2010 UWMP prepared for Ojai Water System by Golden State Water Company (GSWC, 2011) reported historical water use from 1994-2010 by residential and commercial category. This water consumption data is listed in **Table 2-3**.

Table 2-3. Total Historical Water Use by All Ojai Water System Customers

Year	Total Historical Water Use by All Customers (AF)
1994	1,638
1995	1,844
1996	2,064
1997	2,210
1998	1,737
1999	2,120
2000	2,193
2001	2,153
2002	2,398
2003	2,070
2004	2,182
2005	1,954
2006	2,077
2007	2,283
2008	2,218
2009	1,973
2010	1,779

Data for recent annual water production and consumption from Lake Casitas, the Mira Monte Well, and Ojai Wells was provided by Casitas by calendar year and is shown in **Table 2-4**. The water production data represents the total water produced to meet the needs of customers currently in the Casitas service area and Casitas' contracts with resale agencies.

For water supply planning, water production data is needed to plan raw water requirements. Based on the data in **Table 2-4**, the average ratio between production water and consumption water is 1.09 (i.e., the need for total water production is and average of 9% greater than total measured customer water use at the meter). The difference between water production and water consumption represents unaccounted for water, which includes distribution system losses and non-revenue water. Variability in the difference between annual water production and water consumption is shown in **Figure 2-3**.

Table 2-4. Water Production and Water Consumption in Casitas and Ojai, 2011-2018

	Produced Water				Consumed		
Calendar Year	Lake Casitas	Mira Monte	Ojai Wells	Produced Total	Casitas	Ojai	Consumed Total
2011	14,841	150	1,934	**16,925**	13,441	N/A	**13,441**
2012	16,245	180	1,760	**18,185**	15,269	N/A	**15,269**
2013	20,402	180	1,421	**22,003**	18,294	2,099	**20,393**
2014	18,810	180	1,337	**20,327**	18,325	1,994	**20,319**
2015	17,247	180	1,220	**18,647**	14,989	1,483	**16,472**
2016	14,152	180	944	**15,276**	12,796	1,373	**14,169**
2017	12,213	164	450	**12,827**	12,120	N/A	**12,120**
2018	11,632	151	1,381	**13,164**	9,600	1,380	**10,980**
Average past 3 years	**12,666**	**165**	**925**	**13,756**	**11,505**	**1,376**	**12,882**
Average past 5 years	**14,811**	**171**	**1,066**	**16,048**	**13,566**	**1,557**	**15,123**
Average past 8 years	**15,693**	**171**	**1,306**	**17,169**	**14,354**	**1,666**	**16,020**

Notes:
Data reported by calendar year.
Mira Monte Well production set equal to effective capacity for 2012-2016 considering water quality blending requirements.
N/A – not available
Averages computed excluding years with missing data.

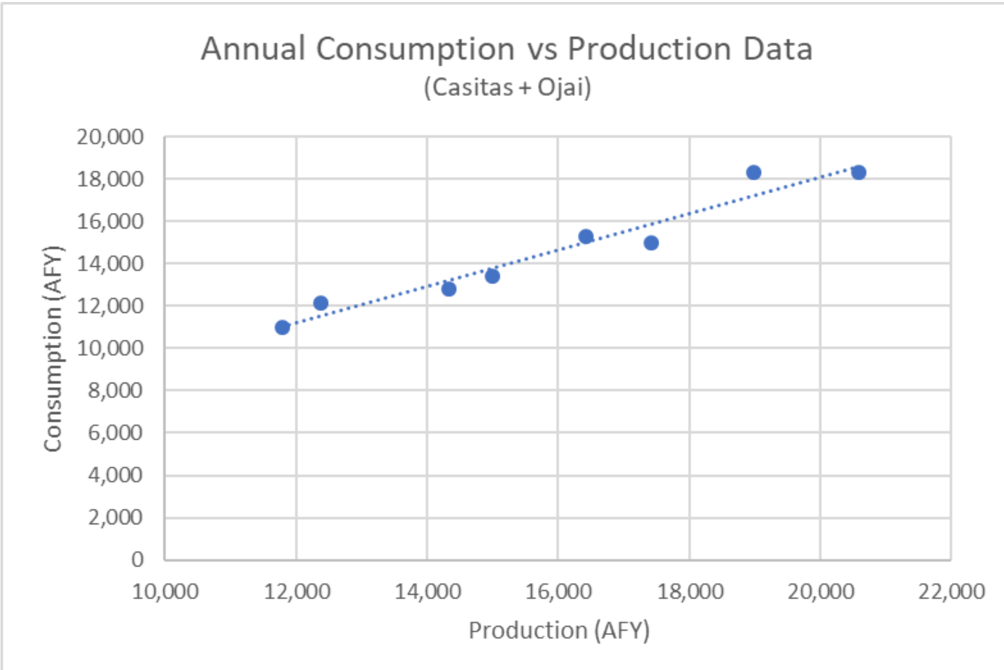

Figure 2-3. Consumption vs Production Data for Casitas + Ojai Water System, 2011-2018

3.0 Water Demand Forecasts

3.1 Current Casitas Service Area and Contract Customers

Because Casitas took over GSWC customers and assets in 2017, a comprehensive demand forecast for the current Casitas service area has not been prepared yet. The demand forecast should include Casitas municipal and agricultural retail customers, including those in Ojai Valley, and resale customers with which Casitas has contracts to supply supplemental water. However, separate demands should also be reported for the Casitas customers and the Ojai Water System customers because water produced from the Ojai Basin wells can only be used in the Ojai Water System. Ojai demands would be met first from the Ojai Basin wells, with supplemental water provided by the Casitas system as in the past prior to the GSWC acquisition. **Figure 3-1** schematically shows the relationship between Casitas sources of supply, retail customers and resale customer agencies.

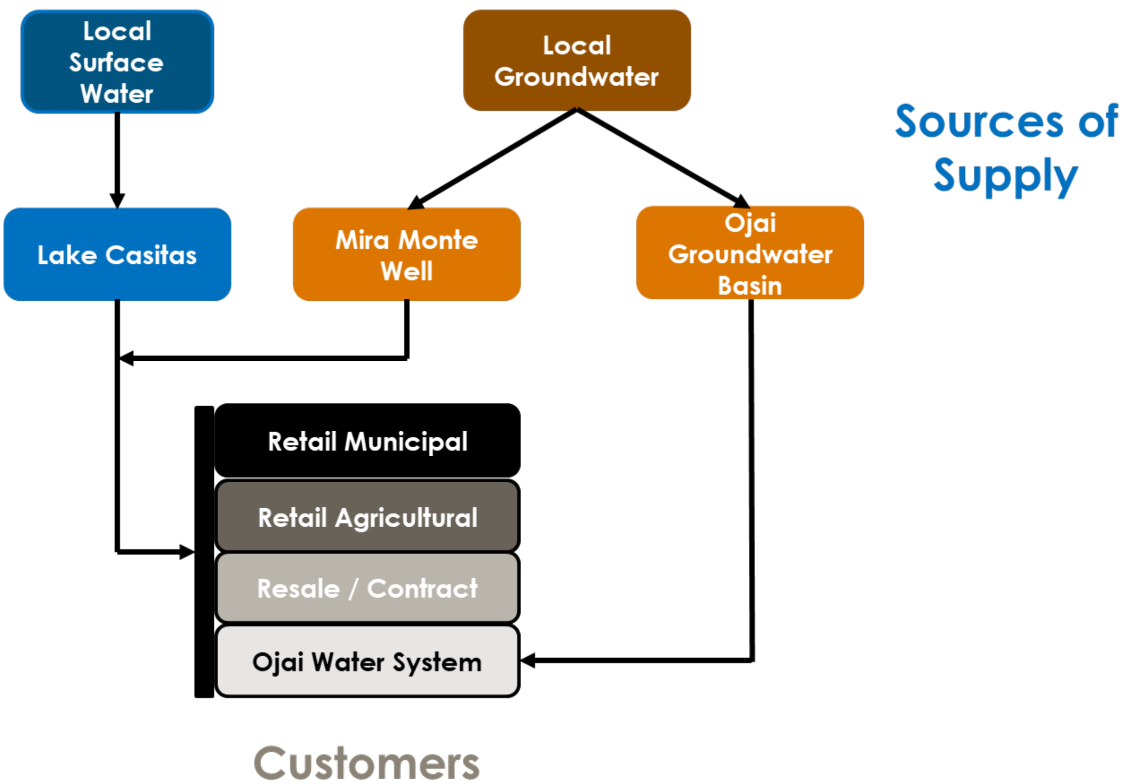

Figure 3-1. Current Casitas Customers and Water Sources

3.2 Previous Water Demand Forecasts

Table 3-1 shows the projected demands for the Casitas system from 2020 to 2040 from the 2016 UWMP. The total demands on the Ojai Water System were not included in the projections in the 2016 UWMP, though they are expected to be included in the next update. Historically, the Casitas system provides approximately 20 percent of the Ojai Water System supplies as part of the resale or sales to other agencies. The values in **Table 3-1** were used by Casitas for water supply planning prior to the GSWC acquisition. This projection assumes population in the Casitas retail service area remains relatively constant based on the Ventura County population forecast. It also assumes agricultural water demand is unchanged and there is a small increase in current deliveries to resale customers. The data in **Table 3-1** is water consumption data because it is measured as water delivered to customers. Produced water requirements would be an average of 9% greater, as described in Section 2.

Table 3-1. Projected Casitas Water Demands for Pre-2017 Service Area (UWMP, 2016)

Category (1)	2020	2025	2030	2035	2040
Sales to other agencies	6,200	6,200	6,500	6,500	6,500
Agricultural sales (2)	8,000	8,000	8,000	8,000	8,000
Retail sales (2)	3,000	3,000	3,000	3,000	3,000
TOTAL	**17,200**	**17,200**	**17,500**	**17,500**	**17,500**

Notes:
(1) Source, CMWD, 2016. All values in AF, rounded. Data does not include water losses.
(2) Direct sales to CMWD customers.

The 2010 GSWC UMWP (2011) forecasted water use for the Ojai Water System. This was based on past water use history, forecasted population growth, and assumed reduction in per capita use due to implementation of water conservation measures. The Ojai Water System demand forecast from the UWMP is shown in **Table 3-2**.

Table 3-2. Projected Water Sales, Unaccounted-for System Losses, and Total Water Demand for Ojai Water System (AFY)

Year	Projected Water Sales (AFY)	System Losses (AFY)	Total Water Demand Baseline (AFY)	Conservation to Meet SBX7-7 (AFY)	Total Water Demand with SBX7-7 compliance (AFY)
2005	1,955	284	2,239	0	2,239
2010	1,780	227	2,007	0	2,007
2015	2,266	339	2,605	111	2,494
2020	2,384	356	2,740	409	2,331
2025	2,483	371	2,854	426	2,428
2030	2,569	384	2,953	440	2,513
2035	2,625	392	3,017	450	2,567

Notes:

(1) Source, GSWC UMWP, 2011. Table based on DWR Guidebook Table 11.

(2) Based on calendar year.

3.3 Water Demand Estimates for CWRP

There is no single previous water demand estimate suitable for use for the CWRP. Changing water use behavior by Casitas' customers and addition of the Ojai Water System to the Casitas service area require an updated future water demand estimate. The future water use estimates in the Casitas UWMP and GSWC UWMP do not necessarily reflect future conditions based on recent water use history. Therefore, a new water demand estimate was prepared for the CWRP comprised of separate estimates for the Casitas and Ojai Water System portions of the combined service area. This estimate was based on comparison of the results of applying two approaches: (1) modification of published UWMP data, and (2) extrapolation of historical water use data.

Table 3-3 documents the calculation of the future water production requirement for the Casitas service area based on published UWMP data. The Casitas UWMP in 2016 provided estimates of 2040 water requirements for Casitas' retail and contract customers. The UWMP estimate of 17,500 AFY for future use is much higher than recent historical use shown in **Table 2-2** and **Table 2-4**, although population in the Casitas service area is not expected to increase substantially compared to current population. These estimates also assume Casitas must be prepared to deliver the full contracted amount of water to its resale customers, although they have not used their full allotment in recent years (see **Table 2-2**).

The GSWC UWMP in 2010 provided an estimate of 2035 water requirements for Ojai Water System customers (see **Table 3-2**). This estimate accounted for distribution system losses so it represented water production requirements. It also assumed water conservation goals would be met and would result in a 15% water use reduction. However, unlike in the original Casitas service area, the forecast shows a small increase in water use through 2035 due to population growth, and it is assumed this increase will continue into the future.

The UWMP estimates did not account for changes in customer behavior and permanent changes to landscaping (e.g., conversion to xeriscape) and water-using fixtures implemented by Casitas' customers in response to the recent severe California drought. To account for this, the Water Resources Committee of the Casitas Board recommended reducing future requirements to reflect the need to preserve recent conservation savings. The project team reduced the previous forecasts by 10% to account for permanent water use changes.

Making the adjustments to previous UWMP forecasts described above resulted in a future water requirement estimate of 15,750 AFY for the Casitas system including the portion of Ojai Water System demands met from Lake Casitas, 2,042 AFY for the portion of the Ojai Water System demand not met from Lake Casitas, and a total of 17,792 AFY in the combined CMWD system.

The extrapolation of future water demand from historical water use was performed as follows.

- As shown in **Table 2-4**, the average water produced by Casitas and GSWC over the past 8 years to meet the demands of all current Casitas customers is 17,226 AFY (15,864 AFY for original Casitas customers including resale water to Ojai, and 1,362 AFY for Ojai Water System customers from local groundwater).
- The Casitas UWMP showed a 300 AFY increase in water demand from 2020 to 2040. This was added to the average produced water requirement of the past 8 years for Casitas original customers.
- The GSWC UWMP showed a 220 AFY increase in water demand from 2020 to 2035. This was rounded up to 250 AFY to account for growth in the Ojai Valley after 2035.
- Adjusting the recent historical water production for future growth gives a value of 17,776 AFY for future water requirement in the total Casitas service area – 16,163 AFY in the original Casitas area (include resale water for Ojai) and 1,612 AFY in Ojai Valley from Ojai Basin wells.

Table 3-4 compares the two methods for estimating future water demands. Both gave a total future demand of approximately 17,800 AFY, but the distribution between the original Casitas service area and Ojai Water System service area are different. For CWRP planning purposes, the average of the two estimates was adopted. This yields a future total water production requirement of 17,825 AF, with 16,000 AFY in the original Casitas portion of the service area and 1,825 AFY by Ojai Valley wells for the Ojai Water System.

Table 3-3. Casitas Future Annual Water Production Requirement Based on Published UWMP Water Use Data

Customer Class	Future Annual Demand (AFY) (Production)	Year	Sources/Comments
Original CMWD Municipal Customers	3,000	2040	2015 Casitas UWMP, Table ES-3. Table footnote says "data does not include water losses" but it must include Casitas losses if they were using this for planning.
Original CMWD Ag Customers	8,000	2040	2015 Casitas UWMP, Table ES-3. Table footnote says "data does not include water losses" but it must include Casitas losses if they were using this for planning.
Original CMWD Resale Customers	6,500	2040	2015 Casitas UWMP (Meiners Oaks WD, Sisar MWC, Tico MWC, Ventura River WD, City of Ventura, Senior Canyon MWC, Siete Robles MWC)
Deduct Conservation Savings	1,750		Effect of current conservation practices - 10% reduction per WRC direction
Subtotal Casitas Demand	**15,750**		
Ojai Valley - All Customer Classes	2,567	2035	2010 GSWC UWMP; includes portion of demand previously met through temporary agreements with Casitas. This includes system losses.
Deduct Purchase from Casitas	525		Included in "Resale Customers" category above
Subtotal Ojai Valley Demand from Local Wells	**2,042**		Excludes resale water supplied from Lake Casitas
Total	**17,792**		

Table 3-4. Water Production Demand Forecasts for Casitas Service Area

Portion of Service Area	UWMP Forecast (AFY)	Historical Projection (AFY)	Average, Rounded (AFY)
Production for Original Casitas Customers (includes resale deliveries to Ojai)	15,750	16,163	16,000
Production from Ojai Valley Wells	2,042	1,612	1,825
Total	**17,792**	**17,776**	**17,825**

Table 3-5 presents a summary of the water demand forecast adopted for the CWRP. In this table, the total Ojai Water System demand is shown, including the portion of demand met from Lake Casitas. Demand estimates apply to the 2040 time period, but current population projections show very little growth after that period so these water demands should be usable for planning beyond 2040.

Table 3-5. Water Demand Forecast Adopted for CWRP

Demand Parameter	Casitas System	Ojai Water System	Total
UWMP 2040 Forecast (AFY)	15,750	2,570	-
Historical Extrapolation (AFY)	16,200	2,140	-
Adopted for CWRP (AFY)	16,000	2,350	18,350
Ojai Demand Included in Casitas Demand (AFY)	-	-	525
Net Casitas Municipal Water District Demand (AFY)	-	-	17,825

4.0 References

CMWD, 2016. Final Urban Water Management Plan and Agricultural Water Management Plan, 2016 Update, prepared by Milner-Villa Consulting for Casitas Municipal Water District, June 2016.

Golden State Water Company, 2011. 2010 Urban Water Management Plan, Ojai. Prepared by Kennedy Jenks Consultant for Golden State Water Company, August 2011.

CMWD, 1983-2018, Lake Casitas Reservoir Levels

Appendix D Lake Casitas Water Supply Analysis Technical Memorandum

Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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1.0 Introduction

This Technical Memorandum (TM) describes the water supply analysis performed for Lake Casitas as part of the Comprehensive Water Resources Plan (CWRP). It documents the updates made to a previous yield model for Lake Casitas, and presents results of applying the model to analyses of estimated water supply available from Lake Casitas under different future hydrology and operating conditions. This TM satisfies the requirements of Task 6.3 in the CWRP Scope of Work.

2.0 Lake Casitas Yield Model

Lake Casitas is the primary source of water available to Casitas Municipal Water District (Casitas). Hence an estimate of the yield available from this source is critical to water resources decision-making by the Casitas staff and Board. A previously developed simulation model to estimate the safe yield of Lake Casitas was provided to Stantec as part of CWRP project, with the understanding it would be updated and improved to reflect current and potential future conditions and incorporate hydrologic uncertainty. This section describes the Lake Casitas Yield Model and the improvements made to it under the CWRP project.

2.1 Original Lake Casitas Yield Model

Casitas provided the Stantec consulting team with an Excel-based simulation model of Lake Casitas developed by staff in the early 2000s. The model consisted of several related files containing data and calculations. It is documented in the 2004 Water Supply and Use Status Report (CMWD 2004). The details of this previous documentation, which are also contained in an appendix to the current Casitas Municipal Water District Urban Water Management Plan (CWMD 2016), are not repeated here.

The original Lake Casitas Yield Model is a mass-balance model that tracks Lake inflows, outflows (including evaporation) and change in storage to simulate operations over historical hydrology conditions. Highlights of the model configuration and capabilities include:

Period of record in model provided by Casitas: 1945-1965; Period of record for most data supporting the model: 1945-1999.

- Surface inflows include streams that are directly tributary to the Lake and diversions from the Ventura River at the Robles Diversion Structure.
- Outflows include net evaporation (evaporation minus precipitation) and withdrawals to meet Casitas demands.
- Monthly simulation of reservoir operations using a maximum Lake capacity of 254,000 acre-feet (AF). Lake water surface area or elevation were not calculated in the model.

- Daily tracking of Ventura River extraction and accretion, and Robles Diversion Structure inflows.
- Monthly tracking of tributary inflows and Lake evaporation based on historical data.
- Identification of critical historical drought period (WY1945-WY1965).
- Robles Diversion simulated based on 1959 Operating Criteria and the Robles Biological Opinion (BO) in effect at the time.
- Comparison of Lake inflows while operating under the 1959 Operating Criteria, Biological Opinion, and Keinlen D20 Study Criteria (CMWD, 2004).

2.2 Lake Casitas Yield Model Improvements

In the course of updating the Lake Casitas Yield Model for use in the CWRP, several significant improvements were made to the model. These are described in this section.

2.2.1 Extension of Period of Record

The model period of record was extended to include all available years of historical hydrologic data at the time the CWRP was started. The full updated model period extends from 1944 to 2018 and includes the 1945 – 1965 data provided in the original model. The extension process consisted of updating model input data for historical direct tributary inflows to the Lake, Robles Diversion inflows, evaporation and precipitation, and Lake storage volumes for the period 1966-2018.

- Historical direct tributary inflows from 1966 - 2018 were provided by Casitas. These inflows were given as back-calculated values from historical water inventory data for Lake Casitas.
- Robles Diversion inflows were extended using historical hydrological information from USGS stream gages along tributaries to the Ventura River.
- Extraction and Accretion values within the Ventura River between streamgage locations and the Robles Diversion Structure were extended using a multiplier that varied by calendar month. This method was provided in the original model and outlined in the 2004 Water Supply and Use Status Report (CMWD 2004).
- Net evaporation values were extended using historical water inventory data provided by Casitas.

The original model used historical net evaporation volumes for each month of the reservoir simulation calculations. In the updated model this was changed so reservoir evaporation in each month is calculated dynamically based on the known (historical) net evaporation rate in feet in that month and the computed reservoir surface area as determined during the simulation for that month.

2.2.2 New Bathymetric Survey

A new bathymetric survey of Lake Casitas was performed in 2017. The updated data for lake volume, water surface elevation and water surface area were incorporated into the elevation-area-capacity table in the Lake Casitas Yield Model. The new survey resulted in a reduction in maximum Lake capacity from 254,000 acre-feet (AF) to 237,761 AF, which in turn resulted in a decrease in estimated yield from the Lake for the same hydrology and operating conditions.

2.2.3 Spillway Calculation

The original model only included the drought period of 1945 – 1965 in which lake volumes never reached the maximum capacity of 254,000 AF and lake levels were not above the elevation of the spillway crest. Throughout the extended period of record there were multiple periods of recovery when the lake levels would exceed the elevation of the spillway.

In order to refine the simulation of Lake operations during periods of high inflow when the Lake is full, a computation of spillway overflow based on historical records and the configuration of the spillway structure was added to the model. The new bathymetric survey of 2017 did not include elevation, area and capacity data above the spillway crest. In order to model high inflow when the lake is full and apply the derived spillway equation, the elevation-area-capacity (EAC) table from the new bathymetric survey was extended. Fitting a curve to the EAC table allowed Lake surface area and capacity values to be extrapolated beyond the elevation of the spillway crest.

Historical spillway flows were plotted against the height of flow over the spillway crest (H). A good-fit equation for the data was developed using an exponent of 1.5 on the height parameter H to be consistent with the form of the ogee crest spillway flow equation - $Q=CLH^{3/2}$. The resulting equation derived for flow over the Lake Casitas spillway is $Q=281*H^{3/2}$.

A monthly spill volume in AF was needed for the monthly Lake simulation performed by the Yield Model. Using the spillway outflow rate calculated based on the beginning-of-month height of the reservoir level over the spillway crest would overestimate the spillway outflow because absent new inflows the Lake level will fall and the spillway outflow will decline during the month. An adjustment was needed as a substitute for doing a daily diminishing head analysis since the Yield Model operates on only a monthly time step. Empirically it was found that multiplying the instantaneous flow rate corresponding to the Lake level at the beginning of the month by 10 provided good agreement with running a daily diminishing head simulation throughout the month. This compares to a conversion factor of 55 to convert cfs to a monthly flow volume. The resulting equation used in the updated model for monthly flow over the Lake Casitas spillway in months when the lake water surface elevation exceeds the spillway elevation is $\text{Volume} = 10 * 281 * H^{3/2}$.

2.2.4 Robles Diversion Operation

The Robles Diversion Structure diverts water from the Ventura River into the Robles Diversion Canal, which conveys the diverted water to Lake Casitas. The diversion system has a nominal capacity of 500 cfs. Environmental considerations and physical operating conditions govern operation of the diversion structure under different hydrologic situations. The Biological Opinion (BO) adopted in 2004 modified previous requirements for passage of flows for fish habitat. This was further modified during the recent drought to allow increased diversions to the Lake when storage levels in the Lake are low.

As part of the model upgrade, the functions used to simulate operation of the Robles Diversion Structure were modified to reflect the current operating rules. The operation of the diversion structure in the model followed the 2004 BO as follows.

- The Extraction and Accretion values are applied to historical hydrology based off the method outlined within the 2004 Water Supply and Use Status Report. This resulting flow rate is categorized as 'Available to Divert' at the Robles Diversion Structure.
- Within the Migration Period (Jan. 1st to June 30th) outlined in the BO, available flows above 30 cfs up to 500 cfs are diverted down the Robles Canal. Flows equal to and below 30 cfs bypass the diversion structure and are sent downstream.
- Outside of the migration period (July 1st to Dec. 31st), available flows over 20 cfs up to 500 cfs are diverted down the Robles Canal.
- Storm events within the Migration Period are categorized within the BO as available flows above 149 cfs, Following the peak storm event, flows above the thresholds as outlined in the applicable primary 12-day and secondary 10-day fish passage tables in the BO, up to 500 cfs, are diverted down the Robles Canal.

In addition to simulating the regulatory factors affecting operation of the diversion structure, the diversion efficiency based on physical and operational factors was added as model input. The original model did not account for the fact that actual historical diversions were generally less than the theoretical or legal diversion amounts allowed under the adopted operating rules. The relationship between theoretical and actual historical diversions was investigated by plotting the actual daily diversions against the theoretical diversion calculated based on the adopted operating rules. This data was plotted for two periods of record: 2004-2018 when the current BO governed operation of the structure, and 2017-2018 when Lake Casitas storage was low. Results are shown in **Figure 2-1** and **Figure 2-2**.

The figures show that on most days the actual recorded diversion is less than what the model would have predicted based on the legal operating rules. The difference could be attributed to clogging of the diversion structure with debris, poor water quality making it inadvisable to divert to the Lake, or other physical or administrative factors affecting operation of the structure. For the 2004-2018 period, the ratio of total historical to total modeled flows is 0.66. For the 2017-2018 period that ratio is 0.73. To accommodate the uncertainty in this important factor, the updated Lake Casitas Yield model allows the user to set this parameter for each simulation. Based on discussion with Casitas staff, a value of 0.70 (70%) was adopted for the Robles diversion efficiency factor when simulating typical operating conditions with the current diversion structure facility.

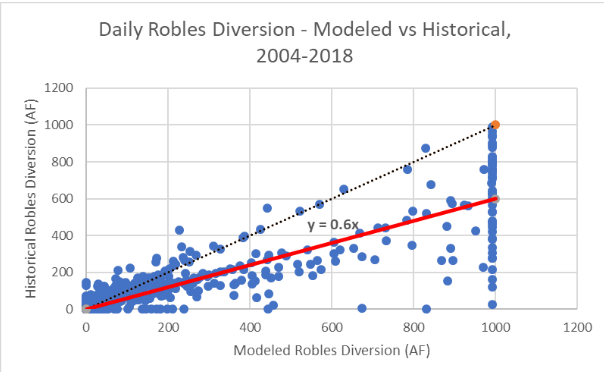

Figure 2-2. Daily Robles Diversion - Modeled vs Historical, 2004-2018

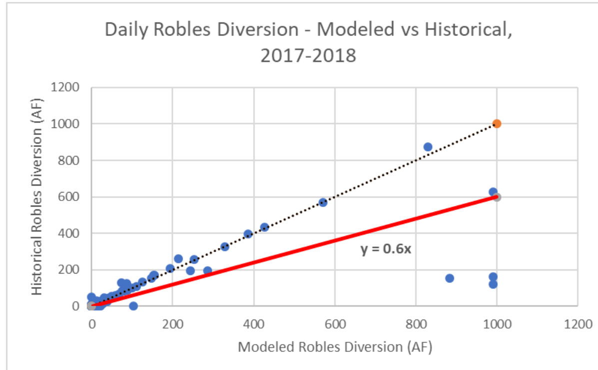

Figure 2-1. Daily Robles Diversion - Modeled vs Historical, 2017-2018

2.2.5 Minimum Allowable Storage

In previous applications of the Lake Casitas Yield Model, the safe yield was determined by finding the largest demand that could be met from the Lake based on drawing the lake level down to the dead pool elevation. The storage at this elevation is 950 AF, and represents the amount of water that cannot be released from the Lake using the normal outlet works. This would leave no buffer for emergencies or for droughts more severe than the drought in the historical record. In practice the Casitas managers would not want to draw the Lake down to the dead pool level, but would want to reserve water in storage for conditions outside the range used for prudent planning (e.g., more severe droughts, equipment failures). In addition, water quality is poor at very low lake levels and Casitas may not be able to treat water with its current water treatment facilities when water is pulled from the Lake when storage is very low. The amount of emergency storage appropriate for Casitas is a policy decision, as discussed below.

To accommodate this planning strategy, the updated Lake Casitas Yield Model allows the user to set a minimum allowable storage level to be used in safe yield simulations. Making this value a variable allows Casitas to test different minimum allowable storage levels and their impact on reservoir performance.

2.2.6 Effect of Model Upgrades

Figure 2-3 shows the effects on Lake Casitas safe yield estimates of the Yield Model improvements described above. Updating the elevation-area-capacity data, adding minimum allowable storage, incorporating the Robles Diversion Structure BO rules, and adjusting modeled Robles diversions for historical experience progressively reduced the Lake Casitas safe yield estimates. Overall these model changes resulted in a 17% reduction in the safe yield estimate for the historical hydrologic period. [Note: the version of the model used for the preliminary analyses described above was updated later in the study, giving slightly different results.]

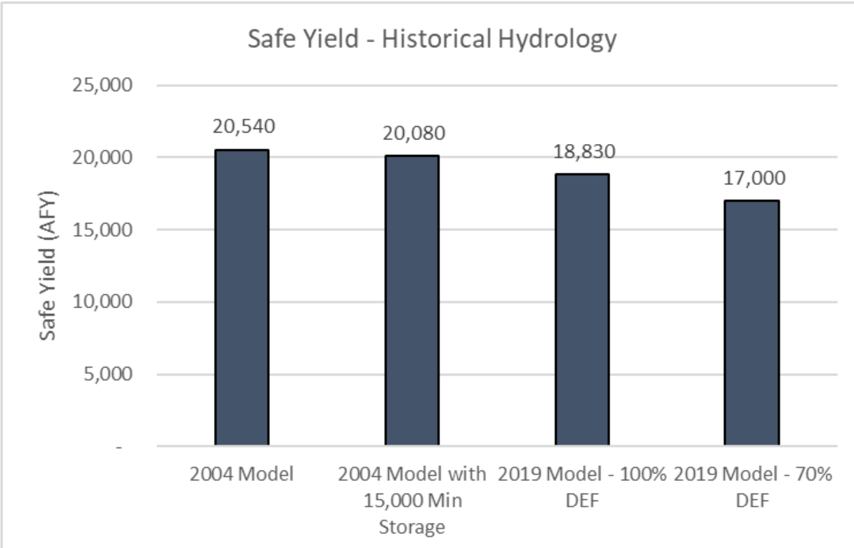

Figure 2-3. Effects of Model Improvements on Safe Yield Estimates

2.2.7 Water Efficiency and Allocation Program and the "Safe Demand" Concept

The original Lake Casitas Yield Model determined the safe yield for the Lake by allowing the user to iterate on the estimated annual demand on the Lake until the largest demand without drawing the Lake below the dead pool level was determined. This annual demand was distributed monthly based on percentages of total annual demands determined from historical water use data. The monthly percentages were applied in every year of the simulation. This approach does not account for the inherent variability in annual demand as a function of weather, economics, and other factors, but more importantly does not account for the impact of water conservation measures implemented by Casitas during years of drought. The updated Lake Casitas Yield Model incorporated changes to address the second factor but not the first. Future updates could link water demand to weather conditions (hot/dry, normal, cool/wet) as a further model refinement.

For the CWRP, the Lake Casitas Yield Model was updated to incorporate the effects of Casitas' policies for implementing demand management practices during periods of low Lake levels. The Casitas Water Efficiency and Allocation Program (WEAP) policy provides information to the Casitas Board in setting water use reduction goals during droughts and other water shortage periods. The policy is summarized in Table 6 in the WEAP report. It sets water allocations for Casitas customers based on usage records from 1989, and provides guidance for reducing water allocations based on Lake Casitas storage volumes. The policy was designed to use demand management as a strategy for managing through critical shortage periods, and assures that supplies are available to meet reduced demands throughout the critical period in the historical period of record (1945-2018).

Key values of Lake Casitas storage levels and demand thresholds incorporated in the current WEAP policy are summarized in **Table 2-1**, as defined in Table 6 in the WEAP report. In simplified form, the WEAP sets water reduction goals based on a starting water demand that is reduced by 20 percent from the 1989 system-wide water demand. Different water use categories were treated differently, but the overall effect was a reduction of about 20 percent. With this assumed system-wide demand (19,127 AFY), the demand reductions at different lake levels as described in WEAP Table 6 are capable of managing supply and demand through the historical critical period.

Table 2-1. WEAP Demand Reduction Targets

	Reservoir % Full		Reservoir Storage (AF)		Water Use Reduction Response Goal as a Percent of Current Water Allocation (Table 6) (1)	Water Demand Target Value Based on Percent Reduction from "80% of 1989" Water Allocation (AFY)
Stage Title	Minimum	Maximum	Minimum	Maximum		
Stage 1 - Water Conservation	50	100	118,881	237,761	100% (80% voluntary reduction) (2)	19,127
Stage 2 - Water Shortage Warning	40	50	95,104	118,881	80%	15,302
Stage 3 - Water Shortage Imminent	30	40	71,328	95,104	70%	13,389
Stage 4 - Severe Water Shortage	25	30	59,440	71,328	60%	11,476
Stage 5 - Critical Water Shortage	0	25	-	59,440	50%	9,564

(1) Values based on information from Table 6 in CMWD, 2018.
(2) 100% water use reduction goal was used in the model.

The WEAP policy provides guidance to the Board; it does not establish fixed operating rules. When simulating the impact of the WEAP policy, it was assumed that water customers would actually reduce their demands consistent with the targets in the policy. That is, if Lake Casitas storage was in the Stage 2 range at the beginning of a year in the simulation, a demand of 15,302 AFY was simulated for that year. In the recent drought in Southern California, Casitas' customers demonstrated the ability to meet or exceed the WEAP demand reduction targets. Some of the landscape changes and customer behavior changes made in response to the drought will be permanent and have lasting effects on reducing customer demand. In turn, achieving similar levels of demand reduction during future droughts may be more difficult because the "easy" savings have already been built into the system. Despite this difficulty, Casitas' staff felt comfortable in assuming for water supply planning purposes that the levels of demand reduction outlined in the current WEAP policy will be achievable in the future.

The Lake Casitas Yield Model used for the CWRP includes a toggle that allows the user to simulate safe yield in the traditional sense (constant demand for all periods of simulation) or what for this study is termed "safe demand", which includes demand reductions in accordance with the WEAP policy as described above. For Casitas' future water supply planning, the safe demand concept is more applicable because it is consistent with the WEAP policy adopted by the Board and with the behavior of Casitas' customers during the recent drought.

3.0 Simulation of Net Evaporation

Evaporation loss is an important part of the water budget for Lake Casitas. The Casitas Water Resources Committee has asked several questions regarding how evaporation is accounted for in the Lake Casitas Yield Model. This section describes that process. More detail on evaporation data and modeling is provided in CWMD (2004).

As noted previously, the Yield Model simulates monthly operations of Lake Casitas. Evaporation losses are accounted for in a net evaporation term (evaporation – precipitation) that is estimated for each month of the 1945-2018 simulation period. When possible, historical evaporation and precipitation data for the years in the simulation period was used. Evaporation was based on the average of pan evaporation measurements for two evaporation pans at Lake Casitas, adjusted by a pan evaporation coefficient for each calendar month provided by the U.S. Bureau of Reclamation. Precipitation was based on the average of recorded rainfall at two rain gauges at Lake Casitas. When historical data was not available for evaporation precipitation, monthly averages for the period of record were used. The average annual evaporation rate for Lake Casitas is about 42 inches per year. It can vary substantially from year to year; for example, in 2018 the evaporation rate was 45.7 inches. The typical monthly distribution of annual evaporation is shown in **Table 3-1**.

Table 3-1. Distribution of Annual Evaporation by Month

Month	Fraction of Annual Evaporation
October	0.0712
November	0.0607
December	0.0609
January	0.0669
February	0.0450
March	0.0641
April	0.0759
May	0.0955
June	0.1099
July	0.1320
August	0.1204
September	0.0975
Total	**1.0**

The net evaporation rate in inches for each month in the 1945-2018 simulation period was calculated as evaporation minus precipitation for that month. This resulted in a unique net evaporation rate for each month in the simulation period. In some months rainfall exceeded the evaporation loss; in those cases the value of the net evaporation parameter in the Yield Model was negative.

The net evaporation loss in acre-feet from reservoir storage was calculated in the model for each month of the simulation by multiplying the net evaporation rate in feet by the reservoir surface area in acres. The surface area is a function of reservoir storage and lake level. As the reservoir level increases or decreases over time, the evaporation loss in volume reflects this change. For the same monthly net evaporation rate, reservoir losses are higher at higher storage levels and lower at lower storage levels because of the difference in reservoir surface area. This effect is shown conceptually in **Figure 3-1**.

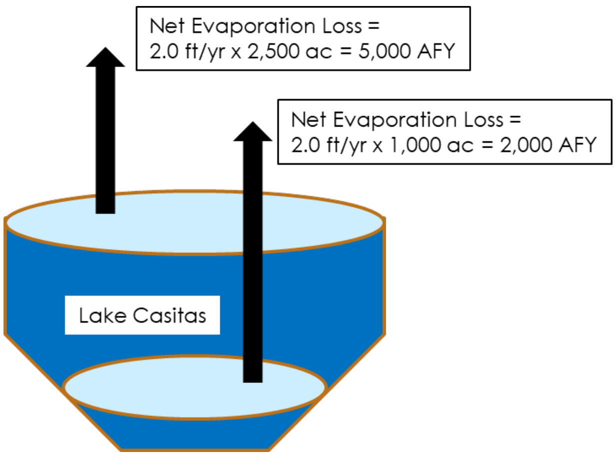

Figure 3-1. Effect of Reservoir Surface Area on Calculated Monthly Net Evaporation Loss

This effect is shown in the chart in **Figure 3-2**, which shows the primary reservoir inflows (tributary inflow and Robles Diversion inflow) and reservoir outflows (net evaporation and withdrawals to meet demands) for the 10 year simulation period from 1945-1954. It is evident that as the reservoir storage volume declines (and the reservoir surface area shrinks), the evaporation loss in acre-feet also tends to decline.

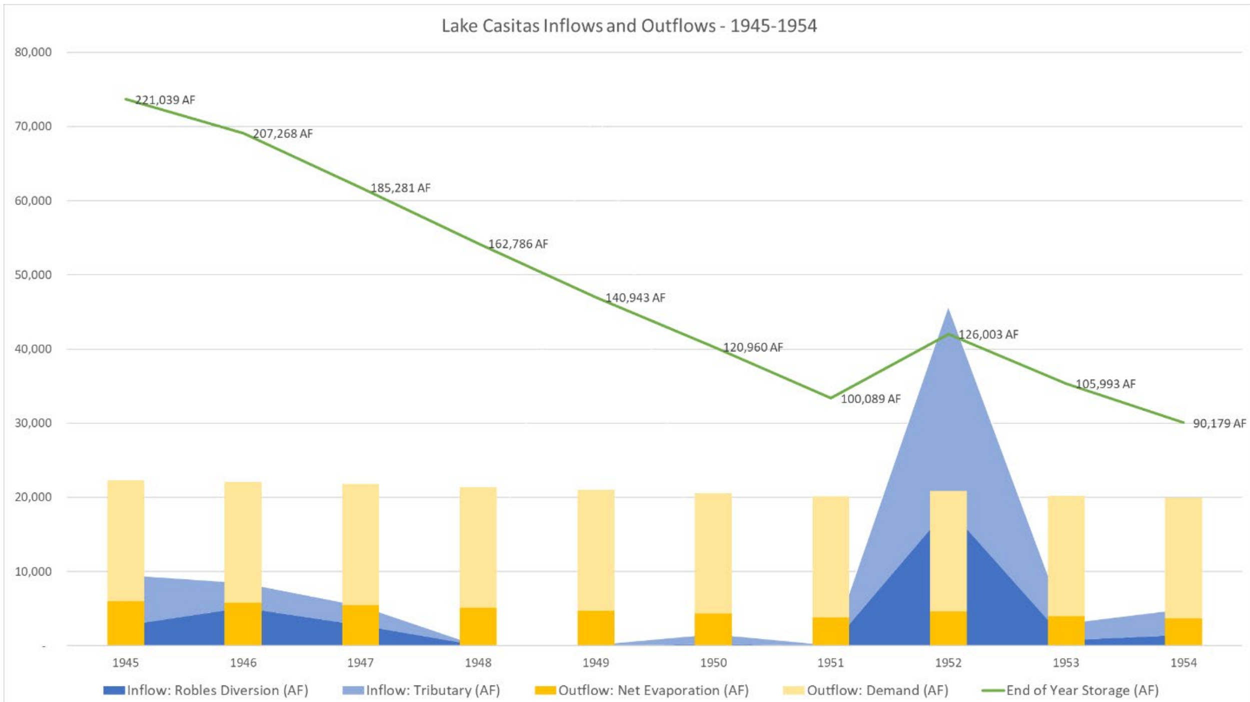

Figure 3-2. Sample Modeled Lake Casitas Inflows and Outflows, 1945-1954 Historical Hydrology

4.0 Minimum Allowable Storage and Robles Diversion Sensitivity Analysis

Key modeling assumptions affecting safe yield and safe demand analyses include the minimum allowable storage in Lake Casitas and the effectiveness of the Robles Diversion Structure. The sensitivity of model results to those input parameters are described in this section.

As described previously, the minimum allowable storage is a policy decision based on the amount of emergency storage desired in Lake Casitas. As such the selection of the minimum allowable storage is affected by the Casitas Board's risk tolerance. A higher minimum allowable storage reduces the risk of impacts from unforeseen events, but reduces the amount of working storage to meet demands under normal conditions and thus results in a lower safe yield. Similarly, a lower minimum allowable storage increases the risk of impacts from unforeseen events but results in higher safe yield for normal operations. To test the sensitivity of Lake Casitas simulated yield to the minimum storage level, yield analyses were performed for minimum allowable storage values varying from 15,000 AF to 100,000 AF.

The Robles Diversion Structure is a critical facility in determining the Lake Casitas yield, since it controls the amount of water diverted into the Lake from the Ventura River. As described previously the amount of water diverted on a daily basis is governed by both physical and regulatory constraints. To account for the uncertainty in actual vs theoretical operations, the yield model has a parameter that allows the user to set the Robles diversion efficiency factor. An efficiency factor of 0.70 was adopted for all simulations of base conditions with the existing facility. To test the sensitivity of the Lake Casitas simulated yield to the Robles diversion efficiency factors, yield analyses were performed for efficiency factors varying from 0.6 to 1.0. All simulations were performed using historical hydrology and the full model period from 1945-2018.

The sensitivity analyses of minimum allowable storage and Robles diversion efficiency were combined into sets of yield model runs in which both parameters were varied over the stated ranges. The sensitivity analysis was performed for safe yield and safe demand assumptions. Results are shown in **Figures 4.1 – 4.3** and **Table 4-1** and **Table 4-2**.

The minimum allowable storage level has a substantial effect on safe yield and safe demand over the range of 15,000 AF to 100,000 AF. This is a large range, representing 6% to 42% of total available capacity. The safe yield varies by an average of 5,370 AFY over this range, and the safe demand varies by an average of 13,260 AFY over this range. The results are less sensitive to the Robles diversion efficiency factor. Over the range of 0.6 to 1.0 the safe yield varies by an average of 1,920 AFY and the safe demand varies by an average of 2,340 AFY.

Based on these results the Casitas staff felt comfortable with setting the Robles diversion efficiency factor at 0.70. The minimum allowable storage level was presented to the Board as a policy decision.

[Note: the model results described in this section are based on a previous version of the Yield Model which was changed slightly later in the study. The conclusions of this section are still valid.]

Table 4-1. Safe Yield Sensitivity Analysis of Minimum Allowable Storage and Robles Diversion Efficiency Factor

Lake Casitas Safe Yield (AFY)					
Minimum Allowable Storage (AF)	Robes Diversion Efficiency Factor				
	100%	90%	80%	70%	60%
15,000	18,830	18,230	17,625	17,000	16,400
30,000	17,875	17,260	16,660	16,050	15,450
50,000	16,620	16,010	15,400	14,800	14,175
75,000	15,075	14,460	13,850	13,250	12,650
100,000	13,050	12,700	12,350	11,750	11,140

Table 4-2. Safe Demand Sensitivity Analysis of Minimum Allowable Storage and Robles Diversion Efficiency Factor

Lake Casitas Safe Demand (AFY) – WEAP Policy Operation					
Minimum Allowable Storage (AF)	Robles Diversion Efficiency Factor				
	100%	90%	80%	70%	60%
15,000	27,150	26,325	25,500	24,775	24,025
30,000	24,650	23,910	23,160	22,450	21,700
50,000	21,015	20,600	20,225	19,650	18,425
75,000	16,300	15,900	15,325	14,550	13,810
100,000	13,250	12,875	12,530	12,050	11,400

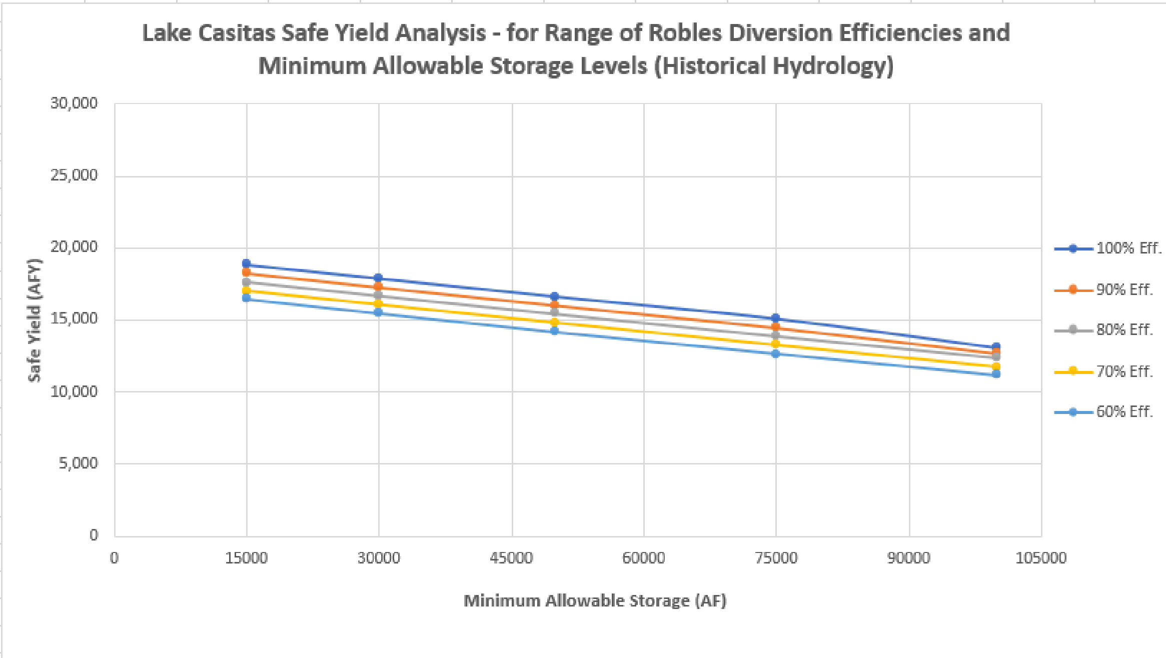

Figure 4-1. Lake Casitas Safe Yield for Range of Minimum Allowable Storage and Robles Diversion Efficiency

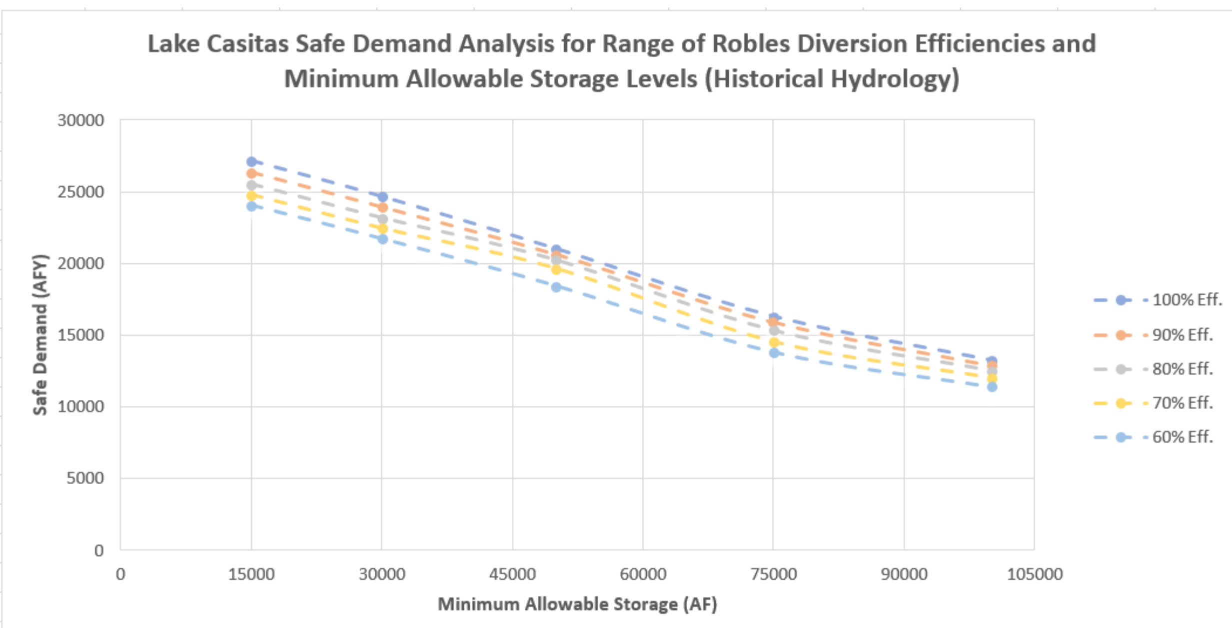

Figure 4-2. Lake Casitas Safe Demand for Range of Minimum Allowable Storage and Robles Diversion Efficiency

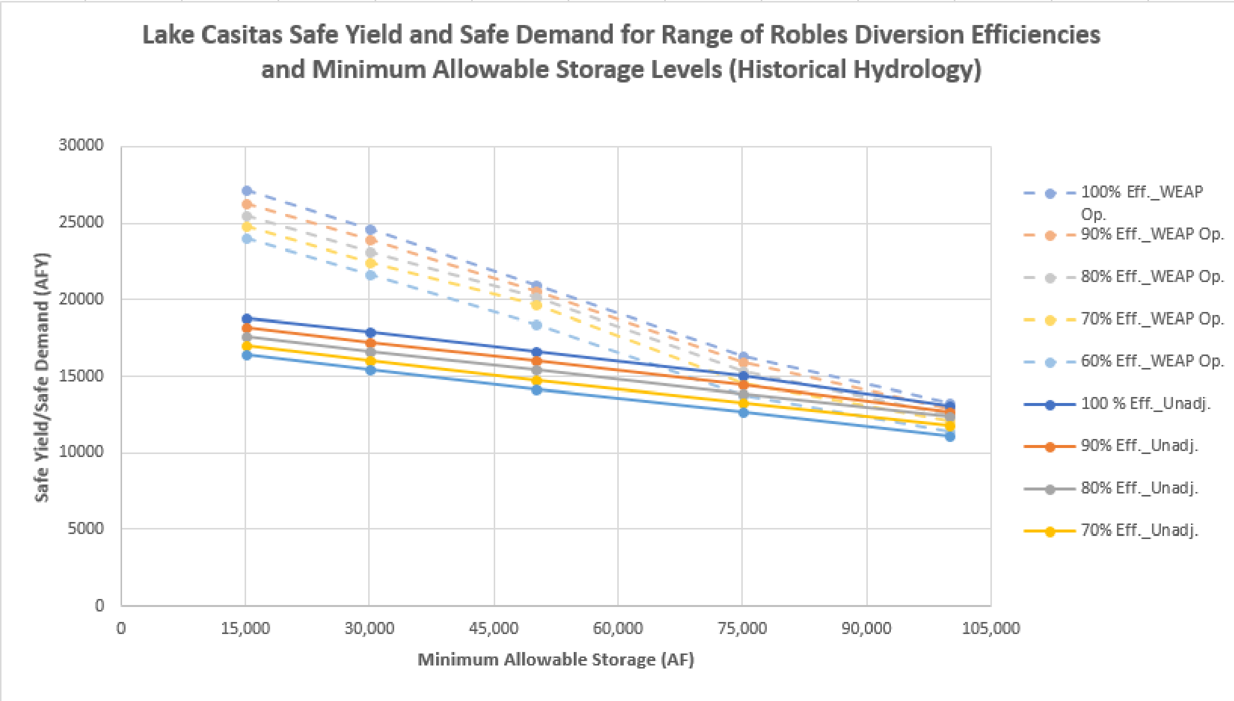

Figure 4-3. Lake Casitas Safe Yield and Safe Demand for Range of Minimum Allowable Storage and Robles Diversion Efficiency

5.0 Analysis of Hydrologic Uncertainty

The previous Lake Casitas yield analyses – both those conducted with the original model and those performed with the new model as described in the foregoing sections – all used historical hydrology in the simulations. That includes historical data for direct inflows to Lake Casitas, flows in the Ventura River on which diversions at the Robles Diversion Structure were based, and net evaporation from the Lake. This type of analysis assumes historical hydrology will recur in the future in exactly the same sequence and magnitude. In fact, the one thing known about future hydrology is that it will <u>not</u> occur in the same sequence and magnitude as the historical record. Natural variability in climate, shifts in climate drivers such as ocean temperatures, and other factors all are responsible for affecting future hydrologic conditions.

Hydrologic variability is being addressed in long-range water supply plans being conducted by water utilities throughout the nation. For this study, hydrologic variability was incorporated into the Lake Casitas water supply analysis in two ways:

1. Natural variability was incorporated by generating 100 sequences of hydrologic model inputs with the same basic statistics as the historical record. Simulations based on selected sequences from this dataset were used to develop a probabilistic approach to estimating Lake Casitas yield.

2. Potential effects of climate change on temperature and precipitation were incorporated by reviewing published climate change studies and adjusting yield estimates to reflect likely future climate conditions.

Each of these modifications to Lake Casitas Yield Model inputs are described below.

5.1 Resequencing of Historical Hydrology

Natural hydrologic variability was incorporated into the Lake Casitas yield analysis by generating 100 hydrologic datasets (traces) derived from the historical dataset and having the same basic statistics (e.g., standard deviation and serial correlation of annual streamflows) as the historical record. This was accomplished in the following steps.

1. Resequencing was based on Ventura River streamflows upstream of the Robles Diversion Structure from the yield model. This was considered a more reliable dataset than the direct tributary inflows to the Lake, as aggregated model input data for the tributary inflow node was estimated by Casitas from 1983 to present. Annual streamflow volumes for the Ventura River upstream of the Robles Diversion Structure for the model period of record (1944-2018) were extracted from the Yield Model for use in the resequencing analysis.

2. Ventura River annual streamflows were input to a k-nearest neighbor (KNN) software routine to generate 100 similar sequences of annual Ventura River streamflows. In a KNN routine, a historical year is randomly selected as the first year in the new sequence. Using that first year's associated annual flow, remaining annual flows are ranked and weighted based on how close they are to the selected first year's annual flow. To determine the second year of the new KNN sequence, one of these weighted historical annual flows and its corresponding historical year is selected. This is akin to selecting one ping pong ball from a jar of ping pong balls, in which the number of balls representing a given year is based on the nearness of the annual flow in that year to the annual flow in the first year. The second year in the KNN sequence is then chosen to be the year <u>after</u> the selected historical year. This generates new streamflow sequences that reflect the persistence in the historical record (i.e., probability of a wet year following a wet year or a dry year following a dry year). The synthetic streamflow sequences generated by the KNN approach contain substantial variability, as shown in **Figure 5-1**.

3. The KNN methodology produced many hydrologic sequences with longer and deeper droughts than the critical drought in the historical period. Because the historical critical drought was 21 years long (1945-1965), the synthetic streamflow records were analyzed for 5-year, 10-year and 20-year moving average annual streamflow to assess their severity relative to the historical record. **Figure 5-2** shows a range of statistics for the synthetic hydrologic traces, and demonstrates the large number of traces with longer, deeper droughts than the historical critical period.

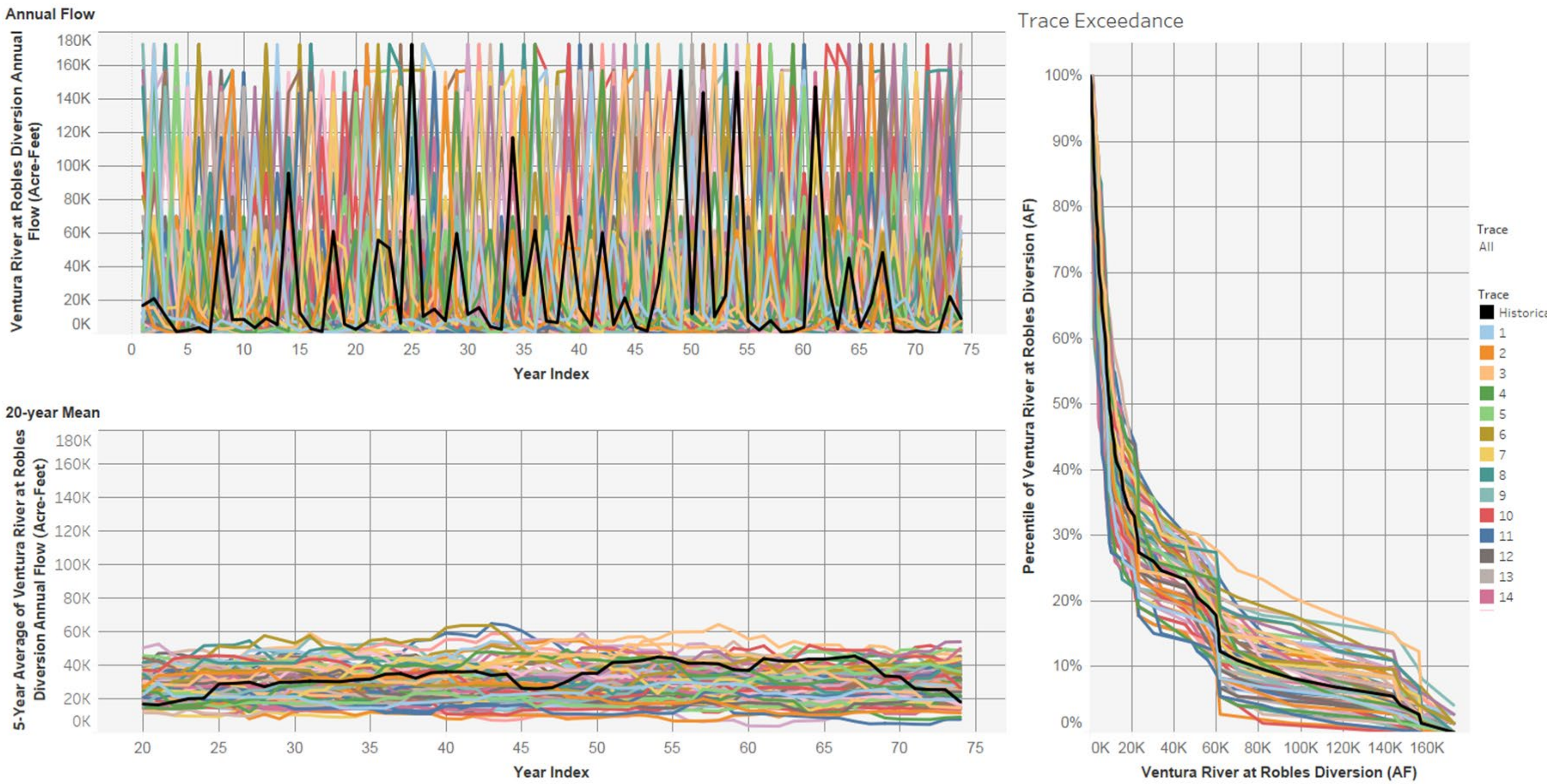

Figure 5-1. 100 Hydrologic Traces for Ventura River Upstream of Robles Diversion

Note: Each color is a different hydrologic trace. The black trace is historical hydrology.

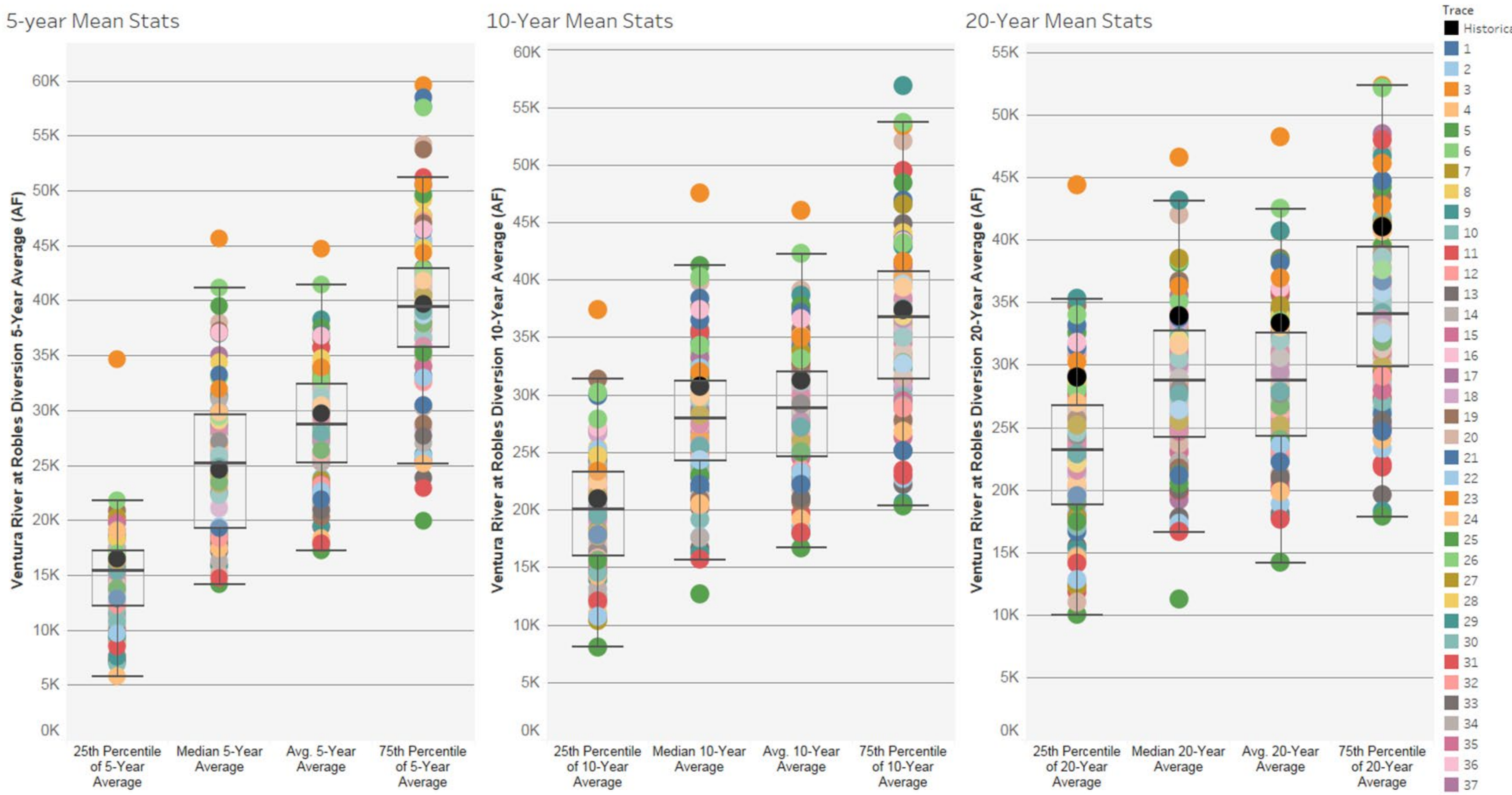

Figure 5-2. 5-year, 10-year, and 20-year Moving Average Statistics for Ventura River Synthetic Streamflows

Note: Each colored dot represents one of the 100 synthetic streamflow records. The black dot is the historical record.

4. For each of the 100 resequenced Ventura River historical annual streamflows, the corresponding historical year was used as an index to resequence the other two Lake Casitas Yield Model inputs dependent on climate – the direct Lake inflows and Lake net evaporation. For example, in trace 1 the annual Ventura River streamflow selected for the first year in the sequence was the 1982 annual flow. To generate the other model inputs, the annual direct Lake inflow was taken from 1982 and annual net evaporation was taken from 1982. In this way the historical correlation between all the hydrologic inputs was preserved.

5. The Lake Casitas Yield Model simulates Lake operations on a monthly basis. To generate the monthly input for each synthetic sequence, the monthly data for the corresponding year in the resequencing process was taken from the historical database. For the example used in the previous step, the yield model input for the first year in the simulation of trace 1 was populated with the historical monthly streamflows from 1982 for the direct Lake inflow and net evaporation. Similarly, the historical daily Ventura River flows from 1982 were used to calculate the Robles diversion volumes for the first year in trace 1.

6. Because the safe yield and safe demand analyses involved iteration, selected traces from the set of 100 were used to test the process of performing the reliability analysis. The selected traces represented the full range of long-term average streamflow statistics shown in **Figure 4-2**. Twelve traces were selected, plus the historical record, for use in the yield reliability analysis. The moving average statistics for the 13 traces are shown in **Figure 5-3**.

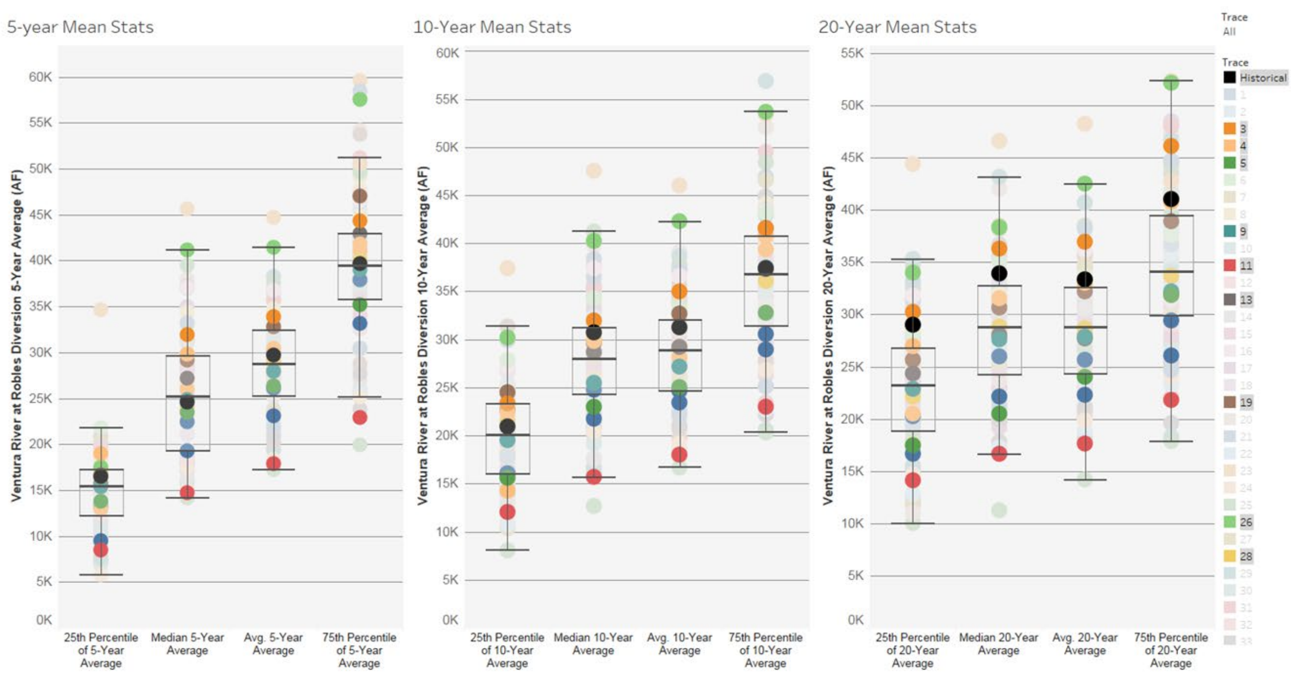

Figure 5-3. Moving Average Statistics for Traces Selected for Yield Reliability Analysis

5.2 Yield Reliability Analysis

The 100 resequenced hydrologic traces plus the historical hydrologic record were simulated in the Lake Casitas Yield Model to determine the corresponding safe yield and safe demand for each trace. Simulations used a minimum allowable storage of 20,000 AF and a Robles diversion efficiency factor of 0.70. The exceedance probability of each safe yield and safe demand result were computed and the results were plotted as shown in **Figure 5-4**. Polynomial equations were fitted to the probability distribution to estimate safe yields and safe demands for a range of exceedance probabilities.

Because the extreme tails of the distributions differed significantly from the bulk of the data, a sensitivity analysis was performed by excluding the upper and lower 10% of traces from the analysis and the results were replotted. The truncated safe yield and safe demand exceedance probability curves are shown in **Figure 5-5** and **Figure 5-6**. **Table 5-1** summarizes the safe yield and safe demand reliability results for the two datasets. Using the middle 80% of the traces provides a better polynomial fit to the data. However, because the primary interest of the CWRP is in the reliability of Lake Casitas yield during extreme dry periods (i.e., 90%-99% exceedance probability range), the analysis based on the full 100 traces was adopted for this study.

Table 5-1. Lake Casitas Safe Yield and Safe Demand Reliability Results

Exceedance Probability	Safe Yield – 100 Sequences (AFY)	Safe Yield – 80 Sequences (AFY)	Safe Demand – 100 Sequences (AFY	Safe Demand – 80 Sequences (AFY
0.10	19,265	18,409	26,115	24,714
0.25	18,015	17,232	24,512	23,535
0.50	15,498	15,270	20,851	20,878
0.75	12,440	13,308	15,952	17,359
0.90	10,346	12,130	12,419	14,833
0.95	9,605	11,738	11,142	13,922
0.99	8,996	11,424	10,085	13,168

Note: Simulations are based on 20,000 AF minimum allowable storage, 0.70 Robles diversion efficiency factor, and no climate change adjustment

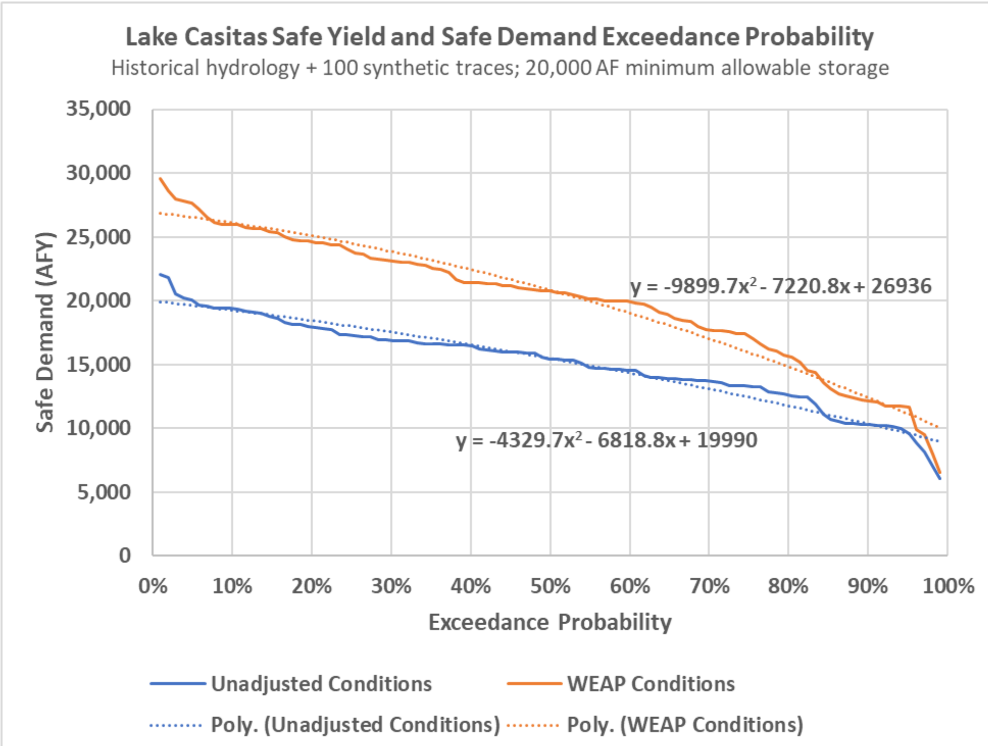

Figure 5-4. Safe Yield and Safe Demand Probability Based on 100 Synthetic Hydrologic Sequences

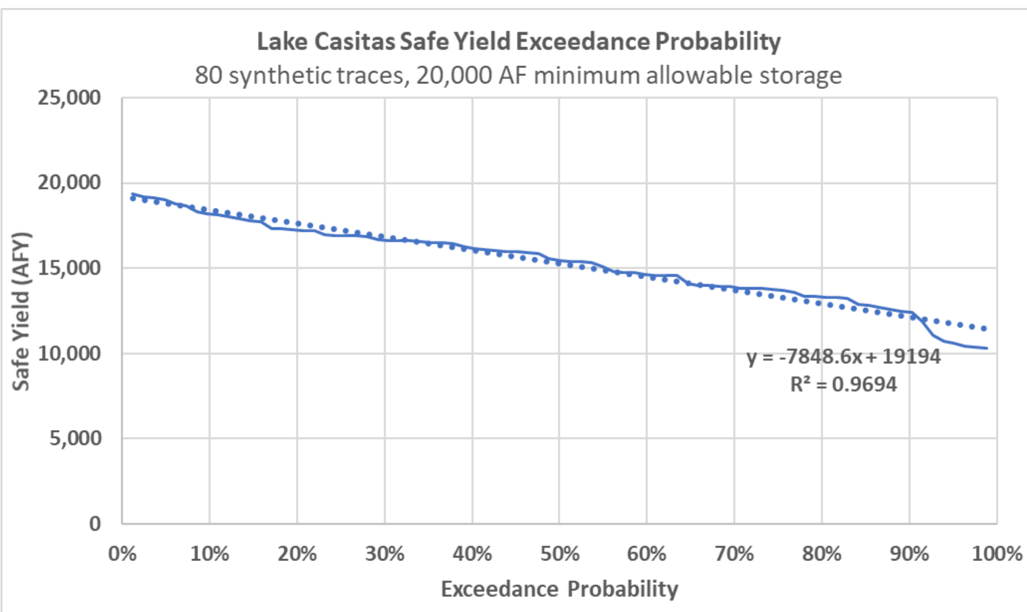

Figure 5-5. Safe Yield Probability Based on 80 Synthetic Hydrologic Sequences

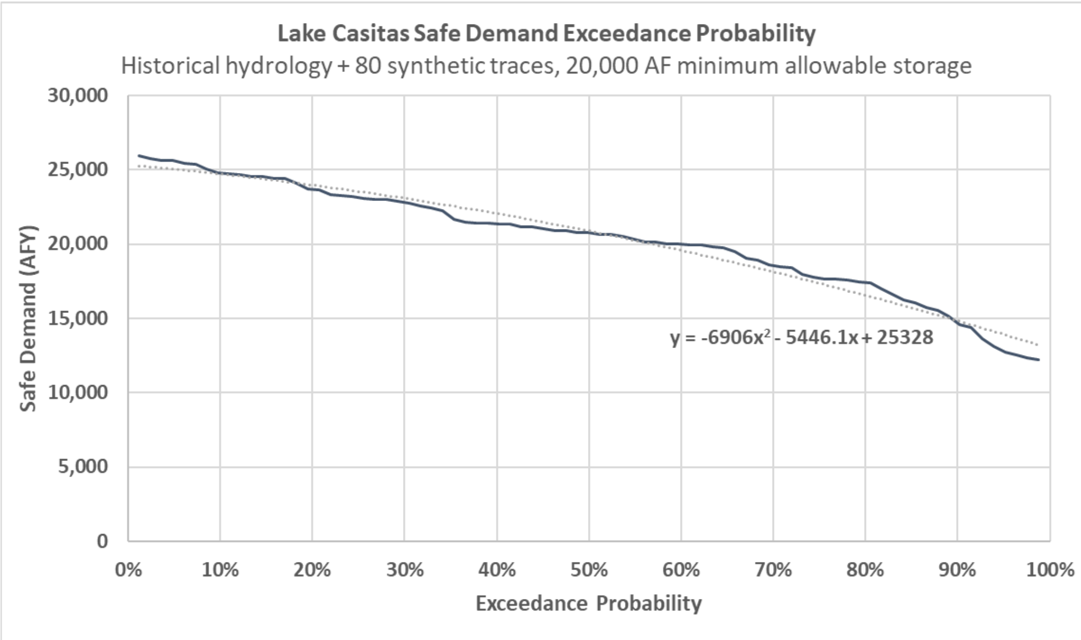

Figure 5-6. Safe Demand Probability Based on 80 Synthetic Hydrologic Sequences

5.3 Climate Change Analysis

The analysis of the effects of climate change on Lake Casitas hydrology was based on the findings of *Projected Changes in Ventura County Climate: 2021-2040, Western Regional Climate Center/Desert Research Institute and Watersheds Coalition of Ventura County, 2019.* This is considered to be the most reliable estimate of near-term climate change effects for the Casitas region. The study was supported by Casitas and other Ventura County agencies.

Primary findings as they relate to this study for the time period through 2040 are:

- Average temperatures will increase.
- Maximum temperatures will increase by 3-5 degrees.
- Average annual precipitation could increase or decrease; for this study it was assumed there would be no substantial change in annual precipitation.
- There will be more 3-4 more dry days per year, primarily in spring and fall.
- Precipitation intensity will increase. The wettest 5% of rainfall days will contribute 10% more of the total annual precipitation.
- Evapotranspiration will increase by 2.5 to 6.5 inches per year, with higher increases occurring in inland areas.

- Runoff production (conversion of rainfall to runoff) will decrease due to reduction in soil moisture associated with higher temperatures and greater evapotranspiration.

The Lake Casitas Yield Model simply simulates inflows, outflows and change in storage in Lake Casitas based on an assumed demand. Changes in temperature and precipitation could affect lake hydrology and demands on the Casitas system. Demands are varied in the safe yield and safe demand analysis to find the largest demand that can be met throughout the simulation period. For the safe demand and safe yield modeling analysis, climate effects on lake hydrology could captured in two ways: adjusted lake inflows and adjusted lake evaporation.

Potential climate effects could alter Lake inflows in three primary ways:

- Increase in Precipitation Intensity: Increase runoff from the top 5% of rainfall days without increasing mean annual rainfall
- Increase in Number of Dry Days: Increase the number of days when no runoff would occur
- Decrease in Soil Moisture: Reduce runoff from smaller storm events

The Lake Casitas Yield Model represents lake inflows in two time series: flow in the Ventura River at the Robles Diversion and direct inflow into the lake. Both time series would be affected by these changes. Increase in precipitation intensity would increase runoff, whereas the increase in number of dry days and reduction in soil moisture would decrease runoff. To properly investigate the impact of these climatological changes on watershed runoff, a rainfall-runoff model would be needed to simulate watershed response to changed meteorological inputs on a daily basis. Such a model was not available for the Casitas watershed and developing a model was beyond the scope of the CWRP. For purposes of this analysis, it was assumed the three climate factors affecting Lake inflows would compensate for each other with no appreciable impact on Lake yield.

The Lake Casitas Yield Model has monthly rates of evaporation that are applied to the computed lake surface area to calculate the volume of evaporation loss on a daily basis. The regional climate change assessment indicates that evapotranspiration will increase by 2.5 to 6.5 inches per year, with higher increases occurring in inland areas.

Table 5-2 summarizes the approach to the lake evaporation climate change adjustment. Two levels of climate change impact were considered – low climate change (LCC) impact corresponding to the lower end of the range of anticipated impacts by 2040, and high climate change (HCC) impact corresponding to the upper end of the range of anticipated impacts by 2040.

Table 5-2. Assumed Climate Change Effects on Lake Casitas Evaporation

Climate Change Impact	Modeling Approach	Magnitude of Change to Simulate Lower Climate Impact	Magnitude of Change to Simulate Higher Climate Impact
Increase in Evapotranspiration	Increase annual Lake Casitas evaporation, distributed monthly on a pro rata basis	3 inches/year	6 inches/year

Based on data from the Ventura County climate change study, annual evaporation at Lake Casitas could increase by about 3-6 inches depending on the climate scenario assumed. This effect was modeled using the following steps.

1. For LCC, assume annual evaporation rate increases by 3 inches. For HCC, assume annual evaporation rate increases by 6 inches.
2. Distribute the increase in annual evaporation across the 12 calendar months on a pro rata basis. For example, if the January evaporation rate represents 3 percent of the total annual evaporation rate, then for LCC the increase in evaporation rate would be 3 x 0.03 = 0.09 inches and for HCC the increase in evaporation rate would be 6 x 0.03 = 0.18 inches.

The Lake Casitas Yield Model was run in the safe yield mode (no demand reductions for the WEAP policy) for the two reduced evaporation scenarios using historical hydrology, a minimum allowable storage of 15,000 AF, and a Robles diversion efficiency factor of 0.70. The results are summarized in **Figure 5-6**. The Low Climate Change assumption of an increase in annual evaporation rate of 3 inches reduced the safe yield by 2.2%. The High Climate Change assumption of an increase in annual evaporation rate of 6 inches reduced the safe yield by 4.3%. These are relatively modest impacts over the 2040 planning horizon. For the CWRP it was decided to use the High Climate Change condition to be conservative. When appropriate, climate change adjustments to safe yield and safe demand estimates developed from the Lake Casitas Yield Model were made by reducing modeled values by 4.3%.

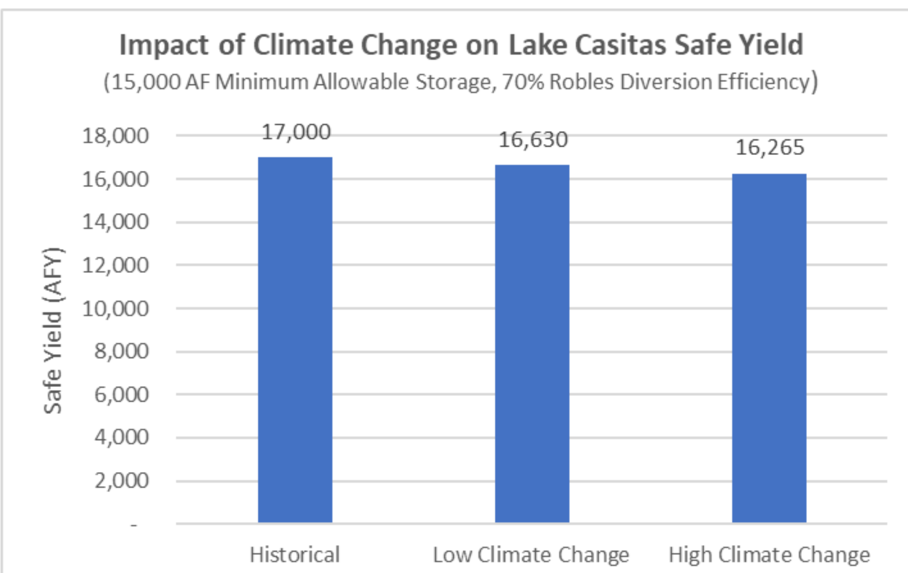

Figure 5-7. Impact of High Climate Change Assumptions on Lake Casitas Safe Yield

6.0 Critical Period

Previous safe yield analyses with the original Lake Casitas Safe Yield Model using the historical period in the simulations found that the critical drought period occurred from 1945-1965. After making the adjustments to elevation-area-capacity table, the Robles Diversion Structure simulation, and the minimum allowable storage level, the critical drought period in the historical record was still the 1945-1965 period. This is shown in **Figure 6-1**.

However, when the demands on Lake Casitas were adjusted during the simulation to account for the effect of the WEAP policy, the critical period in the historical record became the 1998-2018 period that contains the recent severe drought. This is shown in **Figure 6-2**. If future hydrologic studies depend on the critical period, it is recommended that both the 1945-1965 and 1998-2018 periods be included in the analysis.

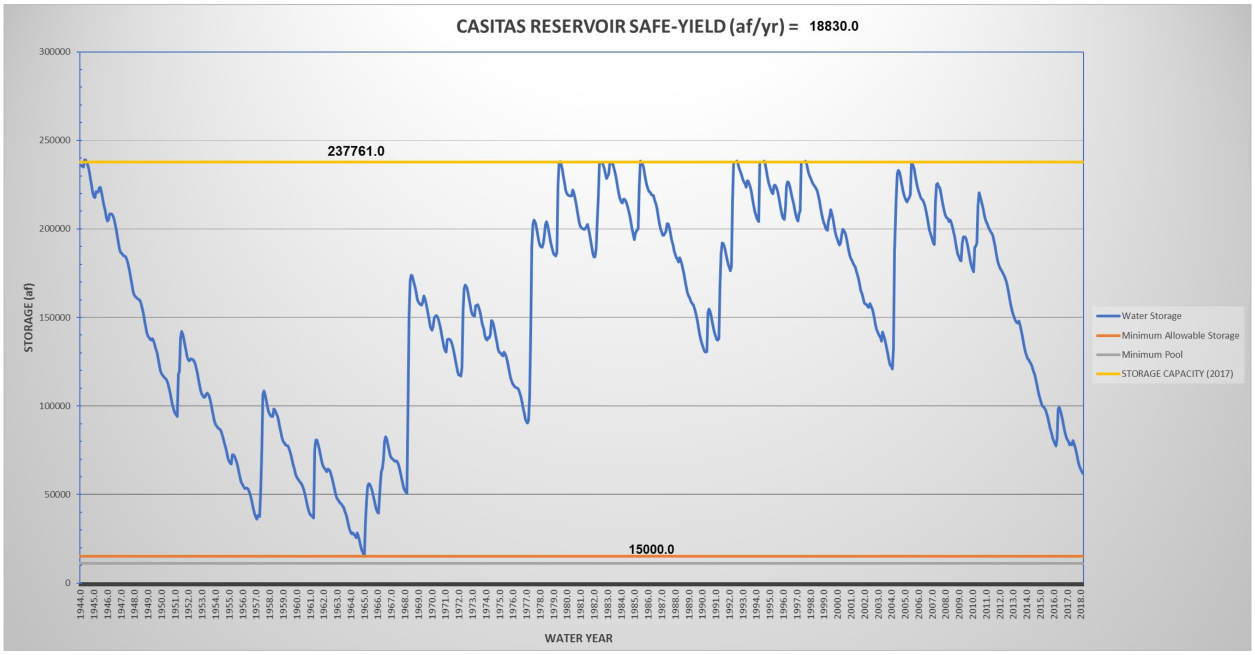

Figure 6-1. Simulated Lake Casitas Storage for Safe Yield with Constant Demand Throughout Simulation

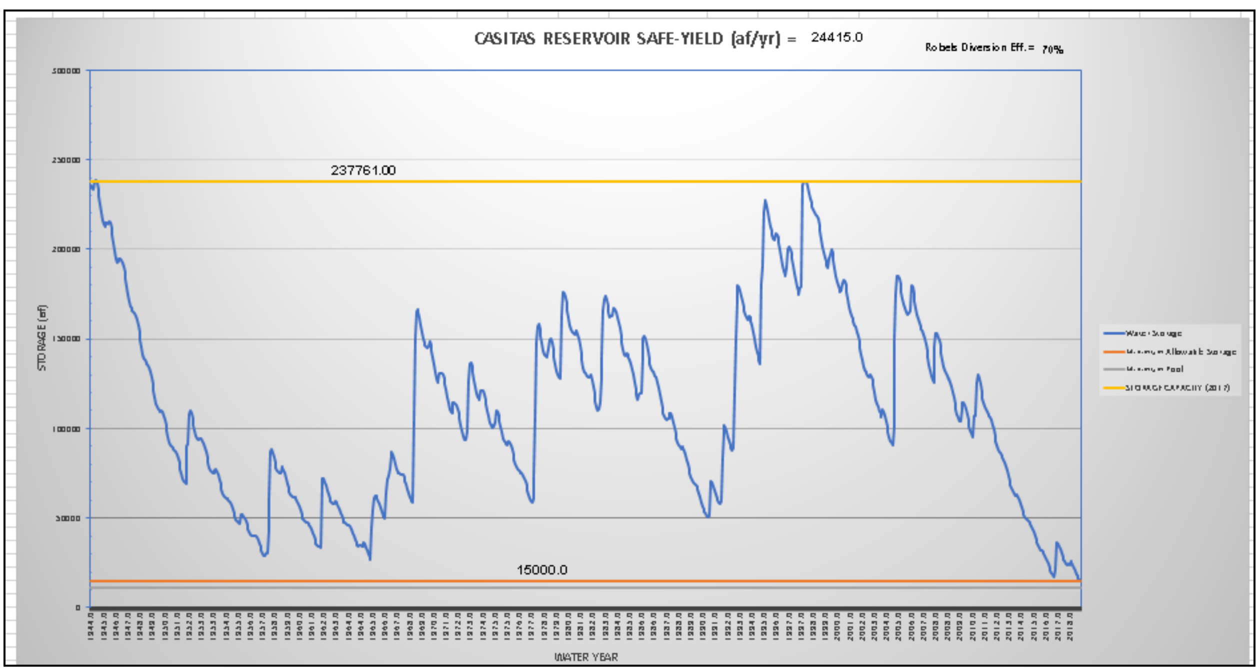

Figure 6-2. Simulated Lake Casitas Storage for Safe Yield with Demand Adjusted Based on WEAP Policy

7.0 Minimum Allowable Storage Policy Development

Casitas staff and Water Resources Committee wanted to base the selection of the Lake Casitas minimum allowable storage on the ability to meet critical uses supplied by Lake Casitas. Critical uses are defined as uses that should be met even during emergency periods to meet health and safety obligations, contractual obligations, and regional economic goals. The minimum allowable storage was related to the number of years of critical use volume to be held in storage at all times for the safe yield and safe demand model simulations.

A proposed minimum allowable storage policy was developed by reviewing future water demand estimates for categories of Casitas customers and estimating the percentage of critical water use in each category. Three options were developed – upper bookend, lower bookend, and recommended value. Assumptions for each option were made for future water demand, the percentage of demand considered critical, the amount of water lost from the Lake due to net evaporation, and the number of years of critical use to be retained in storage. Assumptions were validated by Casitas staff.

Table 7-1 provides details on the calculations and assumptions made for each minimum allowable storage option. After reviewing this information, Casitas staff agreed that the recommended minimum allowable storage value of 20,000 AF would be presented to the Board as a policy to be considered.

Table 7-1. Minimum Allowable Storage Calculations

	Upper Bookend			Lower Bookend			Recommended A		
	Percent Critical Use	**2040 Forecasted Water Use from Lake (AFY)**	**2040 Critical Use from Lake (AFY)**	**Percent Critical Use**	**2040 Forecasted Water Use from Lake (AFY)**	**2040 Critical Use from Lake (AFY)**	**Percent Critical Use**	**2040 Forecasted Water Use from Lake (AFY)**	**2040 Critical Use from Lake (AFY)**
Retail Use	60%	3,000	1,800	50%	2,700	1,350	50%	2,700	1,350
Agricultural Use	70%	8,000	5,600	50%	7,200	3,600	50%	7,200	3,600
Contract Sales	100%	6,500	6,500	25%	5,850	1,463	50%	5,850	2,925
Total Use		17,500	13,900		15,750	6,413		15,750	7,875
Years of Critical Use in Emergency Storage			3.0			1.0			2.0
Emergency Storage (AF)			41,700			6,413			15,750
Net Evap Make-Up			2,000			0			1,400
Dead Pool (AF)			950			950			950
Minimum Allowable Storage (AF)			**44,650**			**7,363**			**18,100**
Recommended Value (AF)			**45,000**			**7,000**			**20,000**

Assumptions

Upper Bookend:	Percent Critical Use is very conservative 2040 forecasted use is from 2016 UWMP without Ojai Valley demands met from wells 3.0 years of critical use gets through 3 additional drought years with no backup supplies Net evaporation make-up volume assumes no natural inflow or Robles diversions
Lower Bookend:	Percent Critical Use is based on all users cutting back to WEAP levels 2040 forecasted use assumes 10% permanent reduction from 2016 forecast values due to demand management 50% of ag deliveries keeps trees alive but does not produce a harvest 25% of contract deliveries assumes contract allocation is 50% per WEAP and contractors get 50% of that amount 1.0 years of critical use in storage gets through one additional drought year with no backup supplies Net evaporation make-up volume assumes natural inflow is minimal but enough to compensate for evaporation losses
Recommended:	WEAP allocations for all customer classes 10% reduced 2040 demand forecast for demand management is consistent with supply gap calculations 2.0 years of critical use in storage gets through two additional drought years with no backup supplies Net evaporation make-up volume based on conservative assumption of no significant Lake inflow

8.0 Results for Use in CWRP

As noted in previous sections, the Yield Model was updated during the course of the project to correct minor calculations and the application of the resequenced hydrologic data. This section presents results based on the final version of the model. The reliability analysis using all 100 synthetic hydrologic traces was used.

Based on the recommendation of staff and the Water Resources Committee, a minimum allowable storage level of 20,000 AF will be recommended to the Board for planning. **Figure 8-1** shows the exceedance probabilities for safe yield and safe demand modeling analyses based on that assumption and using the final version of the Yield Model. **Table 8-1** summarizes the results and provides the yield reliability values to be used in the CWRP. As an example of how the results in this table should be interpreted, the 95% safe demand reliability can be stated in words as follows:

There is a 95% chance that in the future Casitas will be able to safely support a demand of up to 10,660 AFY every year from Lake Casitas with existing supplies and infrastructure, 20,000 AF minimum allowable storage, and implementation of our current WEAP policy. There is a 5% chance that hydrology will be drier than expected and we will need to use our emergency storage pool at least once to meet the demand of 10,660 AFY.

Table 8-1. Lake Casitas Safe Yield and Safe Demand Reliability with Climate Adjustment for 20,000 AF Minimum Allowable Storage

Exceedance Probability (Reliability)	Safe Yield (AFY)	Safe Yield with Climate Adjustment (AFY)	Safe Demand (AFY)	Safe Demand with Climate Adjustment (AFY)
0.90	10,350	9,900	12,420	11,890
0.95	9,610	9,190	11,140	10,660
0.99	9,000	8,610	10,090	9,650

Note: Results based on 20,000 AF minimum allowable storage and 70% Robles diversion efficiency factor.

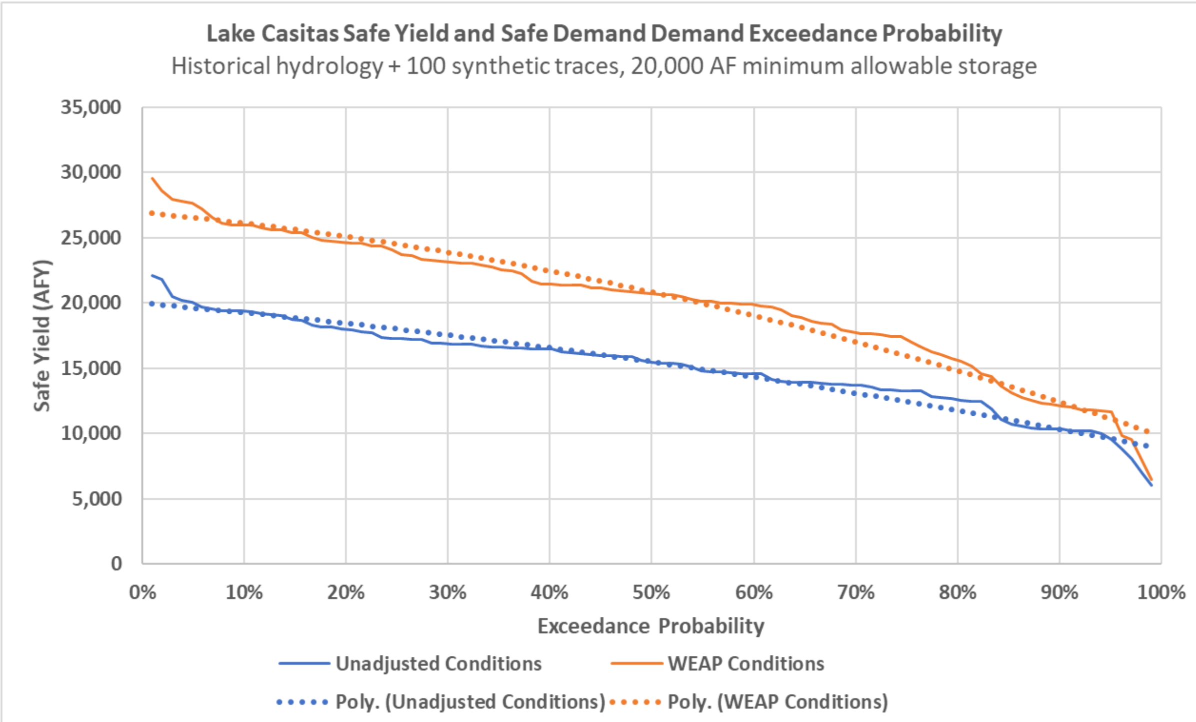

Figure 8-1. Exceedance Probability for Lake Casitas Safe Yield and Safe Demand Simulations With Synthetic Hydrology

The results summarized in **Table 8-1** demonstrate the significant benefits of the WEAP demand reduction policy in terms of managing and stretching existing water supplies. At the 95% reliability level with 20,000 AF minimum allowable storage, a base safe yield of 9,190 AFY can be delivered in every year. However, with implementation of the WEAP demand reduction targets during periods of low Lake levels, the safe demand with 95% reliability is 10,660 AFY. The difference – 1,570 AFY – is a measure of the benefit of Casitas' customers reducing their demands during drought periods. Without a commitment to implement water conservation measures during these periods, Casitas would have to acquire sufficient new water supplies to produce the equivalent of 1,570 AFY in additional yield.

9.0 References

CMWD, 2004. Water Supply and Use Status Report, Casitas Municipal Water District, December 7, 2004.

CMWD, 2016. Final Urban Water Management Plan and Agricultural Water Management Plan, 2016 Update, prepared by Milner-Villa Consulting for Casitas Municipal Water District, June 2016.

CMWD, 2018. Water Efficiency and Allocation Program, Casitas Municipal Water District, May 9, 2018.

Western Regional Climate Center/Desert Research Institute and Watersheds Coalition of Ventura County, 2019. Projected Changes in Ventura County Climate: 2021-2040.

Appendix E Analysis of the Risk of Lake Casitas Being Drawn Down to the Minimum Pool Level

Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services, Inc.

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Prepared by Chip Paulson

Reviewed by Autumn Glaeser

Approved by Autumn Glaeser

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1.0 Introduction

This Technical Memorandum (TM) presents analyses of the risk of Lake Casitas being drawn down to unacceptable levels due to future hydrology and operating conditions. The analyses were conducted to support decision-making for the Casitas Municipal Water District (Casitas) Comprehensive Water Resources Plan (CWRP). As a result of the recent historical minimum storage level that occurred at the end of 2018 and the possibility of a hotter and drier climate in the future, Casitas leadership and the community have expressed concern that there is an increased risk of the lake never fully recovering. This TM presents analyses that attempt to quantify that risk.

2.0 Assumptions

2.1 Starting Lake Storage

The storage volume in Lake Casitas on September 11, 2019 was 101,829 acre-feet (AF), based on information from the Casitas web site. For purpose of this analysis a starting lake storage volume of 100,000 AF was adopted.

2.2 Minimum Reservoir Pools

The Lake Casitas dead pool is 950 AF. It is currently not possible to withdraw water from below that level for distribution to customers. A minimum allowable storage volume of 20,000 AF was selected by the Casitas Water Resources Committee as a provisional level below which the lake would not be drawn down except in extreme emergencies beyond the conditions used for CWRP planning. Although that value may be changed in the future, it was used in this analysis of the risk of lake drawdown.

2.3 Water Demand and Production from Lake Casitas

Recent data provided by Casitas for water produced from Lake Casitas to meet customer demands is shown in Table 1. The average water production for the past 3 years was 12,670 acre-feet per year (AFY) and for the past 5 years was 14,810 AFY. Since water demand in the Casitas service area is trending downward based on effective conservation practices, this analysis used a demand on Lake Casitas from all its retail and resale customers of 13,000 AFY. (Note some of Casitas' demands are met from Mira Monte Well and Ojai Valley groundwater wells; demands met by those sources are not included in this analysis.) When simulating performance of Lake Casitas, demands were either held constant in every year at 13,000 AFY or adjusted based on water use reductions prescribed by the Casitas Water Efficiency and Allocation Policy (WEAP). For the CWRP, the unadjusted demand analysis was termed a "safe yield analysis" while the WEAP-adjusted demand analysis was termed a "safe demand analysis." Because 13,000 AFY is the recent historical demand on the lake and includes the effect of WEAP policy reductions in those years of low lake storage, the simulations with unadjusted demand may be better representations of future use. However, Casitas' customers have shown an ability to reduce water consumption to levels exceeding goals in the recent drought, so it is reasonable to expect a certain amount of additional conservation can be achieved during emergency conditions when lake level are close to the minimum allowable storage. Demand data for Casitas is described in more detail in the Water Demand Estimate for Casitas Municipal Water District TM prepared for the CWRP.

Table 1. Historical Water Production from Lake Casitas, 2011-2018.

Calendar Year	Water Produced from Lake Casitas
2011	14,841
2012	16,245
2013	20,402
2014	18,810
2015	17,247
2016	14,152
2017	12,213
2018	11,632

Modeling. The Lake Casitas Yield Model developed for use in the CWRP and based on a previous lake operations model was used for this analysis. This model is described in detail in the Lake Casitas Supply Analysis TM prepared for the CWRP.

Hydrology. The CWRP developed a suite of 100 hydrologic datasets for lake inflows and evaporation based on the statistics of the historical record. Each dataset has a length of 74 years to match the historical record used in the Yield Model. Each dataset is comprised of resequenced data from historical years, where the resequencing preserves the serial correlation statistics (e.g., the probability that a dry year will be followed by another dry year) of the historical record. This process is described in detail in the Lake Casitas Supply Analysis TM prepared for the CWRP.

3.0 Analysis

3.1 Historical Lake Levels

The Background Information TM for the CWRP presented a chart of historical Lake Casitas storage levels over the project history. This is shown in Figure 1. It demonstrates that there have been alternating 10- to 20-year cycles of wet and dry periods. The lowest storage volume since the lake began filling in 1959 occurred at the end of the recent prolonged drought when the lake storage was 72,278 AF in January 2019. Since that low level the lake has recovered marginally during the wet winter of 2018-19. The previous low storage level occurred at the end of a dry period in the late 1980s and early 1990s when the lake storage dropped to 127,786 AF in February 1991. Neither of the historical low storage levels approached the 20,000 AF minimum allowable storage level currently proposed for use for CWRP planning.

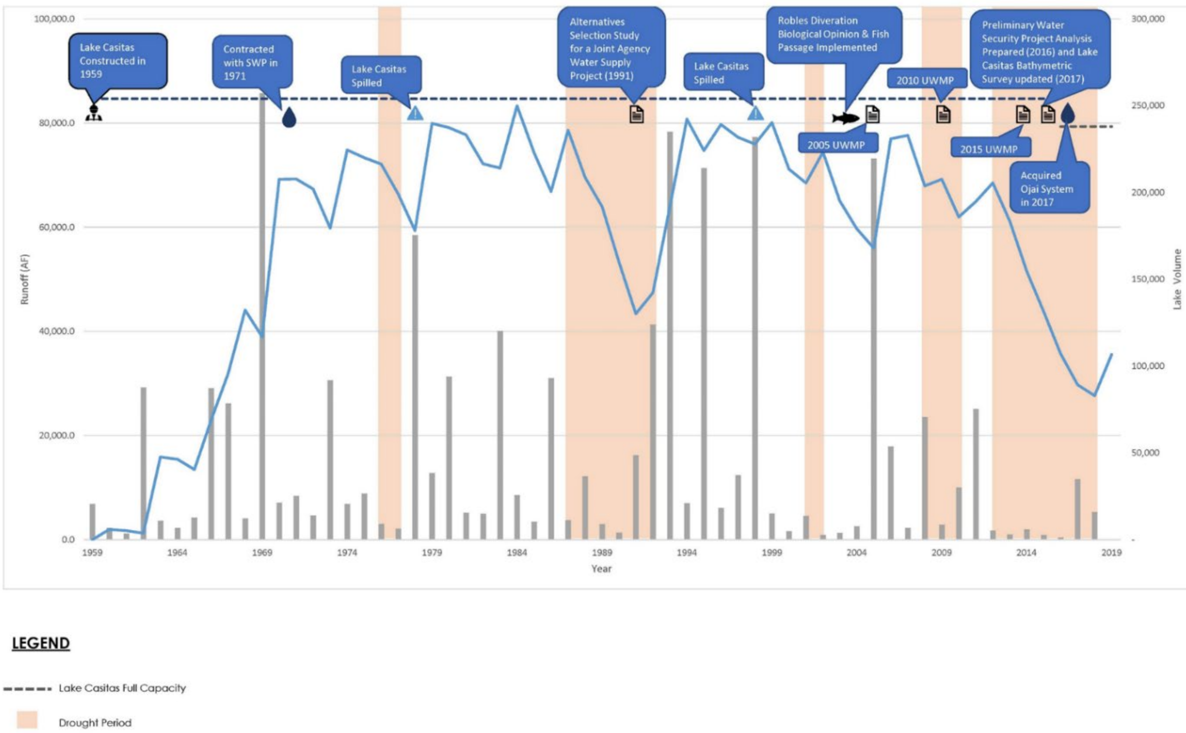
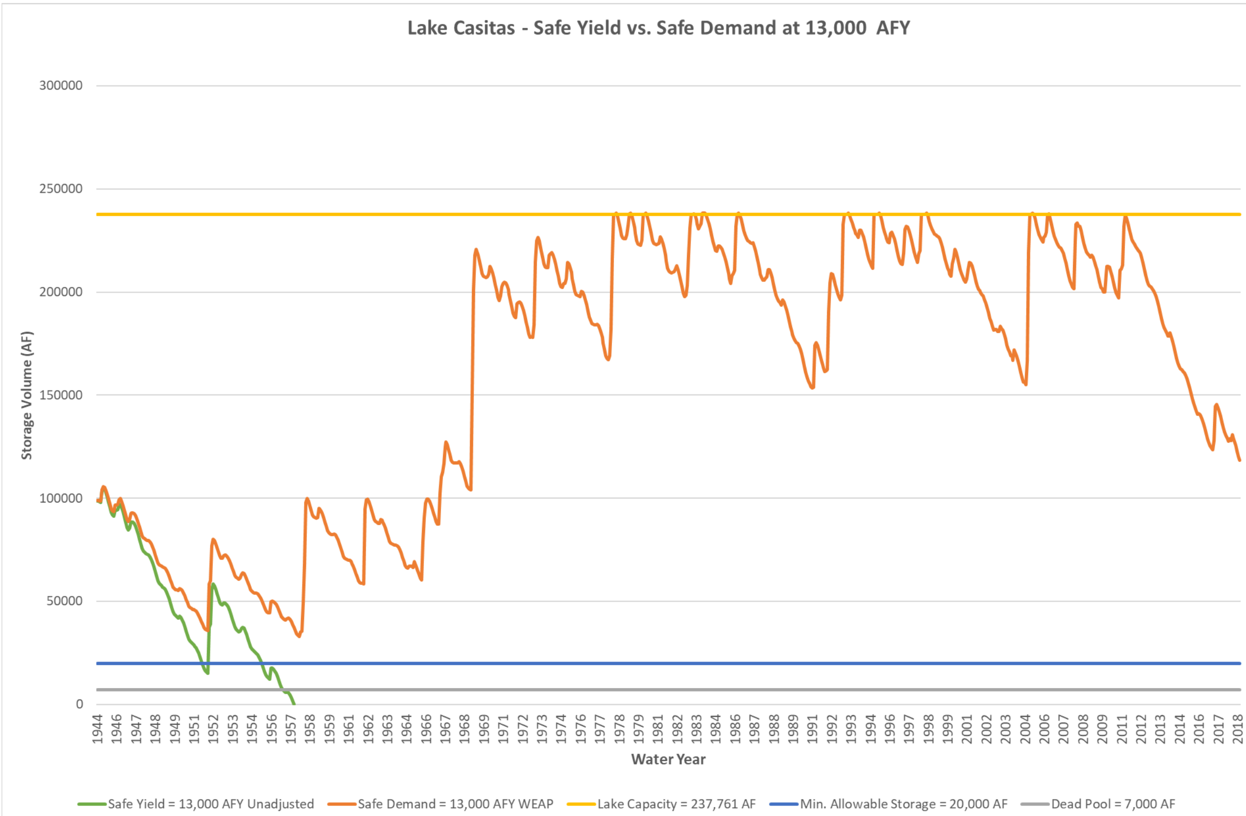


Figure 1. Historical Lake Casitas Storage Volumes and Inflows

3.2 Impacts of Repeat of Historical Hydrology

The Lake Casitas Yield Model was used to simulate performance of the lake based on the starting initial storage volume of 100,000 AF, a constant 13,000 AFY demand, and a recurrence of the 1945-2018 hydrologic record. This resulted in a complete drawdown of the lake. The lake storage volume was below the 20,000 AF minimum allowable storage level for 25 months before becoming completely depleted. Figure 2 shows the monthly storage volume over the simulation period using historical hydrology.



Note: Dead pool storage assumption was changed to 950 AFY later in the project

Figure 2 – Lake Casitas Drawdown Starting from Current Lake Storage for Historical Hydrology (Safe Yield and Safe Demand)

When WEAP policy water use reductions were applied based on the lake storage volume, there was a significant improvement in lake storage for the same initial conditions and historical hydrology. In this case the minimum storage volume for the period of simulation is 36,257 AF. Application of the water conservation targets prescribed in the WEAP policy would be effective in keeping the lake above the 20,000 AF minimum allowable storage level. However, reducing demands on the lake far below the 13,000 AFY assumed base demand for this analysis would require significant water use reduction by Casitas' customers. For example, in years when the lake storage volume is below 59,440 AF, the WEAP policy calls for a 50% reduction in water use.[1] This would reduce customer demands on Lake Casitas to 6,500 AFY, a value much less than any historical annual water demand.

[1] This is based on the study team's initial interpretation of the WEAP water use reduction guidelines. That interpretation was later changed based on input from Casitas, resulting in less drastic demand reductions at low lake levels. The lake storage risk analysis within this technical memorandum was not updated with the revised WEAP interpretation but the CWRP includes the revised results.

3.3 Statistical Analysis of Future Hydrologic Conditions

The 100 synthetic hydrologic traces for lake inflow developed for performing risk analyses for the CWRP were simulated with the assumptions of 100,000 AF initial storage and 13,000 AFY demand (with and without the WEAP reductions). Each hydrologic trace consists of 74 years of resequenced historical lake inflows. Because each trace has a different sequence of flows, some start with wet periods and others start with dry periods. Each sequence is equally likely, so the results of all the simulations can be evaluated to estimate the risk of the lake storage falling to different levels in the future.

Results of the statistical analysis of all 100 hydrologic traces are shown in Figure 3, which depicts the probability of the minimum storage on the y axis being equaled or exceeded during the 74-year simulation period.

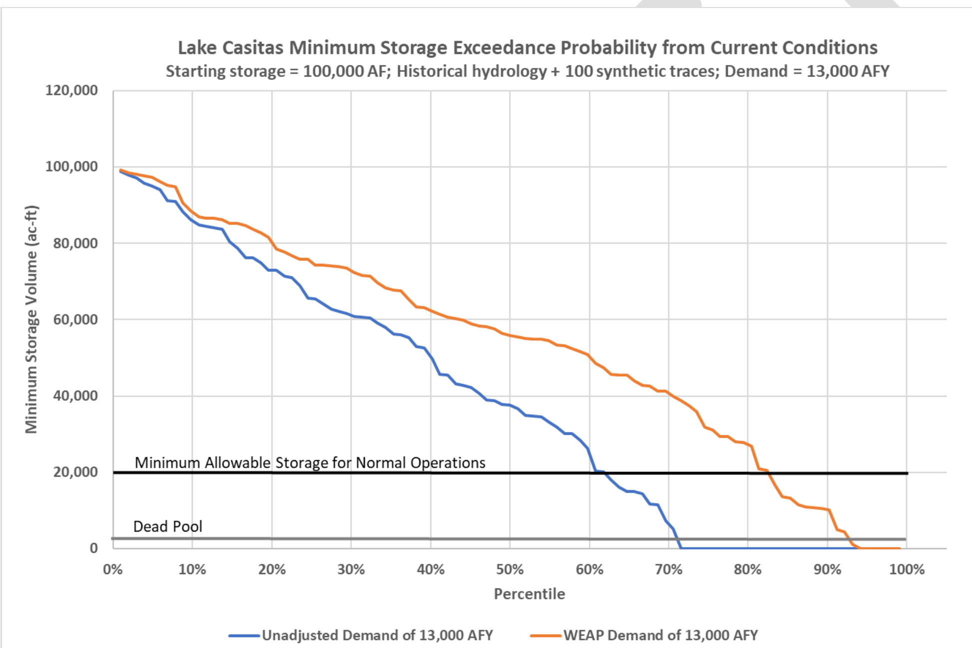


Figure 3. Exceedance Probability of Minimum Storage Occurring in Lake Casitas for Simulation of 100 Synthetic Hydrologic Sequences

If it is assumed the demand on the lake is constant at 13,000 AFY, there is a 37% chance the lake storage will fall below 20,000 AF in the future and a 28% chance it will fall below the dead pool level. If it is assumed the base demand is 13,000 AFY but it would be reduced as customers respond to measures called for in the WEAP policy during periods of low lake storage levels, there is a 17% chance the lake storage will fall below 20,000 AF in the future and a 6% chance it will fall below the dead pool level. A summary of the risk of Lake Casitas falling below these key levels over the next 74 years is provided in Figure 4.

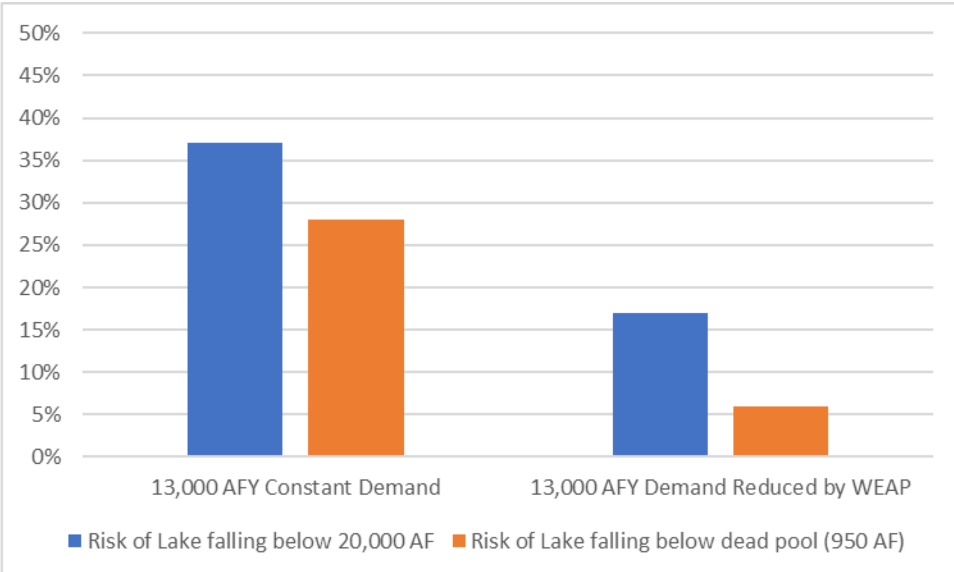


Figure 4. Percent Chance of Lake Casitas Being Drawn Down to Low Levels Over the Next 74 Years

3.4 Benefits of Supplemental Water

All inflows to Lake Casitas originate from local watersheds (directly tributary streams and the Ventura River). Casitas is actively pursuing multiple options for bringing in supplemental water supplies that are not dependent on runoff from local watersheds. These include options for accessing the District's allocation of State Water Project water, Matilija Formation deep wells, and seawater desalination options. This would add diversity to the Casitas water portfolio and provide alternate sources of supply at times when the local system is in drought conditions.

Benefits of importing supplemental water to Lake Casitas were investigated. For this analysis there was no assumption made about the specific source of water. A simple analysis with a continuous source of supplemental water was conducted (equal deliveries in every month and every year). The volume of supplemental water needed to prevent the lake level from falling below the minimum allowable storage volume of 20,000 AF for a recurrence of historical hydrology was estimated to be 2,350 AFY.

See **Figure 5** for a plot of storage volumes showing the benefit of importing 2,350 AFY of supplemental water every year assuming a starting lake storage volume of 100,000 AF, a repeat of historical hydrology, and a constant demand of 13,000 AFY. The synthetic hydrology analysis showed that future hydrology is likely to be drier than the observed historical record. To be conservative, a supplemental supply of 2,500 AFY is recommended to mitigate the risk of Lake Casitas storage dropping below 20,000 AF.

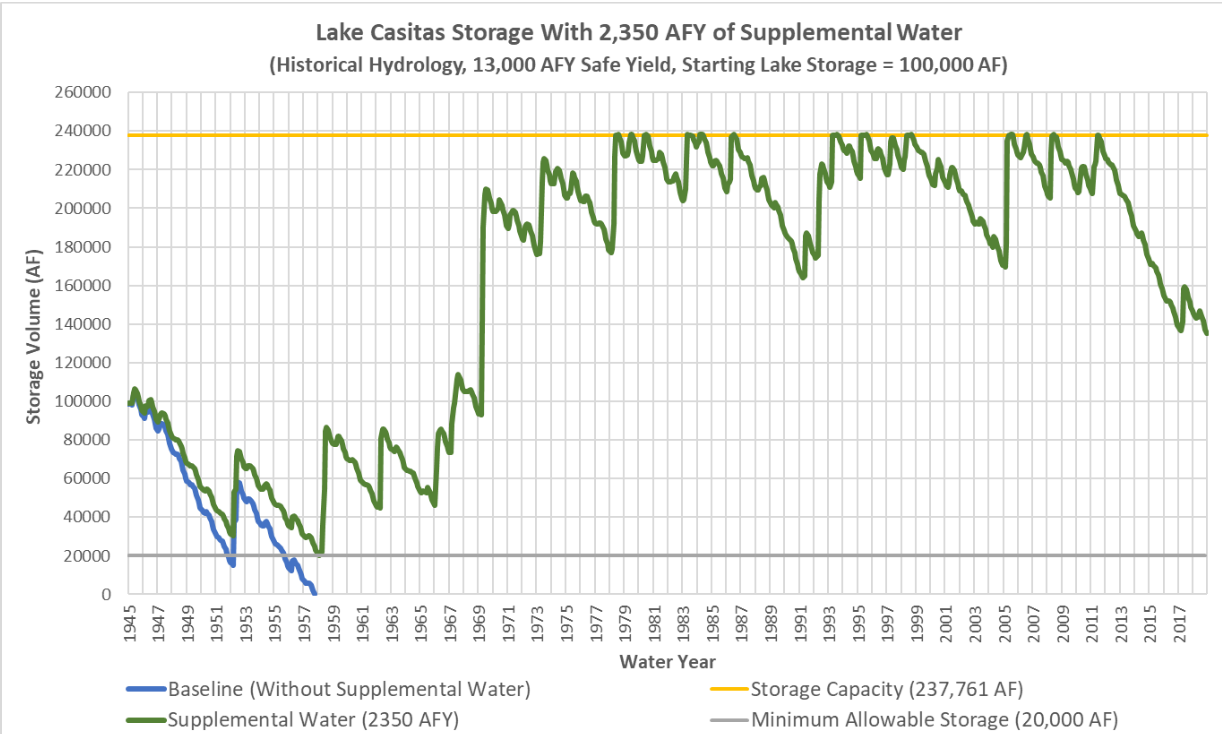


Figure 5 – Lake Casitas Storage with 2,350 AFY of Supplemental Water, Historical Hydrology, and 13,000 AFY Constant Demand

4.0 Summary

The following points summarize the risk of Lake Casitas being drawn down to unacceptable levels based on the current lake storage volume and recent operating history.

- If historical hydrology were to repeat starting in 2020, Lake Casitas would be drawn down to a low storage of about 36,000 AF. This would be the lowest lake storage ever recorded after the lake first filled, but would be above the minimum allowable storage of 20,000 AF set by the Water Resources Committee.
- There is a 17% chance the lake storage will fall below 20,000 AF in the future and a 6% chance it will fall below the dead pool level.
- The volume of supplemental water needed to prevent the lake level from falling below the minimum allowable storage volume of 20,000 AF is approximately 2,350 AFY if historical hydrology were to reoccur. To be conservative a supplemental supply of 2,500 AFY is recommended to mitigate the risk of the lake going dry in the future.

Appendix F Decision Support Tool Documentation Technical Memorandum

Casitas Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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Prepared by Autumn Glaeser

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1.0 Summary

Stantec developed a decision support tool for Casitas Municipal Water District (Casitas) to organize water supply options and portfolios identified in the Comprehensive Water Resources Plan (CWRP) and evaluate and rank them based upon common criteria. Evaluation criteria selected for use in this tool included factors representing a triple bottom line approach to decision-making. Stantec prepared this tool to assist Casitas and stakeholders in evaluating the sensitivity of the ranking of water supply options and water supply portfolios (groupings of water supply options) to the various factors that were defined during the study. The decision support tool includes graphical outputs showing how the rating and ranking of each option and portfolio responds to different weightings of the identified criteria.

The Excel-based decision support tool was provided to Casitas separately from this TM. The Excel workbook contains instructions on how to update the tool to revise input data and add new projects.

2.0 Decision support Tool Overview

The CWRP decision support tool was developed in Excel for ease of use and transparency of results. The tool implements a basic multi-criteria decision analysis methodology in which:

1. Evaluation criteria are identified based on the success factors important to Casitas.
2. Options are given a numerical rating (in this case 1-5, with 5 being best) for each of the selected criteria based on objective data or subjective professional opinion.
3. Criteria categories are given weights based on preferences and values of the group doing the scoring.
4. A composite weighted score is calculated for each option as the sum of the products of the rating and the weight for each criterion.
5. A composite weighted score is calculated for each water supply portfolio as the sum of the products of the option composite weighted score and the percentage of annual yield contributed by the option in the overall portfolio.

To select key criteria that can help Casitas identify beneficial options, categories were identified that represented key factors for evaluating each of the options. These categories consist of Technical, Cost, Environmental, and Social factors, and cover the traditional triple bottom line approach to decision-making. For each of the four categories, multiple criteria were defined and scored individually to develop a combined option score. The criteria defined for each category are listed in Table 2-1.

Table 2-1 – Decision Support Tool Criteria for Evaluating Water Supply Options and Portfolios

Criteria Category	Individual Criteria
Technical	Annual Yield Technical Feasibility Reliability Time to Implement Phased Construction
Cost	Construction Cost O&M Cost Cost Effectiveness
Environmental	Water Quality Permitting and Regulatory Constraints Energy Efficiency
Social	Casitas Control Stakeholder Support Regional and Ancillary Benefits

These criteria were reviewed and approved by Casitas staff and Water Resources Committee.

3.0 Ranking Criteria

The following sections summarize the criteria used to evaluate each of the water supply options considered in the CWRP.

3.1 Technical Category

3.1.1 Annual Yield

The average annual yield contributed by each water supply option was estimated. For the majority of options, an estimate or range of possible annual yield was available from previous planning documents or was developed as part of the CWRP studies. Average annual yield for all alternatives was estimated in acre-feet per year where the option provided a new or expanded supply of water. Some of the options do not provide a direct new supply of water, such as sediment removal from Lake Casitas which would improve the available storage capacity of the lake but not create any new supply for Casitas. These options were ranked in terms of their effectiveness in increasing the yield of Lake Casitas based on existing water sources.

3.1.2 Technical Feasibility

This criterion reflects the ability to construct and implement the option. Options that would be implemented using established construction methods are scored higher than those with new or technically challenging elements. Options such as well improvements and conservation measures (i.e., options for which Casitas has a proven track record of delivering successful projects) score highest for this criterion.

3.1.3 Reliability

The reliability criterion is used to rank the ability of an option to deliver a consistent and predictable supply of water. Options that can provide consistent supply on an annual basis, even in dry years, are preferred. Examples of projects that scored high for this criterion include the Ojai Basin well improvement project, whereas environmental modification is scored lower as it is unclear how much water will become available on a consistent basis. Similarly, SWP connection projects have a large average yield but during dry years the availability of water may be severely reduced, and thus they received a lower score for this criterion.

3.1.4 Time to Implement

The approximate time needed to plan, design, and implement an option was considered. In general, options were separated into one of three categories: those that were considered to have a short time frame to implement (0-5 years), a mid-range time to implement (5-10 years), and long-term options (10-20+ years). Options that were already being delivered or had substantial pre-planning, such as conservation and the Ojai Basin well rehabilitation option, scored the highest in this category.

3.1.5 Phasable Construction

This criterion was scored but not included in the final weightings and scoring for each of the options. This criterion was used to assess the ability of each project to be delivered in phases and may or may not be a determining factor for pursuing the project being considered. The findings from Stantec's analysis are included for Casitas' reference, though whether or not an option can be phased was not considered an attribute of the project that should make it more or less desirable than another project independent of the criteria considered in this analysis.

3.2 Cost Category

3.2.1 Construction Cost

The cost for construction was estimated or identified for each of the options evaluated. In some cases this was based on a qualitative assessment of the order of magnitude of the likely construction cost. This criterion was based on the total capital cost only and considered benefits of regional cost sharing. Options that required low capital investment such as conservation measures and environmental habitat modification scored the highest for this category. The relative cost per AFY of increased yield was not considered as part of this criterion as cost effectiveness was considered separately from the total capital cost needed to implement an alternative.

3.2.2 Operation & Maintenance Cost

For this criterion, the typical yearly cost to operate and maintain the option was evaluated. Ongoing costs were either estimated by Stantec staff or adopted from prior studies if they delineated an estimated yearly O&M cost for the alternative. In many cases qualitative estimates of relative O&M

costs were used in the analysis. Options that require a large yearly outlay of capital, such as operation and maintenance of a desalination plant or desalter, ranked the lowest for this category.

The cost of water was also considered for this category, but at a conceptual level. The current relative costs of imported water, versus desalinated water, versus local supplies was considered when ranking projects for anticipated O&M costs. In general, projects that developed local groundwater and surface water supplies were the most favorable in terms of anticipated O&M cost, while imported and highly processed water were ranked less favorably. However, future decreases in the cost of treatment technology also make desalination projects more favorable for long term supply planning than new imported water connections.

3.2.3 Cost Effectiveness ($/AFY)

For this category, a cost per AFY of increased yield produced was either identified from past studies or calculated for each option. Cost was based on capital cost of implementing the option. For many of the options, this value had been identified in previous planning documents. For other options, the value identified for the annual yield criterion and the capital cost criterion were used to compute a cost per AFY of increased yield. Stantec used the capital cost per AFY of water for each option to quantify the anticipated cost to develop each new source. Given the stage of planning that most of these projects are currently in (i.e., mostly conceptual), this metric can be used to get a general idea of cost effectiveness to develop the project.

3.3 Environmental Category

3.3.1 Water Quality

The water quality criterion was used to capture any negative effects to environmental water quality (e.g., in Lake Casitas or the Ventura River) that the options might pose. Those options that would require more work and study by Casitas to address water quality concerns were ranked lower. The majority of options scored relatively high in this category as no alternatives were identified that posed significant concerns for water quality. Alternatives like Ojai Basin well improvement and conservation scored the highest as they represented gains in existing sources of water where water quality issues were known and previously addressed.

3.3.2 Permitting and Regulatory Constraints

This criterion was established to capture any regulatory or permitting issues that may be associated with any of the alternatives. Alternatives that pose significant challenges to permitting or regulatory compliance were identified, and all alternatives were scored based on the expected level of effort to get them approved with all anticipated agencies and partners. Alternatives that scored the lowest in this category include new desalination projects and construction of a new water supply dam, which would both pose significant challenges to permitting and regulatory compliance in order to be implemented.

3.3.3 Energy Efficiency

The relative energy efficiency of each option was considered during the option ranking process. This category was difficult to define for many of the options as they have not undergone detailed planning or design. Stantec considered the qualitative energy requirement to construct and operate each of the options and assigned a relative scoring for each of the options based on best engineering judgement and experience from similar. The options that were determined to have the highest concern for energy efficiency are the desalination projects, where the energy needed to process water through membranes is high.

3.4 Social Category

The Social category was established to help quantify the social and political factors that could affect implementation of the options.

3.4.1 Casitas Control

This criterion was meant to capture the amount of control Casitas would have when implementing an option. Those options that involve ownership by or coordination with outside agencies or partners depend on political decisions and financial commitments outside Casitas' control. Ongoing operations may also be more challenging to coordinate. Options such as development of the Matilija deep formation wells or improvements to wells in the Ojai groundwater basin received the highest scores for this category as Casitas would be able to initiate and complete these options independently and would not need to rely on partners to complete or operate them.

3.4.2 Stakeholder Support

The stakeholder support criterion was intended to capture feedback from stakeholders and ratepayers for Casitas and identify options that have been historically supported by these groups or have not been identified as politically volatile. Options such as continued conservation and construction of improved Robles Diversion Structure features are options that have historically been supported by the local community and were scored high for this criterion.

3.4.3 Regional and Ancillary Benefits

The final criterion evaluated for the decision support tool is intended to capture whether an option offers any ancillary or regional benefit besides the creation of a new source of water, or greater confidence in an existing source of water, for Casitas. Examples of options that scored high for this category include the interconnections with the SWP, as all of these options bring in a new source of water for the region, build regional partnerships, and require multi-agency coordination that can help other options move forward by establishing protocols and practices for these agencies working together that can be applied to future endeavors.

3.5 Initial Weightings

Once criteria were established for the decision support tool, initial weightings were applied to each of the criteria listed above. Criteria weights capture the relative importance of each of the criteria compared to the others, based on the values and judgements of decision-makers. These weightings were discussed with Casitas staff and the Water Resources Committee of the Casitas Board. Ultimately the Water Resources Committee made the final selection of criteria weights. It is noted that as part of the decision support tool process, several iterations of the criteria rankings were analyzed based on different criteria weights in order to establish the sensitivity of the ranking of options to the criteria weights. Those iterations and the impact on the ranking of options are discussed below.

Table 3-1 – Base Weightings

Description	Annual Yield	Technical Feasibility	Reliability	Time to Implement	Construction Cost	O&M Cost	Cost Effectiveness ($/AFY)	Water Quality	Permitting and Regulatory Constraints	Energy Efficiency	Casitas Control	Stakeholder Support	Regional and Ancillary Benefits	Technical Sum	Cost Sum	Environmental Sum	Social Sum	Total
	Percentage of Total Weight (%)																	
Base Weightings: The preferred criteria weighting based on discussion with Casitas staff	15	5	5	5	15	5	10	10	8	7	5	5	5	30	30	25	15	100

4.0 Water Supply Options Summary

The options discussed in this technical memorandum (TM) are detailed in the Appendix A Background Information Technical Memorandum included the CWRP. For reference, the options are listed in Table 3-1, followed by a brief description of each.

Table 4-1 – Water Supply Options Long List Ranked using Decision Support Tool

1	C 01 (Low Conservation/Enhanced Demand Management Programs)
2	C 02 (High Conservation/Enhanced Demand Management)
3	DW 01 (Supplemental Water from City of Santa Barbara)
4	DW 02 (Casitas Desal Plant)
5	DW 03 (Ventura County Regional Desal Plant)
6	GW 01 (Matilija Formation Deep Wells)
7	GW 06 (Ojai Basin Desalter)
8	GW 08 (Well Improv in Ojai GWB)
9	MO 01 (Environmental/Habit Modif)
10	MO 06 (Sediment Removal at North End of Lake Casitas)
11	MO 08 (Robles Diversion Fish Passage Improvements)
12	RW 06 (Ojai East Septic Collect, Treat, Recharge)
13	SW 03 (Matilija Dam GW/SW)
14	SW 04 (Exp of Robles Canal)
15	SW 05 (New Dam Upstream of Lake Casitas)
16	SWP 01 (Deliveries via City of Ventura SWP Interconnect & Casitas-Ventura Interconnect)
17	SWP 02 (Calleguas Emergency Interconnection)
18	SWP 03 (Ventura-SBC Interconnection)
19	SWP 04 (Casitas-Calleguas Interconnection)
20	SWP 05 (In-Lieu Project Water)

1. **C 01 (Conservation/Enhanced Demand Management Programs – 5%).** This option involves implementing additional demand management measures to drive water use even lower. In this option demand management measure would reduce average annual demand 5% below the average annual demands of 16,000 AFY for the Casitas System and 2,350 AFY for the Ojai Valley System. It is anticipated this program, in additional to measures targeting municipal uses, would

include incentives to help promote on-farm water efficiency and ensure the Casitas resale entities continue to aggressively promote post-drought conservation among their customers.

2. **C 02 (Conservation/Enhanced Demand Management Programs – 10%).** This option involves implementing additional demand measures to drive water use even lower than in option C 01. In this option demand would be reduced 10% below the average annual demands of 16,000 AFY for the Casitas System and 2,350 AFY for the Ojai Valley System. It is anticipated this program, in additional to measures targeting municipal uses, would include incentives to help promote on-farm water efficiency and ensure the Casitas resale entities continue to aggressively promote post-drought conservation among their customers.

3. **DW 01 (Desal Water from City of Santa Barbara).** The City of Santa Barbara reactivated its desalination plant in late 2017. The City of Santa Barbara has a variety of infrastructure projects that need to take place to allow the distribution of desalinated water throughout the entire city water system, including the South Coast Conduit that supplies Montecito Water District (MWD) and Carpinteria Valley Water District (CVWD). Casitas is in preliminary design for the SWP 03 Ventura-Santa Barbara Counties Interconnection Project, which would construct infrastructure to connect the Casitas system to the CVWD system. This infrastructure could be utilized to also deliver desalinated water to Casitas to help offset the reliance on Lake Casitas supplies.

4. **DW 02 (Casitas Desal Plant).** This option involves development of desalinated water supplies by Casitas to supplement surface water supplies for coastal communities within the Casitas service area.

5. **DW 03 (Ventura County Regional Desal Plant).** Ventura County formed a Desalination Task Force in 1991. The task force was formed to assess the possibility of developing a desalination facility in the County and stay up to date on other desalination projects within California including neighboring Santa Barbara County. From this task force to the most current drought, the County has determined a desalination project should remain a future possibility and is considered as an option in this analysis.

6. **GW 01 (Matilija Formation Deep Wells).** The Matilija Formation Deep Wells project consists of the construction of one or more deep water wells in the Matilija sandstone. This formation contains groundwater that recharged over very long periods and is essentially non-renewable. This option includes the exploration of both horizontal and vertical wells and would allow for drought-period production of groundwater and delivery directly to the Robles Canal.

7. **GW 06 (Ojai Basin Desalter).** This option conceptually would target otherwise unusable high chloride water from the lowest aquifers in the Ojai Basin to allow for its potable use and allow for recharge water to replace the poorest quality water over time. Casitas would own and operate the desalter project infrastructure. Delivering the water acquired from the Ojai Desalter Project will require installation of a membrane treatment system, and connection to the existing Casitas Ojai transmission system, as well as targeting a well (existing or new) to supply the high chloride water. Additionally, the brine from the treatment process would be delivered to the existing Ojai Valley Sanitary District (OVSD) collector lines in the project area. Production for the Ojai Basin Desalter Project is estimated to be in a range from 300 to 400 AFY.

8. **GW 08 (Well Improvements in Ojai GWB).** Casitas acquired GSWC's Ojai water system in June of 2017. Casitas operates these wells on two parcels located on either side of San Antonio Creek, south of Grand Avenue. Recent studies identified several well improvement projects specific to

the Ojai wellfield. The projects that can be implemented within a 12-month time period were included in the Early Action Plan (EAP). The remaining project was a new well replacing Mutual #4 at Grand Avenue Wellfield.

9. **MO 01 (Environmental/Habitat Modification).** The Environmental/Habitat Modification option consists of activities to reduce the amount of a major water consuming plant in the Casitas service area and contributing watershed, Arundo donax (Arundo). Activities to remove this plant in the Casitas service area are already underway by Ventura County. This option assumes Casitas takes an active role in the Arundo removal program in order to prioritize treatment of areas in the Lake Casitas watershed, and thus increase runoff to the lake.

10. **MO 06 (Sediment Removal from North End of Lake Casitas).** This option was identified in the 2005, 2010, and 2016 UWMP and would involve removing sediment from the north end of Lake Casitas to increase the reservoir storage volume. Removing sediment in a portion of the reservoir pool area would recover some of the storage volume lost due to sediment accumulation since the dam was constructed in 1959.

11. **MO 08 (Robles Diversion Fish Passage Improvements).** This project is meant to optimize the operation of the Robles Diversion Dam and maximize the efficiency of the intake of the diversion structure into the Robles Diversion Canal. Several alternatives were proposed in the Robles Diversion Fish Screen Alternatives Feasibility Study (MKN Associates, 2019). The most extensive (and expensive) alternative was assessed in the decision support tool.

12. **RW 06 (Ojai East Septic Collection, Treatment, Recharge).** The Ojai East Septic Recharge project would install a package wastewater treatment plant in east Ojai Valley and a network of sewer collection mains and laterals to collect sewage that is currently being disposed in septic systems. The influent would be treated by means of a centralized redundant extended aeration system including anoxic chambers and clarification followed by membrane filtration and disinfection to meet tertiary standards. The treated effluent would then be piped to the lower pond in the San Antonio Creek Spreading Grounds (SACSGRP) to help recharge the Ojai Groundwater Basin.

13. **SW 03 (Matilija Dam Groundwater/Surface Water).** Matilija Dam Groundwater/Surface Water project involves collecting and transmitting water to Lake Casitas that currently exists in the shallow sediments in and near Matilija Lake and in the ponding area behind the dam.

14. **SW 04 (Exp of Robles Canal)**. The Robles Canal is part of the U.S. Bureau of Reclamation Ventura River water supply project and diverts water from the Ventura River to Lake Casitas. The present capacity of the Robles diversion canal is 500 cfs. Expansion of the Robles Canal was considered by Reclamation in 1968. The proposed project would enlarge the existing canal and headworks capacity up to 2,200 cfs, thereby allowing greater diversions to Lake Casitas during high flow periods.

15. **SW 05 (New Dam Upstream of Lake Casitas).** The 1991 Alternatives Selection Study for a Joint Agency Water Supply Project prepared by Boyle Engineering Corporation includes five project alternatives for new dam and reservoir construction considered in the 1968 Bureau of Reclamation Report. These five projects were proposed as viable alternatives in anticipation of the Matilija Dam silting over time and losing its role in aiding supply to Lake Casitas.

16. **SWP 01 (Calleguas Inter-tie and Casitas-Ventura SWP Interconnection).** This option would allow for access to SWP water using a combination of the City of Ventura SWP Interconnection pipeline and a new pump station to deliver water to the Casitas distribution system.
17. **SWP 02 (Calleguas Emergency Interconnection).** This option was identified as part of Calleguas Municipal Water District's (Calleguas) Water Supply Alternatives Study and would include a bi-directional pipeline to deliver SWP water to Lake Casitas during normal operations and deliver Lake Casitas water to Calleguas during emergencies. This alternative, referred to as the Calleguas Emergency Interconnection with Casitas, would allow for a direct connection between Calleguas and Casitas.
18. **SWP 03 (Ventura-Santa Barbara Counties Interconnection).** This option, referred to as the Ventura-Santa Barbara Counties Interconnection, involves constructing infrastructure from Carpinteria Valley Water District to the Casitas water system and would allow for Casitas to receive SWP water from the Central Coast Branch through the South Coast Conduit. This project is currently in preliminary design stages.
19. **SWP 04 (Casitas-Calleguas Interconnection).** This option, referred to as the Casitas-Calleguas Interconnection, involves a new pipeline from the proposed City of Ventura SWP Interconnection pipeline directly to the proposed Casitas pump station to deliver water to Casitas directly from Calleguas. This project is in the early planning stages.
20. **SWP 05 (In-Lieu Project Water).** This option would allow for the in-lieu transfers of SWP allocations between the City of Ventura and Casitas. Ventura would take a portion of the Casitas SWP allocation in return for reducing its demand on Lake Casitas. This project requires the City of Ventura SWP Interconnection pipeline to be constructed for Ventura to access SWP supplies.

5.0 Criteria Scoring

For all of the above criteria, each option was given a 1 through 5 score based on the background material available for each option, Stantec's best engineering judgement, and experience from other similar options. This initial scoring was discussed with Casitas during an in-person workshop, where every score was discussed in detail. Based on that workshop, some scores were revised and updated, and some of the scoring was flagged for additional research. The scores shown in Table 5-1 represent the conclusion of this process and the final scores assigned for each of the evaluated options.

Table 5-1 – Criteria Scores for CWRP Options

Option Number	Option	Technical					Cost			Environmental			Social		
		Annual Yield	Technical Feasibility	Reliability	Time to Implement	Phasable Construction	Construction Cost	O&M Cost	Cost Effectiveness ($/AFY)	Water Quality	Permitting and Regulatory Constraints	Energy Efficiency	Casitas Control	Stakeholder Support	Regional and Ancillary Benefits
1	C 01 (Low Conservation/Enhanced Demand Management Programs)	4.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	3.0	3.0
2	C 02 (High Conservation/Enhanced Demand Management)	5.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
3	DW 01 (Supplemental Water from City of Santa Barbara)	5.0	4.0	4.0	3.0	5.0	3.0	2.0	3.0	4.0	4.0	1.0	3.0	4.0	4.0
4	DW 02 (Casitas Desal Plant)	5.0	2.0	5.0	1.0	4.0	1.0	1.0	2.0	4.0	1.0	1.0	5.0	1.0	3.0
5	DW 03 (Ventura County Regional Desal Plant)	5.0	2.0	4.0	1.0	4.0	2.0	1.0	3.0	4.0	1.0	1.0	2.0	2.0	5.0
6	GW 01 (Matilija Formation Deep Wells)	5.0	1.0	2.0	3.0	1.0	1.0	2.0	2.0	3.0	3.0	3.0	5.0	2.0	2.0
7	GW 06 (Ojai Basin Desalter)	3.0	2.0	5.0	3.0	2.0	3.0	1.0	2.0	4.0	3.0	2.0	5.0	3.0	2.0
8	GW 08 (Well Improv in Ojai GWB)	4.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	5.0	3.0	5.0	5.0	2.0
9	MO 01 (Environmental/Habit Modif)	3.0	4.0	1.0	4.0	5.0	5.0	3.0	2.0	5.0	4.0	5.0	3.0	5.0	5.0
10	MO 06 (Sediment Removal at North End of Lake Casitas)	4.0	2.0	2.0	2.0	5.0	1.0	4.0	2.0	5.0	2.0	3.0	4.0	3.0	2.0
11	MO 08 (Robles Diversion Fish Passage Improvements)	3.0	4.0	2.0	4.0	2.0	3.0	4.0	4.0	5.0	4.0	5.0	4.0	5.0	2.0
12	RW 06 (Ojai East Septic Collect, Treat, Recharge)	2.0	3.0	3.0	2.0	2.0	2.0	4.0	2.0	3.0	3.0	2.0	2.0	3.0	4.0
13	SW 03 (Matilija Dam GW/SW)	3.0	2.0	3.0	3.0	1.0	3.0	3.0	2.0	3.0	3.0	4.0	4.0	3.0	1.0
14	SW 04 (Exp of Robles Canal)	4.0	1.0	5.0	2.0	1.0	1.0	4.0	3.0	3.0	1.0	5.0	4.0	2.0	2.0
15	SW 05 (New Dam Upstream of Lake Casitas)	5.0	1.0	4.0	1.0	2.0	1.0	2.0	3.0	4.0	1.0	4.0	5.0	1.0	2.0
16	SWP 01 (Deliveries via City of Ventura SWP Interconnect & Casitas-Ventura Interconnect)	5.0	4.0	2.0	2.0	3.0	1.0	2.0	2.0	4.0	3.0	3.0	3.0	4.0	5.0
17	SWP 02 (Calleguas Emergency Interconnection)	5.0	4.0	3.0	2.0	3.0	1.0	2.0	2.0	4.0	2.0	3.0	1.0	4.0	5.0
18	SWP 03 (Ventura-SBC Interconnection)	5.0	4.0	2.0	4.0	3.0	3.0	2.0	3.0	4.0	4.0	3.0	4.0	4.0	5.0
19	SWP 04 (Casitas-Calleguas Interconnection)	5.0	4.0	3.0	2.0	3.0	1.0	2.0	2.0	4.0	3.0	3.0	3.0	4.0	5.0
20	SWP 05 (In-Lieu Project Water)	5.0	4.0	2.0	2.0	5.0	1.0	2.0	2.0	4.0	4.0	5.0	2.0	4.0	5.0

6.0 Water Supply Option Criteria Rankings and Sensitivity Analysis

In order to prioritize and rank the water supply options, the base weightings for each of the criteria were adjusted to determine whether the relative order of options from best (highest score) to worst (lowest score) was significantly affected by the weights assigned to the criteria. A sensitivity analysis was performed consisting of seven different criteria weighting scenarios to assess whether the ranked order of options changed significantly when applying a different weighting to any of the specified criteria. **Table 6-1** shows how each criterion was weighted for each of the seven scenarios. In all instances, the total weighting for all criteria equals 100%. The top row of **Table 6-1** shows the base weightings that were established through conversation with Casitas staff. The following six scenarios changed the combined weighting of one of the four categories and held the relative weightings of each criterion within those categories at the same ratio to the total for that category. Therefore, the base weighting scenario established the relative importance of the criteria within each of the categories, and the overall percentages were varied based on which category was emphasized in each of the scenarios.

Using the different criteria weightings for each scenario shown in **Table 6-1**, the options were each given a combined score for each of the weighting scenarios. **Table 6-2** shows the ranking for each of the options for each of the seven weighting scenarios. As shown in this table, the top 10 options are comprised of the same 12 options for all seven scenarios.

Figure 6-1 through **Figure 6-7** show bar graphs that display the options in order of their score for each of the seven weighting options. These charts display the prioritization order of the options evaluated with the decision support tool for each scenario, and display the rankings shown in **Table 6-2**. The bar charts also display the portion of the total option score contributed by the four criteria categories (technical, cost, environmental, and social) to help discern which options offer the most benefits in each of those categories.

Based on the results of the criteria weighting sensitivity analysis, Casitas determined that the base weighting scenario adequately represented the values of the District and those results were carried forward into the water supply portfolio analysis.

Table 6-1 – Criteria Weighting Percentages Used in Sensitivity Analysis

Scenario Number	Description	Annual Yield	Technical Feasibility	Reliability	Time to Implement	Construction Cost	O&M Cost	Cost Effectiveness ($/AFY)	Water Quality	Permitting and Regulatory Constraints	Energy Efficiency	Casitas Control	Stakeholder Support	Regional and Ancillary Benefits	Technical Sum	Cost Sum	Environmental Sum	Social Sum	Total
		Percentage of Total Weight (%)																	
1	Base Weightings: The preferred criteria weighting based on discussion with Casitas staff	15	5	5	5	15	5	10	10	8	7	5	5	5	30	30	25	15	100
2	Higher Technical Weight: The technical category is elevated to 40% of total from 30%	20	7	6	7	14	5	9	7	6	5	5	5	5	40	27	18	15	100
3	Highest Technical Weight: The technical category elevated to 50% of total	25	9	8	8	9	3	6	7	6	5	5	5	5	50	17	18	15	100
4	High Environmental: The environmental category is elevated to 40% of total	13	4	4	4	13	4	8	16	13	11	3	3	3	25	25	40	10	100
5	High Cost: The cost criteria are weighted as 45% of the total	4	2	2	2	23	8	15	8	6	6	8	8	8	10	45	20	25	100
6	Even Weights: technical, cost, environmental, and social categories weighted at 25%	13	4	4	4	13	4	8	10	8	7	8	8	8	25	25	25	25	100
7	High Social Weight: The social category is elevated to 40% of the total	17	6	5	6	9	3	6	4	3	3	13	13	13	33	17	10	40	100

Table 6-2 – Options Ranking Comparison for Different Criteria Weighting Scenarios

Base Case Rank	Option	Higher Technical Weight Rank	50% Technical Weight Rank	High Environmental Weight Rank	High Cost Weight Rank	Even Category Weights Rank	High Social Weight Rank
1	C 02 (High Conservation/Enhanced Demand Management)	1	1	1	1	1	1
2	C 01 (Low Conservation/Enhanced Demand Management Programs)	2	2	2	2	2	2
3	GW 08 (Well Improv in Ojai GWB)	3	3	3	3	3	3
4	MO 01 (Environmental/Habit Modif)	5	6	4	4	4	5
5	MO 08 (Robles Diversion Fish Passage Improvements)	6	7	5	5	6	7
6	SWP 03 (Ventura-SBC Interconnection)	4	4	6	6	5	4
7	DW 01 (Supplemental Water from City of Santa Barbara)	7	5	7	7	7	6
8	SWP 05 (In-Lieu Project Water)	8	8	8	9	8	10
9	SWP 04 (Casitas-Calleguas Interconnection)	9	9	9	11	9	8
10	SWP 01 (Deliveries via City of Ventura SWP Interconnect & Casitas-Ventura Interconnect)	10	10	10	12	10	9
11	GW 06 (Ojai Basin Desalter)	12	13	12	8	11	12
12	SWP 02 (Calleguas Emergency Interconnection)	11	11	13	17	12	11
13	SW 03 (Matilija Dam GW/SW)	14	19	11	10	13	19
14	SW 04 (Exp of Robles Canal)	16	17	16	15	15	18
15	MO 06 (Sediment Removal at North End of Lake Casitas)	18	18	14	14	14	16
16	SW 05 (New Dam Upstream of Lake Casitas)	15	14	15	18	16	17
17	DW 03 (Ventura County Regional Desal Plant)	13	12	18	16	17	13
18	GW 01 (Matilija Formation Deep Wells)	17	15	17	19	18	14
19	DW 02 (Casitas Desal Plant)	19	16	20	20	20	15
20	RW 06 (Ojai East Septic Collect, Treat, Recharge)	20	20	19	13	19	20

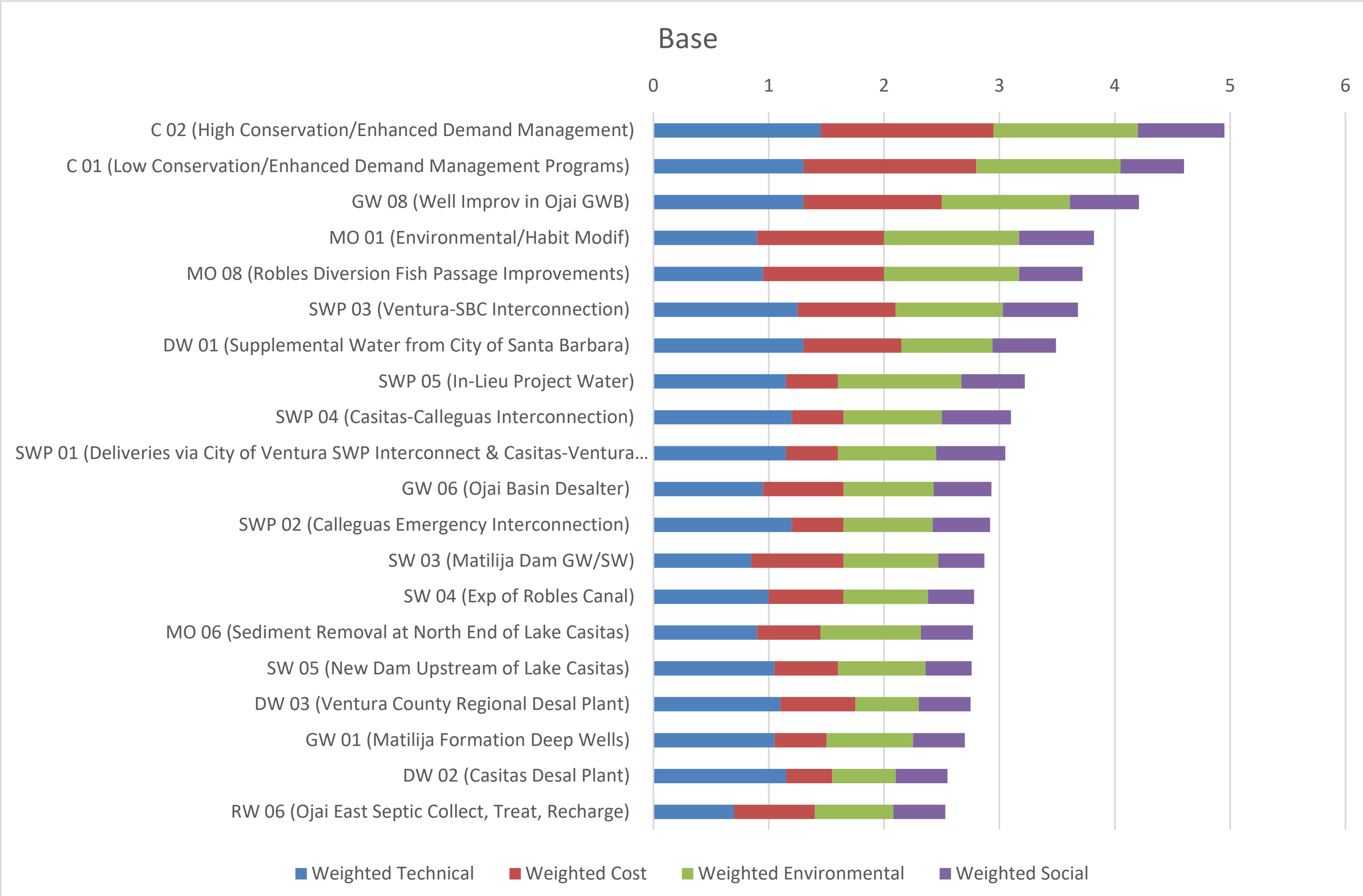

Figure 6-1 – Options Ranking with Base Weighting

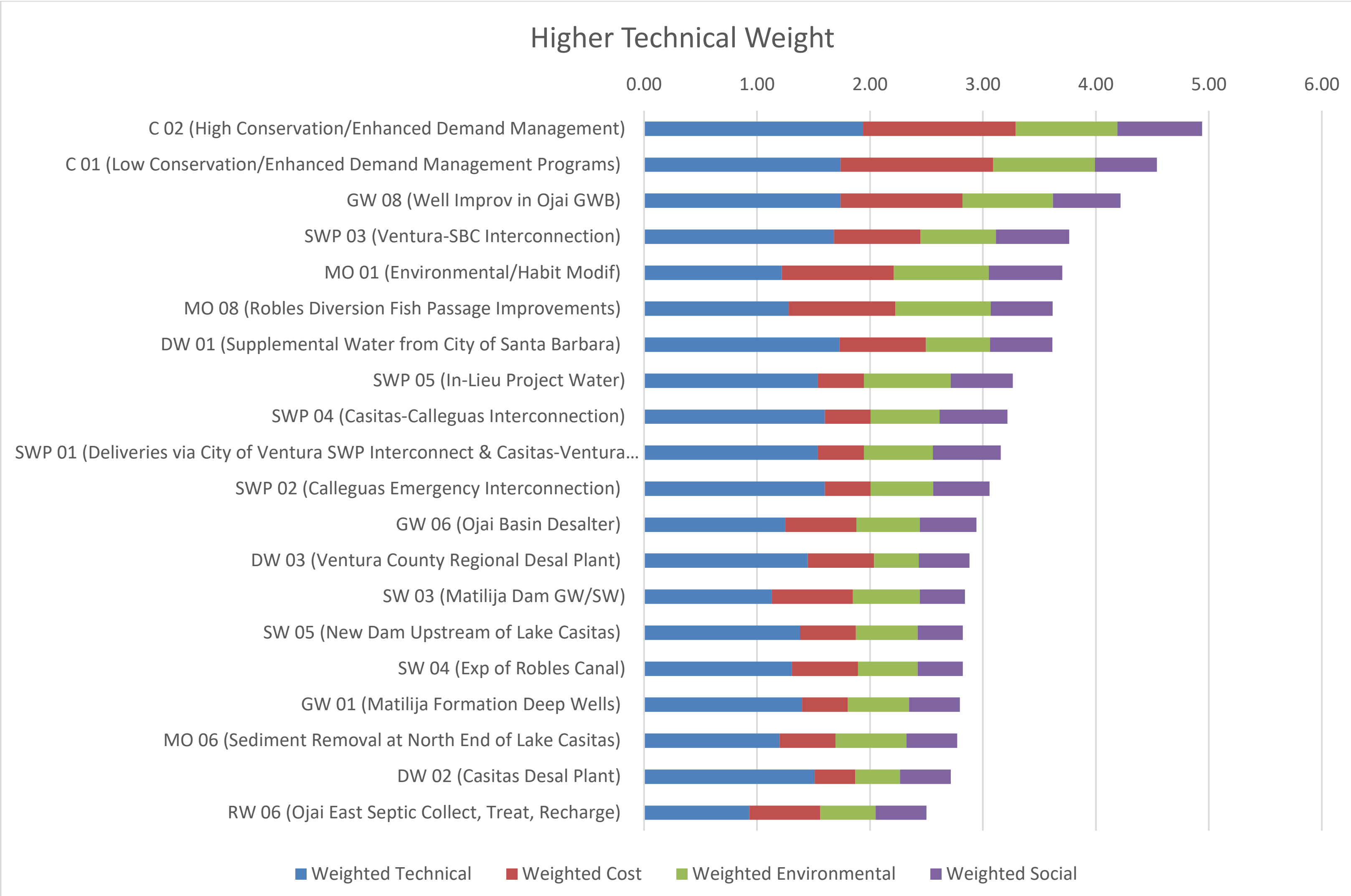

Figure 6-2 – Options Ranking with Higher Technical Weighting

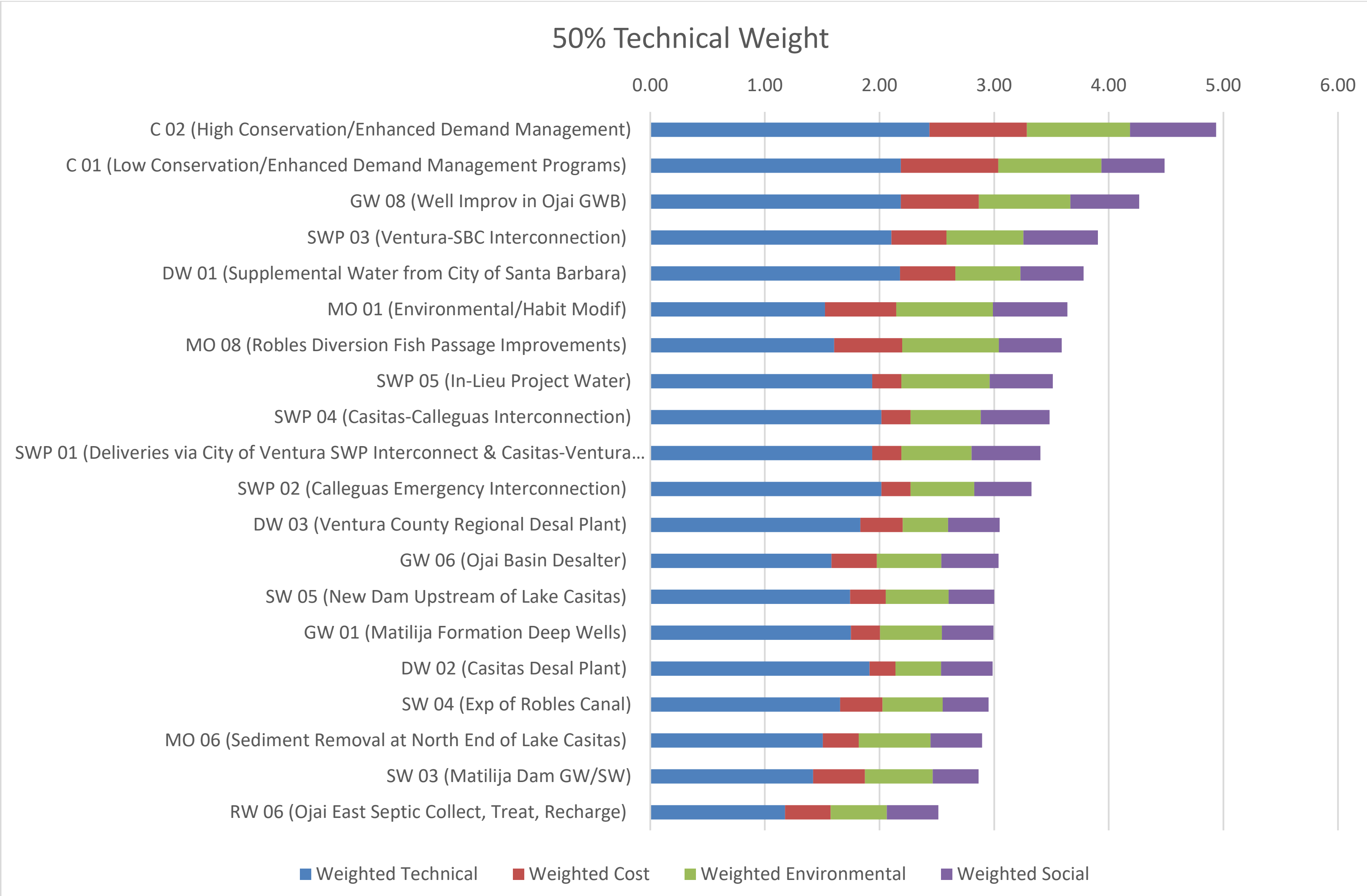

Figure 6-3 – Options Ranking with Percent Technical Weighting

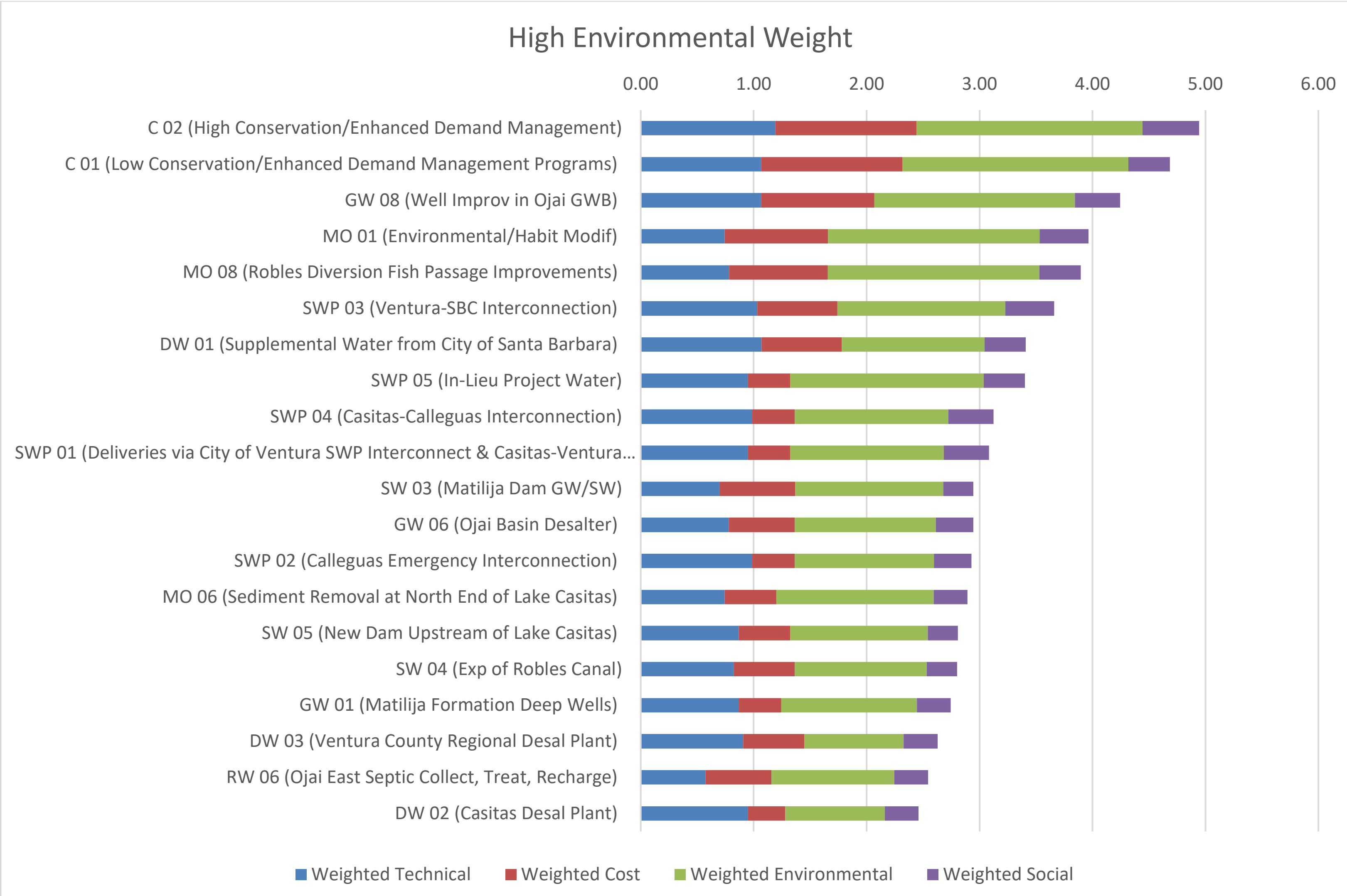

Figure 6-4 – Options Ranking with High Environmental Weighting

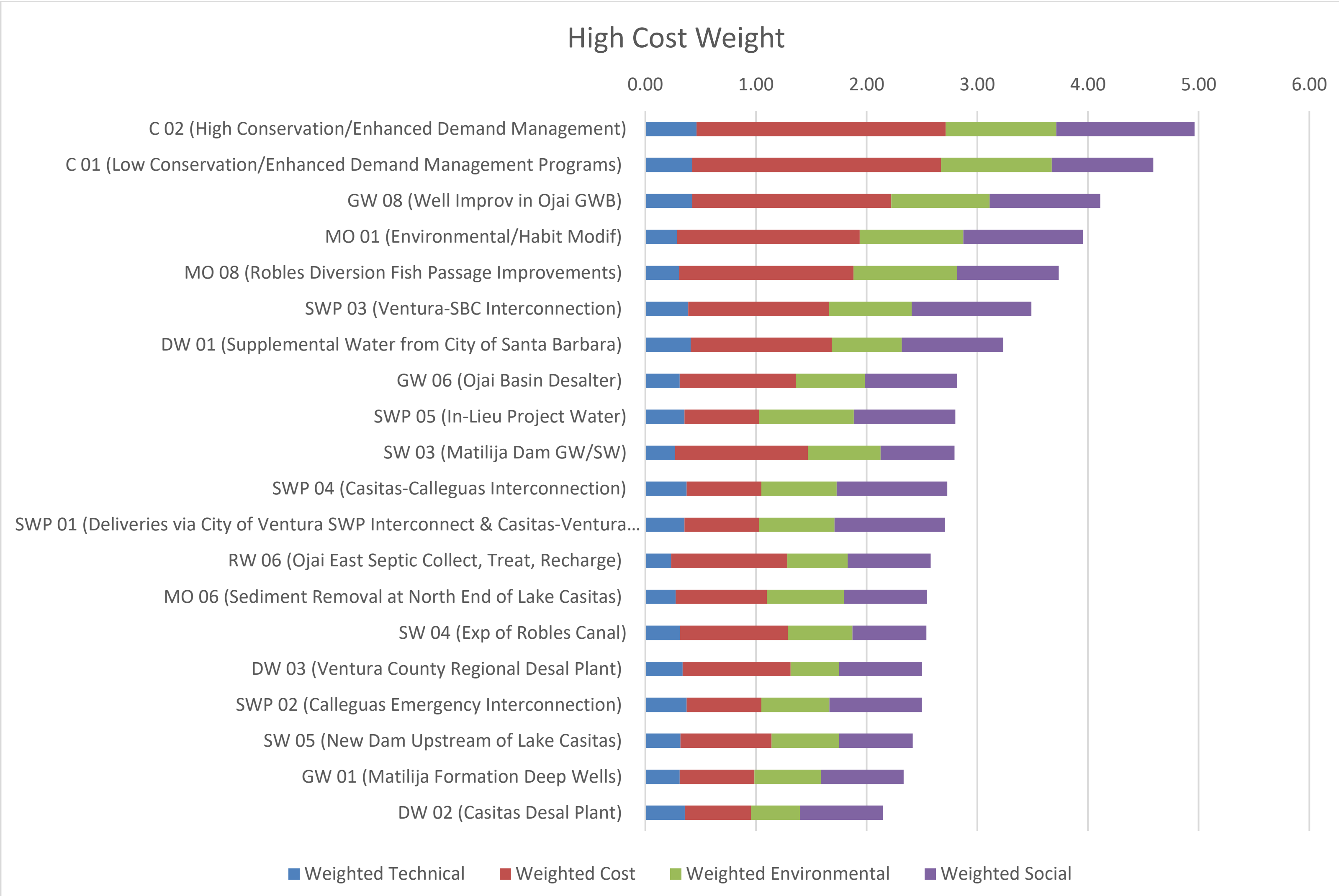

Figure 6-5 – Options Ranking with High Cost Weighting

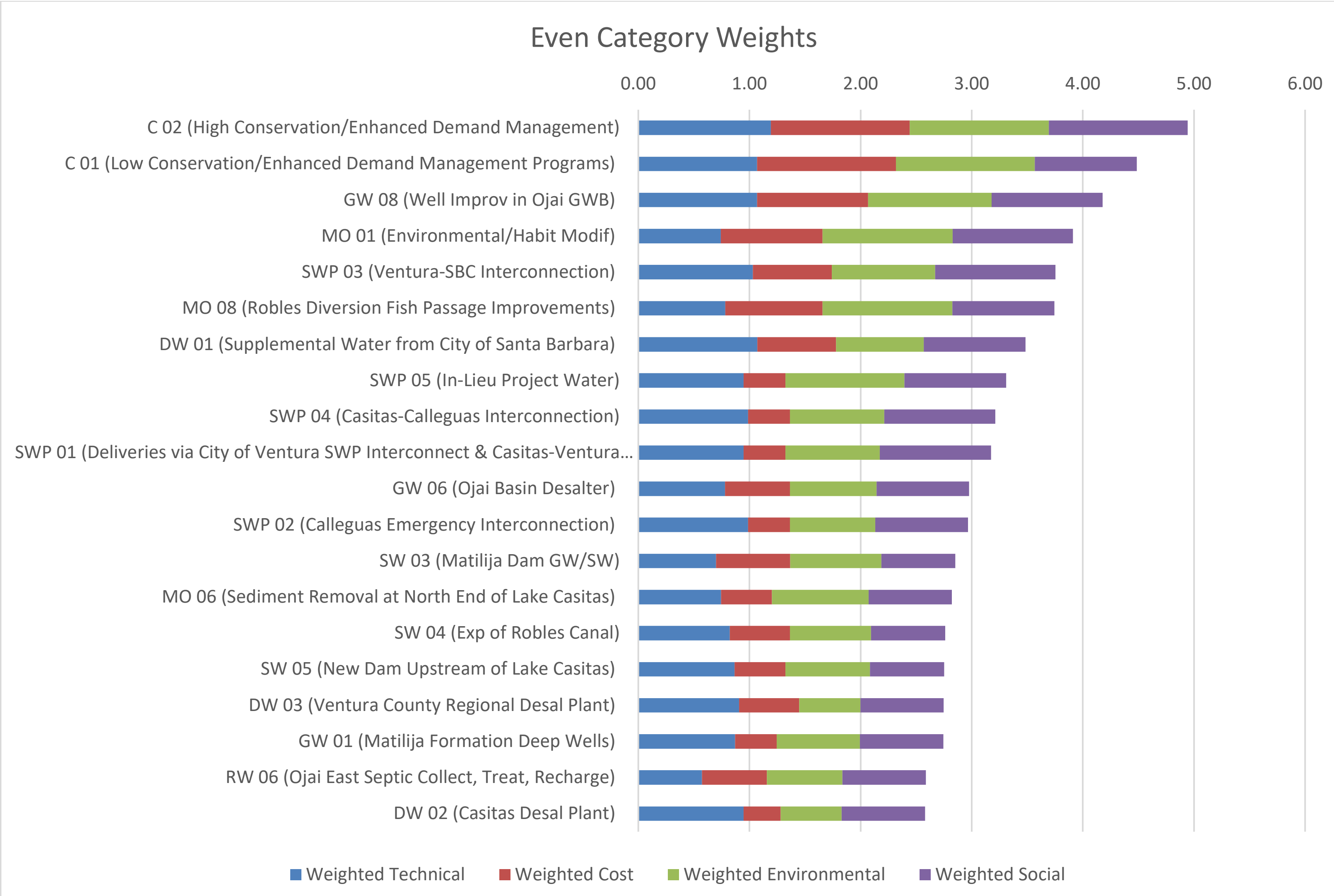

Figure 6-6 – Options Ranking with Even Category Weighting

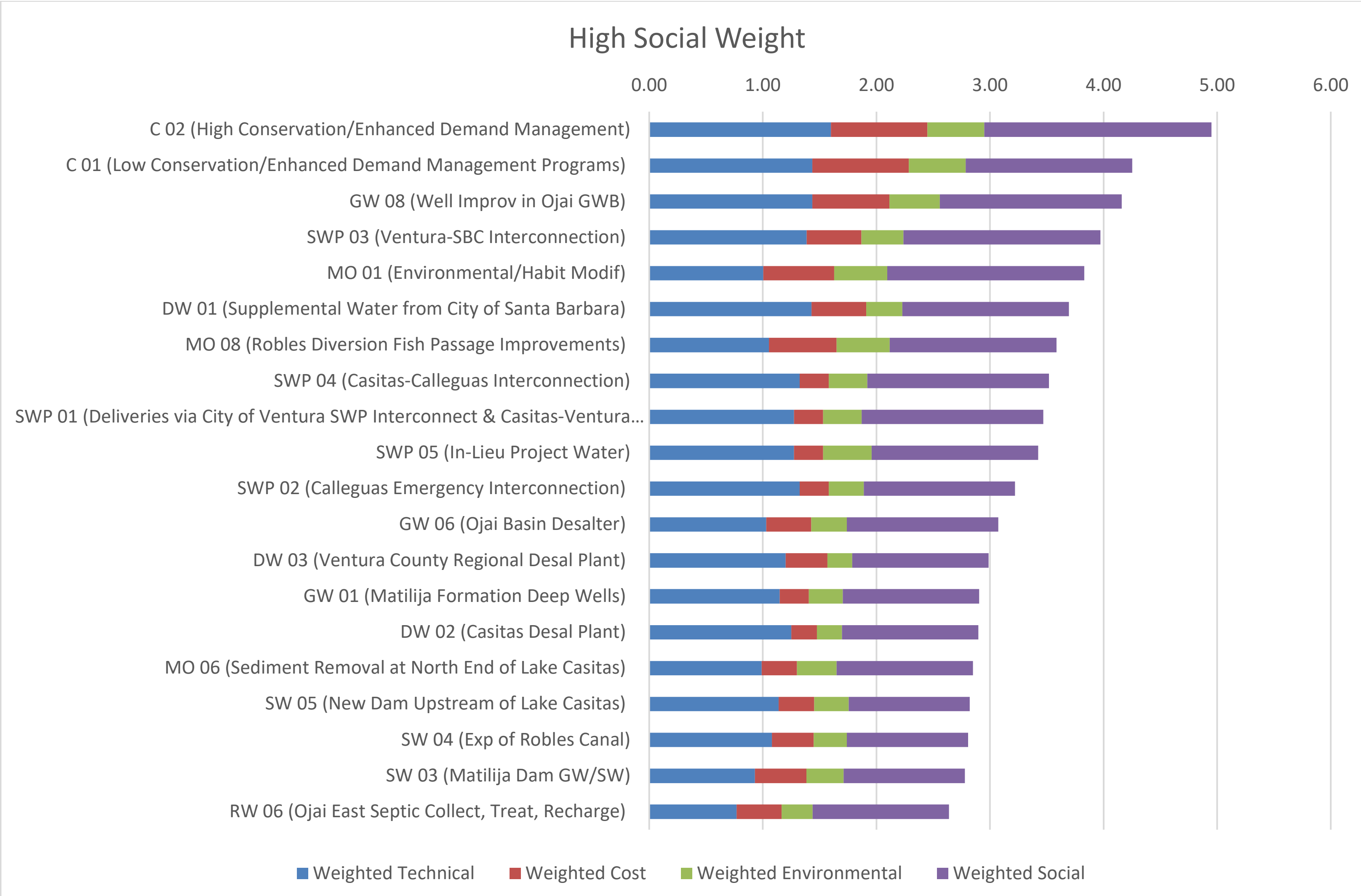

Figure 6-7 – Options Ranking with High Social Weighting

7.0 Portfolio Development and Ranking

The decision support tool was used to compare relative benefits of water supply portfolios using a similar process to that described above for comparison of water supply options. Portfolios are combinations of options that would meet all the objectives of the CWRP.

7.1 Portfolio Development

Casitas selected the top 10 options from the base criteria weighting scenario for use in developing portfolios. Options were categorized as either Local Options (i.e., those that rely on water from the local Lake Casitas watershed or Ojai Groundwater Basin), or Supplemental Water Options (i.e., those that rely on water from outside the Lake Casitas watershed or Ojai Groundwater Basin). Three portfolio development strategies were used to create combinations of options that meet the CWRP objectives:

- Local Focus Portfolios that emphasized use of more Local Options;
- Diversification Portfolios that emphasized use of more Supplemental Water Options; and
- Balanced Portfolios that used a balanced blend of the other two strategies.

The CWRP objectives for meeting long-term water supply needs, short-term water supply needs, and diversification needs allowed for significant flexibility in how options were combined to create portfolios. The portfolio development process is described in more detail in the CWRP report. **Table 7-1** list the options included in each portfolio analyzed with the decision support tool.

Table 7-1 – Portfolios

Options		Balanced Portfolios			Diversification Portfolios			Local Focus Portfolios		
		Balanced Portfolio A (Dual Connection Subportfolio)	Balanced Portfolio B (Ventura Subportfolio)	Balanced Portfolio C (Santa Barbara Subportfolio)	Diversification Portfolio A (Ventura SWP & Wells Subportfolio)	Diversification Portfolio B (Ventura & Santa Barbara SWP Subportfolio)	Diversification Portfolio C (Ventura Only Subportfolio)	Local Focus Portfolio A (Ventura SWP Subportfolio)	Local Focus Portfolio B (Santa Barbara SWP Subportfolio)	Local Focus Portfolio C (Santa Barbara SWP Subportfolio – No Matilija Wells Subportfolio)
C 01	Low Conservation/Enhanced Demand Management Programs	X	X	X						
C 02	High Conservation/Enhanced Demand Management							X	X	X
DW 01	Supplemental Water from City of Santa Barbara			X						X
GW 01	Matilija Formation Deep Wells			X	X			X	X	
GW 08	Well Improv in Ojai GWB	X	X	X	X	X	X	X	X	X
MO 01	Environmental/Habit Modif	X	X	X				X	X	X
MO 08	Robles Diversion Fish Passage Improvements	X	X	X	X	X	X	X	X	X
SWP 01	Deliveries via City of Ventura SWP Interconnect & Casitas-Ventura Interconnect	X						X		
SWP 03	Ventura-SBC Interconnection	X	X	X		X			X	X
SWP 04	Casitas-Calleguas Interconnection				X	X	X			
SWP 05	In-Lieu Project Water		X			X	X			

7.2 Portfolio Development Without Delta Conveyance Facility

A fourth set of portfolios was developed to show the impacts to the portfolios without the proposed Delta Conveyance Facility (DCF) see **Table 7-2**. The DCF is the proposed solution to California Delta constraints on deliveries to the State Water Project. Without the DCF, SWP yields would decrease compared to values used in the other water supply portfolios. There is risk of the DCF or similar solution not being completed, which would put SWP yields at risk. In addition, Casitas would have to commit to paying a portion of the DCF cost to receive SWP deliveries at "with DCF" volumes. The impact of this possible future condition was tested by modifying the Balanced Portfolios by reducing the SWP option yields and compensating for the lost yield adding other options to meet the CWRP objectives.

Table 7-2 – Balanced Portfolios without Delta Conveyance

Options		Balanced Portfolio A – No Delta Conveyance (Ventura and Santa Barbara Connections)	Balanced Portfolio B – No Delta Conveyance (Ventura Connection)	Balanced Portfolio C – No Delta Conveyance (Santa Barbara Connection)
C 01	Low Conservation/Enhanced Demand Management Programs	X	X	X
C 02	High Conservation/Enhanced Demand Management			
DW 01	Supplemental Water from City of Santa Barbara			X
GW 01	Matilija Formation Deep Wells			
GW 08	Well Improv in Ojai GWB	X	X	X
MO 01	Environmental/Habit Modif	X	X	X
MO 08	Robles Diversion Fish Passage Improvements	X	X	X
SWP 01	Deliveries via City of Ventura SWP Interconnect & Casitas-Ventura Interconnect	X	X	
SWP 03	Ventura-SBC Interconnection	X		X
SWP 04	Casitas-Calleguas Interconnection			
SWP 05	In-Lieu Project Water	X	X	

7.3 Portfolio Rankings

The decision support tool was used to rank the water supply portfolios using the same criteria and base weighting scheme as described previously for the water supply options. However, an additional step was needed to account for the fact that each portfolio was comprised of multiple options. The portfolio score was computed as the weighted average of the scores of the options comprising the portfolio, where the weighting was done based on the percentage of the total annual yield contributed by each option. The equation for this calculation is:

Portfolio Score = Option 1 Score x (Option 1 Yield / Portfolio Yield) + … + Option n Score x (Option n Yield / Portfolio Yield)

The portfolio scores and relative rankings generated by the decision support tool are shown in **Figure 7-1**. This information was used by Casitas to develop a recommended plan for the CWRP.

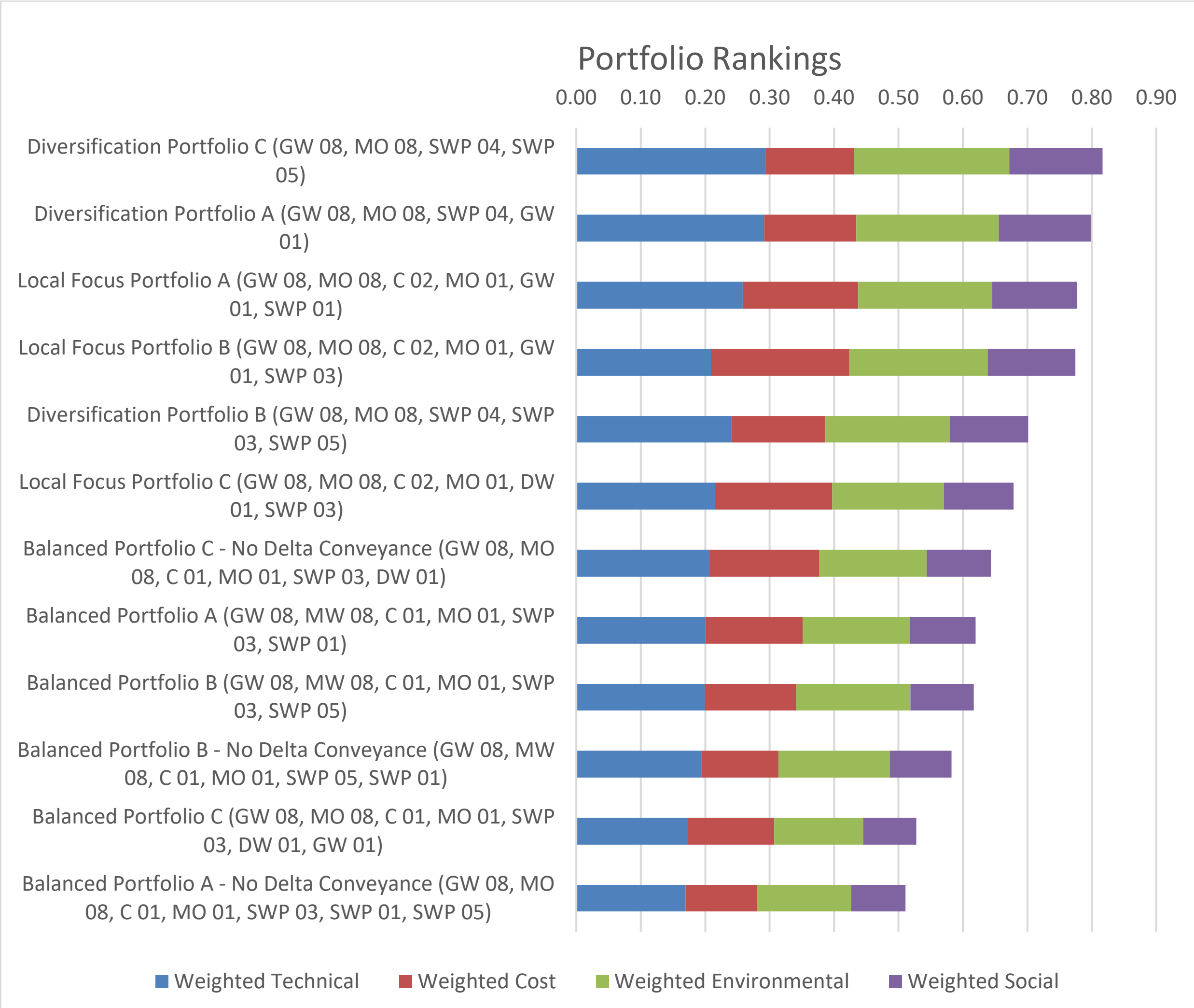

Figure 7-1 – Portfolio Scores and Rankings

Appendix G Water Supply Option Selected for Additional Analysis

Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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Prepared by Stephanie Soldo

Reviewed by Chip Paulson

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Abbreviations

AF	acre-foot
AFY	acre-foot per year
AWMP	Agricultural Water Management Plan
Casitas	Casitas Municipal Water District
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CVWD	Carpinteria Valley Water District
CWA	Clean Water Act
CWRP	Comprehensive Water Resources Plan
Desal Plant	Charles E Meyer Desalination Plant
EA	Environmental Assessment
EIR	Environmental Impact Report
FONSI	Finding of No Significant Impact
GSWC	Golden State Water Company
IS	Impact Statement
LARWQCB	Los Angeles Regional Water Quality Control Board
MND	Mitigated Negative Declaration
mg/l	milligrams per liter
MWD	Montecito Water District
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service

NWP	Nationwide Permit
OBGMA	Ojai Basin Groundwater Management Agency
OVSD	Ojai Valley Sanitary District
RWQCB	Regional Water Quality Control Board
SACSG	San Antonio Creek Spreading Grounds
SCC	South Coast Conduit
SMC	Senior Canyon Mutual Water Company
SWP	State Water Project
SWPCP	Stormwater Pollution Control Plan
SWPPP	Storm Water Pollution Prevention Plan
TDS	Total Dissolved Solids
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish & Wildlife Service
UVRB	Upper Ventura River Basin
UWMP	Urban Water Management Plan
VCFCD	Ventura County Flood Control District
VCWPD	Ventura County Watershed Protection District
VRWC	Ventura River Watershed Council
VRWMP	Ventura River Watershed Management Plan
WEAP	Water Efficiency and Allocation Program

Introduction

1.0 Introduction

This technical memorandum presents information on six water supply project options discussed in previous planning documents prepared for or by Casitas Municipal Water District (Casitas). These projects are not currently in design by Casitas but may be considered as supply options for future water reliability sources in the future. All six projects are listed in the Background Information Technical Memorandum prepared for the Casitas Comprehensive Water Resources Plan (CWRP) and were selected by Casitas for further evaluation because they had not been previously developed to a conceptual level. The additional information described in this TM was needed to properly evaluate them for possible inclusion in the CWRP. The project details prepared for each option include conceptual project descriptions, preliminary costs, regulatory permitting needs, environmental compliance requirements, inter-agency coordination, Casitas water system integration, phasing and implementation timelines.

Each project, along with the estimated costs and yield benefits, are listed in **Table 1-1**. Each project was included in the CWRP project evaluation process.

Table 1-1 Water Supply Project Options

Option Number	Project
MO 01	Environmental/Habitat Modifications
DW 01	Desalinated Water from City of Santa Barbara
MO 06	Sediment Removal at North End of Lake Casitas
GW 06	Ojai Basin Desalter Project
SW 04	Expansion of Robles Canal
RW 06	Ojai East Septic Collection, Package Treatment, Recharge

Project Descriptions and Analyses

2.0 Project Descriptions and Analyses

The six water supply project options listed in **Table 1-1** are described in this section. Each project description includes a conceptual level layout and design of required facilities, conceptual opinion of probable costs, regulatory permits required and environmental compliance needs, inter-agency coordination requirements, project system integration issues, project phasing, project timeline, and recommendations for inclusion in the CWRP alternative evaluation process.

2.1 MO 01 – Environmental/Habitat Modifications

2.1.1 Project Description

The Environmental/Habitat Modification project consists of activities to reduce the amount of *Arundo donax* (*Arundo*), a major water consuming plant within the watershed. Based on available information and previous studies, this project considers Arundo removal within the Ventura River watershed north of the Robles Diversion (contributing watershed). Other watersheds directly contributing to Lake Casitas may be considered in the future but the information was not available on area of Arundo at the time of report. Reduction of the consumptive use in the contributing watershed would improve the water balance and potentially increase inflows to Lake Casitas. Turfgrass is also considered a major water consuming plant, but to a considerably lesser extent than *Arundo*, and turfgrass removal through incentives to property owners is already part of the Casitas water conservation measures. Therefore, this project focuses only on removal of *Arundo*.

Arundo is an invasive species with very high-water consumption. The rate of water loss is estimated at approximately six times more than that of the native riparian vegetation. Estimates of *Arundo* water consumption vary between 1 and 48 AFY/acre, with a reasonable average of 24 AFY/acre consumptive use (California Invasive Plant Council, 2011). *Arundo* removal and replacement with native riparian plants would reduce evapotranspiration losses and result in net savings of approximately 20 AFY per acre of *Arundo* removed. This would improve recharge to the groundwater basin as well as help keep the river alluvium more saturated, which in turn would induce more surface flow into Lake Casitas.

The Ventura River Watershed Council (VRWC) has included an Arundo-Free Watershed Campaign as one of their top six priority projects per the 2015 Ventura River Watershed Management Plan (Ventura River Watershed Coordinator, 2015). In 2015, it was estimated that over 180 acres of land in the Ventura River watershed were covered with *Arundo*, after 270 acres of *Arundo* were already removed. It is understood the Ventura County Watershed Protection District (VCWPD) will be responsible for the implementation of Arundo removal projects. VCWPD will continue this project on an annual basis. For the Casitas project evaluation, it is assumed an *Arundo* removal project would be implemented through an agreement between Casitas and VCWPD. All work would continue to be managed and run through VCWPD. Therefore, this project would likely be outside of Casitas control and is described in further detail for conceptual level planning only.

2.1.1.1 Conceptual Level Layout and Design of Required Facilities

As stated above, there were 180 acres of land in the Ventura River watershed still infested with *Arundo* in 2015. The California Invasive Plant Council mapped the areas in the Ventura River Watershed in 2011, showing that the areas infested with *Arundo* are clustered around the Ventura River and other streams (California Invasive Plant Council, 2011).

Figure 2-1 shows the Ventura River contributing watershed upstream of the Robles Diversion (contributing watershed) and the distribution of *Arundo* within the Ventura River Watershed. There are approximately seven miles of stream length infested with *Arundo* in the contributing watershed, and 20 miles of stream length infested with *Arundo* in the Ventura River Watershed but outside the contributing watershed. Assuming that the *Arundo* infested stream length is representative of *Arundo* infested area and using the proportion of *Arundo* infested stream length within and outside of the contributing watershed, it was estimated that approximately 45 acres of land in the contributing watershed were infested with *Arundo* in 2015.

While the VCWPD may continue to work on *Arundo* removal throughout the Ventura River Watershed, this project would include Casitas working with VCWPD to expedite removal of *Arundo* from the 45 acres within the contributing watershed.

Figure 2-1 Robles Diversion Contributing Watershed and Arundo Locations

2.1.2 Conceptual Opinion of Probable Costs

Arundo removal and replacement with native species can vary in cost based on the method of removal. Methods can vary in cost of approximately $20,000 per acre to as much as $579,000 per acre (Ventura County Watershed Protection District, 2010; WREA & KG, 2016). However, *Arundo* removal is not permanent and ongoing management programs are required to control this invasive species.

Possible *Arundo* removal methods are outlined in the 2015 Ventura River Watershed Management Plan (Ventura River Watershed Coordinator, 2015). These removal methods are summarized in **Table 2-1** along with the unit prices associated with each method.

Table 2-1 Conceptual Opinion of Probable Costs for *Arundo* Removal Methods

Method Name	Method Description	Approximate Cost for One Acre with 100 Percent *Arundo* Density	Advantages	Disadvantages
Cut-Stump Herbicide Application and Biomass Removal	Mechanical removal immediately followed by painting the cut stumps with herbicide. Also known as "cut and paint" or "cut and daub".	$29,000	Minimal re-sprouting and low post-removal maintenance costs.	High initial costs.
Foliar Application of Herbicide	Foliar spray application of herbicide at lower concentrations; let the biomass remain on site until dead; remove dead materials mechanically in the next spring.	$20,000	Lower initial costs than cut and paint method.	Dead material may become a fire or flood hazard.
Biomass Removal Only	Removal of above-grade biomass without applying herbicide; later applying regrowth with an herbicide as it emerges.	$19,000	Lower initial costs.	Immediate and frequent herbicide application necessary to control re-sprouting.
Hand Removal of All Vegetative Matter	Mechanical removal of all biomass including root mass excavation. Includes monitoring and hand removal of regrowth including root mass excavation.	$579,000	No herbicide application necessary.	Expensive labor costs. May trigger additional permitting requirements and erosion problems.

The first three methods were roughly similar in terms of costs when normalized to an acre with 100 percent *Arundo* density, while the fourth method is substantially more expensive.

In the long-term management plan for *Arundo* removal in the Matilija Dam ecosystem, the VCWPD planned to use foliar spray and cut and daub as the two treatment methods (Ventura County Watershed Protection District, 2010). Retreatment sweeps of the entire 1,100-acre area treated in the Matilija area was estimated to cost $100,000. The plan estimated that retreatment would occur three times a year for the subsequent two years; twice a year for the subsequent five years; and once a year thereafter. Thus, for retreatment for the 15 years following initial removal the total cost over the 15 years would be approximately $2.4 million, or an average of approximately $2,200 per acre/year (excluding inflation).

It is assumed for purposes of the CWRP that expediting removal of *Arundo* from the estimated 45 acres within the Ventura River contributing watershed north of the Robles Diversion would use either foliar spray or cut and daub as the treatment method. For a conservative price estimate, the cost of removal of an acre of land with 100 percent *Arundo* density using cut and daub was used. Thus, the estimated cost of initial removal of *Arundo* from 45 acres within the Robles Diversion contributing watershed is approximately $1.3M. Using the estimate of $2,200 per acre for retreatment, the estimated annual cost of retreatment would be approximately $99,000 (excluding inflation).

Table 2-2 and **Table 2-3** below presents a summary of the conceptual opinion of probable costs and benefits of *Arundo* removal in the Robles Diversion contributing watershed.

Table 2-2 Conceptual Opinion of Probable Costs of MO 01 Environmental/Habitat Modifications

Parameter	Value	Unit
Estimated Area Infested with *Arundo*	45	acres
Estimated Water Savings for *Arundo* Removal	20	AFY/acre
Project Impact Lifetime	15	years
Estimated Annual Water Savings[1]	900	AFY
Unit Cost of Removal	$29,000	USD/acre
Unit Cost of Retreatment for 15 years	$2,200	USD/acre/year
Total Estimated Cost of Removal (assumes expedited over one year)[2]	$1,305,000	USD
Total Estimated Annual Retreatment Costs (15-year period, excluding escalation)[3]	$1,485,000	USD

[1] Note: assumed contributing watershed savings. Casitas benefit may be lower due to restrictions on diversions.

[2] Costs are project totals without escalation. Cost sharing would need to be coordinated between Casitas and VCWCD.

[3] Assumed 15 Years of O&M costs for estimation purposes.

Table 2-3 Costs and Benefits of Environmental/Habitat Modifications

Parameter	Value	Unit
Conceptual Opinion of Probable Costs [2,3]	$2,790,000	USD
Estimated Annual Yield (after 15 years) [1]	900	AFY
Conceptual Unit Capital Cost per AFY	$3,100	USD/AFY

[1] Note: assumed contributing watershed savings. Casitas benefit may be lower due to restrictions on diversions.

[2] Costs are project totals without escalation. Cost sharing would need to be coordinated between Casitas and VCWCD.

[3] Assumed 15 Years of O&M costs for estimation purposes.

2.1.3 Regulatory Permits & Environmental Compliance

The following permits have been acquired for other *Arundo* removal projects and would likely need to be acquired or renewed for *Arundo* removal by the County of Ventura:

- U.S. Army Corps of Engineers (USACE) Regional General Permit No. 41 Removal of Invasive Exotic Plants;
- Los Angeles Regional Water Quality Control Board (LARWQCB) Section 401 Water Quality Certification; and
- California Department of Fish and Game (CDFG) Streambed Alteration Agreement.

Additionally, a Storm Water Pollution Prevention Plan (SWPPP) or Stormwater Pollution Control Plan (SWPCP) would likely need to be prepared to comply with requirements related to the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities.

The WREA Preliminary Water Security Project Analysis report stated that *Arundo* removals will not likely trigger CEQA (WREA & KG, 2016). However, the Ventura River Arundo Removal Demonstration Project Final Implementation report discussed an Environmental Impact Report (EIR) prepared for the project (Ventura County Watershed Protection District, 2007). In this EIR, project impacts for biological resources, water resources, air quality, and transportation/circulation were mitigated below a level of significance while temporary noise impacts could not be reduced below significant levels despite mitigation.

2.1.4 Inter-Agency Coordination

It is assumed this project would involve Casitas financially supporting the VCWPD to expedite *Arundo* removal in the Robles Diversion contributing watershed. The level of that financial support has not been discussed. Additionally, this effort would likely require or benefit from coordination with the Natural Resources Conservation Service (NRCS), if they would plant native riparian species as they have done for similar projects (Ventura County Watershed Protection District, 2007).

2.1.5 System Integration

No system integration issues are anticipated. The project would not change existing operation of any Casitas facilities or systems.

2.1.6 Phasing

The project is naturally divided into a planning and permitting phase, a removal phase, and a monitoring and herbicide reapplication phase, as shown in **Table 2-4**.

2.1.7 Timeline

It is assumed that *Arundo* can be removed at a rate of 10 acres each month and that *Arundo* treatment would be most easily carried out in spring and fall to avoid hot weather and rainfall while working on removal.

Table 2-4 Preliminary Timeline for MO 01 Environmental Habitat/Modifications

Project MO 01	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Following 15 Years[1]
Planning	Planning & Permitting				
Removal		Removal		Removal	
Follow-up					Monitoring & Herbicide Reapplication

[1] 15-year timeframe used for estimation purposes.

2.1.8 CWRP Recommendation

This project was moved forward into the CWRP decision support tool and ranked in the top ten. However, it is extremely difficult quantify water savings from this project and therefore its benefit to Casitas is hard to capture. It is recommended that Casitas continues to support the County in its campaign of *Arundo* removal for the overall health of the Ventura River watershed. This project is included in the draft CWRP as a conditional option.

2.2 DW 01 – Desalinated/Supplemental Water from City of Santa Barbara

2.2.1 Project Description

The City of Santa Barbara reactivated the Charles E. Meyer Desalination Plant (Desal Plant) in late 2017. The Desal Plant has a full build-out capacity of 10,000 AFY but is currently operating around 3,125 AFY. The City of Santa Barbara is pursuing a variety of projects to allow for desalinated water to be conveyed to Cater Water Treatment Plant Clearwell. This would allow for desalinated water to be delivered to all of the City customers as well as provide the ability to convey desalinated water to the State Water Project (SWP) South Coast Conduit (SCC). Three of these projects include the construction of a 24-inch water main through the downtown area, upgrades to the Product Water Pump Station, and treatment expansion at the Desal Plant to increase capacity. The existing SCC supplies SWP water to Montecito Water District (MWD) and Carpinteria Valley Water District (CVWD). MWD is in negotiations with the City of Santa Barbara for a supplemental water supply through the existing SCC. The City of Santa Barbara has the ability to sell additional water supplies above and beyond their demands. This supplemental water supply could be a combination of water from all the City's water sources, including desalinated water.

Casitas is in the preliminary design phase of infrastructure to allow for SWP water to be conveyed from CVWD to the Casitas service area as part of the project referred to in the CWRP as Ventura-Santa Barbara Counties Interconnection Project (SWP 03). Once this infrastructure is in place, conveyance of other supplemental water sources can be explored including supplemental water from the City of Santa Barbara.

2.2.2 Conceptual Level Layout and Design of Required Facilities

This project would rely on the infrastructure constructed for various other projects as listed in **Table 2-5**, but no additional infrastructure is anticipated for this project. An evaluation of the SCC may be warranted to understand available hydraulic capacity and water age/treatment requirements once the water is conveyed to the Casitas distribution system.

Table 2-5 Required Facilities & Studies for Desalinated Water from the City of Santa Barbara

Projects Required	Status	Project Owner
Desal Plant Treatment Expansion from 3,125 AFY to 5,000 AFY or more	In planning	City of Santa Barbara
City of Santa Barbara transmission system update to distribute desalinated water throughout the City and to SCC	In construction	City of Santa Barbara
City of Santa Barbara Product Water Pump Station upgrades	In planning	City of Santa Barbara
SWP 03 Ventura-Santa Barbara Counties Interconnection Project	Preliminary Design In progress	Casitas Municipal Water District
SCC hydraulic capacity analysis	Future	Casitas Municipal Water District
Water age and stability modeling	Future	Casitas Municipal Water District

2.2.3 Conceptual Opinion of Probable Capital Costs

The infrastructure costs required to access City of Santa Barbara supplemental water are captured in other proposed projects and therefore there are no additional infrastructure capital costs included in this estimate. Casitas would need to enter into an agreement with the City of Santa Barbara, which could include financial contribution to a share of other potential capital costs and supplemental water supply unit costs. This agreement would likely mimic the agreement Montecito Water District is pursuing with the City of Santa Barbara, which is currently under negotiations. At the same time of this analysis, the draft agreement was proposed to be a 50-year term and allows MWD to receive around 30 percent of the Desal Plant's total production capacity after certain terms are met. In the draft agreement, the City of Santa Barbara retains ownership of the Desal Plant and MWD pays the full annual contract amount whether or not MWD takes the water in a given year. MWD will also pay a prorated portion of potential increases from any capital improvements to the Desal Plant.

The contract water unit price will be allocated in proportion to the percentage of water MWD receives, along with any administrative costs associated with managing the operations of the Desal Plant. For the first 20 years of the agreement, an index-linked Water Supply Development Fee of $237,500 would be paid by MWD. MWD would also be responsible for contributing to a debt service coverage deposit and debt service reserve account. Montecito Water District will also pay 64.6% of the costs of both a new pipeline (required from the Desal Plant to the Cater Water Treatment plant Clearwell) and what is associated with the reuse of an existing City pipeline.

The terms of an agreement between Casitas and the City of Santa Barbara could be similar to those in the City's agreement with MWD. Project costs specific to a Casitas connection to receive supplemental water would need to be coordinated with the City of Santa Barbara.

Table 2-6 Costs and Benefits of DW 01 Desalinated/Supplemental Water from Santa Barbara

Parameter	Value	Unit
Conceptual Opinion of Probable Costs	TBD [1]	USD
Estimated Annual Yield	Up to 2,000	AFY
Conceptual Unit Capital Cost per AFY	TBD [1]	USD/AFY

[1] Cost is subject to future decisions and negotiations with City of Santa Barbara and other water users.

2.2.4 Regulatory Permits & Environmental Compliance

This project does not require any individual environmental compliance measures as all compliance measures are met within other subsidiary projects listed in **Table 2-5**.

2.2.5 Inter-Agency Coordination

This project requires coordination with multiple agencies including City of Santa Barbara and CVWD. In order to proceed with utilizing City of Santa Barbara desalinated water or other surplus supplies in the Casitas service area, an agreement is needed with the City of Santa Barbara to purchase supplemental water. Coordination will also be necessary with CVWD and other agencies to understand hydraulic capacity availability to utilize the existing infrastructure and also proposed SWP 03 project infrastructure for conveyance of supplemental water.

2.2.6 System Integration

The infrastructure connection will be part of SWP 03. This project would introduce an alternative water source with a different water quality. A blending study is recommended to evaluate the different water quality characteristics from each source and potential impacts to the existing distribution system.

2.2.7 Phasing

There is no infrastructure anticipated to be phased, but the rate at which Casitas can take supplemental water can vary from year to year.

2.2.8 Timeline

The timeline to implement this project includes the time required to design and construction the required infrastructure, as well as the time required to negotiate the agreement with the City of Santa Barbara. The overall project timeline would be determined at a later date.

2.2.9 CWRP Recommendation

This project was moved forward into the CWRP decision support tool and ranked in the top ten in combination with SWP 03 project. It is recommended to pursue supplemental water options utilizing any constructed infrastructure as part of SWP 03 project between CVWD and Casitas.

2.3 MO 06 – Sediment Removal at North End of Lake Casitas

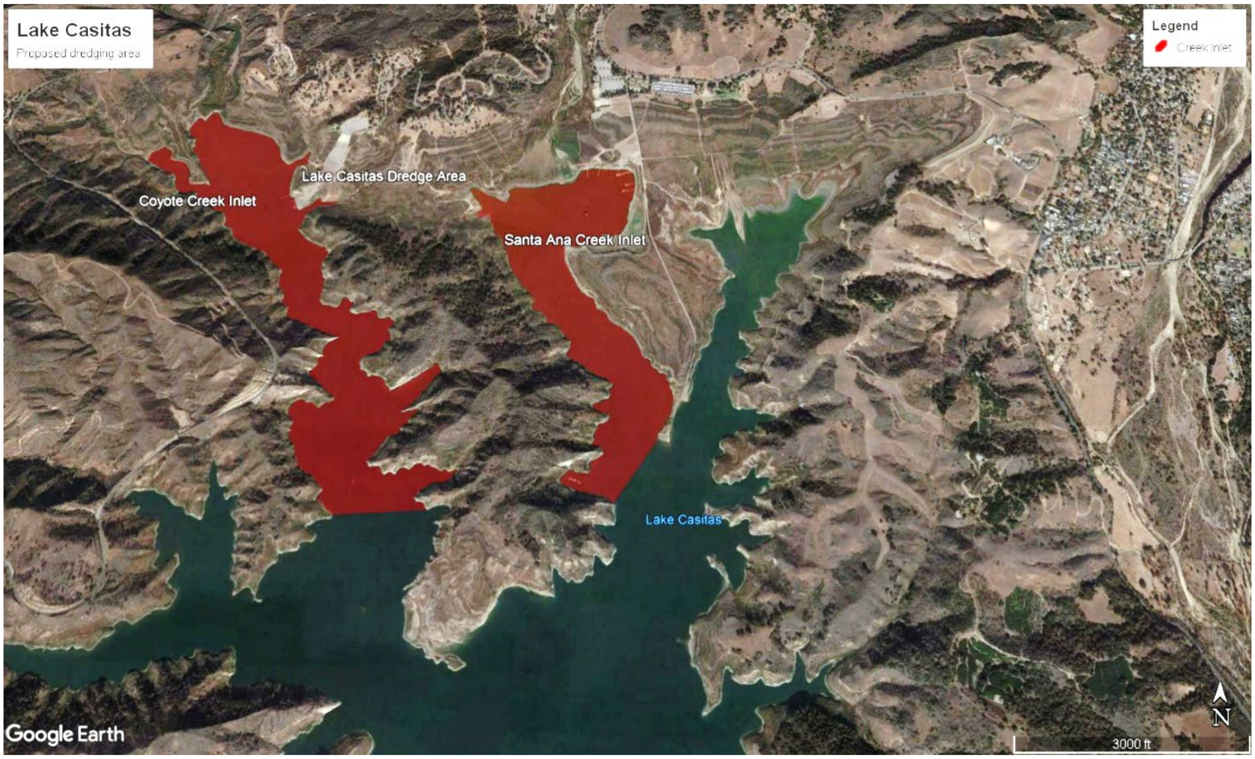
2.3.1 Project Description

Casitas Dam was constructed in 1959 on Coyote Creek to form Lake Casitas with an initial reservoir capacity of 254,000 AF. Since initial construction, sediment accumulation has reduced the capacity to 237,760 AF based on the 2017 bathymetric survey, a difference of 16,240 AF. Based on the difference in storage volume it is estimated that annual sediment loading into the lake is approximately 500 AFY. This value varies from year to year depending on hydrologic conditions and existing watershed conditions such as effects of wildfires.

Excavating or dredging a portion of Lake Casitas could recover some of the storage volume lost due to this accumulation. Lake Casitas is fed from two direct tributaries, Coyote Creek and Santa Ana Creek, near its northern shore, as shown in **Figure 2-2.** In addition, Lake Casitas receives diversions from the Ventura River via the Robles Canal. For this report, it is assumed that the focus of the sediment accumulation is at the Coyote Creek and Santa Ana Creek tributaries (including a likely more predominant amount in Santa Ana Creek from the 2017 Thomas Fire). Therefore, any sediment removal project would be focused on the north end of Lake Casitas as shown in **Figure 2-3**. It is noted, these areas are focused on for this report only and further evaluation would be required before determining where and how to perform sediment removal.

Figure 2-2 Lake Casitas Tributaries

Figure 2-3 Lake Casitas Possible Sediment Removal Locations



2.3.2 Conceptual Level Layout and Design of Required Facilities

While there is potentially approximately 17,000 AF of accumulated sediment in Lake Casitas, removing that large quantity of sediment is impractical. This report assumes Casitas would remove enough sediment to obtain an assumed 25 percent of the lost storage back over a 20-year period, or a total of 4,200 AF. Based on simulations using the current Lake Casitas Yield Model, this would provide approximately 420 AFY in average annual yield.

Before any sediment is removed, a survey of the shoreline and a bathymetric survey of Coyote Creek and Santa Ana Creek inlets would be required to identify the underwater features of the lake and determine where sediment removal is most feasible. In addition, haul road alignments and any stockpiling areas would need to be laid out and surveyed.

A sediment survey would also be required to determine the sediment thickness, depth and quality. The sediment survey would be a geotechnical investigation (including sampling, field and lab testing) to characterize the sediment engineering properties, chemistry, and water quality within the reservoir and tributary drainages in the immediate vicinity of the reservoir. The survey would provide information to be used in the disposal methods which can vary depending on soil and water quality. The field and laboratory testing plan would be prepared in accordance with the Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (EPA, 1998) commonly referred to as the "Inland Testing Manual." Locations and extent of sediment deposits to be removed must be identified. Sediment dewatering pads must also be identified.

Once lake and sediment characteristics are identified, a suitable removal technique can be chosen. There are multiple methods for removing sediment from lakes and reservoirs, primarily excavation and dredging.

- Excavation – Excavation is conducted above the waterline and can occur during periods of low water level, either occurring seasonally or by inducted by temporarily reducing reservoir levels. During excavation, earth-moving equipment would remove and load dewatered sediment into trucks and haul the sediment to disposal sites. Excavation is preferred for moving large amounts of sediment as it may minimize environmental disturbances and may be more cost effective than dredging. Many factors need to be considered regarding access for equipment, lake levels, and sediment deposit areas.
- Dredging – Dredging consists of excavating underwater sediments by either mechanical or hydraulic means and does not require lowering of lake levels. Dredging equipment is typically mounted on a barge and excavation depths can extend up to 100 feet below the water surface. Shallow dredging may also be done from the shore. Mechanical dredging utilizes large cranes, draglines or hydraulic excavators with buckets to excavate sediments from lake floors and transfer them into barges and/or trucks for disposal. Hydraulic dredging utilizes continuous pumping to vacuum sediment and dispose of it offshore. Combination mechanical / hydraulic dredgers may include a cutter head to excavate larger or consolidated material and then use hydraulic suction to remove it. Dredged sediment may be loaded into a barge and transported to shore or may be pumped to shore. For either type of dredging, sediment must be dewatered before disposal by truck which requires dewatering sites.

Based on the available information and evaluation of the terrain, it is assumed dredging would be recommended as the primary sediment removal method as excavation above the water level may be difficult due to the rugged terrain, rocky shoreline, and lack of access to these areas for equipment. In addition, it is likely that sediment has been deposited at the bottom of the lake and not along the shoreline. During dredging operations, equipment will need access to provide the means for moving the sediment to the designated dewatering site and ultimately the disposal site. Existing roads may need to be expanded or new roads constructed for disposal routes outside of the lake boundaries.

The disposal site is dependent on the type of sediment determined by the sediment survey, water quality, and local needs. The extracted sediment can be disposed of in multiple, beneficial ways such as raising subsided lands, habitat restoration projects, levee support and maintenance, or agricultural enhancement.

2.3.3 Conceptual Opinion of Probable Capital Costs

Table 2-7 provides approximate unit costs for dredging activities, and **Table 2-8** summarizes the cost-benefit of the sediment removal project.

Table 2-7 Conceptual Opinion of Probable Capital Costs for MO 06 Sediment Removal at North End of Lake Casitas

Item No.	Description	Unit Costs[1]	Quantity	Cost[2]
1	Survey (Bathymetry and Terrestrial)	$100,000/year	20 years	$2,000,000
2	Geotechnical Sediment Survey	$300,000/year	20 years	$6,000,000
3	Environmental & Permitting	$200,000/year	20 years	$4,000,000
4	Dredging, dewatering and disposal offsite	$35/CY per year (may vary significantly depending on material quality and disposal site)	1,145,000 CY per year for 20 years	*$40,075,000 (estimated annual cost)* $801,500,000 (over 20 years)
5	Mobilize dredge equipment	$1,000,000/year	20 years	$20,000,000
6	Construction Quality Assurance	$500,000/year	20 years	$10,000,000
7	Engineering, Legal and Administrative	$1,000,000/year	20 years	$20,000,000
8	Contingency		20%	$172,700,000
Conceptual Opinion of Probable Capital Costs				**$1,036,200,000**
[1] Unit Costs are provided for order of magnitude only, actual costs may vary significantly due to disposal site locations, water quality results, and other field results. [2] Calculated order of magnitude costs do not include escalation rate				

Table 2-8 Costs and Benefits of MO 06 Sediment Removal at North End of Lake Casitas

Parameter	Value	Unit
Conceptual Opinion of Probable Capital Costs	**$1,036,200,000**	USD
Estimated Annual Yield (after 20 years)	420	AFY
Conceptual Unit Capital Cost per AFY	$2,467,140	USD/AFY

2.3.4 Regulatory Permits & Environmental Compliance

In order to dredge Lake Casitas, Casitas would have to obtain regulatory permits from the United States Army Corps of Engineers (USACE). Under the Federal Clean Water Act of 1976, the USACE is required to regulate the removal of sediments from waterways to protect water equality and ecosystem. Casitas would have to obtain permits from the California Department of Fish and Wildlife (CDFW) for dredging. It should be noted that, currently, a permit is required for suction dredging throughout California. Depending on the method and location of disposal, this permit may be obtained from the Regional

Water Quality Control Board under the 401 Water Quality Certification and Wetlands Program for the discharge of dredged material.

Lake Casitas is a Bureau of Reclamation facility. A use permit is required from Reclamation to apply for possession or occupancy of, or for extraction or disturbance of natural resources from land, facilities, or waterbodies under the jurisdiction of Reclamation.

It is also likely the following will be required.

- Conduct site environmental survey(s) and prepare a wetland delineation.
- Submit delineation to USACE and meet with USACE for initial consultation for CWA Section 404 requirements for this project.

Given the size of the project, it is likely that the project will not meet the USACE requirements for a Nationwide Permit (NWP) and an individual permit will be required. The following will likely be required to obtain ab Section 404 Individual Permit:

- Prepare IS/EA and FONSI/MND under NEPA/CEQA
- Prepare Individual 404 Permit Package to include:
    - USACE ENG Form 4345 and required project diagrams
    - Project Description/Project Purpose
    - Draft Public Notice
    - 404(b)(1) Alternatives Analysis
    - Wetland Delineation
    - Biological Assessment
    - Cultural Resource Technical Report
    - Wetland Mitigation Plan
- Obtain 401 Certification from Regional Water Quality Control Board (RWQCB)
- Obtain take exemption under the Endangered Species Act or "not likely to adversely affect" concurrence from USFWS and NMFS

Fish and Game Code section 1602 requires any person, state or local governmental agency, or public utility to notify CDFW before beginning any activity that will substantially modify a river, stream, or lake. CDFW will review the notification and issue a Lake or Streambed Alteration Agreement when necessary to protect fish and wildlife resources.

2.3.5 Inter-Agency Coordination

This project would require coordination and a potential use permit with Reclamation, the Lake Casitas owner. There may be other agency coordination required depending on final selected disposal location and disposal routes required.

2.3.6 System Integration

This project will not produce a significant additional volume and will take many years to perform. To retain the removed storage volume will require periodic maintenance dredging. If maintenance dredging is not completed, the volume could be lost in an estimated 9 years due to incoming sediment. Casitas may want to explore watershed management or stream management alternatives for reducing sediment deposits from reaching Lake Casitas and/or performing annual sediment removal to maintain current volumes through a reservoir maintenance plan.

2.3.7 Phasing

It is assumed that the removal of all sediment accumulation in Lake Casitas would be phased over an estimate of 20 years due to the high volume of removal and funding restrictions. While not all sediment accumulation could be removed in a short amount of time, yearly sediment dredging could help the increase storage volume over the long term. Maintenance dredging would be required after removal is complete to maintain the storage volume.

Assuming 500 AF of sediment accumulates in the lake per year, to remove a total of 4,200 AF in 20 years would require an annual dredge removal volume of 710 AF (1.1 million yards). See **Table 2-9** for potential 20-year dredging program.

Table 2-9 Twenty-Year Dredging Program

Year	Starting Accumulated Sediment Volume (AF)	Dredged Volume (AF)	New Accumulation (AF)	Ending Accumulated Sediment Volume (AF)	Net Gain/loss in Lake Casitas Capacity (AF)
1	17,000	-710	500	16,790	210
2	16,790	-710	500	16,580	420
3	16,580	-710	500	16,370	630
4	16,370	-710	500	16,160	840
5	16,160	-710	500	15,950	1,050
6	15,950	-710	500	15,740	1,260
7	15,740	-710	500	15,530	1,470
8	15,530	-710	500	15,320	1,680
9	15,320	-710	500	15,110	1,890
10	15,110	-710	500	14,900	2,100
11	14,900	-710	500	14,690	2,310
12	14,690	-710	500	14,480	2,520
13	14,480	-710	500	14,270	2,730

14	14,270	-710	500	14,060	2,940
15	14,060	-710	500	13,850	3,150
16	13,850	-710	500	13,640	3,360
17	13,640	-710	500	13,430	3,570
18	13,430	-710	500	13,220	3,780
19	13,220	-710	500	13,010	3,990
20	13,010	-710	500	12,800	4,200
Total		-14200			
Yearly dredge volume			-1,145,467	CY / year	

2.3.8 Timeline

For the purposes of this report, it is assumed that dredging and disposal of the 4,200 AF of sediment would occur intermittently throughout 20 years, primarily between the months of May-October each year, or whenever lake levels are low enough. Before any dredging occurs, sediment surveys are key to determine where and how the sediment can be removed and disposed. It is assumed both a bathymetric survey and sediment survey would take several months to perform. Permitting activities could take up to 12-24 months before removal can begin.

Table 2-10 Preliminary Timeline for MO 06 Sediment Removal at North End of Lake Casitas

Project MO 06	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4+
Bathymetry Survey	Annual Survey							
Sediment Survey	Annual Survey							
Permitting	Repeated as required annually (over 20-year period)							
Construction					Annual Dredging (over 20-year period)			

2.3.9 CWRP Recommendation

This project was moved forward into the CWRP decision support tool but was not ranked as one of the top 10 projects. This project is not recommended due to the prohibitive costs and little supply yield. Casitas may want to explore other maintenance alternatives for reducing sediment loading into Lake Casitas through a reservoir operations and maintenance plan.

2.4 GW 06 – Ojai Basin Desalter Project

2.4.1 Project Description

This project targets otherwise unusable high chloride water from the lowest aquifers in the Ojai Basin to allow for its potable use and provides recharge water to replace the poorest quality water over time. Groundwater rights limitations will need to be evaluated as part of this project.

Casitas would own and operate the desalter project infrastructure. Delivering the water acquired from the Ojai Desalter Project would require installation of a membrane treatment system, and connection to the existing Casitas Ojai transmission system, as well as drilling a well to supply the high chloride water. Additionally, the brine from the treatment process was assumed to be delivered to the existing Ojai Valley Sanitary District (OVSD) collector lines in the project area. Further evaluation is required to determine the feasibility of using existing collector lines as there may be concerns with salt build-up and the project may require a completely independent collection system. For the purposes of this report, it is assumed the existing OVSD collector lines are available for brine disposal. Production volume for the Ojai Basin Desalter Project is estimated to range from 300 to 400 AFY. Estimated maximum flow rate to be used in conceptual facility design is approximately 200 gpm.

Produced water prior to treatment is expected to be sodium-chloride in character, with total dissolved solids (TDS) in the near brackish state (around 2,000 milligrams per liter, or mg/l, TDS). Desalting would result in water quality of 500 mg/l TDS added to the distribution system.

2.4.2 Conceptual Level Layout and Design of Required Facilities

The purpose of this project is to introduce a new water source to the Casitas potable water distribution system. The existing Ojai groundwater wellfield on Grand Avenue is the most feasible and cost-effective location for this project since the site is already owned by Casitas and distribution lines are accessible (Figure 2-4). According to records provided by the Golden State Water Company (GSWC), 12 wells have been constructed in the well field, 6 of which have been decommissioned and six of which are currently operating. The supply wells currently being used are listed in **Table 2-11**. It is assumed neither the active nor the destroyed wells can be repurposed for this project. Therefore, a new well would need to be constructed.

Figure 2-4 Grand Avenue Wellfield Vicinity

Table 2-11 Existing Grand Avenue Wellfield Well Supply Summary

Well	Year Constructed	Well Depth (ft)	Design Production Capacity (gpm)	Observed Production Capacity (gpm)
San Antonio #3	1956	600	551	197
San Antonio #4	2005	610	500	174
Gorham	1996	650	1000	239
Mutual #4	1947	580	275	131
Mutual #5	1951	610	670	140
Mutual #6	2012	510	471	280
Total			**3,467**	**1,161**

According to the Ojai Wellfield Interference Assessment Report (Pueblo Water Resources, 2018), the wells are built with carbon steel casing. Due to encrusting, the carbon steel casing has a useful life of about 30 years. This indicates that the oldest wells in the wellfield, Mutual well #4, Mutual well #5, and San Antonio well #3, are nearing the end of their useful lives. For this reason, the new well location is proposed to be on the east side of San Antonio Creek, in the vicinity of Mutual Wells #4, #5, and #6.

In order to obtain the otherwise unusable high chloride water from the lowest aquifers in the Ojai basin, it is estimated that the borehole will be reamed to 500 ft + below ground surface with an approximate borehole diameter of 36 in. For preliminary estimates, the well casing and screen is proposed to be a diameter of 26 in and constructed to 500 to 1000 ft below ground surface. The borehole will then be backfilled with sand pack, bentonite grout mixture and grout. The approximate lengths and depths of backfill will be determined after logging borehole lithology, again, to ensure proper well construction. Post well construction, well development and groundwater sampling will be required to determine a proper treatment plan. For this purpose, a vertical turbine pump is recommended. In order to determine a stable pumping rate for this new well, as well as the interference on the surrounding wells, a pump test would be required.

According to a Stratified Water Quality Report shown in the 2018 Ojai Basin Groundwater Management Plan (Ojai Basin Groundwater Management Agency, 2018), the concentrations of chloride were determined to be between 36 to 638 ppm (**Table 2-12**). In order to treat the expected levels of TDS in the groundwater, a Package Reverse Osmosis Treatment system is recommended and would be located at the proposed well site. In the reverse osmosis treatment process, a portion of the groundwater would be treated and recombined with the other groundwater from the same well as a split stream process to meet the 500 mg/L to reduce capital and operating costs.

It is assumed the existing 8-inch pipeline connected to the Mutual Wells No. #4, #5, and #6 would be utilized for preliminary estimates. A hydraulic analysis would be required in order to size the discharge pipeline and determine any necessary distribution system upgrades.

Table 2-12 Solute Concentrations in Ojai Basin Groundwater

	Concentrations in mg/l (ppm)					
Depth (ft)	Calcium	Bicarbonate	Magnesium	Sulfate	Sodium-Potassium	Chlorine
240	120.23	244.07	36.46	192.12	45.98	35.45
320	100.20	244.07	36.46	192.12	45.98	35.45
380	100.20	305.08	36.46	288.18	68.97	35.45
440	120.23	305.08	36.46	288.18	183.92	212.72
505	180.35	305.08	48.61	432.27	344.85	638.15
575	240.47	366.10	48.61	576.36	344.85	567.25
Average	143.61	294.91	40.51	328.21	172.42	254.08

2.4.3 Conceptual Opinion of Probable Capital Costs

Anticipated cost of the Ojai Desalter Project ranges from $2.6 million to $3 million. **Table 2-13** and **Table 2-14** list the conceptual opinion of probable costs and the cost benefit of the Ojai Basin Desalter project.

Table 2-13 Opinion of Probable Capital Costs for Ojai Basin Desalter Project

Item	Description	Unit	Quantity	Cost Per Item[1]	Total Cost[1,2]
1	Well Construction	ea	1	$ 1,000,000	$ 1,000,000
2	Well Pump	ea	1	$ 25,000	$ 25,000
3	Water Treatment System (RO)	ea	1	$ 300,000	$ 300,000
4	Water Stabilization	ea	1	$ 100,000	$ 100,000
5	Chloramination	ea		$ 100,000	$ 100,000
6	Brine Pipeline	linear foot	550	$ 460	$ 253,000
7	Treated Water Pipeline	linear foot	100	$ 460	$ 46,000
8	Mobilization, Demobilization, Bonds, & Insurance	%	10		$ 172,400
9	Potholing Existing Utilities	%	1.50		$ 30,000
10	Planning and Permitting Allowance	%	5		$ 100,000
11	Engineering Design Costs	%	15		$ 290,000
12	Contingency	%	20		$ 490,000
Conceptual Opinion of Probable Capital Costs					$ 2,936,400

[1] Unit Costs are provided for order of magnitude only, actual costs may vary significantly due to disposal site locations, water quality results, and other field results.

[2] Calculated order of magnitude costs do not include escalation rate

Table 2-14 Costs and Benefits of Ojai Basin Desalter Project

Parameter	Value	Unit
Conceptual Opinion of Probable Capital Costs	$2,936,400	USD
Estimated Annual Yield	350	AFY
Conceptual Capital Unit Cost per AFY	$8,390	USD/AFY

2.4.4 Regulatory Permits & Environmental Compliance

In order to construct the groundwater well and install an attached pump, Casitas must submit multiple permits to the Ventura County Resource Management Agency. This includes a Well Permit Application, specifying the owner, well type and purpose, and construction parameters. The well construction must follow Ordinance No. 4468, to ensure the protection of groundwater quality, supply, and quantity. Next, a Well Pump Test Form must be submitted to demonstrate that the well has an adequate water supply and a sufficient recovery time. Moreover, the Well Pump Test form must contain the proper licenses and certification from the well driller, pump contractor, and the supervising Civil Engineer or Geologist that provides oversight. The Well Pump Test must adhere to the Water Pump Test Criteria set by Ventura County specifying the pump test duration, pumping rate, and recovery time.

This project is not anticipated to have a significant effect on the environment based on the tenants of CEQA. The anticipated environmental document to be required is an Initial Study Mitigated Negative Declaration. Alternatively, a Categorial Exemption could also be implemented.

2.4.5 Inter-Agency Coordination

Although Casitas owns and operates the wellfield on Grand Avenue, inter-agency coordination will be required for operation of the project. The involved agencies will include the Ojai Basin Groundwater Management Agency, County of Ventura, and OVSD.

2.4.6 System Integration

This water source introduces approximately 300 to 400 AFY of 500 mg/l water into the existing distribution system, as well as brine water into the sewer collector line. The Ojai Water System hydraulic model should be updated to evaluate the impact of the additional flow to the distribution system. OVSD may require additional studies to evaluate the impact on the brine water disposal into the sewer collection system and blending of water sources.

2.4.7 Phasing

This project is not anticipated to be broken into phases.

2.4.8 Timeline

The time required from conception to completion if allowed to progress without delay could take up to 24-months if a Categorical Exemption is available for CEQA compliance and a new well or wells are to be constructed.

Table 2-15 Preliminary Timeline for GW 06 Ojai Basin Desalter Project

Project GW 06	Year 1 - Q1-Q3	Year 1 - Q4	Year 2 - Q1-Q3	Year 2 – Q4
Planning	Planning and Permitting			
Design		Design		
Construction			Well Construction and Desalter Station construction	Desalter Installation and connection to distribution System

2.4.9 CWRP Recommendation

This project was moved forward into the CWRP decision support tool but was not ranked as one of the top 10 projects. This project is not recommended as a current water supply project due to the high cost-benefit ratio and relatively small amount of supply.

2.5 SW 04 – Expansion of Robles Canal

2.5.1 Project Description

The Robles Canal is part of the Bureau of Reclamation's Ventura River water supply project and diverts water from the Ventura River to Lake Casitas. The present capacity of the Robles Canal is 500 cubic feet per second (cfs). Expansion of the Robles Canal to a capacity of 2,200 cfs was considered by the Bureau of Reclamation in 1968 but was not implemented at the time for unknown reasons.

Utilizing the Lake Casitas Yield Model, a range of potential Robles Canal conveyance capacities were simulated using historical hydrology to determine the optimal canal capacity. As shown in **Figure 2-5**, there is a lower marginal increase in safe demand[1] for higher capacities. The additional capital cost to increase the size of the canal to accommodate flows higher than 900 cfs would outweigh the benefits of this larger expansion. This proposed project assumes the existing canal and headworks would be enlarged to a capacity of 900 cfs, thereby allowing greater diversions to Lake Casitas during high flow periods.

[1] Safe demand is the maximum demand that can be supplied in every year of simulation when the Casitas Water Efficiency and Allocation Program (WEAP) is implemented. The WEAP includes guidance for implementing conservation measures to reduce demand when Lake Casitas storage is low. See the Water Supply Technical Memorandum for more detail.

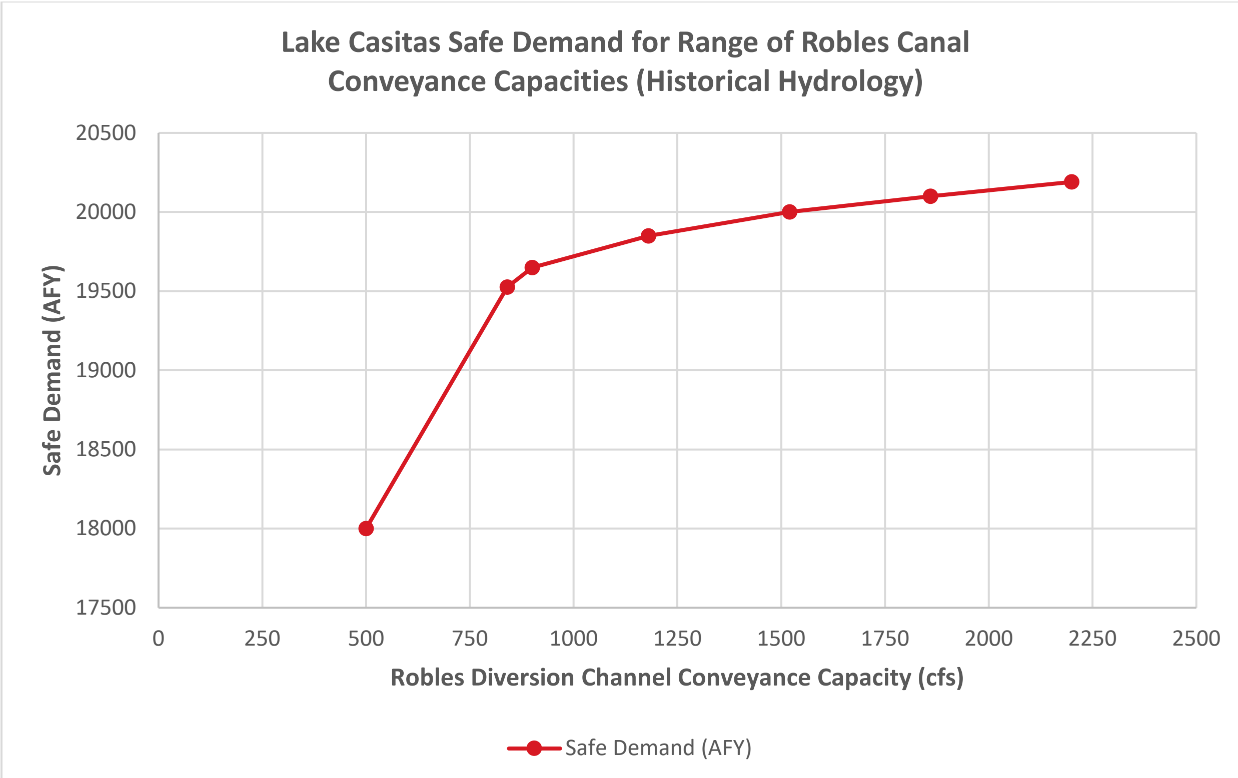


Figure 2-5 Lake Casitas Safe Demand as a Function of Robles Canal Capacity

The Robles Canal is approximately five miles long and winds along the border of Los Padres National Forest to connect the Robles Forebay on the Ventura River to Lake Casitas. The alignment includes an inverted siphon approximately 5,400 feet in length. The current canal is approximately 7 feet wide at the bottom, approximately 27.5 feet wide at the top, and has a maximum water depth of 5.56 feet with 15 inches of freeboard (NOAA Fisheries, 2003). See Figure 2-6 for the Robles Canal alignment and location.

Figure 2-6 Robles Canal and Surroundings

2.5.2 Conceptual Level Layout and Design of Required Facilities

Two design options were considered for the possible expansion of the Robles Canal to a capacity of 900 cfs:

A) expand the canal while maintaining the same depth to base width ratio as the current canal; and

B) expand the canal while maintaining the current depth of the canal.

Both options were vetted to:

- Understand differences in estimated cost;
- Estimate space constraints between the expanded canal and the existing right of way; and
- Assess constructability and temporary construction access requirements.

Table 2-16 presents the simplified conceptual design criteria for the current canal and the two possible expansion options. The inverted siphon portion is discussed separately following the table.

Table 2-16 Robles Canal Expansion Design Criteria

Parameter	Current	Expansion Options: A. Maintain D/BW ratio	B. Maintain depth	Units	Notes
Bottom width	7.00	8.71	16.12	ft	This is found using Solver such that the flow rate equals 900 cfs.
Top width	27.50	33.30	36.62	ft	
Water depth	5.56	6.92	5.56	ft	For Option A, depth to base width ratios are equal. For Option B, water depth is maintained as its current value.
Freeboard	1.25	1.25	1.25	ft	Maintained as current value for both options.
Side wall slope	0.66	0.66	0.66	ft/ft	Maintained as current value for both options.
Width at high water level	23.74	29.54	32.85	ft	
Area	85.45	132.30	136.14	sf	
Wetted Perimeter	27.09	33.71	36.21	ft	
Hydraulic radius	3.15	3.92	3.76	ft	Area divided by wetted perimeter.
Slope	0.00066	0.00066	0.00066	ft/ft	Slope over the majority of the canal.
Manning's coefficient	0.014	0.014	0.014		Manning's n for unfinished concrete.
Cross-sectional average velocity	5.88	6.80	6.61	ft/s	Calculated using Manning's equation.
Flow rate	502	900	900	cfs	Cross-sectional velocity multiplied by cross-sectional area.

Based on the Robles Canal as built construction drawings, the shortest distance between the western and eastern right-of-way lines is approximately 100 ft. Assuming a minimum laydown area width of 20 ft on each side, the canal could be no wider than 60 ft without requiring a temporary construction easement for surrounding properties as it would extend beyond the existing right of way. Neither option would require a temporary construction easement along the full alignment to accommodate the laydown area, but several temporary construction easements would need to be acquired in order to enter and exit from the construction area and for staging areas for equipment and materials.

Maintaining the existing channel depth and allowing for expansion while protecting the existing canal bottom and one of the sides, it is assumed that Option B would be preferred, and the opinion of probable costs in the following section reflects Option B. There is a road on the southeastern side of the canal and thus it is assumed that the canal would expand to the northwest.

An inverted siphon of approximately 5,400 ft length delivers water between the two open channel portions of the canal. The existing inverted siphon is 78-inch diameter pipe. In order to assess whether the existing siphon could deliver 900 cfs, the available static head between the beginning and end of the siphon was compared to the head loss with 900 cfs flow. **Table 2-17** shows these hydraulic calculations; the head loss with 900 cfs flow would far exceed the available static head.

Table 2-17 Robles Canal Siphon Hydraulic Calculations

Parameter	Value	Units	Notes
Diameter	78	in	Existing siphon diameter.
Flow rate	900	cfs	
Roughness	0.007	ft	Roughness for rough concrete from White's Fluid Mechanics. Conservative value given that the concrete will likely be lined.
Area	4778.36	sq in	
Velocity	27.12	ft/s	
Kinematic viscosity	1.06E-05	ft^2/s	Assumed water temperature at 70 degrees Fahrenheit.
Reynolds number	1.66E+07		Calculated based on velocity, diameter, and kinematic velocity.
Relative roughness	0.0011		Calculated as roughness over hydraulic diameter.
Friction factor	2.00E-02		Based on the Moody friction factor chart, using calculated Reynolds number and relative roughness.
Length	5400	ft	Length of existing siphon.
Head loss	189.79	ft	Calculated using the Darcy equation.
Static head available	47	ft	Based on elevation profile from Google Earth.

It is assumed that a second, identical inverted siphon would be constructed to handle flows above 500 cfs.

As mentioned, Figure 2-6 above shows the alignment of the Robles Canal along with surrounding parcels. It is assumed that a temporary construction easement will be required for five parcels along the canal (one per mile of canal alignment) and all five parcels along the inverted siphon.

2.5.3 Conceptual Opinion of Probable Costs

Assuming Option B would make use of the existing canal bottom and one of the sloped sides, and also assuming the expansion would be built into the existing canal, Table 2-18 presents an opinion of probable costs for the Robles Canal expansion.

Table 2-18 Opinion of Probable Capital Costs for Robles Canal Expansion

Item	Description	Unit	Quantity	Cost Per Item[1]	Total Cost[1,2]
1	Channel Construction (including additional siphon)	ls	1	$9,400,000	$9,400,000
2	Demolition	ls	1	$2,000,000	$2,000,000
3	Excavation and Grading	ls	1	$8,100,000	$8,100,000
4	Miscellaneous	ls	1	$50,000	$50,000
5	Mobilization and Demobilization, Bonds, and Insurance	%	10%		$1,960,000.00
6	Design, Legal, and Administrative	%	15%		$3,000,000.00
7	Contingency	%	20%		$4,902,000.00
8	Fish Passage Modifications			TBD	TBD
9	Easement Cost			TBD	TBD
10	Environmental Permitting			TBD	TBD
Conceptual Opinion of Probable Capital Costs					**$29,412,000**

[1] Unit Costs are provided for order of magnitude only, actual costs may vary significantly due to final design and other considerations

[2] Calculated order of magnitude costs do not include escalation rate

Table 2-19 summarizes the cost-benefit of the Robles Canal Expansion project.

Table 2-19 Costs and Benefits of SW 04 Expansion of Robles Canal

Parameter	Value	Unit
Conceptual Opinion of Probable Capital Costs	$29,412,000	USD
Estimated Annual Yield	1,650	AFY
Conceptual Unit Capital Cost per AFY	$17,830	USD/AFY

2.5.4 Regulatory Permits & Environmental Compliance

Expansion of the Robles Canal requires approvals and permits from the Bureau of Reclamation and environmental regulatory agencies. The 2003 Biological Opinion related to operation of the Robles Diversion to accommodate fish habitat objectives affects the estimated project yield and complicates future permitting requirements.

It is anticipated that impacts on biological resources, air quality, transportation/circulation, and noise would be able to be mitigated below a level of significance. Impacts on water resources would need to be evaluated and considerations made to downstream impacts due to reduced flows during high flow periods.

2.5.5 Inter-Agency Coordination

Extensive coordination with the Bureau of Reclamation would be necessary to carry out this project.

2.5.6 System Integration

There are no significant issues since the water is coming from the same source (Ventura River) at the same location (Robles Diversion) and will enter into Lake Casitas at the existing discharge of the Robles Canal.

2.5.7 Phasing

Canal construction could be accomplished in phases in which sections of the canal would be expanded with construction completed only during the dry season. Construction of a temporary neck-down between the new wider canal and the existing canal before each rainy season would allow for the canal to deliver its current capacity during each rainy season until the expansion is completed. **Table 2-20** shows anticipated activities by phase.

Table 2-20 Robles Canal and Siphon Construction Phasing

Phase	Activities
Phase 1	• Expansion of canal northeast of the siphon • Fish passage construction • Neck down into existing siphon
Phase 2	• Construction of new duplicate siphon, except for connection to and from canal
Phase 3	• Expansion of canal southwest of the siphon • Connect new duplicate siphon to expanded canal

2.5.8 Timeline

Expansion of the Robles Canal would ideally begin in early summer when Lake Casitas is relatively full, thus allowing for adequate supply in Lake Casitas despite no flow from the Robles Canal.

A preliminary timeline for the project that reflects phasing broken out into three dry seasons is shown below. This timeline assumes that approximately 75 ft of canal could be constructed in each working day.

Table 2-21 Preliminary Timeline for SW 04 Expansion of Robles Canal

	Q1	Q2-Q4	Year 2	Year 3	Year 4
Planning	Planning & Permitting				
Design		Design			
Construction			Construction – Phase 1	Construction – Phase 2	Construction – Phase 3

2.5.9 CWRP Recommendation

This project was moved forward into the CWRP decision support tool but was not ranked as one of the top 10 projects. This project is not recommended as a current water supply project due to the high costs and major construction and coordination challenges.

2.6 RW 06 – Ojai East Septic Collection, Package Treatment, Recharge

2.6.1 Project Description

The Ojai East Septic Collection, Package Treatment, Recharge project includes the installation of a package wastewater treatment plant in east Ojai Valley and a network of sewer collection mains and laterals to collect sewage that is currently being disposed in septic systems. The influent would be treated by means of a centralized redundant extended aeration system including anoxic chambers and clarification followed by membrane filtration and disinfection to meet tertiary standards. The treated effluent would then be piped to the lower pond in the San Antonio Creek Spreading Grounds (SACSG) to help recharge the Ojai Groundwater Basin. Production is estimated to be approximately 74 AFY. Current conditions may allow upwards of 37 AFY to recharge with 37 AFY taken up consumptively by local trees and plants at individual sites. The project would provide the ancillary benefit of replacing septic systems with a centralized treatment system, which could improve local groundwater quality.

2.6.2 Conceptual Level Layout and Design of Required Facilities.

The SACSG is located on the San Antonio Creek northeast of the City of Ojai. An area just under 800 acres to the east and south of the SACSG has been identified as a potential opportunity to disconnect private residences from septic systems and connect to a proposed sewer system. Figure 2-7 shows a map of the location of the SACSG, potential location of homes connected to septic tanks to convert, and a potential site for the package wastewater treatment plant.

Figure 2-7 San Antonio Creek Spreading Grounds and Area of Septic Conversion

2.6.2.1 Flow Rate

There are approximately 300 homes in the area southeast of the SACSG that can be converted from septic to a sewer system. TIGER data from the US Census Bureau shows the area has 2.91 persons per household, providing a population of approximately 860 people. Using the flow per capita without water conservation (Metcalf and Eddy, Wastewater Engineering 2003, Page 161, Table 3-8) of 74 gallons per person per day, the household wastewater flow in the area is approximately 71.3 AFY. Additionally, there are two small schools in the area providing another 5.7 AFY. The total wastewater flow anticipated is 77 AFY. Previous studies have assumed about half of this flow is lost to evapotranspiration in the septic system arrangement; that loss can be counted as an unused water source for this project.

2.6.2.2 Housing Connection Conversion

In order to convert the existing homes from septic systems to a sewer collection system, the homes will need to be disconnected from the septic tanks and new piping will need to be installed in the homes as well as a new sewer line on the homeowners' properties to connect to the CVWD sewer system. It is anticipated that two cleanouts per home will be needed to make the piping connections. Once disconnected, the septic systems should be decommissioned by pumping out the sewage in the tank and filling in the tank with suitable grades of sand or cement slurry.

2.6.2.3 Sewer System Design and Layout

In order to collect and convey the wastewater, a low-pressure sewer network is recommended. A gravity-based system is also possible but is not recommended due to the low flow rates causing a risk of stagnant wastewater in the collection pipes. The sewer system layout is anticipated to be a grid of 2-in HDPE pipes in each street in the area. Since the entire system is low-pressure a common header is not needed. The proposed grinder pumps will convey the wastewater to the northwestern-most point of the grid where a 4-in pipe will convey the wastewater to the package treatment plant. The package treatment plant will be located at a higher elevation than the SACSG in order to allow for gravity flow to the injection wells at the spreading grounds. An effluent holding tank will be required after the package treatment plant to maintain a steady head on the effluent and equalize the flow. The grinder pumps will be purchased and installed by Casitas and owned by each homeowner while the package treatment plant will be owned and operated by Casitas.

2.6.2.4 Packaged Wastewater Treatment Plant

Typical household wastewater has high concentrations of BOD, TSS, COD, nitrogen, phosphorus, chlorides, sulfate, oil and grease, and coliforms that need to be removed. Title 22 regulations must be met in order to discharge into the SACSG. **Table 2-22** below shows the typical wastewater contaminant concentrations and the limits required to meet for Title 22. Samples will need to be taken before a design of the package plant can be performed. Any contaminants not identified below are subject to federal EPA MCLs as well.

Table 2-22 Anticipated Wastewater Constituents and Package Treatment Plant Requirement Limits

Constituent	Typical Household Wastewater Concentration, medium strength	Title 22 Limits[1]	Los Angeles Regional Water Quality Control Board Groundwater Basin Plan – Ojai Valley[2]
Biochemical Oxygen Demand (BOD)	190 mg/L	30 mg/L	n/a
Total Suspended Solids (TSS)	210 mg/L	30 mg/L	n/a
Total Nitrogen (TN)	40 mg/L	< 10 mg/L	< 10 mg/L
Sulfate	30 mg/L	n/a	200 mg/L
Turbidity	n/a	≤ 2 NTU	n/a
Total Coliform	10^7 - 10^9 per 100 mL	< 2.2 total coliform per 100 mL	n/a
Total Dissolved Solids (TDS)	500 mg/L	400 mg/L	700 mg/L
Total Organic Carbon (TOC)	140 mg/L	≤ 0.5 mg/L	n/a
Conductivity	unknown	1170 µmhos	n/a
Chloride	50 mg/L	≥ 99.0% rejection	50 mg/L
Boron	unknown	n/a	0.5 mg/L

[1] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20181001.pdf

[2]Since the SACSG are along Senior Canyon, the more stringent of the Basin Objectives is presented in this table. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/2019/chap3updatedMay2019.pdf

2.6.2.5 Injecting Treated Effluent into the SACSG

The SACSG have a capacity of 914 AFY while annual groundwater recharge is projected to average approximately 126 AFY through passive injection wells (OBGMA.com). There is plenty of capacity available to increase the flow by less than 75 AFY; however, the spreading grounds are currently not in operation. The SACSG Rehabilitation Project began in 2014 and construction finished, but winter and spring rains in 2017-2018 brought debris from the Thomas Fire into the spreading grounds and caused obstruction of the injection well operation. Maintenance will be required to clear the debris.

2.6.3 Conceptual Opinion of Probable Capital Costs

The conceptual opinion of probable costs for converting the area from septic to sewer and treating the wastewater is anticipated to be greater than $18 million. This is more than $200,000 per AFY when considering the total treated water generates only 74 AFY in new supply for Casitas. Refer to **Table 2-23** for a breakdown of the conceptual costs, and **Table 2-24** for a summary of the cost benefit.

Table 2-23 Conceptual Opinion of Probable Capital Costs for RW 06 Ojai East Septic Collection, Package Treatment, Recharge

Item No.	Description	Unit	Quantity	Cost per Unit	Cost
1	Materials and Installation of E-One Grinder Pumps Duplex Stations at parcel	ea	300	$12,000	$3,600,000
2	Spare E/One Grinder Pumps	ea	10	$6,000	$60,000
3	Cleanouts at parcel	ea	390	$150	$58,500
4	Decommission septic tanks at parcel	ea	295	$1,000	$295,000
5	Housing lateral Lines - 1 1/4" Line	lf	59,000	$45	$2,655,000
6	2" diameter force main - Open Cut or HDD - collection system in streets	lf	100,000	$45	$4,500,000
7	Connection fee to sewer system	ea	300	$1,000	$300,000
8	Packaged Treatment Plant	ea	1	$1,110,000	$1,110,000
9	Potholing Existing Utilities	%	1	1.5%	$230,000
10	Engineering, Legal, Admin Costs	%	1	10% of construction costs	$1,280,000
11	Environmental Permitting	ea	1	$50,000	$50,000
12	Mobilization, Demobilization, Bonds, & Insurance	%	1	10% of construction costs	$1,280,000
13	Easement on Spreading Grounds (Co of Santa Barbara)	ea	1	TBD	TBD
	Running subtotal				$15,418,500
14	Contingency	%	1	20%	$2,962,500
	Estimated Opinion of Probable Capital Costs				**$18,381,000**

Table 2-24 Costs and Benefits of Ojai East Septic Collection, Package Treatment, Recharge

Parameter	Value	Unit
Conceptual Opinion of Probable Capital Costs	$18,380,000	USD
Estimated Annual Yield	74	AFY
Conceptual Unit Capital Cost per AFY	$248,400	USD/AFY

2.6.4 Regulatory Permits & Environmental Compliance

In order to discharge recycled water into any aquifer in California, extensive permitting is required. The treatment of the wastewater will need to meet Title 22 regulations for indirect potable reuse. The permitting process will be performed through the Department of Drinking Water, the Ventura Regional Water Quality Control Board, and the Ojai Basin Groundwater Management Agency.

Removing the household septic systems from use is anticipated to reduce the loading of nitrogen and chloride in the aquifer by removing point sources of contamination; however, adding wastewater to the drinking water system requires compliance with Title 22 regulations for recycled water. The wastewater must be treated to 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction with treatment process requirements. Part of the regulation for indirect potable reuse requires a downstream distance from the injection well to the extraction well to provide at least 6 months of retention time. This is already considered in the design and location of the existing SACSG but will be a consideration required for the permitting.

2.6.5 Inter-Agency Coordination

Casitas will need to obtain permission from the Ventura County Watershed Protection District and the Ojai Basin Groundwater Management Agency to use the SACSG.

2.6.6 System Integration

This water source introduces approximately 37 AFY that would have been taken up by vegetation and relocates another 37 AFY in the watershed via the SACSG. A follow-up study is recommended to evaluate the impact of the flow being diverted from individual parcels to injection at the spreading grounds. At least 6,400 feet downstream of the spreading grounds, groundwater wells pump the water and treat it in the San Antonio Pressure Filter Plant for reduction of iron and manganese as well as chlorination. Treated water fills the San Antonio Forebay and is then pumped into the main zone of the water system.

2.6.7 Phasing

It recommended that this project not be phased. It requires a sequence of construction for each part to be brought online, but due to the small size of the project phases are not recommended. In the future, other areas in Ojai on septic systems could be connected to the sewer as a separate project. At that time, sewer pipes may need to be replaced with larger pipes and the packaged treatment plant may need additional treatment capacity.

2.6.8 Timeline

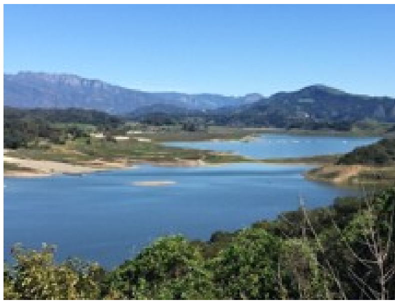
Groundwater modeling and water quality sampling can be performed concurrently before the design begins. The design is basic and should take no longer than 6-8 months; however, an extensive public outreach program to get buy-in from community members, easements from property owners for the grinder pump stations and force laterals, as well as user agreements with the property owners will be necessary and could take several months if property owners agree. Without agreement from the property owners, the project could stall. Installation may take from 1-2 years to get all homes connected to the system and for manufacturing and installation of the package treatment plant. Siting and obtaining permission to place the package treatment plant on County land should be done concurrently and as early as possible.

Table 2-25 Preliminary Timeline for RW 06 Ojai East Septic Collection, Package Treatment, Recharge

Project RW 06	Year 1 - Quarter 1	Year 2 - Quarter 2-4	Year 2	Year 3
Planning	Groundwater Modeling			
Design		Design		
Public Outreach and Property Owner Agreements		Public Outreach	Property Owner Agreements	
Construction			Installation of Sewer Piping, E/One Grinder Pump Systems, and package treatment plant	
Startup and Commissioning				Connect homes to E/One grinder pump systems and startup sewer network
Decommission septic systems				Decommission septic systems

2.6.9 CWRP Recommendation

This project was moved forward into the CWRP decision support tool but was not ranked as one of the top 10 projects. This project is not recommended as a current water supply project due to the high costs and low supply yield.



Summary

3.0 Summary

Six conceptual project alternatives for increasing Casitas water supply were evaluated at a conceptual level. Project descriptions, layouts, permitting requirements, system integration issues, implementation timing, and conceptual cost estimates were prepared for each project. The costs and benefits of each project are summarized in **Table 3-1**.

The information from this analysis was used in the CWRP alternative evaluation process. In that process the 10 highest ranking alternatives were considered for inclusion in the CWRP recommended plan. Of the six alternatives assessed in this TM, only the Environmental/Habitat Modifications and Desalinated Water from City of Santa Barbara alternatives ranked in the top 10.

Table 3-1 Project Capital Cost and Benefit Summary

CWRP Option Number	Option Name	Average Annual Yield (AFY)	Preliminary Capital Costs	Approximate Cost-Benefit Ratio
MO 01	Environmental/Habitat Modifications	1,080	$1,405,000	$1,300/AFY
DW 01	Desalinated Water from City of Santa Barbara	TBD	$0	TBD
MO 06	Sediment Removal at North End of Lake Casitas	420	$1,036,200,000	$2,467,000AFY
GW 06	Ojai Basin Desalter Project	350	$2,936,400	$8,400/AFY
SW 04	Expansion of Robles Canal	1,650	$29,412,000	$17,830/AFY
RW 06	Ojai East Septic Collection, Package Treatment, Recharge	74	$18,380,000	$248,400/AFY

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Appendix H Funding Options for Water Supply Project

Comprehensive Water Resources Plan

May 29, 2020

Prepared for:

Casitas Municipal Water District

Prepared by:

Stantec Consulting Services Inc.

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1.0 Background

Casitas Municipal Water District (Casitas) is a special district supplying both wholesale and retail water. The service area is approximately 150 square miles and includes the City of Ojai, Upper Ojai, the Ventura River Valley area, a portion of the City of Ventura, and the coastal Rincon area to the Santa Barbara County line. Casitas serves approximately 70,000 persons through over 6,000 service connections. There are three main water customer sectors: municipal and commercial (retail customers), agricultural, and resale (i.e., other water providers that deliver Casitas water to their own customers).

The Comprehensive Water Resources Plan (CWRP) includes the following objectives: meet the long-term water supply gap, mitigate the short-term risk, and diversify the water supply portfolio. The CWRP outlines the Recommended Plan which includes the Recommended Portfolio of Supplies. Additional detail regarding demand, supply and characteristics of the recommended projects is presented in the CWRP.

The Recommend Portfolio of Supplies includes “local, near-term, no-regrets options”, “preferred supplemental water options” and “conditional options” to be tracked and considered as need and opportunities present themselves. Combined, the “local, near-term, no-regrets options” and the “preferred supplemental water options” have an estimated capital cost of $155 million. The projects included in this portfolio meet the objectives set forth in the CWRP to mitigate short-term supply risk, address the long-term supply gap and diversify the water supply portfolio for Casitas.

Table 1 below shows the projects included in the Recommended Portfolio of Supplies. Table 2 presents the approximate capital costs and long-term average annual yield associated with the project options included in the Recommended Portfolio.

Table 1: CWRP Recommended Portfolio of Supplies

Local, near term, no-regrets options	Preferred supplemental water options
1. **GW 08** - Ojai Basin Well Rehabilitation and Replacement (500 AFY) 2. **MO 08** - Robles Fish Screen Improvements (350 AFY)	1. **SWP 03** – Ventura-Santa Barbara Interconnection* 2. **SWP 04** – Casitas-Calleguas Interconnection* 3. **SWP 05/DW 01** Supplemental Water (600 AFY)

Conditional options – track only
1. **C 01** – Demand Management: 5%-10% (800-1,600 AFY) 2. **MO 01** – Watershed Management/Arundo Removal (300 AFY) 3. **GW 01** – Matilija Deep Formation Wells (TBD) 4. **SWP 05/DW 01** – Supplemental Water Options (up to 4,000 AFY)

Table 2: Recommended Portfolio of Supplies Approximate Capital Costs and Annual Yield

Project Options	Approximate Capital Cost ($)	Long Term Avg. Annual Yield (AFY)
GW08 – Well Improvements in Ojai Groundwater Basin	$1,500,000	500
MO08 – Robles Diversion Fish Passage	$3,000,000	350
SWP03 – Ventura-Santa Barbara Counties Interconnection	$14,500,000	2,000*
SWP04 – Casitas – Calleguas Interconnection	$136,000,000	3,180*
SWP 05/DW 01 Supplemental Water (via SWP Connections)	Included in SWP project alternatives	600+
Total Portfolio	$155,000,000	4,630 (AFY)

The Casitas Municipal Water District Water Rate Study (March 2017) anticipated a Capital Improvement Program (CIP) of slightly more than $24.2 million between fiscal year (FY) 2017 and 2026. To meet operating and CIP costs without taking on any debt, the Rate Study recommended annual rate increases of 12 percent between 2018 and 2022. Based on the recommendations of the CWRP, Casitas requires an additional $155 million to develop the Recommended Portfolio of Supplies. Cash reserves cannot fund the Recommended Portfolio. Based on financial resources currently available, Casitas would need to secure additional capital to fund water supply project(s) and likely be required to raise rates to meet related financing obligations.

Importantly, all funding decisions will ultimately have an impact on Casitas' customers. New fees, assessments, loan maturities, interest rates, grant management requirements, and repayment conditions - all the direct and indirect costs - are ultimately reflected in the customers' bill.

A conceptual funding plan for the Recommended Portfolio of Supplies is presented in this technical memo. The memo explores potential funding options Casitas may wish to consider funding the "local, near term, no-regrets options" and the "preferred supplemental water options" articulated in the CWRP. This memo provides some preliminary recommendations to advance an integrated approach to project delivery. To access alternative funding, or non-cash funding, Casitas must consider both the price and timing of the projects within the portfolio. With a ten-year delivery timeframe, no single alternative funding source or debt issuance will adequately meet needs.

2.0 Funding Options Overview

Developing a strategic funding plan hinges on having a robust understanding of current funding sources, identifying and characterizing new funding sources, and evaluating the applicability and attractiveness of those funding sources. Funding sources can be tapped to support a single water supply project or multiple projects. To secure adequate capital to fund the Recommended Portfolio, Casitas may benefit from pursuing a suite of funding options.

Cash-funding projects through available reserves is often the least expensive source of funding. As funds are available, Casitas should leverage the accrued reserves to, in particular, fund “local, near-term, no-regrets options” and the SWP03-Ventura Santa Barbara Counties Interconnection. For the MO 08 Robles Fish Screen Improvements project, Casitas should consider grant programs administered by the California Department of Fish and Wildlife, the Coastal Conservancy, the California Wildlife Conservation Board, and the Ocean Protection Council. Even smaller grant awards can have a positive impact on project financing and several programs have more funding available related to Proposition 68. Additional detail on these programs is presented in the attached Funding Matrix.

To fund the SWP03 and SWP04 Casitas-Calleguas Interconnection, Casitas should consider positioning for the California Drinking Water State Revolving Fund (DWSRF). While this program is competitive and targets small and disadvantaged communities, the regional and resiliency aspects of SWP03 and SWP04 may recommend the projects to the program. Additionally, Casitas may consider bundling the projects under a single WIFIA loan issuance. The DWSRF and Water Infrastructure Finance and Innovation Act (WIFIA) programs offer low interest rates and other favorable borrowing terms. Opportunistically, and highlighting the sustainability, redundancy, regional aspects, and resiliency of the projects, Casitas should track resiliency funding available through the Federal Emergency Management Act (FEMA) Building Resilient Infrastructure and Communities (BRIC) grant program. Between now and the delivery of these projects, other resiliency programs at the state and federal level may become available. Efforts should be made to track the availability of funding for regional projects supporting resiliency. With an awareness of potential funding sources, to stay aware of emerging funding options, Casitas can sign up for Notices of Funding Opportunity and Notices of Funding Availability email alerts through state and federal agencies.

Revenue bonds are an effective tool for financing funding gaps. Casitas should consider issuing revenues bonds to complement cash, grant and government loan program funding.

The following provides a high-level overview of funding options.

2.1 Cash-Funded Capital

The most direct form of capital funding is to pay for projects through available cash balances or revenue cash flows, often referred to as “pay-as-you-go” (PAYGO) funding. This funding source is very often the cheapest form of funding (except grant funding) as there is no interest expense to be paid off over time, nor administrative or issuance costs associated with procuring funding. Projects can be partially or entirely funded as PAYGO capital based on the funds available to meet the project funding needs. Funds may be generated to build a reserve and meet capital needs through a variety of sources. The 2017 Rate Study recommended a Capital Improvement Program Reserve Target of $5 million, to stabilize funding for capital projects through accumulated “pay as you go” reserves.[1]

The first and most common source of funding is from rate, fee, or assessment revenue collected by the District from rate payers. These are rates or fees paid for potable water services. Generating the revenue needed to meet the project funding needs would likely require an increase and/or change to existing rates, requiring completion of a Proposition 218 compliant rate study to show the cost justification for rates and fees, in addition to notification to affected property owners, voters, or rate payers prior to Board approval.

The second source of cash funding is system development fees (also referred to as impact fees, capacity fees, capital facilities fees, among others), which are fees strictly dedicated to meeting specific capital needs. In particular, these fees are intended to charge new customers for their respective share of the existing system, and for the additional capital investment required to meet their added demands on the system. System development fees are charged as one-time fees upon approval for connection to the system. Development fees are not a good source of funding for the Recommended Portfolio as Casitas is currently projecting no future customer growth.

Lastly, assessments may be charged to fund projects that provide a “special benefit”[2] to property owners of a clearly defined set of parcels. Assessments are commonly used to meet capital funding needs for a specific project, but they can also be used to meet ongoing debt service and O&M funding needs as long as the basis for the continuation of the fee is clearly defined. Additionally, any basis for annual increases to the assessment to account for inflation or cost escalation must be clearly defined in the original assessment proposal. Assessments must be accompanied by an engineering report that outlines the costs to be recovered, the parcels receiving a special benefit, and the method of apportionment of benefit to individual parcels. Assessments must be approved by a majority of affected property owners, whose votes are weighted based on the benefit apportioned to their respective parcels.

2.1.1 Enhanced Infrastructure Financing Districts (EIFD)

Enhanced Infrastructure Financing Districts (EIFDs) were authorized under state law in 2014 to aid in funding a broad range of public capital facilities (including water infrastructure projects) by capturing the increment of property tax revenue generated within the district above the base year established at formation. The statute authorizes cities and counties to create the district, which then becomes a legal entity separate and distinct from the city or the county. Special districts, such as Casitas, can participate in such districts if they receive property tax revenue. The EIFD may finance the purchase, construction, expansion, or improvement of projects with a useful life of 15 years or longer. Property tax increment generated within the EIFD can be used to cash-fund projects and/or pay debt service on bonds issued to fund the projects. There is no required voter approval to create the district; however, to issue bonds, the district must secure 55 percent voter approval. This funding option would require significant collaboration with nearby municipalities and may be well suited for project options that include overlapping water supply projects, such as the Casitas-Calleguas and Ventura-SB County Interconnections.

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[1] For reference, to cover all capital needs for the Recommended Portfolio of Supplies in a single issuance, a 3.5% interest rate, 25 year maturity $155,000,000 loan would require over $9.4 million in debt service annually. $9.4 million does not consider the likely debt service coverage loan terms.

[2] Special benefit is defined as a particular and distinct benefit over and above general benefits conferred on real property located in the district or to the public at large.

Table 3 summarizes the strengths, weaknesses, opportunities (SWOT) and threats related to Cash Funded Capital.

Table 3: Cash Funding SWOT

Strengths • Low Cost • Control • No external compliance requirements	**Weaknesses** • Must accrue adequate capital over time • Requires rate increases • Could delay delivery
Opportunities • Blend cash with government funding programs and bonds to reduce overall costs • Fund “local, near term, no-regrets” options with existing cash reserves	**Threats** • Unforeseen costs depleting capital reserves and delaying or preventing projects • Failure to implement adequate rate increases

2.2 Debt Financing

Debt financing is a viable option to meet the planning, design, and construction funding needs to complete the recommended projects. Debt financing can come in various forms, most commonly revenue bonds, general obligation bonds, certificates of participation, or loans. Each of these is described in the following subsections.

2.2.1 Revenue Bonds

Revenue bonds are the most common form of debt financing for utility infrastructure investments. Revenue bonds require specific, dedicated, non-tax revenues to be pledged to guarantee payment, and are often issued based on the financial standing and credit rating of the individual utility issuing the bonds (as opposed to the City or other taxing authority). Additional costs are commonly incurred in the issuance of revenue bonds, including legal fees, registration fees, underwriting fees, and others. In addition to these costs and administrative requirements, revenue bonds also carry covenants commonly requiring a utility to generate net revenue after operating costs to meet debt service needs plus a defined margin (e.g. 25%).

2.2.2 General Obligation Bonds

General obligation (GO) bonds are similar to revenue bonds, with the distinction that GO bonds are issued based on the issuer’s pledge of its full faith, credit, and taxing authority. GO bonds are issued by local governments, sometimes to meet municipal utility capital investment needs. In these cases, the GO bonds are still repaid by utility rate revenues, similar to a revenue bond, although the bond is issued based on the financial standing and credit rating of the taxing authority.

2.2.3 Certificates of Participation

Certificates of participation (COPs) provide long-term financing without some of the administrative, regulatory, or legal hurdles often associated with bonds, including voter approval. However, legislative approval is still required prior to issuance of COPs. Under a COP, the lessee makes payments to shareholders using revenues generated from the operation of the facilities, similar to a revenue bond. Interest rates are often higher under a COP based on the increased risk of non-appropriation.

Table 4 summarizes the strengths, weaknesses, opportunities and threats related to Municipal Bonds and COPs.

Table 4: Municipal Bonds and COPs SWOT

Strengths • Control • Minimal compliance requirements • Currently rates are low	**Weaknesses** • Typically higher rates than government financing programs • Inflexible repayment terms • Potentially high issuance costs
Opportunities • Blend bonds with government funding programs • Leverage current issuance trends to keep costs low • Issue numerous bonds over implementation of Recommended Portfolio to reduce capitalized interest prior to substantial completion	**Threats** • Interest rate risk exposure • Project risk impacting interest rate

2.3 Government Financing and Funding

The Recommended Portfolio of Supplies may be a strong contender for competitive government funding programs but not all programs are a good fit. Evaluation criteria drives the assessment and comparison of potential funding options. These criteria weigh the qualitative risks and benefits, as well as the quantitative revenue and timing associated with each funding option.

Key evaluation components include:

- Competitiveness – Provides a measure of how likely Casitas is to successfully compete for funding from the program

- Maximum Grant Award or Loan Amount - Determines the adequacy of the funding available to meet the needs of Casitas
- Funding Terms – Evaluates the attractiveness of anticipated loan interest rate and maturity compared to bonding
- Application Costs – Considers the level of effort necessary to effectively compete for funding. Outlines the application requirements
- Compliance Costs – Assesses the costs of grant or loan management after the funding has been secured
- Timing – Overlays the likely timing of funding program disbursements with the project cash flow requirements

The following narrative describes programs to which Casitas may opt to apply. Additional details related to advantages and disadvantages of the various programs and approaches are summarized in the attached Funding Matrix. Securing funding takes time and costs money. Small grants can be competitive and have extensive application requirements even though they have little impact on filling the funding gap. Therefore, this memo is focused on funding and financing options with more substantial funding resources.

Table 5 summarizes the strengths, weaknesses, opportunities and threats related to Government Funding and Financing Programs.

Table 5 Government Funding and Financing Programs SWOT Loans

Strengths	**Weaknesses**
• Low interest rates • Grant funding • Flexible repayment terms	• Application costs and requirements • Inadequate funding available to meet needs • Compliance and reporting costs • Government coordination and schedule impacts
Opportunities	**Threats**
• Streamline project management and funding program application, reporting and compliance requirements • Reduce impact to rate payers through gradual rate increases that match flexible repayment terms • Utilize multiple programs with same compliance & reporting requirements to spread costs across greater capital contribution • Use a WIFIA loan in a PPP	• Decreases in funding available • Shifting program and political priorities • De-obligation of funds related to non-compliance

Many government financing programs are designed to support the unique funding needs of public water utilities and municipalities. State and federal loan programs offer very low or subsidized interest rates. Recognizing what municipal and water utilities need, state and federal funding program loans may also offer flexible repayment terms, allowing for more gradual rate increases and maturities to more accurately reflect the asset life of water infrastructure. Multiple loan programs exist with the sole purpose of financing infrastructure investments. All the options included in the Recommended Portfolio of Supplies would be eligible for the loan programs described in the following subsections.

2.3.1.1 California Drinking Water State Revolving Fund (DWSRF)

California's DWSRF program offers financings for eligible drinking water infrastructure projects that address drinking water health compliance issues. DWSRF is a competitive program where applicants' projects are scored based on set criteria. Projects aiming to correct or prevent future public health problems (related to potable water) or are needed to comply with the Safe Drinking Water Act, receive higher funding priority. According to the SFY 2019-2020 DWSRF Intended Use Plan, the California State Water Board funding target for SFY 2019-2020 was $420 million in new financing. In SFY 2019-2020, the State Water Board received loan requests for almost $1.4 billion. Based on the United States Environmental Protection Agency (USEPA) Drinking Water Infrastructure Needs Survey, California needs approximately $51 billion over the next 20 years to adequately fund drinking water infrastructure. The greatest need ($31 billion) is for drinking water transmission and distribution repair/replacement.

Loan terms under the DWSRF programs typically include an interest rate of approximately 50% of the latest state GO bond rate, and a repayment period of up to 30 years. Applying for these programs often requires extensive studies and administrative costs to show the project yields the intended benefits, meets compliance requirements, is “shovel-ready” (for construction), and can be repaid by the agency in the form of debt payments.

2.3.1.2 EPA Water Infrastructure Finance and Innovation Act (WIFIA)

Another potential loan program is USEPA Water Infrastructure Finance and Innovation Act (WIFIA) loan program. WIFIA is a relatively new funding program to support large water, wastewater, and stormwater infrastructure projects. Since program initiation in 2017, the WIFIA program has closed more than $2.8 billion in low interest loans.

The WIFIA program is administered by the EPA out of the Washington DC headquarters. Annually, the program is appropriated funds by Congress. The appropriation determines how much the program can lend. In 2020, the Consolidated Appropriations Act provided enough credit subsidy for the WIFIA program to provide approximately $5.5 billion in credit assistance.

WIFIA loans will only cover up to 49% of total project costs, so applicants must demonstrate a viable financial plan to cover the other 51%. Public and private entities are eligible to apply. WIFIA funds may cover project costs previously incurred and can be used to fund project construction for up to seven years. Borrowers are encouraged to bundle projects and think about portfolios of projects to serve a common purpose (like adequate and resilient water supply). Financing terms for WIFIA loans include an interest rate equal to the US Treasury rate of a similar maturity, up to five years of deferred payments from the date of substantial completion of a project, and the option to structure loan repayment to align with projected revenues generated from the funded project. These deferred and sculpted repayment options enable WIFIA borrowers to more gradually increase rates or fees to cover debt service.

The WIFIA selection criteria are generally divided into three main categories – Project Impact, Project Readiness, and Borrower Creditworthiness – and the program is primarily intended to fund large projects. Administrative funding priorities for WIFIA are announced on an annual basis, and currently include drought prevention, reduction, or mitigation projects. WIFIA encourages applicants to bundle projects into larger programs and has prioritized regional infrastructure projects with multiple partners. Though the projects in the Recommended Portfolio of Supplies represent different strategies to mitigate risk and address supply needs, they are part of a coordinated plan by Casitas. As such, the fish screen improvements, groundwater well rehabilitation/replacement and interconnections could be considered part of Casitas’ Water Supply Program and bundled in a single WIFIA credit issuance. Additionally, Casitas might establish partnerships with Santa Barbara County agencies or Calleguas Municipal Water District to apply for WIFIA funding for interconnections.

Debt will likely necessitate an increase in revenues to cover debt service. The magnitude of this increase will be dependent on the amount of debt issued, and the debt terms. WIFIA credit is attractive because, while interest rates are not subsidized as they are with the SRF program, rates are lower than revenue bond interest rates and repayment can be sculpted for borrowers to more gradually implement rate increases.

2.4 Grant Funding

While grant programs for the purpose of funding water infrastructure projects in California do exist, they are often targeted at small disadvantaged communities or narrowly defined projects and often award grants of less than $1 million. Utilizing these programs may require some creative or out of the box type projects, solutions or collaborations. In addition, these programs are highly dependent on funding from federal and state governments, and as such may change over time in their funding capacity and availability, application requirements, and project selection criteria. Because of the limitations and variability, a small number of the largest, most stable and directly applicable programs to the Recommended Portfolio of Supplies are discussed in the following subsections.

2.4.1 Drinking Water SRF Program (DWSRF)

The DWSRF program offers grants to small disadvantaged communities up to a maximum of $8 million over a five-year period for water infrastructure projects. This criteria would generally seem to preclude Casitas from taking advantage of this program, given its demographics, unless there are projects to serve pocket economically disadvantaged communities as indicated by median household income (MHI, must be less than 80% of state MHI).

2.4.2 United States Bureau of Reclamation Water Reclamation and Reuse Program (Tile XVI)

The US Bureau of Reclamation (BOR) has several grant programs relevant to Casitas including the BOR WaterSMART Small-Scale Water Efficiency Projects Grants and the WaterSMART Water and Energy Efficiency Grants. Typically these funding programs awards smaller grants though awardees can receive up to $1.5 million in WaterSMART Water and Energy Efficiency grants.

2.4.2.1 Federal Disaster Resilience and Mitigation Funding

The US Housing and Urban Development (HUD) Community Development Block Grants (CDBG) – Mitigation (MIT) funds represent an opportunity for grantees to carry out activities to mitigate disaster risks and reduce future losses. California Housing and Community Development will submit a State Action Plan in April 2020 outlining targets for the $88 million of CDBG-MIT funds directed toward Sonoma and Ventura counties recovering from fires. Water supply infrastructure to support community resiliency is a potential application of those funds.

The US Department of Homeland Security FEMA Building Resilient Communities and Infrastructure (BRIC) grant program provides up to $10 million grants for resiliency projects. FEMA will cover up to 75% of project costs. Critical infrastructure, like water supply systems, is considered eligible for these funds. BRIC is a newer iteration of the Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant Program (HMGP). These programs require applicants to develop a Benefit-Cost-Analysis to demonstrate the value of the resiliency investment. In past years, these programs were criticized for the amount of time between application submittal to grant funding availability. However, FEMA is working to expedite the process and improve the impact of the program. The California Office of Emergency Services (OES) is the FEMA applicant. Cities, districts, and local agencies are the “subapplicants”.

2.4.2.2 California Agency Grants

Several California grant programs support water conveyance, fish passage, and groundwater projects. Several of these programs deserve consideration even though stated agency priorities may not align perfectly with the Recommended Portfolio of Supplies. The Department of Water Resources (DWR), the State Water Resources Control Board, the California Department of Fish and Wildlife, the Coastal Conservancy, the California Wildlife Conservation Board, and the Ocean Protection Council all have relevant grant programs. The “Grants” tab on the attached Funding Matrix includes summaries of nine of these programs, along with the federal programs referenced previously.

2.5 Public Private Partnerships

Public Private Partnerships (P3s) are an alternative means to deliver infrastructure services. P3s are rare in the US in the water sector but they do provide a real financing and project development option. This memo focuses on P3s that provide upfront capital for infrastructure projects. Design-Build-Operate (DBO), and Design-Build-Operate-Maintain (DBOM) can be considered P3s but, as those delivery approaches do not include financing, they are not a focus of this memo.

In some cases, private financing of infrastructure assets can be a viable option for local and regional projects which might otherwise face challenges or delays using traditional public financing approaches. Typically in a P3, a private entity assembles the delivery team and takes responsibility for project design, construction, operations and financing. The private party forms a special purpose entity, or project company to deliver a public-benefit project. Infrastructure P3s often apply capital from institutional investors with long-term investment horizons and lower return expectations than private equity investors. P3s also tend to be heavily leveraged, meaning the equity ownership makes up a smaller percentage of the total capital provided for project development. This effectively brings down the weighted average cost of capital (WACC[3]) for the project. Commercial debt, private activity bonds, and/or WIFIA funding could all be sources of debt for a P3.

A P3 project delivery approach is sometimes referred to as Design-Build-Operate-Finance, or DBOF.[4] Private participation creates the opportunity to transfer more project risk and project responsibility from the project sponsor (District) to private partners. Private investors will not accept regulatory, political, or disaster risk. Figure 1.0 depicts risks carried by the project sponsor under different delivery scenarios. A project development agreement, or concession agreement, forms the contractual foundation for the P3 and this risk transfer.

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[3] The WACC is the blended cost of capital including equity and debt. The cost of each type of capital is weighted by its percentage of total capital and then added. For example, if 20% of a project is funded by Institutional Investors (equity) with 9% return expectations, 49% of a project is funded by WIFIA loans (debt) with a 2.2% interest rate, and 31% is funded by Commercial Debt (debt) with a 4% interest rate, the project WACC would be 4.118% [(0.2*9%)+(0.49*2.2%)+(0.31%*4%)]=4.118%

[4] In some cases, the public-sector project sponsor may choose to retain operations responsibility.

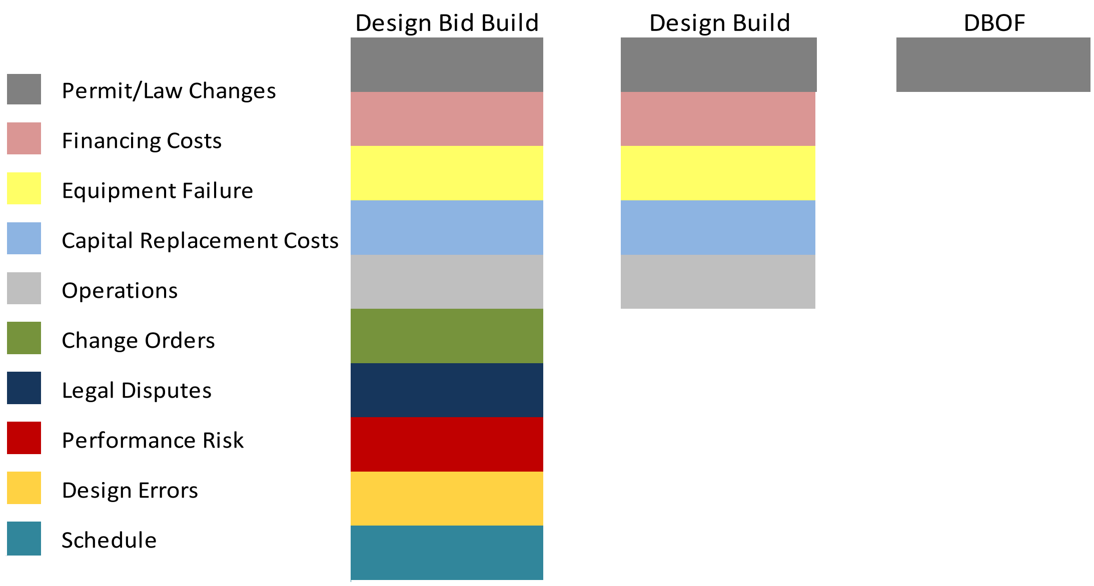

Figure 1.0: P3 Risk Transfer for the Project Sponsor. (The colored bars depict the risks retained by the project sponsors under three example delivery approaches.)

The public-sector project sponsor determines the scope of private participation, project performance and quality requirements. These requirements often include a guaranteed maximum price for capital expenditures, guarantees on infrastructure and operations & maintenance (O&M), and secured financing. With those requirements, the project company and the public project sponsor work together to identify the project delivery and financing structure to meet or exceed the requirements. The District can determine its desired level of participation in project development and in the water sector it is not uncommon for public utilities to demand significant oversight and participation during the design and construction phase. P3s do offer the option of significantly less participation on the part of the public project sponsor, potentially freeing up District staff and resources to focus on other projects or priorities.

In recent years, P3 approaches in the water sector were modified to better integrate the P3 team with the public sponsor team, particularly during the feasibility and design phases. In projects with discrete infrastructure assets, a public sponsor may opt to utilize a P3 for certain infrastructure while retaining development responsibility for other system infrastructure. The same may be true for infrastructure operations and maintenance.

Proponents for P3s believe private management of the design, construction, and operations can result in cost efficiencies outweighing the higher costs related to including private financing. These savings are realized over the life cycle of the project and include the value to the public sponsor associated with risk transfer. To increase the competitiveness of a P3 with other financing options, private investors may also offer more flexibility than revenue bonds and some government financing programs in terms of repayment and maturities. Equity return expectations for water infrastructure P3s are trending downward as market interest in infrastructure investing has grown and new and better-informed investors have entered the market. While return expectations were in the high single and low double digits (~8-12%) five years ago, owner-operators and others have emerged with significantly lower equity return expectations (~6%).

Even as equity investor return expectations have lowered, the interest rates are still several percentage points higher than revenue bonds and government financing programs. P3 financing results in higher financing costs over the life of a project compared to tax-exempt municipal debt or government financing programs. Ultimately equity returns and debt service make up a portion of the rates customers pay for their water. A P3 public sponsor must trust the design, construction, O&M savings and risk transfer, over the life of the project, will outweigh the higher financing costs.

Though newer P3 models allow for more participation from the public project sponsor, the more the District dictates development, the more the project will be built and managed like a public project, effectively minimizing the efficiencies purported to be gained through private DBOF. In order to realize those savings, the District must give up some of control.

Translating requirements and expectations into contractual agreements necessitates a team of strong legal and financial advisors. As there have been few successful water P3s in the US, there are few firms with significant experience. These advisors are expensive and the process of negotiating the P3 agreements and refining the financial models can take a long time. P3s transaction costs can be 2-5% of total project value. Several public entities have spent years exploring the potential benefits of P3s only to decide on a traditional delivery model after spending millions on the analysis.

Garnering public support for P3s can be very difficult. There is a prevalent perception that P3s benefit private investors at the expense of utility customers. With a very large project requiring significant rate increases, private participation can attract negative attention. A lack of stakeholder support can manifest in a lack of political support and this can result in delays and other major project issues.

Table 6 summarizes the strengths, weaknesses, opportunities and threats associated with P3s.

Table 6. P3 SWOT

Strengths • Design, build, operate & maintain efficiencies resulting in cost savings • Project risk transfer • Transfer of project development and O&M responsibility • City staff directed to other projects or priorities • More flexible repayment terms	**Weaknesses** • Higher financing costs • Less control • High transaction costs • Longer project development phase
Opportunities • Leverage WIFIA • Explore ownership configurations, other options and costs during development • Identify investor-partner with lower return expectations	**Threats** • Stakeholder support • Political support • Regulatory changes • Force majeure/Disaster

3.0 CONCLUSION

This narrative provides information on strategic funding sources for the CWRP Recommended Portfolio of Supplies. A critical next step is integrating the key financial characteristics of the supply option projects included in the portfolio with the most attractive funding scenario currently available to Casitas. Based on projects' characteristics and the funding options available, Casitas may be required to make critical financial decisions in the near term to effectively position for the impact of accruing and securing capital in the future.

Preliminary analysis suggests Casitas cash and grant fund the "local, near-term, no-regrets" options and position SWP03 and SWP04 for loan and grant programs and bond issuances to meet the more significant capital needs associated with those projects, particularly SWP04. There may be opportunities under certain programs, like WIFIA, to bundle all of the Recommended Portfolio of Supplies, even with a longer term delivery timeline. Key considerations included Casitas debt service capacity; program borrowing terms including maturities, rates and repayment; bond issuance costs and timing; and emerging grant and loan opportunities targeting regional water supply resiliency.

Today, Casitas should capitalize on the opportunity to market the Recommended Portfolio of Supplies to government funding programs, regional planning entities, and potential partners. Discussions with state and federal funding agencies may influence project delivery, timing and financing. Raising regional awareness of how Casitas selected the Recommended Portfolio of Supplies can demonstrate to potential partners the analytical rigor behind and legitimacy of Casitas’ water supply decisions. It is important to plan and position now. WIFIA and/or SRF loans may require rate increases to cover debt service. In addition, in some cases it takes more than 18 months after submitting an application to receive funding from programs.