PROJECT JUSTIFICATION

This attachment provides the project justification for the various projects contained in this Proposal. This Attachment is organized as follows:

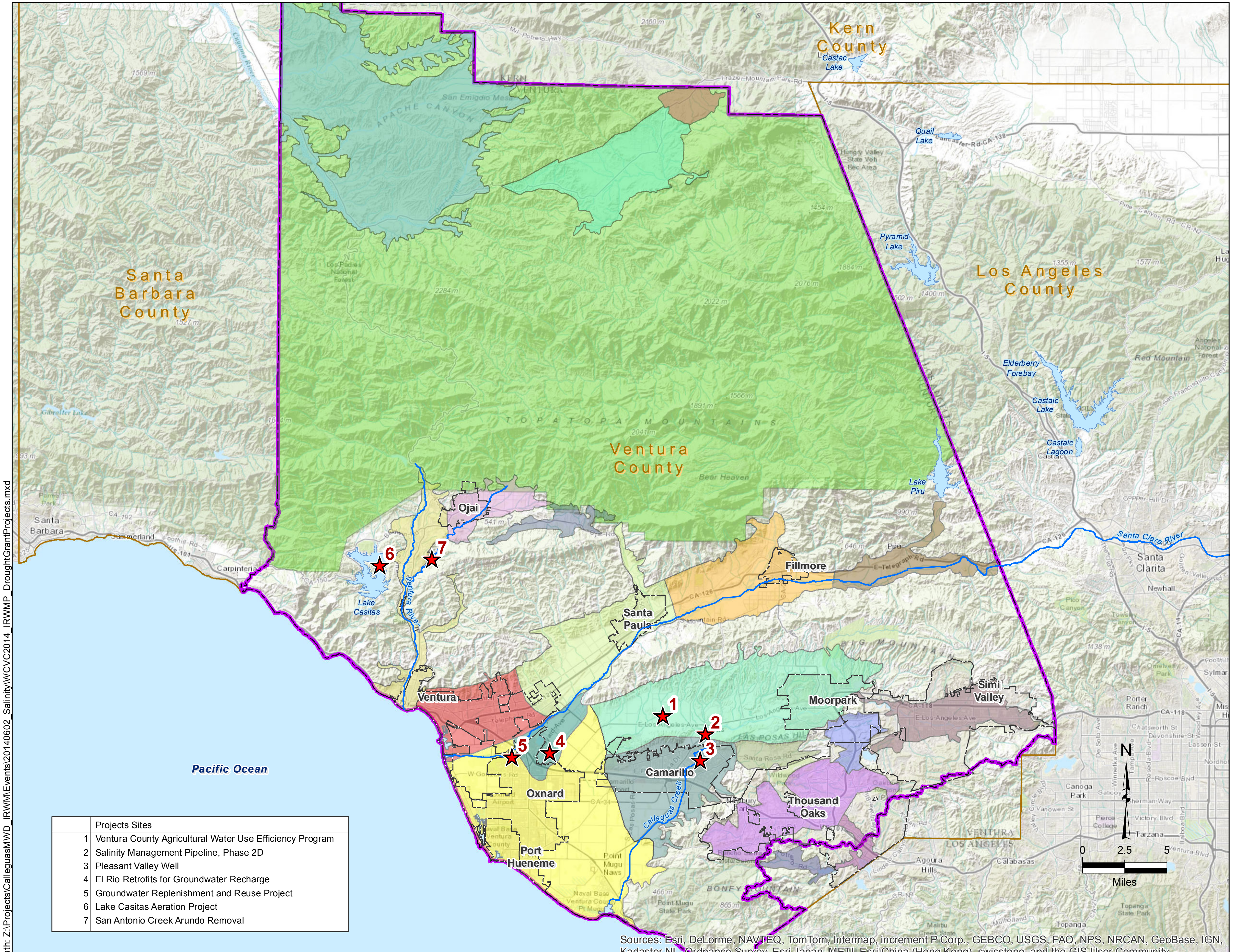
Project Summary Table – A table showing how each project meets the Drought Project Elements and IRWM Project Elements of the Drought Grant Solicitation. This table is consistent with PSP Table 4.

Regional Map - An illustration of the IRWM regional boundary and the location of each project.

Project Specific Information. For each project, a project description, map, a description of project physical benefits, the technical analysis of physical benefits claimed, and cost effectiveness analysis.

Table 3-1 - 2014 IRWM Drought Solicitation Project Summary Table (PSP Table 4)

Drought Project Category		Ventura County Agricultural Water Use Efficiency Program	Salinity Management Pipeline, Phase 2D	Pleasant Valley Well	El Rio Retrofits for Groundwater Recharge	Groundwater Replenishment and Reuse Project	Lake Casitas Aeration	San Antonio Creek Arundo Removal
D.1	Provide immediate regional drought preparedness	💧		💧	💧	💧	💧	💧
D.2	Increase local water supply reliability and the delivery of safe drinking water	💧	💧	💧	💧	💧	💧	💧
D.3	Assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective							
D.4	Reduce water quality conflicts or ecosystem conflicts created by the drought	💧	💧	💧	💧	💧	💧	💧
IRWM Project Element								
IR.1	Water supply reliability, water conservation, and water use efficiency	💧	💧	💧	💧	💧	💧	💧
IR.2	Stormwater capture, storage, clean-up, treatment and management				💧			
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands							💧
IR.4	Non-point source pollution reduction, management, and monitoring	💧			💧			
IR.5	Groundwater recharge and management projects				💧			
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users		💧					
IR.7	Water banking, exchange, reclamation, and improvement of water quality		💧	💧			💧	
IR.8	Planning and implementation of multipurpose flood management programs				💧			
IR.9	Watershed protection and management	💧	💧	💧	💧	💧	💧	💧
IR.10	Drinking water treatment and distribution			💧			💧	
IR.11	Ecosystem and fisheries restoration and protection						💧	💧



Path: Z:\Projects\CalleguasMWD IRWM\Events\20140602 Salinity\WCVC2014 IRWMP DroughtGrantProjects.mxd

Legend

- Project Sites
- Los Padres National Forest
- Watersheds Coalition Ventura County Boundary
- Counties

B118 Groundwater Basins

- ARROYO SANTA ROSA VALLEY
- CONEJO
- CUDDY RANCH AREA
- CUYAMA VALLEY
- HIDDEN VALLEY
- LAS POSAS VALLEY
- LOCKWOOD VALLEY
- OJAI VALLEY
- PLEASANT VALLEY
- SIMI VALLEY
- THOUSAND OAKS AREA
- TIERRA REJADA
- UPPER OJAI VALLEY
- VENTURA RIVER VALLEY

Santa Clara River Valley Sub-Basins

- FILLMORE
- MOUND
- OXNARD PLAIN FOREBAY
- OXNARD PLAIN PRESSURE
- PIRU
- SANTA PAULA

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

WCVC 2014 IRWMP
Drought Grant Projects

K/J 1444212.00
July 2014

VENTURA COUNTY AGRICULTURAL WATER USE EFFICIENCY PROGRAM

This project is being implemented by the Ventura County Watershed Protection District (VCWPD).

PROJECT DESCRIPTION

A county-wide effort to work with growers to analyze irrigation methods and then implement system improvements for increased agricultural water use efficiencies.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

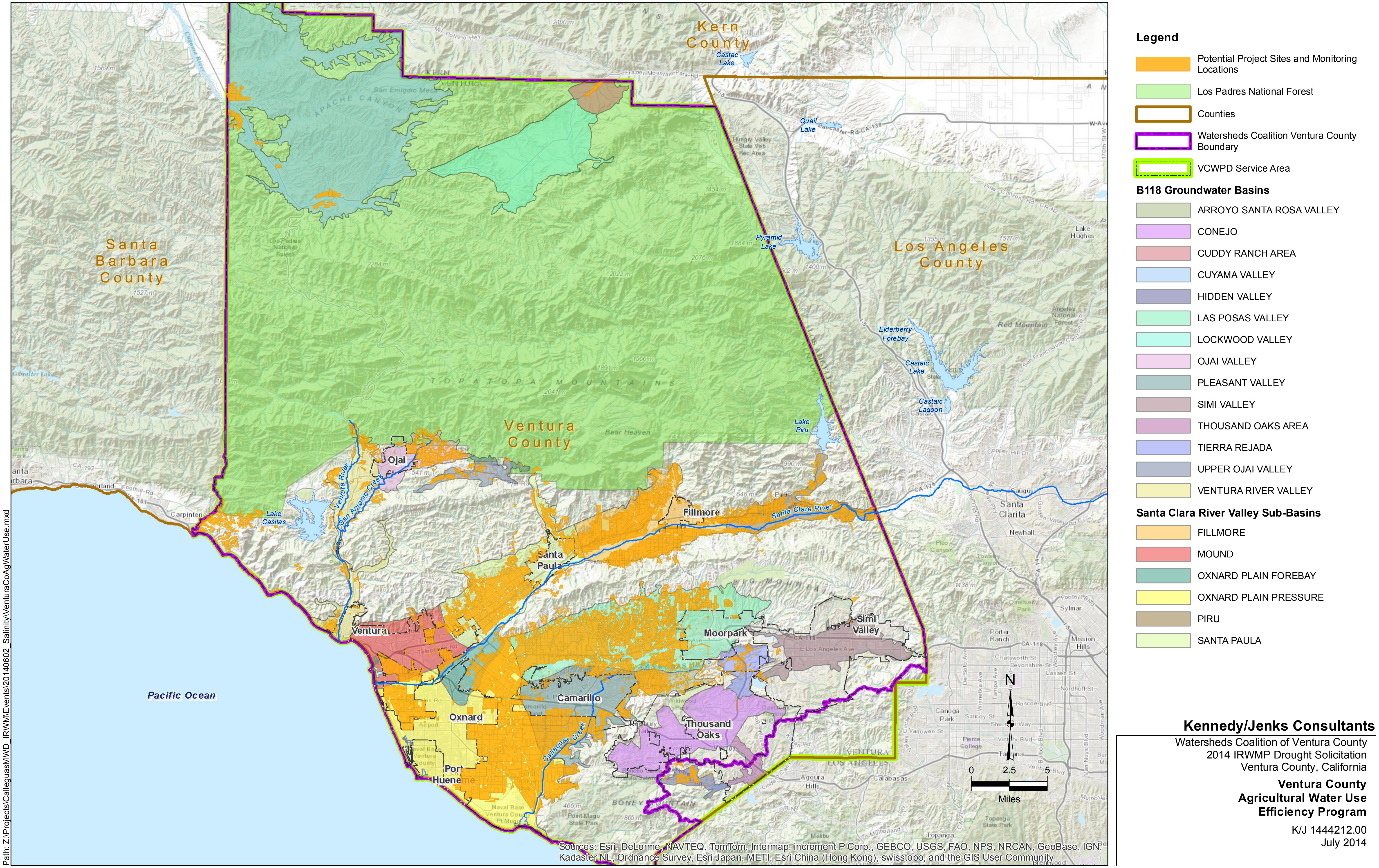
HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

During this drought, water elevations in coastal and near-coastal aquifers have dropped to near sea level in at least one area (Oxnard Plain Forebay), and further below sea level in multiple areas (Oxnard Plain Pressure Basin, Pleasant Valley Basin, and West Las Posas Basin), raising the likelihood of both further seawater intrusion and further migration of poor quality water from marine sediments and other sources. Water levels are approaching historic lows, raising the possibility of subsidence. If dry conditions continue, water levels will continue to drop, causing additional water quality problems, which are very difficult to reverse. The threat of land subsidence will also increase. Agricultural groundwater use in Ventura County is estimated to be more than 160,000 acre-feet per year (AFY). Any groundwater savings would significantly help to alleviate these threats.

The project provides immediate regional drought preparedness. This project will help reduce agricultural groundwater extractions on approximately 65 farms. Groundwater savings will be achieved immediately upon project implementation and initially be an estimated 182 AFY, increasing to an estimated 1,820 AFY within approximately 2 years.

The project will increase local water supply reliability. If drought conditions continue into 2015, it is likely that groundwater levels will reach historic lows. Data from 2013 show that water levels in the County were already at or approaching the lowest water levels observed during the 1978 and 1991 droughts. Continued depressed water levels will cause a number of negative water quality and water quantity effects. Agricultural water conservation efforts are one of the best ways to ensure water is left within the groundwater basin to preserve the long-term viability of this supply.

Expedited funding is needed. Expedited funding is needed as the water levels in the aquifers are already approaching historic lows and the long-term viability of groundwater supplies is threatened. Mandatory cutbacks in groundwater pumping implemented by groundwater management agencies will help to protect the aquifers, but action is needed to help groundwater users comply with the restrictions. Agricultural water use efficiency is essential to assure short- and long-term affordable supplies for Ventura County's critical agricultural community.



Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

Ventura County Agricultural Water Use Efficiency Program

K/J 1444212.00
July 2014

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Avoided use of 1,820 AFY of groundwater due to increased irrigation efficiency. This project will enable agricultural water users in Ventura County to use less groundwater by assisting them in identifying and implementing Best Management Practices (BMPs) for increasing irrigation efficiency.
- 910 megawatt hours (MWh) of reduced energy use per year and an associated reduction in carbon dioxide (CO_2) emissions of 328 metric tons (MT) per year. When growers use less groundwater, they also use less energy associated with groundwater pumping, which will reduce associated CO_2 emissions.

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of this project:

- Reduced nitrogen loading due to reduction in agricultural runoff
- Reduced salt application
- Reduced subsidence potential
- Educational and technology transfer benefits

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Reduction in Agricultural Water Use for Irrigation

This project will reduce groundwater extractions associated with the irrigation of at least 3,250 acres of farmland in Ventura County. In the first year of implementation, the groundwater savings is estimated to be 182 AFY. Savings will increase to 1,820 AFY within approximately 2 years, when all of the 3,250 acres of irrigated farmland are upgraded.

Technical Basis of the Project

VCWPD and the Ventura County Resource Conservation District (VCRCD) have conducted numerous projects of a similar nature through the Mobile Irrigation Lab (MIL) Program. For example, VCWPD and VCRCD (along with several other project partners) conducted more than 130 on-site efficiency evaluations between 2012 and 2013 with funding from the Proposition 84 Agricultural Water Quality Grant Program (VCRCD 2014a, p.2). The Proposition 84 grant funding also provided for rebates to help 14 growers implement the recommended BMPs. Example BMPs are shown in the sidebar.

Example BMPs Implemented Through the MIL Program

- Pressure compensating emitters and filters
- Soil moisture sensors
- Irrigation software
- Drip and micro irrigation systems
- Valves
- Emitters/nozzles
- Irrigation Controllers
- Irrigation Timers
- Other equipment as approved by US Dept. of Agriculture, Natural Resources Conservation Service, and/or UC Extension

As part of the previous Proposition 84 Agricultural Water Quality Grant Program, MIL staff quantified the water savings associated with the BMPs implemented at the 14 project sites. To do this, they used the Low-Quarter Distribution Uniformity (lqDU) protocol developed by Irrigation Training and Research Center (ITRC) faculty at California Polytechnic University San Luis Obispo to establish baseline irrigation efficiency estimates. Through this method, they determined that the average lqDU[1] of irrigation systems within Ventura County watersheds ranges from 0.72 - 0.76, reflecting inefficiencies of 28% to 24%, respectively (VCRCD 2014b, p.1). MIL staff also conducted post-project monitoring at the 14 project sites where BMPs were installed as part of the previous Proposition 84 Agricultural Water Quality Grant Program. Results of the monitoring effort indicate that BMP installation increased the lqDU to 0.88 on average, exceeding industry standards of 0.85. This compares to an average baseline DU of 0.69, calculated based on project data presented by VCRCD (VCRCD 2014a, Appendix C p.22). In total, the previously-funded project upgraded 500 acres of farmland, saving 278 AFY. This is an average savings of 0.56 AFY per acre.[2]

<u>Recent and Historical Conditions</u>

Agricultural users in Ventura County rely on groundwater to meet the majority of their irrigation needs. There is approximately 160,000 AFY of groundwater pumping by agricultural users in Ventura County (personal communication R. Viergutz, Ventura County Watershed Protection District Groundwater Section Manager, June 2014).

During the current drought, water elevations in coastal and near-coastal aquifers have dropped to near sea level (in the Oxnard Plain Forebay) and further below sea level in some areas, such as the Oxnard Plain Pressure Basin, Pleasant Valley Basin, and West Las Posas Basin (United Water Conservation District 2014a, Figures 4.3-22 to 4.3-42). Data from 2013 show that some water levels in the County are at, or approaching, the lowest water levels seen during the 1978 and 1991 droughts. If drought conditions continue into 2015 and the trends of groundwater elevation declines continue, it is likely that groundwater levels will reach historic low levels in parts of the County. Continued depressed water levels will result in a number of negative water quantity and water quality effects, including further seawater intrusion and the migration of poor water quality into the aquifer. The potential for subsidence will also increase in some areas.

Drought conditions and federal regulations have also had a significant impact on the availability of imported surface water deliveries. Most notably, as a result of drought conditions and federal regulations related to endangered species, there will likely be no water deliveries to Ventura County from the local Freeman Diversion this summer. The Freeman Division diverts water from the Santa Clara River and delivers it to water agencies and agricultural users within the County for aquifer recharge and direct irrigation purposes. As a result of these reduced deliveries, recovery of the groundwater levels will be slowed and perhaps delayed for some time. In 2012-2013, more than 22,000 AFY was diverted from the Santa Clara River at the Freeman Diversion and sent to groundwater recharge or use in-lieu of

[1] Distribution Uniformity (DU) is a measure of how uniformly water is applied to an irrigated area, expressed as a percentage. DU is often calculated when performing an irrigation audit. The most common measure of DU is the Low Quarter DU (lqDU), which is a measure of the average of the lowest quarter of samples, divided by the average of all samples. The higher the lqDU, the better the performance of the system. If all samples are equal, the lqDU is 100%. If a proportion of the area greater than 25% receives zero application, the lqDU will be 0%. There is no universal value of lqDU for satisfactory system performance, but generally a value >80% is considered acceptable.

[2] For the 14 project sites evaluated under the Proposition 84 Agricultural Water Quality Grant, cabbage made up close to 50% of the total acres upgraded. Thus, the data from the previous grant is conservatively representative of the water requirements associated with, and savings that could be anticipated from, the types of crops that will be included in the project. The project will focus on high water-using crops, such as berries, which typically use more water and where more water savings might be achieved.

groundwater pumping. Cumulatively since October 2013, less than 3,600 AF has been diverted and made available for recharge (United Water Conservation District 2014b, p.14).

Estimates of Without Project Conditions

Without this project, agricultural growers would continue to use the same amount of groundwater to meet their irrigation needs as they have historically. Growers within the Fox Canyon GMA would be unable to meet the pumping restriction requirements. The continued groundwater use would exacerbate water quality problems associated with groundwater overdraft (e.g., saltwater intrusion and migration of poor quality water).

Descriptions of Methods Used to Estimate Physical Benefits

As noted above, estimates of water savings for the project are based on past efficiency improvements that have been verified by VCRCD as part of a similar project performed under the Proposition 84 Agricultural Water Quality Grant Program. The calculation used to translate lqDU estimates into water savings uses an average irrigation application rate for different types of crops (e.g., AFY applied per acre). For the 14 on-site improvements implemented by VCRCD, relevant crop types (and application rates) included: Citrus (2.1 AF/acre), Avocado (2.2 AF/acre), and Cabbage (1.0 AF/acre) (VCRCD 2014a, pg. 2). The average application rate is then divided by the initial lqDU estimate, as well as the post-project estimate. The difference between these two numbers is then multiplied by the number of acres upgraded. This product represents the total estimated irrigation needs reduction in AFY (VCRCD 2014a, pg. 2).

For example, assuming an average application rate of 2.1 AFY per acre and an increase in lqDU from 0.72 to 0.88, results are calculated as follows (VCRCD 2014a, pg. 2):

$$((2.1\ \text{AF/acre} \div 0.72\ \text{DU}) - (2.1\ \text{AF/acre} \div 0.88\ \text{DU})) \times 20\ \text{acres} = 10.67\ \text{AFY reduction}$$

For this project, the project proponents will conduct on-site evaluations at approximately 65 farms, with an average farm size of 50 acres.[3] Based on the project schedule, it is estimated that 325 acres will be upgraded within the first year of the project (2015), and the remaining 2,925 acres will be upgraded in 2016. At an average water savings of 0.56 AFY, total estimated savings amount to about 1,820 AFY (182 AFY in 2015 and an additional 1,638 AFY in 2016).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No new facilities or policies are required in order to obtain the physical benefits from the project, other than those included as part of the project. To achieve this benefit, the agricultural water users served by the project will need to implement the recommended BMPs through the rebate program.

Description of Any Potential Adverse Physical Effects

Reduced groundwater pumping for agricultural irrigation is not expected to result in any adverse physical effects.

[3] According to the Ventura County Farm Bureau, average farm size is 103 acres; to be conservative, 50 acres per farm has been assumed.

Summary of Benefit

As shown in Table 3-2, at full implementation, the project will result in the avoided use of 1,820 AFY of groundwater within Ventura County. The project will result in a total of 9,100 AF of avoided groundwater use over the 5-year project life. This will help to alleviate drought conditions and reduce saltwater intrusion into the aquifer as well as the other negative impacts discussed previously.

Table 3-2 – Annual Project Physical Benefits

Project Name: Ventura County Agricultural Water Use Efficiency Program
Type of Benefit Claimed: Avoided groundwater use
Units of the Benefit Claimed: Acre-feet (AF)
Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	182	182
2016	0	1,820	1,820
2017	0	1,820	1,820
2018	0	1,820	1,820
2019	0	1,820	1,820
2020: Last Year of Project Life	0	1,638	1,638
Total	0	9,100	9,100

Comments: The expected 5-year project life runs from mid-2015, following implementation of the initial set of BMP recommendations, through 2020. The project lifetime ends 5 years after the last set of BMP recommendations has been implemented.

Benefit: Energy Savings of 910 MWh Per Year, and Carbon Emissions Reduction of 328 MT Per Year

At full implementation, this project will avoid pumping 1,820 AFY of groundwater. This will result in a reduction in energy use of 910 MWh per year, and an associated reduction in carbon equivalent emissions (CO_2e) of 328 metric tons (MT).

Technical Basis of the Project

The amount of energy required for agricultural groundwater pumping varies, based on pump efficiency and depth of the well. According to a recent Public Interest Energy Research Program Report (Cal Poly ITRC 2011, p.113-115 assumes the average dynamic head needed is greater than approximately 300 feet), average agricultural groundwater pumping in Ventura County requires 500 kWh per AF (0.5 MWh).

CO_2 emissions resulting from the production of electricity, measured as tons of CO_2 per MWh, vary by energy source. Based on the current mix of energy sources for California (including imports), the CO_2 emissions rate for energy used to pump groundwater in Ventura County is estimated to be 0.354 MT/MWh. This number was calculated based on the 2010 U.S.

Environmental Protection Agency (US EPA) eGrid data for carbon dioxide equivalent (CO_2e) emissions rates in the regions that produce the electricity used in California.

Recent and Historical Conditions

Electricity used in California is generated within three different energy sub-regions [known as Western Electricity Coordinating Council (WECC) subregions]: California, the Northwest, and the Southwest. In 2013, about 67% of California's electricity was generated within the state (CEC 2014, calculated from table). The approximate breakdown of California's major sources of electricity is as follows: 41% is provided by natural gas, 8% is provided by hydroelectric plants, 6% is provided by nuclear power, 11% comes from renewable sources, and less than 1% comes from coal-fired power plants (CEC 2014, calculated from table). The remaining 33% of electricity used in California is imported from the Northwest (12%) and Southwest (21%) WECC sub-regions (CEC 2014, calculated from table).

Estimates of Without Project Conditions

Without the project, agricultural water users would continue to use an additional 1,820 AFY of groundwater for irrigation purposes. This would require an additional 910 MWh for pumping, resulting in 322 MT of CO_2e emissions.

Descriptions of Methods Used to Estimate Physical Benefits

To calculate energy savings associated with the project, the amount of energy required to pump 1 acre-foot of groundwater was multiplied by the amount of groundwater use that will be avoided as a result of the project (e.g., 1,820 AFY × 0.50 MWh). At full implementation (i.e., by 2016), this project will avoid the use of 910 MWh per year.

Next, the CO_2e emissions rate associated with energy use in California was calculated using 2010 EPA eGrid data (U.S. EPA 2014, website database). EPA publishes average CO_2e emissions rates for subregions within the U.S. based on the various energy sources used to generate electricity within them (e.g., natural gas, hydropower). Table 3-3 shows the CO_2e emissions rate for the three WECC sub regions that produce the electricity used in California and the average weighted rate for electricity used within the state. It is assumed that the mix of energy sources used by the state overall is representative of the mix of energy sources used in Ventura County.

Table 3-3. CO_2 Equivalent Emissions Rates for Energy Used in California by Regions that Produce Electricity

WECC Region	Emissions Rate (MT/MWh)	Percent of California Electricity Use
California	0.278	67%
Southwest	0.537	21%
Northwest	0.384	12%
Weighted average emissions rate for electricity used in California	0.354	
Source: U.S. EPA, 2014.		

Given the calculated weighted average emissions rate of 0.354 MT of CO_2e emitted per MWh, 0.18 MT of CO_2 are produced for every acre-foot of groundwater pumped in Ventura County (0.50 MWh per acre-foot multiplied by 0.354 MT/MWh). By avoiding use of 1,820 AFY of groundwater (at full implementation), the project will avoid emissions of about 322 MT of CO_2 per year.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No new facilities or policies are required in order to obtain the physical benefits from the project other than those included as part of the project. To achieve this benefit, the agricultural water users served by the project will need to implement the recommended BMPs through the rebate program.

Description of Any Potential Adverse Physical Effects

Energy savings and associated CO_2 emissions reductions due to avoided use of groundwater are not expected to result in any potential adverse physical effects.

Summary of Benefit

As is shown in Tables 3-4 and 3-5, at full implementation, the project will result in energy savings of 910 MWh per year, and an associated reduction in CO_2 emissions (carbon equivalents) of 322 MT per year. Given the schedule for project implementation (with some benefits beginning to accrue in 2015), the project will result in a total energy savings of 4,551 MWh and a CO_2 emissions reduction of 1,610 MT over the 5-year project life.

Table 3-4 – Annual Project Physical Benefits

Project Name: Ventura County Agricultural Water Use Efficiency Program

Type of Benefit Claimed: Avoided energy use

Units of the Benefit Claimed : Megawatt-hours (MWh)

Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	163	163
2016	0	910	910
2017	0	910	910
2018	0	910	910
2019	0	910	910
2020: Last Year of Project Life	0	748	748
Total	0	4,551	4,551

Comments: The expected 5-year project life runs from mid-2015, following implementation of the initial set of BMP recommendations, through 2020. The project lifetime ends 5 years after the last set of BMP recommendations has been implemented.

Table 3-5 – Annual Project Physical Benefits			
Project Name: Ventura County Agricultural Water Use Efficiency Program			
Type of Benefit Claimed: Avoided carbon dioxide equivalent emissions			
Units of the Benefit Claimed: Metric tons (MT)			
Additional Information About this Benefit: N/A			
(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	33	33
2016	0	322	322
2017	0	322	322
2018	0	322	322
2019	0	322	322
2020: Last Year of Project Life	0	289	289
Total	0	1,610	1,610
Comments: The expected 5-year project life runs from mid-2015, following implementation of the initial set of BMP recommendations, through 2020. The project lifetime ends 5 years after the last set of BMP recommendations has been implemented.			

Discussion of Non-Quantified Benefits

Reduced Nitrogen Loading Due to Reduction in Agricultural Runoff

Ventura County has more than 96,000 acres of irrigated cropland. The application of irrigation water to these lands can result in dry weather agricultural runoff, which carries sediment, fertilizer, nutrients, and other pollutants to local surface water bodies. In Ventura County, nitrogen is a primary pollutant of concern with respect to agricultural runoff. Calleguas Creek is currently 303(d)-listed for nitrogen, and there is a TMDL in effect for nitrogen in this watershed. The Ventura River has a TMDL for algae, which requires nitrogen reductions. Studies show that agricultural runoff significantly contributes to nitrogen discharges in these two watersheds (Los Angeles RWQCB Order R4-2008-009, p.8 and Los Angeles RWQCB Order R12-011, Attachment A p.3). Without the project, agricultural water users will continue to use a higher amount of groundwater for irrigation purposes. This will result in the continued loading of approximately 171 lbs/day/acre of nitrogen during irrigation events.

Reduced Salt Application

The groundwater in Ventura County contains a relatively high amount of salts, which accumulates in the soil as irrigation water is applied. As soil salinity increases, most plants find it increasingly difficult to extract water from the soil. Although there is a wide range of salt tolerance in plants, crops typically grown in Ventura County are not highly salt-tolerant and will be significantly less productive and lower in quality if irrigated with saline water. Plants with particularly low salt tolerance levels include avocados and strawberries, some of the County’s key crops.

Ventura County's water quality database (2013), contains data from approximately 175 groundwater wells sampled once per year and indicates that the average total dissolved solids (salts) in groundwater sampled is approximately 1,100 mg/L (2,991 lbs/AF). Anecdotal evidence suggests that many growers in the County experience adverse yield impacts as a result of high salinity levels. Growers have managed these impacts through different practices, including applying excess irrigation water to "flush" the salts from the soil (a practice known as leaching).

By reducing the amount of groundwater needed for irrigation by 1,820 AFY, growers will reduce the amount of salts applied to the soil by 5,444,166 pounds per year at full implementation (2,991 lbs per AF × 1,820 AFY). This has the potential to increase crop yields on affected lands and/or decrease the amount of water used for leaching. Because data on the impacts of salts on crop yield within the project area are not available and the extent to which management practices counteract this effect is not known, it is not possible to quantify the extent of this benefit.

Reduced Subsidence Potential

By reducing groundwater pumping, the project will likely reduce subsidence potential in the area. Subsidence of 2.2 feet was last documented in the Pleasant Valley area during the 1960s and 1970s (Fox Canyon GMA 2007, p.3). Groundwater levels during that period generally averaged 100 feet below mean sea level (msl) in the project area. With the current drought, groundwater levels in the Pleasant Valley are approaching 135 feet below msl, below that seen during the earlier subsidence period (United Water Conservation District 2014b, p.10).

Educational and Technology Transfer Benefits

A key component of this project is to verify the water savings resulting from BMP implementation. This information will be shared with other growers as part of an educational campaign to encourage the adoption of more efficient irrigation technologies.

For example, under the requirements of the *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Los Angeles Region* (Los Angeles RWQCB Order R4-2010-0186, p.9 Item 39), all growers in Ventura County are required to attend educational classes. These classes usually include grower testimonials of new technologies being used in the field. In addition, the Ventura County Farm Bureau, VCRCD, and Fox Canyon GMA all have a history of providing educational opportunities for technology transfer. Project results will be shared via these regular channels, and as a result, additional water saving technologies will likely be installed in other areas of the County. Unfortunately, there is no way to quantify the additional implementation of water saving technologies beyond that performed by the participating growers.

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. The alternatives considered include: 1) purchasing 1,820 AFY of imported water from Calleguas Municipal Water District, and 2) fallowing 800 acres of agricultural land (the amount of irrigated land that would offset 1,820 AFY of irrigation demand). Answers to the cost effectiveness analysis questions are presented in summary form in Table 3-6, with narrative description for each alternative provided below.

The implementation costs for the Ventura County Agricultural Water Use Efficiency Program total $2,505,920. Implementation of the project is expected to be roughly divided equally between the years 2015 and 2016, with benefits being accrued towards the end of 2015. As is shown in Table 3-7, the total present value of project costs in 2014 dollars is $2,296,676.

<table>
<tr><th colspan="2">Table 3-6 – Cost Effectiveness Analysis
Project Name: Ventura County Agricultural Water Use Efficiency Program</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Tables 3-4 and 3- 5:
• Avoided use of 1,820 AFY of groundwater due to increased irrigation efficiency
• 910 MWh of reduced energy use per year and an associated 328 MT per year of reduced carbon dioxide emissions</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
• Yes.</td></tr>
<tr><td>If no, why?
• Not Applicable</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.

The Ventura County Agricultural Water Use Efficiency Program has a total present value cost of $2.3 million. Alternative methods to achieve the same amount of groundwater savings include:
• Purchasing Imported Water - Present value cost totaling $10.5 million
• Fallowing Agricultural Land - Present value cost totaling $41.4 million for direct losses
The project was determined to be the least cost alternative and provides significant additional benefits.</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
• Not Applicable</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

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Table 3-7 – Annual Costs of Project (All costs in 2014 Dollars) Project: Ventura County Agricultural Water Use Efficiency Program										
	Initial Costs	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	
2015	1,252,960							1,252,960	0.943	1,181,541
2016	1,252,960							1,252,960	0.890	1,115,134
2017									0.840	
2018									0.792	
2019									0.747	
2020: Last Year of Project Life									0.705	-
Total Present Value of Discounted Costs (Sum of column (j))										$ 2,296,676
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Purchasing Imported Water

As an alternative to reducing agricultural groundwater use through the implementation of more efficient irrigation technologies, growers could purchase imported water from the Calleguas Municipal Water District. Purchasing imported water in amounts equivalent to the savings associated with the project would provide the same groundwater benefits, but would be much more expensive, require more energy (for pumping the imported water over long distances), and would import additional salts into the Watershed.

Calleguas is a wholesale water supplier for retail agencies in Ventura County. Calleguas imports around 110,000 AFY from the State Water Project (SWP) and Colorado River Aqueduct via the Metropolitan Water District of Southern California (Metropolitan). Calleguas distributes this water on a wholesale basis to 20 local purveyors in Ventura County, which in turn deliver water to area residents, businesses, and agricultural customers. Calleguas supplies water to meet new demand for existing customers at its Tier 2 rate. The current Calleguas Tier 2 water rate is $1,315 per AF. In 2015, this will increase to $1,340 per AF (for 2016 and beyond, a 3% rate increase over and above inflation is assumed) (Calleguas Municipal Water District 2014, p.1; personal communication Kristine McCaffrey, Calleguas Municipal Water District Manager of Engineering, June 2014). In addition, given the current drought conditions, it is unlikely that imported water would be available for purchase at the current rates. Finally, imported water can only be delivered within Calleguas' service area, which does not include many of the agricultural areas within the County.

Table 3-8 shows the annual and total net present value costs associated with importing enough water to offset the amount of groundwater that could be saved with the project. As shown, the costs of importing water are much greater than implementing BMPs on agricultural lands, amounting to more than $10.5 million through 2020.

Fallowing 800 Acres of Agricultural Land

To achieve a 1,820 AFY reduction in groundwater use, growers in the Region could also fallow an equivalent amount of agricultural land. Using the results of the analysis conducted for the 14 project sites included in the Proposition 84 Agricultural Water Quality Grant Program, it is assumed that the average current water use per acre amounts to 2.29 AFY. Thus, growers would need to fallow about 800 acres of agricultural land to offset 1,820 AFY of water use (1,820 AFY ÷ 2.29).

According to Ventura County's 2012 Crop and Livestock Report, fruit, nut, and vegetable crops were planted on 92,543 acres in Ventura County in 2012. Together, these crops had a total annual value of $1,254,592,000 (Ventura County Office of the Agricultural Commissioner 2012, p.5).[4] For this analysis, it is assumed that crop land planted in vegetables would be fallowed because they have a lower per acre value than fruit or nut crops and are not perennial. The average per acre value of vegetable crops amounts to about $12,940 (Ventura County Office of the Agricultural Commissioner, 2012, updated to 2014 values using CPI). Retiring 800 acres of irrigated vegetable crops would result in a direct loss of $10,352,000.

[4] In 2012, 55,688 acres were planted in fruit and nut crops and 36,855 acres were planted in vegetables. With an average value of $22,529 per acre, fruit and nut crops made up 73% of this total. Vegetables made up the remaining 27% and had an average value of $12,489.

Table 3-8 – Annual Costs of Project (All costs in 2014 Dollars) Project: Purchasing Imported Water in Amounts Equivalent to Groundwater Savings Under the Project										
	Initial Costs Grand Total	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	
2015				243,880				243,880	0.943	229,979
2016				2,511,964				2,511,964	0.890	2,235,648
2017				2,587,323				2,587,323	0.840	2,173,351
2018				2,664,943				2,664,943	0.792	2,110,635
2019				2,744,891				2,744,891	0.747	2,050,433
2020: Last Year of Project Life				2,544,514				2,544,514	0.705	1,793,882
Total Present Value of Discounted Costs (Sum of column (j))										$ 10,593,928
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

In addition, a 2008 report entitled *Ventura County's Agricultural Future: Challenges and Opportunities* reports that the economic multiplier for agriculture in Ventura County is 1.86 (Kambara et al. 2008, p.14)[5]. This means that for every direct loss in agricultural value in the county, an additional $0.86 is lost in indirect and induced economic activity (e.g., due to reduced sales of agricultural inputs such as fertilizer and irrigation equipment, decreased income of agricultural workers being spent in the local economy). Therefore, the direct loss of $10.4 million in agricultural output would result in the loss of an additional $8.9 million in indirect and induced economic activity.

Table 3-9 shows the direct losses associated with fallowing agricultural land as an alternative to the project. In 2015, about 80 acres of land would be fallowed, enough to offset the use of 182 AF of water. In 2016, an additional 720 acres would be fallowed to offset the use of 1,683 AF of water. As shown, direct losses would amount to more than $41.4 million over the 5-year project life. The Region would also experience significant indirect and induced economic losses, but those losses are not directly comparable and therefore omitted.

Table 3-9. Costs associated with Fallowing Agricultural Land

Loss in Crop value associated with fallowing agricultural land (2014 USD)				
	Acres fallowed	Annual loss in crop value	Discount Factor(3)	Discounted Loss (h) x (i)
Year	(a)	(d)	(i)	(j)
2014			1.000	
2015	80	1,035,200	0.943	976,194
2016	800	10,352,000	0.890	9,213,280
2017	800	10,352,000	0.840	8,695,680
2018	800	10,352,000	0.792	8,198,784
2019	800	10,352,000	0.747	7,732,944
2020: Last Year of Project Life	720	9,316,800	0.705	6,568,344
Total Present Value of Discounted Loss in Value				$ 41,385,226

Comments: Includes direct losses only; does not include indirect or induced economic losses, which would amount to $8.9M per year at full implementation (with fallowing of 800 acres of agricultural land).

Summary

The physical benefits claimed for this project include groundwater savings and reduced energy use and associated carbon emissions. There are multiple non-quantifiable benefits of the project including: reduced nitrogen loading due to reduction in agricultural runoff, reduced salt application, reduced subsidence potential, and educational and technology transfer benefits. The alternatives presented in the cost-effectiveness analysis included purchasing imported water from Calleguas Municipal Water District and fallowing agricultural land to offset the water that would be saved with the project. The project was determined to be the most cost effective alternative and has significant additional benefits.

[5] This multiplier was estimated using IMPLAN Pro Economic Impact Model, data for Ventura County.

References

These references are provided as Att3_DG_ProJust_2of5.pdf. The pdf file is bookmarked so that all references can be easily located.

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SALINITY MANAGEMENT PIPELINE, PHASE 2D

This project is being implemented by the Calleguas Municipal Water District (Calleguas).

PROJECT DESCRIPTION

Phase 2D extends the Salinity Management Pipeline further into the Calleguas Creek Watershed enabling 3,400 AFY of high-quality agricultural water supplies to come on-line.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

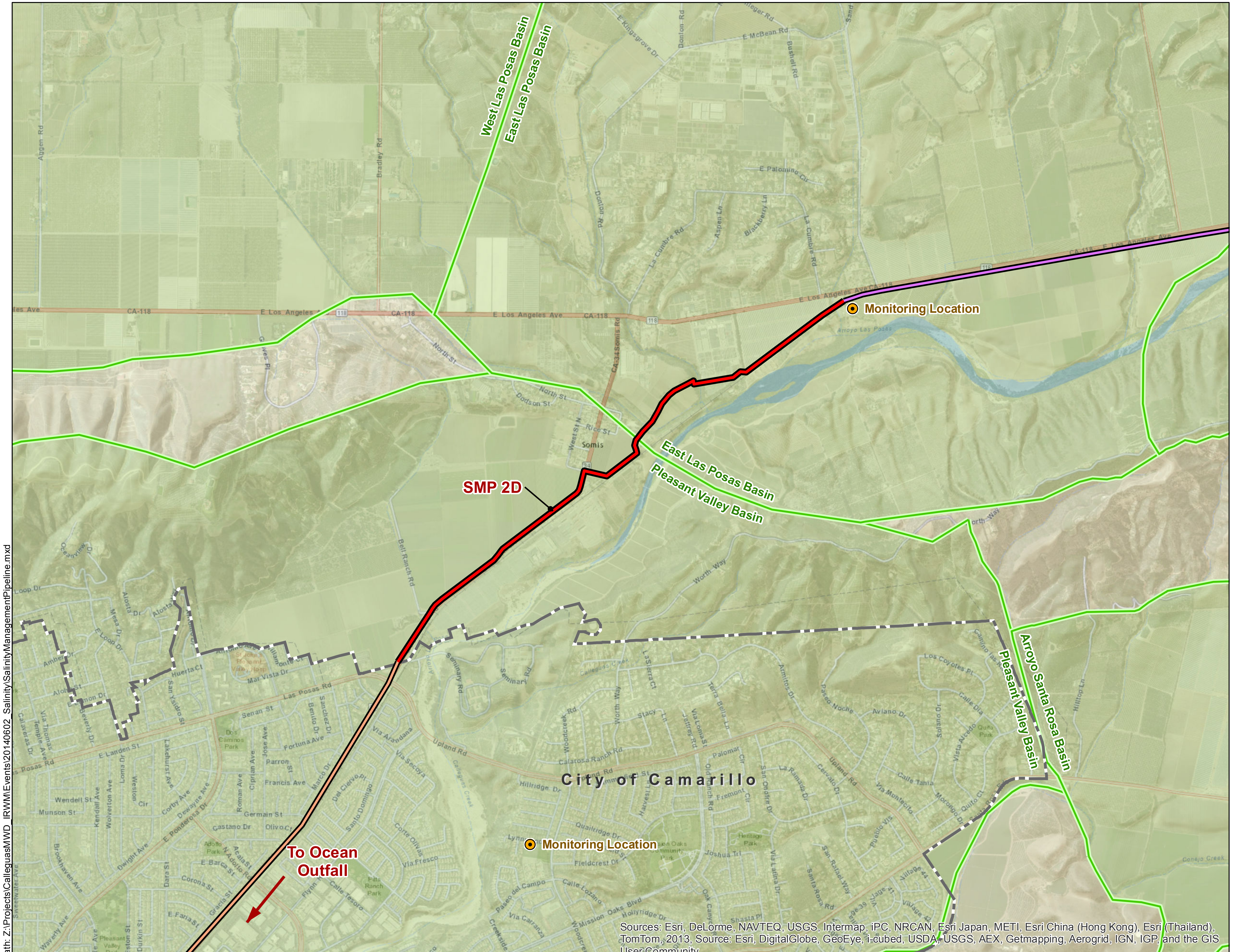
HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

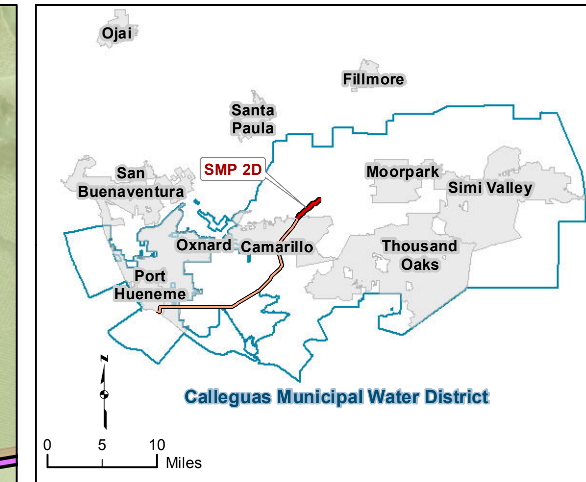
Similar to many agencies throughout California, Calleguas and its purveyors are largely dependent on imported water sources, despite the availability of local groundwater. Unfortunately, this local groundwater is not readily usable due to water quality concerns, primarily total dissolved solids (TDS) and other salts. The only way to remove these constituents is through a treatment process which produces concentrate that must then be managed and disposed. Calleguas, working with other agencies and stakeholders through the Calleguas Creek Watershed Management Plan process, initiated the implementation of the Salinity Management Pipeline (SMP). The SMP collects concentrate from desalting of brackish groundwater and excess recycled water from municipal wastewater treatment plants and conveys the flows to other areas for beneficial reuse or, when there are insufficient demands for reuse, ocean discharge. Phase 2D will consist of approximately 12,700 linear feet of 18 inch diameter pipeline that will extend the SMP further into the Calleguas Creek Watershed and enable additional desalters to be constructed, particularly the Las Posas Agricultural Desalter (LP Desalter).

The project will increase local water supply reliability and the delivery of safe drinking water. SMP 2D facilitates the production of up to 3,400 AFY of high-quality agricultural water supplies and serves as a critical link to bringing up to 5,000 AFY in additional municipal and industrial supplies on-line. SMP 2D will increase the local water supply portfolio – enhancing water supply reliability and overall drought preparedness.

The project will reduce water quality conflicts created by the drought. The current drought has curtailed water supplies available to Ventura County agriculture, and this problem will grow with continued drought. Even without drought, it is anticipated that groundwater quality in the East Las Posas Basin will continue to decline to the point where the water will have to be desalted before it can be used by agricultural or municipal users. Drought conditions are accelerating the water quality decline. SMP 2D will help address these water quality problems.

Expedited funding is needed. Ventura County agricultural water users are already experiencing mandatory cutbacks. SMP 2D is needed to assure short- and long-term affordable water supplies for Ventura County's critical agricultural community.





Legend

- SMP 2D
- Existing SMP
- Future Phases SMP
- Monitoring Location
- Groundwater Basins Boundaries
- City of Camarillo Boundary

N

0 1,000 2,000

Scale: Feet

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

Salinity Management Pipeline, Phase 2D

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWM\Events\20140602_Salinity\SalinityManagementPipeline.mxd

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Reduction of 5,158 metric tons (MT) of TDS (salts) in the Watershed annually.
- Development of 3,400 AFY of high-quality agricultural water supply from an increasingly unusable source of brackish groundwater.

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of this project. SMP 2D will:

- Increase water supply reliability for Las Posas agricultural users.
- Allow for implementation of additional phases of the SMP.
- Facilitate the construction of groundwater desalters, serving as a critical link to bring up to 5,000 AFY in additional municipal and industrial supplies on-line.
- Help bring Calleguas Creek Watershed into compliance with salt Total Maximum Daily Loads (TMDLs).

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Reduction of 5,158 MT of Salt in the Watershed Per Year

The LP Desalter will produce 675 AFY of brine discharge and 3,400 AFY of agricultural water supply (Kennedy/Jenks 2014b, p.7). In order to reduce the chloride concentration of Las Posas groundwater to 120 mg/L of chloride, this brine discharge must have a TDS concentration of at least 4,782 mg/L of TDS.[6] Discharging 675 AFY of brine at 4,782 mg/L of TDS will remove approximately 3,900 MT of salts annually from the Watershed. Also, by avoiding the need to use 3,400 AFY of imported supplies, SMP 2D will reduce the amount of salt in the Watershed by another 1,258 MT each year, for a total of 5,158 MT annually.

<u>Technical Basis of the Project</u>

SMP 2D will connect the LP Desalter to the SMP. Calleguas, in coordination with other agencies and stakeholders through the Calleguas Creek Watershed Management Plan, is implementing the SMP to address increasing groundwater salinity levels in the Watershed. The SMP collects concentrate from desalting of brackish groundwater and excess recycled water from municipal wastewater treatment plants and conveys the flows to other areas for beneficial reuse or, when there are insufficient demands for reuse, ocean discharge. Operation of the SMP will substantially reduce the amount of salts released into the Watershed, and over time, the SMP will reduce salt concentrations in surface waters and groundwater within the Watershed. The SMP will enable the development of local brackish groundwater resources for potable and agricultural uses. Development of new local water supply will often replace the use of imported water. Reduced imported water means reduced import of salts into the Watershed.

[6] There are a number of ways to report the salts content of water, including chloride, TDS, sulfate, and boron. For the purposes of this discussion, typically water quality goals are established in terms of chloride, but salts reduction is measured in TDS.

The water desalted at the LP Desalter will be delivered to agricultural customers, such as Zone Mutual Water Company and Berylwood Heights Mutual Water Company, which serve growers of orchards, row crops, and berries.

Recent and Historical Conditions

Most of the soils, surface water, and groundwater in the Watershed contain high levels of salts, including TDS, boron, sulfate, and chloride. Primary sources of salts in surface water and groundwater include imported surface water (i.e., SWP and Colorado River Aqueduct supplies), fertilizer used in agricultural activities, and discharges from wastewater treatment plants (Los Angeles RWQCB 2007, p.3). Salts continue to accumulate, and the mass of salts and minerals currently coming into the Region is greater than the mass of salts and minerals leaving the Region.

The accumulation of salts due to historical and ongoing point and nonpoint source pollution poses a number of problems for beneficial uses within the Watershed, including municipal, industrial, and agricultural water supply and habitat. Rising salinity is also harmful to agriculture, primarily for growers of high-value strawberries, raspberries, and avocados who are increasingly unable to use local groundwater for irrigation without reducing agricultural productivity. High salinity levels in soils and surface water can also be detrimental to sensitive habitat and can have negative effects on ecosystems in the Watershed.

As a result of these factors, salt TMDLs have been established for the Watershed, including for boron, chloride, sulfate, and TDS. Calleguas Creek is currently 303(d)-listed for salts, as well as for a number of other constituents.

Maintaining salinity levels is essential to Ventura County agriculture due to the prevalence of salt-sensitive crops. Based on shareholder data, the Zone Mutual Water Company and Berylwood Heights Mutual Water Company delivered water to approximately 7,000 acres of agriculture in 2013 (Calleguas 2014a, p.1). While there are some non-salt-sensitive (e.g., citrus) crops, the majority of crops are very susceptible to higher chloride and TDS levels.

Estimates of Without Project Conditions

Some of the agricultural producers that will be served by the LP Desalter are currently using imported supplies for blending. If this phase of the SMP is not constructed, 3,900 MT of salts would remain in the groundwater basin and 1,258 MT of additional salts would be introduced to the Watershed via imports annually. Groundwater use in the area would be affected by increasing groundwater salinity. Salt-sensitive crops, such as berries and avocados, would either no longer be grown, would experience substantially reduced agricultural productivity, or would need to be irrigated with precious imported water.

Descriptions of Methods Used to Estimate Physical Benefits

The LP Desalter is expected to produce 3,400 AFY of product water and have a brine discharge of 675 AFY. However, the design for the LP Desalter has not been finalized, and the TDS concentration of brine discharge from the desalter has not been determined with certainty. Nonetheless, a preliminary feasibility study of a desalter for the Zone Mutual Water Company, the largest water supplier for agricultural customers in the Watershed, can be used to estimate the brine discharge from the LP Desalter (SPI 2013, p.1-28), as the LP Desalter is expected to operate similarly.

The study on desalter feasibility done for Zone Mutual Water Company assumed a target chloride level in finished water of 120 mg/L.[7] Given a raw water quality of 183 mg/L TDS resultant brine of the LP Desalter is estimated to be 4,782 mg/L[8]. So with 675 brine disposal each year, the salt (as TDS) removed will be 3,981 MT (3,981 MT = 675 AFY *x* 4,782 mg/L *x* 1,233,482 liters/AF *x* (1 MT/1,000,000,000 mg)). To be conservative, this has been rounded downward to 3,900 MT/year.

Some agricultural water users in the area currently blend imported water with local groundwater and, with anticipated continued increases in salt concentrations in the groundwater, are anticipated to need more higher quality imported water in the future. By using a new 3,400 AFY source of high-quality agricultural water, Las Posas agricultural users will forego the equivalent amount of imported supplies. The 10-year average TDS concentration of SWP supplies delivered from Metropolitan Water District of Southern California's Jensen Water Treatment Plant, the source of SWP water from Metropolitan to Calleguas, is 300 mg/L (Calleguas 2014c, p.1).[9] The salt load associated with one AF of water with a TDS concentration of 300 mg/L is approximately 0.37 MT/AF.[10] Avoiding 3,400 AFY of imported supplies will avoid the import of 1,258 MT of salts into the Watershed (0.37 MT/AF *x* 3,400 AFY). The combination of salts removed by the LP Desalter and foregone imported salts yields a total annual reduction of 5,158 MT of salts. Over the expected 50-year lifetime of the project, this will result in a total TDS reduction of 257,900 MT.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

The LP Desalter must be constructed in order to achieve the benefits associated with this phase of the SMP. While the desalter will remove TDS from the groundwater, this benefit will not be realized unless SMP 2D is constructed to handle the brine discharge. A Las Posas Conjunctive Use Study that identifies a preferred alternative is being completed, and the LP Desalter is very likely to be constructed (Kennedy/Jenks 2014a, p.1-36).

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects are anticipated as a result of this project.

Summary of Benefit

As is shown in Table 3-10, by discharging 675 AFY of brine and reducing salt imports from imported water, this project will reduce 5,158 MT of salt in the Watershed each year. This will improve water quality and help bring the Watershed into compliance with the salts TMDL established by the US EPA in 2008.

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[7] The 120 mg/L chloride target is based on what the Las Posas Basin groundwater basin stakeholders (agricultural water entities and growers) say their needs are to grow their desired crops and is based on their experience and expertise.

[8] The SPI 2013 study assumed raw water with chloride concentrations of 200 mg/L, requiring removal of 137 mg/L (200 mg/L - 137 mg/L = 120 mg/L) (SPI 2013, p.2). SPI 2013 found that the resulting brine concentrate if starting water quality was 200 mg/L chloride would be 10,400 mg/L TDS (SPI 2013, p.2). Wells that would be used for the LP Desalter have a lower chloride concentration than assumed in the SPI study. These wells have a starting raw water quality of 183 mg/L, necessitating removal of only 63 mg/L (183 mg/L - 63 mg/L = 120 mg/L). So the amount of salts concentrated in the brine and removed by the LP Desalter will only be approximately 46% (63 ÷ 137) of that assumed in the SPI study.

[9] Although Calleguas currently receives approximately 70% SWP water and 30% Colorado River Aqueduct (CRA) water, historically Calleguas has received 100% SWP water. Since SWP water is lower in salts than CRA water, these calculations are therefore conservative and likely underestimate future avoided salts imports.

[10] 0.37 MT of salts = (300 milligrams/liter)* (1,233,482 liters/acre-foot)*(1 MT/1,000,000,000 milligrams)

Table 3-10 – Annual Project Physical Benefits			
Project Name: Salinity Management Pipeline, Phase 2D **Type of Benefit Claimed:** Salts Reduced in the Watershed **Units of the Benefit Claimed:** Metric Tons (MT) of Salt (Total Dissolved Solids) **Additional Information About this Benefit:** This is the sum of the tons of salt removed by the SMP and the avoided import of salts from avoided imported water			
(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	0	0
2016	0	2,579	2,579
2017	0	5,158	5,158
2018	0	5,158	5,158
...	0	5,158	5,158
2065	0	5,158	5,158
2066 (Last Year of Project Life)	0	2,579	2,579
Comments: The project is expected to begin operation in July 2016 and so is assigned a half-year of salt reduction in that year and in the final year of expected useful life. Salts discharge from the LP Desalter that is removed by SMP 2D totals 3,900 MT per year. In addition, SMP 2D enables development of a new local water supply with the LP Desalter that avoids the need for imported water totaling 3,400 AFY. At an average concentration of 300 mg/L, this translates to an additional 1,258 MT of TDS that does not enter the Watershed.			

Benefit: Development of 3,400 AFY of High Quality Agricultural Water Supply from an Increasingly Unusable Source of Brackish Groundwater

SMP 2D is essential for the construction and operation of the LP Desalter and therefore a necessary component in creating 3,400 AFY of high-quality agricultural water from increasingly unusable brackish groundwater.

<u>Technical Basis of the Project</u>

Brackish groundwater in the Las Posas Basin is becoming increasingly unusable due to high chloride concentrations. Construction of SMP 2D will allow the LP Desalter to provide high-quality water from desalted local groundwater with a chloride level suitable for high-value agriculture. This will mean that imported water will no longer be needed to blend with local groundwater and the future use of additional imported water will be avoided.

<u>Recent and Historical Conditions</u>

Agricultural users in Ventura County rely on groundwater to meet the majority of their irrigation needs. There is approximately 160,000 AFY of groundwater pumping by agricultural users in Ventura County (personal communication R. Viergutz, Ventura County Watershed Protection District Groundwater Section Manager, June 2014).

Although some areas contain high-quality water that needs little or no treatment prior to use for agricultural, these aquifers are being pumped at or near practical sustainable yield. Most other sources of groundwater in the Watershed contain problematically high TDS and chloride levels. Therefore, increasing the production of local supplies for potable and high-quality agricultural use will require advanced treatment technology such as reverse osmosis, which requires brine concentrate management and disposal.

Recent drought conditions and severely reduced availability of SWP supplies have placed even more urgency on developing local water supplies and removing salts from the Watershed.

Estimates of Without Project Conditions

Without the SMP, local water suppliers could not construct brackish groundwater desalters as there would be no cost-effective mechanism for brine disposal. Underutilized groundwater supplies would remain unused, and dependence on imported water supplies would increase. Thus, without this project, water supply reliability within the Calleguas service area would decrease. Specifically, if this phase of the SMP is not constructed, agricultural users in the Las Posas Basin would not have access to 3,400 AFY of locally desalted brackish groundwater and would have to either stop growing salt-sensitive crops, accept significantly lower agricultural production, or use precious imported water for irrigation.

Descriptions of Methods Used to Estimate Physical Benefits

The Las Posas Users Group (LPUG) expects the combination of all wells feeding the LP Desalter to yield a maximum of 3,800 AFY of water for agricultural use. Since this is the high end of potential agricultural water production, LPUG conservatively estimates production of 3,400 AFY (Kennedy/Jenks 2014a, Slide 10).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

The LP Desalter must be constructed in order to achieve the full benefits associated with this phase of the SMP. While the desalter will ultimately render the brackish groundwater usable by reducing chloride levels to 120 mg/L, this benefit will not be realized unless SMP 2D is constructed to provide cost-effective brine discharge. The Las Posas Conjunctive Use Study that identifies a preferred alternative is being completed, and the LP Desalter is very likely to be constructed (Kennedy/Jenks 2014a, p.1-36).

Description of Any Potential Adverse Physical Effects

No adverse physical effects are anticipated as a result of this project.

Summary of Benefit

As is shown in Table 3-11, by discharging brine created by the LP Desalter, SMP 2D allows for delivery of 3,400 AFY of high-quality supplies to agricultural customers. This local water supply will lessen reliance on scarce imports.

Table 3-11 – Annual Project Physical Benefits			
Project Name: Salinity Management Pipeline, Phase 2D **Type of Benefit Claimed:** Development of high-quality agricultural water supply from an increasingly unusable source of brackish groundwater **Units of the Benefit Claimed:** Acre-Feet **Additional Information About this Benefit:** Development of 3,400 AFY of supply from brackish groundwater via the Las Posas Desalter is not possible without cost-effective discharge of brines from the LP Desalter via the SMP			
(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	0	0
2016	0	1,700	1,700
2017	0	3,400	3,400
2018	0	3,400	3,400
...	0	3,400	3,400
2065	0	3,400	3,400
2066 (Last Year of Project Life)	0	1,700	1,700
Comments: The project is expected to begin operation in July 2016 and so is assigned a half-year of water supply production in that year and in the final year of expected useful life.			

Discussion of Non-Quantified Benefits

Increases Water Supply Reliability for Las Posas Agricultural Water Users

Removing chlorides from the Watershed and providing a reliable source of high-quality agricultural water will improve water supply reliability for Las Posas agricultural customers. Instead of relying on reduced allocations of imported water and groundwater that is expected to see significant water quality declines, customers will have a local and reliable water source of high quality.

Allows for Implementation of Additional Phases of the SMP

Construction of SMP 2D will allow for implementation of future phases of the SMP, which will remove additional TDS from Calleguas Creek Watershed through brine and wastewater discharges.

Facilitate the Construction of Groundwater Desalters

Desalters serve as a critical link to bring up to 5,000 AFY in additional municipal and industrial supplies on-line. Similarly, SMP 2D will facilitate the construction of future groundwater desalters, which are essential for improving water quality in the Watershed and providing local, reliable sources of water. In particular, SMP 2D serves as a critical link to bringing up to 5,000 AFY in additional municipal and industrial supplies on-line from the future Moorpark Desalter.

Help Bring Calleguas Creek Watershed into Compliance with Salt TMDLs

As discussed above, salt TMDLs have been established for the Watershed, including for boron, chloride, sulfate, and TDS. Calleguas Creek is currently 303(d)-listed for salts, as well as for a number of other constituents. The SMP, including SMP 2D, is an essential mechanism for export of salts out of the Watershed, and compliance with the TMDL will not be possible without it.

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. The alternatives considered are deep well injection, which involves injecting brine into wells below the water supply aquifer, and mechanical vapor recompression combined with discharge to evaporation ponds. Answers to the cost effectiveness analysis questions are presented in summary form in Table 3-12 below with narrative description for each alternative provided below.

Table 3-12 – Cost Effectiveness Analysis Project Name: Salinity Management Pipeline, Phase 2D	
Question 1	Types of benefits provided as shown in Tables 3-10 and 3-11: • 5,158 MT of salts reduced per year in the Watershed (brine disposal and avoided salt import from avoided imported water) • Development of 3,400 AFY of brackish groundwater.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? Yes
	If no, why? • Not Applicable
	If yes, list the methods (including the proposed project) and estimated costs. SMP 2D has a total present value cost of capital and O&M over 50-year lifetime of $7.13 million. Alternative methods to achieve similar levels of brine disposal benefits include: • Deep Well Injection - Present value cost totaling $20.57 million • Mechanical Vapor Recompression - Present value cost totaling $54.51 million The project was determined to be the least cost alternative and provides significant additional benefits.
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods. • Not applicable

Capital costs for SMP 2D are expected to be $7,500,000, with annual operations and maintenance (O&M) costs of approximately $9,300. The total present value cost of the project over its expected 50-year life is $7.13 million (see Table 3-13).

Two alternatives are presented for disposing of the brine associated with the LP Desalter. One alternative to building SMP 2D is utilizing a deep well injection system to dispose of the brine from the LP Desalter. This requires drilling deep wells below the aquifers and discharging brine into these wells. In 2010, a sub-committee of the Central Arizona Salinity Study developed a set of brine management alternatives. This is the most relevant and up-to-date study for considering a deep well injection alternative in Ventura County. The report estimated capital and annual O&M costs for a system capable of discharging 10 MGD (11,200 AFY) of brine (Poulson 2010, p.10). When these costs are scaled down to compare with a system discharging 675 AFY of brine, the capital costs are estimated to be $10,400,000 and O&M costs are estimated to be $787,000 per year. The total present value cost of this alternative over an assumed 50-year useful life is $20.57 million (see Table 3-14). In addition to higher cost for this alternative compared to the project, it has yet to be determined whether a deep well injection system would be feasible in this location.

The second alternative is a mechanical vapor recompression system. This process requires an additional reverse osmosis (RO) pass after two RO phases at the desalter, followed by distillation in a mechanical vapor recompression system and finally discharge to evaporation ponds or a landfill. Analysis for a mechanical vapor recompresssion brine discharge system at the planned Moorpark Desalter yielded capital and annual O&M costs of $23,300,000 and $4,284,896, respectively (Kennedy/Jenks 2014c, p.2-17). Since this study was based on 5,000 AFY of output, O&M costs were scaled down by a factor of 0.68 (3,400 AFY/5,000 AFY) to account for the lower output needed by the LP Desalter, resulting in $2,913,729 in scaled O&M cost. The total present value cost of this alternative of its assumed 25-year life is $54.51 million (see Table 3-15). It should be noted that in order to be directly comparable to the present value cost of SMP 2D, the cost estimate for this alternative would have to be increased by showing a reinvestment of capital cost in year 26 and additional years of O&M to reach a 50-year life. This calculation was not performed because the costs for this alternative with a 25-year life are already much higher than SMP 2D with a 50-year life.

Table 3-13 – Annual Costs of Project (All costs in 2014 Dollars) Project: Salinity Management Pipeline, Phase 2D										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013	226,001							226,001	1.000	226,001
2014	725,688							725,688	1.000	725,688
2015	3,968,987							3,968,987	0.943	3,744,327
2016	2,579,324			4,652				2,583,976	0.890	2,299,729
2017				9,304				9,304	0.840	7,812
2018				9,304				9,304	0.792	7,370
2019				9,304				9,304	0.747	6,952
2020				9,304				9,304	0.705	6,559
2021				9,304				9,304	0.665	6,188
2022				9,304				9,304	0.627	5,837
2023				9,304				9,304	0.592	5,507
2024				9,304				9,304	0.558	5,195
2025				9,304				9,304	0.527	4,901
2026				9,304				9,304	0.497	4,624
2027				9,304				9,304	0.469	4,362
2028				9,304				9,304	0.442	4,115
2029				9,304				9,304	0.417	3,882
2030				9,304				9,304	0.394	3,662
2031				9,304				9,304	0.371	3,455
2032				9,304				9,304	0.350	3,260
2033				9,304				9,304	0.331	3,075

Table 3-13 – Annual Costs of Project (All costs in 2014 Dollars) Project: Salinity Management Pipeline, Phase 2D										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2034				9,304				9,304	0.312	2,901
2035				9,304				9,304	0.294	2,737
2036				9,304				9,304	0.278	2,582
2037				9,304				9,304	0.262	2,436
2038				9,304				9,304	0.247	2,298
2039				9,304				9,304	0.233	2,168
2040				9,304				9,304	0.220	2,045
2041				9,304				9,304	0.207	1,929
2042				9,304				9,304	0.196	1,820
2043				9,304				9,304	0.185	1,717
2044				9,304				9,304	0.174	1,620
2045				9,304				9,304	0.164	1,528
2046				9,304				9,304	0.155	1,442
2047				9,304				9,304	0.146	1,360
2048				9,304				9,304	0.138	1,283
2049				9,304				9,304	0.130	1,210
2050				9,304				9,304	0.123	1,142
2051				9,304				9,304	0.116	1,077
2052				9,304				9,304	0.109	1,016
2053				9,304				9,304	0.103	959
2054				9,304				9,304	0.097	905
2055				9,304				9,304	0.092	853

Table 3-13 – Annual Costs of Project (All costs in 2014 Dollars) Project: Salinity Management Pipeline, Phase 2D										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2056				9,304				9,304	0.087	805
2057				9,304				9,304	0.082	759
2058				9,304				9,304	0.077	716
2059				9,304				9,304	0.073	676
2060				9,304				9,304	0.069	638
2061				9,304				9,304	0.065	602
2062				9,304				9,304	0.061	568
2063				9,304				9,304	0.058	535
2064				9,304				9,304	0.054	505
2065				9,304				9,304	0.051	477
2066 (Last Year of Project Life)				4,652				4,652	0.048	225
Total Present Value of Discounted Costs (Sum of column (j))										$ 7,126,038
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-14 – Annual Costs of Project Alternative 1 (All costs in 2014 Dollars) Project Alternative: Deep Well Injection										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013								0	1.000	
2014								0	1.000	
2015	5,200,000							5,200,000	0.943	4,905,660
2016	5,200,000							5,200,000	0.890	4,627,981
2017				786,863				786,863	0.840	660,665
2018				786,863				786,863	0.792	623,269
2019				786,863				786,863	0.747	587,990
2020				786,863				786,863	0.705	554,707
2021				786,863				786,863	0.665	523,309
2022				786,863				786,863	0.627	493,688
2023				786,863				786,863	0.592	465,743
2024				786,863				786,863	0.558	439,380
2025				786,863				786,863	0.527	414,510
2026				786,863				786,863	0.497	391,047
2027				786,863				786,863	0.469	368,912
2028				786,863				786,863	0.442	348,030
2029				786,863				786,863	0.417	328,330
2030				786,863				786,863	0.394	309,746
2031				786,863				786,863	0.371	292,213
2032				786,863				786,863	0.350	275,673
2033				786,863				786,863	0.331	260,068

Table 3-14 – Annual Costs of Project Alternative 1 (All costs in 2014 Dollars) Project Alternative: Deep Well Injection										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2034				786,863				786,863	0.312	245,348
2035				786,863				786,863	0.294	231,460
2036				786,863				786,863	0.278	218,358
2037				786,863				786,863	0.262	205,999
2038				786,863				786,863	0.247	194,338
2039				786,863				786,863	0.233	183,338
2040				786,863				786,863	0.220	172,960
2041				786,863				786,863	0.207	163,170
2042				786,863				786,863	0.196	153,934
2043				786,863				786,863	0.185	145,221
2044				786,863				786,863	0.174	137,001
2045				786,863				786,863	0.164	129,246
2046				786,863				786,863	0.155	121,930
2047				786,863				786,863	0.146	115,029
2048				786,863				786,863	0.138	108,517
2049				786,863				786,863	0.130	102,375
2050				786,863				786,863	0.123	96,580
2051				786,863				786,863	0.116	91,113
2052				786,863				786,863	0.109	85,956
2053				786,863				786,863	0.103	81,091
2054				786,863				786,863	0.097	76,501
2055				786,863				786,863	0.092	72,170

Table 3-14 – Annual Costs of Project Alternative 1 (All costs in 2014 Dollars) Project Alternative: Deep Well Injection										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2056				786,863				786,863	0.087	68,085
2057				786,863				786,863	0.082	64,231
2058				786,863				786,863	0.077	60,596
2059				786,863				786,863	0.073	57,166
2060				786,863				786,863	0.069	53,930
2061				786,863				786,863	0.065	50,877
2062				786,863				786,863	0.061	47,997
2063				786,863				786,863	0.058	45,281
2064				786,863				786,863	0.054	42,718
2065				786,863				786,863	0.051	40,300
2066 (Last Year of Project Life)				786,863				786,863	0.048	38,018
Total Present Value of Discounted Costs (Sum of column (j))										$ 20,571,756
Comments: Deep Well Injection - Alternative Project A										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-15 – Annual Costs of Project Alternative 2 (All costs in 2014 Dollars) Project Alternative: Mechanical Vapor Recompression										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013								0	1.000	
2014								0	1.000	
2015	11,650,000							11,650,000	0.943	10,990,566
2016	11,650,000							11,650,000	0.890	10,368,459
2017				2,913,729				2,913,729	0.840	2,446,423
2018				2,913,729				2,913,729	0.792	2,307,946
2019				2,913,729				2,913,729	0.747	2,177,308
2020				2,913,729				2,913,729	0.705	2,054,064
2021				2,913,729				2,913,729	0.665	1,937,796
2022				2,913,729				2,913,729	0.627	1,828,110
2023				2,913,729				2,913,729	0.592	1,724,632
2024				2,913,729				2,913,729	0.558	1,627,011
2025				2,913,729				2,913,729	0.527	1,534,916
2026				2,913,729				2,913,729	0.497	1,448,034
2027				2,913,729				2,913,729	0.469	1,366,070
2028				2,913,729				2,913,729	0.442	1,288,745
2029				2,913,729				2,913,729	0.417	1,215,797
2030				2,913,729				2,913,729	0.394	1,146,979
2031				2,913,729				2,913,729	0.371	1,082,055
2032				2,913,729				2,913,729	0.350	1,020,807
2033				2,913,729				2,913,729	0.331	963,025
2034				2,913,729				2,913,729	0.312	908,514

Table 3-15 – Annual Costs of Project Alternative 2 (All costs in 2014 Dollars) Project Alternative: Mechanical Vapor Recompression										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2035				2,913,729				2,913,729	0.294	857,089
2036				2,913,729				2,913,729	0.278	808,575
2037				2,913,729				2,913,729	0.262	762,806
2038				2,913,729				2,913,729	0.247	719,629
2039				2,913,729				2,913,729	0.233	678,895
2040				2,913,729				2,913,729	0.220	640,467
2041 (Last Year of Project Life)				2,913,729				2,913,729	0.207	604,214
Total Present Value of Discounted Costs (Sum of column (j))										$ 54,508,932
Comments: Mechanical Vapor Recompression - Alternative Project B										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Summary

The physical benefits claimed for this project are 5,158 MT of salts reduced in the Calleguas Creek Watershed annually and 3,400 AFY of high-quality agricultural water supply. Non-quantifiable, but valuable, benefits of SMP 2D include increased water supply reliability for Las Posas agricultural users, allows for implementation of additional phases of the SMP, facilitates the construction of groundwater desalters, and helps to bring Calleguas Creek Watershed into compliance with salt TMDLs. The alternatives presented in the cost-effectiveness analysis are deep well injection and mechanical vapor recompression. A comparison of life-cycle costs between the alternatives showed the project was determined to be the cost effective alternative by far.

References

These references are provided as Att3_DG_ProJust_3of5.zip. The pdf file is bookmarked so that all references can be easily located.

1. Calleguas Municipal Water District (Calleguas). 2014a. RE: Questions for SMP Phase 2D. Email communication containing stakeholder-based acreage estimates for agricultural water delivery. Accessed June, 2014.
2. Calleguas Municipal Water District (Calleguas). 2014b. Resolution No. 1816. A Resolution of The Board of Directors of Calleguas Municipal Water District Calling for Enhanced Water Use Efficiency Efforts to Conserve and Extend Regional Water Reserves. February.
3. Calleguas Municipal Water District (Calleguas). 2014c. Metropolitan TDS Values Listed in Table D Results for TDS at Jensen Plant. Accessed June, 2014.
4. Calleguas Municipal Water District (Calleguas). 2014d. Resolution No. 1845. A Resolution of the Board of Directors of Calleguas Municipal Water District Appealing for Implementation of Extraordinary Conservation Efforts and a Minimum 20% Reduction in Water Use within its Service Area in Consideration of Historic Drought Conditions. July.
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8. Los Angeles Regional Water Quality Control Board (Los Angeles RWQCB). 2007. Attachment A to Resolution No. R4-2007-016 Amendment to the Water Quality Control Plan – Los Angeles Region to Incorporate the Total Maximum Daily Load for Boron, Chloride, Sulfate, and TDS (Salts) in the Calleguas Creek Watershed.
9. Poulson, 2010. Central Arizona Salinity Study Strategic Alternatives for Brine Management in the Valley of the Sun. January.
10. SPI. 2013. Preliminary Feasibility for Groundwater Desalter, Letter Report to Zone Mutual Water Company.

PLEASANT VALLEY WELL

This project is being implemented by the Camrosa Water District (Camrosa).

PROJECT DESCRIPTION

Camrosa will deliver non-potable water to the southern Pleasant Valley Basin in exchange for a new 1,000 AFY well in the northern PV Basin.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

The southern coastal portion of the Pleasant Valley (PV) Basin has been in overdraft for many years and groundwater levels have been declining substantially under ongoing dry conditions. In the Lower Aquifer System, groundwater levels have dropped from 25 feet below msl in October 2011 to 110 feet below msl in May 2014. These groundwater level declines are increasing the risk of migration of high salinity water and making the basin increasingly susceptible to subsidence.

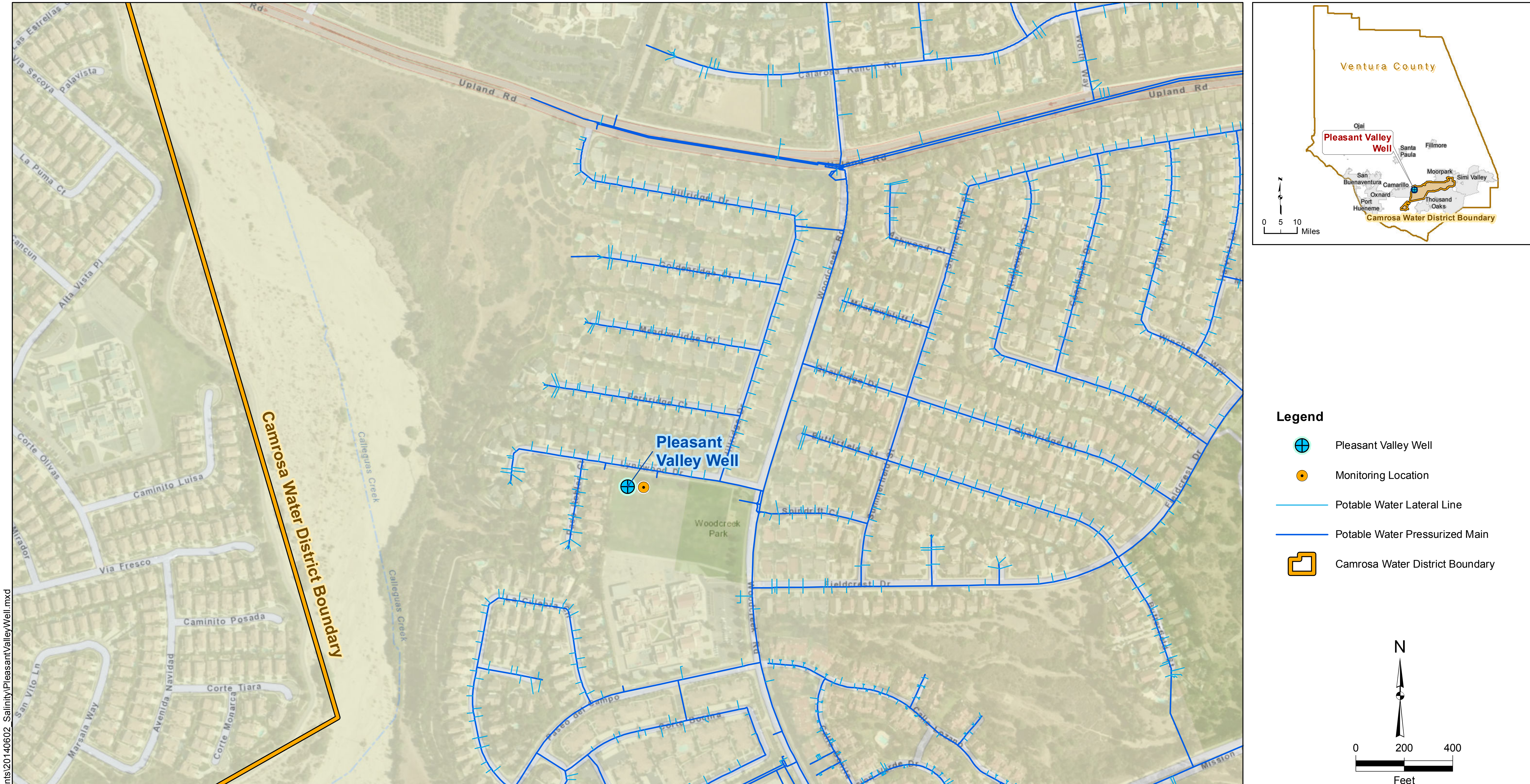
Camrosa, the Pleasant Valley County Water District (PVCWD), and the Fox Canyon GMA have entered into an agreement whereby Camrosa will deliver non-potable water from the Conejo Creek Diversion Project to PVCWD for use by agricultural customers. In turn PVCWD will decrease their pumping by an equal amount from the southern portion of the PV Basin, where groundwater levels are the deepest and the greatest risk of saline intrusion and subsidence exists. As part of the agreement, Camrosa is given pumping credits in the northern unimpaired portion of the PV Basin (Agreement between Camrosa Water District and PVCWD April 2014; Fox Canyon GMA 2014a, p.2). A new well is needed for Camrosa to utilize the potable groundwater from the northern PV Basin. The new well provides Camrosa an additional 1,000 AFY in potable supply while reducing pumping from the southern PV basin, thereby helping to protect the basin from further overdraft, saline intrusion, and subsidence.

The project includes the drilling of a new 1,000 gallons per minute (gpm) well, full enclosure building, masonry block wall, chlorine generation equipment, electrical controls, instrumentation, standby generator and fuel tank, fencing, and landscaping.

The project will provide immediate regional drought preparedness. This project will move groundwater pumping away from the impaired southern portion of the Basin, contributing to improved management of the PV Basin for long-term sustainability of this local groundwater resource. Additionally, this project improves overall supply reliability by making new potable water supplies available to Camrosa. Most importantly, it matches the quality of water to the need by using non-potable water for non-potable purposes and reserving groundwater that can be used for potable purposes for that higher level of use.

The project will increase local water supply reliability and the delivery of safe drinking water. The project will augment Camrosa's potable water supplies by 1,000 AFY and improve Camrosa's ability to reliably meet potable water demands even during dry conditions. Camrosa's current potable demand is about 8,260 AFY (Camrosa Water District 2011, p.3-2).

Expedited funding is needed. This project will help offset pumping restrictions within the PV Basin and increase water supply availability during ongoing drought conditions.



Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

Pleasant Valley Well

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWMEvents\20140602_Salinity\PleasantValleyWell.mxd

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Increases potable water supply obtained from local sources by 1,000 AFY
- Avoids import of 370 MT per year of salts into the Calleguas Creek Watershed

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of the project:

- Improved management of the Pleasant Valley Basin

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Increases Potable Water Supply Obtained From Local Sources By 1,000 AFY

With the project, Camrosa will obtain 1,000 AFY from a well located in the northern portion of the PV Basin, which will be delivered to potable water customers.

Technical Basis of the Project

Camrosa will obtain 1,000 AFY from a new well in the northern portion of the PV Basin. Groundwater pumping in this part of the basin is managed by Fox Canyon GMA. The necessary Fox Canyon GMA pump credits will be provided to Camrosa from PVCWD in exchange for selling non-potable water from the Conejo Creek Diversion Project to PVCWD, who will reduce groundwater pumping accordingly. The exchange between Camrosa and PVCWD would be one-to-one: for every acre-foot of water delivered to PVCWD from Camrosa, Camrosa will receive one acre-foot of groundwater pumping credit from PVCWD (up to 1,000 AFY). Fox Canyon GMA has already approved this transfer of groundwater pumping credits (Fox Canyon GMA 2014a, p.2).

Recent and Historical Conditions

Currently, Camrosa can pump a limited amount of groundwater in the PV Basin. Camrosa's only well in the PV Basin, the Woodcreek Well, has limited capacity and is subject to Fox Canyon GMA's Emergency Ordinance E, which reduces the allowable pumping.

In order to pump more groundwater in the PV Basin, Camrosa needs to obtain more Fox Canyon GMA credits and construct a new well.

Estimates of Without Project Conditions

Without the project, Camrosa would seek to obtain 1,000 AFY from another source. Camrosa would most likely obtain 1,000 AFY in imported water. Camrosa receives a combination of SWP and Colorado River Aqueduct water via Calleguas, a member agency to Metropolitan. In 2010, Camrosa received 5,369 AF from Calleguas, which was 61% of Camrosa's total potable supply (Camrosa Water District 2011, p.4-2). However, future deliveries from the SWP are uncertain: in 2014, water deliveries from the SWP were 5% of normal and most SWP water was being delivered from limited storage. Below normal levels of water delivery will continue in 2015 and beyond if the drought persists. Additionally, due to limitations in Metropolitan's system, Calleguas can only obtain about 30% of its supply from the Colorado River Aqueduct. The balance must come from the SWP or SWP storage. If Camrosa obtains imported water instead of carrying out the project, PVCWD would not decrease groundwater pumping in the southern portion of the PV Basin. PVCWD would continue to pump groundwater in this location until the water level and/or water quality declined to an extent that PVCWD had to stop pumping.

Descriptions of Methods Used to Estimate Physical Benefits

The new well will be capable of extracting 1,000 gpm (personal communication T. Curson, Camrosa Water District, June 2014). If operating continuously, 1,000 gpm is about 1,600 AFY. However, after accounting for time for maintenance and repair, and the availability of Fox Canyon GMA credits, the well is expected to extract 1,000 AFY.

The PV Well will be in operation for 30 years starting in 2015. It is assumed that Camrosa will pump 500 AF in 2015 as the well will be completed part way through the year.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

In addition to approval from Fox Canyon GMA, Camrosa already has an agreement with PVCWD to obtain 1,000 AFY of Fox Canyon GMA groundwater pumping credits (Camrosa Water District 2014, p.1). Facilities already exist to deliver non-potable water from the Conejo Creek Diversion Project to PVCWD. Therefore, no additional facilities, policies, or actions are required in order to obtain this physical benefit of the project.

Description of Any Potential Adverse Physical Effects

There are no adverse physical effects expected from the project. In December 2013, a study was completed showing that the extraction of 1,000 AFY from the northern portion of the PV Basin is feasible and provides overall benefits to the basin (Bachman 2013, p.10).

Summary of Benefit

As shown in Table 3-16, Camrosa will obtain 1,000 AFY from a new well located in the northern portion of the PV Basin where the water quality and water level are high. Camrosa will obtain Fox Canyon GMA credits from PVCWD by delivering non-potable water to PVCWD who will therefore pump an equivalent amount less of groundwater.

Table 3-16 – Annual Project Physical Benefits

Project Name: Pleasant Valley Well

Type of Benefit Claimed: Increases potable water supply from local sources by 1,000 AFY

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Camrosa will obtain 1,000 AFY from groundwater pumping

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	500	500
2016	0	1000	1000
…			
2045 (Last Year of Project Life)	0	500	500
Comments:			

Benefit: Avoids Import of 370 MT per Year of Salts Into the Calleguas Creek Watershed

With the project, Camrosa will obtain 1,000 AFY from a well located in the northern portion of the PV Basin. Without the project, Camrosa would use imported water, bringing additional salt into the Calleguas Creek Watershed, which is 303(d)-listed for salts and other constituents.

Technical Basis of the Project

Camrosa will obtain 1,000 AFY from a new well in the northern portion of the PV Basin. Groundwater pumping from the PV Basin does not bring any additional salt into the Calleguas Creek Watershed as the PV Basin is located in the Calleguas Creek Watershed.

Recent and Historical Conditions

Most of the soils, surface water, and groundwater in the Watershed contain high levels of salts, including total dissolved solids (TDS), boron, sulfate, and chloride. Primary sources of salts in surface water and groundwater include imported water, fertilizer used in agricultural activities, and discharges from wastewater treatment plants (LARWQCB 2007, p.3). Salts continue to accumulate, and the mass of salts and minerals currently coming into the Region is greater than the mass of salts and minerals leaving the Region.

The accumulation of salts due to historical and ongoing point and nonpoint source pollution poses a number of problems for beneficial uses within the Watershed, including municipal, industrial, and agricultural water supply and habitat. Rising salinity is also harmful to agriculture, primarily for growers of high-value strawberries and avocados who are increasingly unable to use local surface water or groundwater for irrigation without reducing agricultural productivity. High salinity levels in soils and surface water can also be detrimental to sensitive habitat and can have detrimental effects on ecosystems in the Watershed.

Calleguas Creek is currently 303(d)-listed for salts, as well as for a number of other constituents. Salt total maximum daily loads (TMDLs) have been established for the Watershed (including for boron, chloride, sulfate, and TDS).

Estimates of Without Project Conditions

Without the project, Camrosa would likely obtain 1,000 AFY of imported water from Calleguas. Importing water brings salt into the Watershed that could be avoided if local water sources are used instead. If Camrosa obtains 1,000 AF of SWP water,[11] 370 tons of salt are brought into the Watershed. As the imported water is used, its salt content eventually becomes part of the local groundwater, resulting in poorer water quality and poorer overall Watershed health.

Descriptions of Methods Used to Estimate Physical Benefits

The new well will be capable of extracting 1,000 gpm. If operating continuously, 1,000 gpm is about 1,600 AFY. However, accounting for maintenance and repair and the available Fox Canyon GMA credits, the well is expected to extract 1,000 AFY.

The 10-year average TDS concentration of SWP supplies delivered from Metropolitan's Jensen Water Treatment Plant, the source of SWP water for Calleguas, is 300 mg/L (Calleguas 2014, p.1). The salt load associated with one AF of water with a TDS concentration of 300 mg/L is

[11] Although Calleguas anticipates delivering approximately 70% SWP water and 30% Colorado River Aqueduct water in 2014, the SWP has a lower salts level and therefore was used in order to provide a conservative estimate of imported salts avoidance.

approximately 0.37 MT/AF.[12] Avoiding import of 1,000 AFY of SWP supplies will avoid the import of 370 MT of salts into the Watershed (0.37 MT/AF *x* 1,000 AFY). Over the expected 30-year lifetime of the project, this will result in a total TDS reduction of 11,100 MT.

Camrosa's well will be in operation for 30 years starting in 2015. It is assumed that Camrosa will pump 500 AF in 2015 as the well will be completed part way through the year.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

In addition to approval from Fox Canyon GMA, Camrosa already has an agreement with PVCWD to obtain 1,000 of AFY Fox Canyon GMA groundwater pumping credits (Camrosa Water District 2014, p.1). Facilities already exist to deliver non-potable water from the Conejo Creek Diversion Project to PVCWD. Therefore, no additional facilities, policies, or actions are required in order to obtain this physical benefit of the project.

Description of Any Potential Adverse Physical Effects

There are no adverse physical effects expected from the project. In December 2013, a study was completed showing that the extraction of 1,000 AFY from the northern portion of the PV Basin is feasible and provides overall benefits to the basin (Bachman 2013, p.10).

Summary of Benefit

Camrosa will obtain 1,000 AFY from a new well located in the northern portion of the PV Basin. As shown in Table 3-17, obtaining groundwater from the PV Basin avoids the import of 370 MT of additional salt into the Watershed that would otherwise occur due to imported water.

Discussion of Non-Quantified Benefits

Improved Management of the Pleasant Valley Basin

The PV Well moves 1,000 AFY of groundwater pumping from the southern portion of the PV Basin to the northern portion of the basin. The southern portion of the PV Basin has water level and saline intrusion problems, while the northern portion, which is near the Arroyo Las Posas (the basin's recharge source), does not have these problems (Bachman 2013, p.6-7). In addition, there is already a pumping depression in the southern portion of the basin, which could increase the extent of the saline intrusion and subsidence risk with more groundwater pumping (Bachman 2013, p.6-7).

Moreover, the drought is placing additional pressure on the PV Basin as less recharge occurs (Fox Canyon GMA 2014b, p.1). Due to this and other groundwater issues associated with the drought, on April 11, 2014, Fox Canyon GMA issued Emergency Ordinance E for the PV Basin (Fox Canyon GMA 2014b, p.1). The ordinance requires mandatory reductions in groundwater extraction by municipal, industrial, and agricultural users in the PV Basin. For most municipal, industrial, and agricultural users, the reduction in groundwater extraction is, as of July 1, 2014, 10% below their average annual extraction over the 2003 to 2012 time period; mandatory reductions increase to 20% by the first half of 2015.

[12] 300 mg/L x (1,233,481.84 liters/AF) x (1 MT/1,000,000,000 mg) = 0.37 MT

Table 3-17 – Annual Project Physical Benefits			
Project Name: Pleasant Valley Well **Type of Benefit Claimed:** Avoided salts import via imported water into the Calleguas Creek Watershed **Units of the Benefit Claimed:** Metric Tons of TDS **Additional Information About this Benefit:** With the project, Camrosa obtains local water, so the amount of salt in the Watershed stays the same. Without the project, importing water brings additional salt into the Watershed.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	185	185
2016	0	370	370
...			
2045 (Last Year of Project Life)	0	185	185
Comments:			

Camrosa's PV Well will be exempt from the ordinance because the overall project – moving groundwater pumping from the southern to the northern portion of the basin and delivering non-potable water to PVCWD in lieu of groundwater pumping – will help improve water levels and prevent saline intrusion. Camrosa has sold excess water from the Conejo Creek Diversion Project to PVCWD since the mid-2000s. During this time period, PVCWD has reduced its groundwater pumping, resulting in groundwater levels rising in the southern portion of the basin (Bachman 2013, p.2). This project is needed to continue PVCWD's usage of non-potable water from the Conejo Creek Diversion Project.[13]

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. The alternatives considered are: (1) obtaining more imported water, and (2) producing indirect potable reuse water. Answers to cost-effectiveness analysis questions are presented in summary form in Table 3-18 below with narrative description for each alternative provided below.

Capital costs for the PV Well are about $1.5 million. In addition, there are annual costs for administration, operation, maintenance, and replacement. Over the project's 30 year lifetime, the annual costs total about $1.9 million or about $0.9 million in present value. The annual costs are based on the annual costs of Camrosa's Woodcreek Well (a similar size well with

[13] Although Camrosa has been delivering non-potable water from the Conejo Creek Diversion Project to PVCWD, recent changes in the multi-agency agreements involved necessitate that the new well be constructed in order to continue to do so.

<table>
<tr><th colspan="2">Table 3-18 – Cost Effectiveness Analysis
Project Name: Pleasant Valley Well</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Tables 3-16 and 3-17:
• Increases Camrosa's potable water supply obtained from local sources by 1,000 AFY
• Avoids import of 370 MT per year of salts via imported water into the Calleguas Creek Watershed</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
• Yes</td></tr>
<tr><td>If no, why
• Not applicable</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.

The Pleasant Valley Well has a total present value cost of $2.3 million in present value 2014 dollars. Alternative methods to provide the same amount of water supply include:
• Purchasing Imported Water - Present value cost totaling $17.6 million
• Indirect Potable Reuse – Present value cost totaling $11.5 million
The project was determined to be the least cost alternative and provides significant additional benefits.</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative?
• Not applicable.</td></tr>
</table>

similar lift). The capital and O&M costs of the project are about $4.6 million. In present value 2104 dollars, the total cost of the project is $2.3 million. These costs are shown in Table 3-19.

Without the project, Camrosa could purchase imported water to meet its need for 1,000 AFY of water. In 2014, the price of Tier 2 imported water from Calleguas via Metropolitan, which is the price Calleguas charges for imported water when purveyors are already using above 90% of their long-term average usage, was $1,315 per AF. Assuming that Tier 2 imported water is sold to Camrosa, the total cost is $39.5 million; in present value, the total cost is $17.6 million. These costs are shown in Table 3-20.

This alternative has an important difference compared to the project, in that if Camrosa obtained imported water instead of carrying out the project, PVCWD would not decrease groundwater pumping in the southern portion of the PV Basin. PVCWD would continue to pump groundwater in this location until the water level and/or water quality declined to the point where PVCWD had to stop pumping. Additionally, the availability of imported water is severely limited by the drought.

Another alternative is producing water via indirect potable reuse (personal communication T. Curson, Camrosa Water District, June 2014). An indirect potable reuse facility would take much longer to permit and construct than the PV Well and cost substantially more. The capital cost of an indirect potable reuse water facility that can produce 1,000 AFY is estimated to be $7.0 million; in present value 2014 dollars, the capital cost is $6.6 million (see Table 3-21). The operations and management costs are approximately $396,000 per year

Table 3-19 – Annual Costs of Project (All costs in 2014 Dollars) Project: Pleasant Valley Well										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014	504,107							504,107	1.000	504,107
2015	1,004,536		400	30,000	1,140	1,250		1,037,326	0.943	978,198
2016			800	60,000	2,280	2,500		65,580	0.890	58,366
2017			800	60,000	2,280	2,500		65,580	0.840	55,087
2018			800	60,000	2,280	2,500		65,580	0.792	51,939
2019			800	60,000	2,280	2,500		65,580	0.747	48,988
2020			800	60,000	2,280	2,500		65,580	0.705	46,234
2021			800	60,000	2,280	2,500		65,580	0.665	43,611
2022			800	60,000	2,280	2,500		65,580	0.627	41,119
2023			800	60,000	2,280	2,500		65,580	0.592	38,823
2024			800	60,000	2,280	2,500		65,580	0.558	36,594
2025			800	60,000	2,280	2,500		65,580	0.527	34,561
2026			800	60,000	2,280	2,500		65,580	0.497	32,593
2027			800	60,000	2,280	2,500		65,580	0.469	30,757
2028			800	60,000	2,280	2,500		65,580	0.442	28,986
2029			800	60,000	2,280	2,500		65,580	0.417	27,347
2030			800	60,000	2,280	2,500		65,580	0.394	25,839
2031			800	60,000	2,280	2,500		65,580	0.371	24,330
2032			800	60,000	2,280	2,500		65,580	0.350	22,953
2033			800	60,000	2,280	2,500		65,580	0.331	21,707
2034			800	60,000	2,280	2,500		65,580	0.312	20,461
2035			800	60,000	2,280	2,500		65,580	0.294	19,281
2036			800	60,000	2,280	2,500		65,580	0.278	18,231

Table 3-19 – Annual Costs of Project (All costs in 2014 Dollars) Project: Pleasant Valley Well										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[(1)]	Annual Costs [(2)]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2037			800	60,000	2,280	2,500		65,580	0.262	17,182
2038			800	60,000	2,280	2,500		65,580	0.247	16,198
2039			800	60,000	2,280	2,500		65,580	0.233	15,280
2040			800	60,000	2,280	2,500		65,580	0.220	14,428
2041			800	60,000	2,280	2,500		65,580	0.207	13,575
2042			800	60,000	2,280	2,500		65,580	0.196	12,854
2043			800	60,000	2,280	2,500		65,580	0.185	12,132
2044			800	60,000	2,280	2,500		65,580	0.174	11,411
2045			400	30,000	1,140	1,250		32,790	0.164	5,378
Total Present Value of Discounted Costs (Sum of column (j))										$ 2,328,550
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-20 – Annual Costs of Project Alternative 1 (All costs in 2014 Dollars) Project: Pleasant Valley Well, Alternative (1) Obtaining More Imported Water										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	
2015				657,500				657,500	0.943	**620,023**
2016				1,315,000				1,315,000	0.890	**1,170,350**
2017				1,315,000				1,315,000	0.840	**1,104,600**
2018				1,315,000				1,315,000	0.792	**1,041,480**
2019				1,315,000				1,315,000	0.747	**982,305**
2020				1,315,000				1,315,000	0.705	**927,075**
2021				1,315,000				1,315,000	0.665	**874,475**
2022				1,315,000				1,315,000	0.627	**824,505**
2023				1,315,000				1,315,000	0.592	**778,480**
2024				1,315,000				1,315,000	0.558	**733,770**
2025				1,315,000				1,315,000	0.527	**693,005**
2026				1,315,000				1,315,000	0.497	**653,555**
2027				1,315,000				1,315,000	0.469	**616,735**
2028				1,315,000				1,315,000	0.442	**581,230**
2029				1,315,000				1,315,000	0.417	**548,355**
2030				1,315,000				1,315,000	0.394	**518,110**
2031				1,315,000				1,315,000	0.371	**487,865**
2032				1,315,000				1,315,000	0.350	**460,250**
2033				1,315,000				1,315,000	0.331	**435,265**
2034				1,315,000				1,315,000	0.312	**410,280**

Table 3-20 – Annual Costs of Project Alternative 1 (All costs in 2014 Dollars) Project: Pleasant Valley Well, Alternative (1) Obtaining More Imported Water										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2035				1,315,000				1,315,000	0.294	**386,610**
2036				1,315,000				1,315,000	0.278	**365,570**
2037				1,315,000				1,315,000	0.262	**344,530**
2038				1,315,000				1,315,000	0.247	**324,805**
2039				1,315,000				1,315,000	0.233	**306,395**
2040				1,315,000				1,315,000	0.220	**289,300**
2041				1,315,000				1,315,000	0.207	**272,205**
2042				1,315,000				1,315,000	0.196	**257,740**
2043				1,315,000				1,315,000	0.185	**243,275**
2044				1,315,000				1,315,000	0.174	**228,810**
2045				657,500				657,500	0.164	**107,830**
Total Present Value of Discounted Costs (Sum of column (j))										**$ 17,588,783**
Comments: Assumes the cost of imported water is $1,315 per AF.										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-21 – Annual Costs of Project Alternative 2 (All costs in 2014 Dollars) **Project:** Pleasant Valley Well Alternative (2) Producing indirect potable reuse water										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	
2015	7,000,000							7,000,000	0.943	6,601,000
2016				117,500	69,500	11,000		198,000	0.890	176,220
2017				235,000	139,000	22,000		396,000	0.840	332,640
2018				235,000	139,000	22,000		396,000	0.792	313,632
2019				235,000	139,000	22,000		396,000	0.747	295,812
2020				235,000	139,000	22,000		396,000	0.705	279,180
2021				235,000	139,000	22,000		396,000	0.665	263,340
2022				235,000	139,000	22,000		396,000	0.627	248,292
2023				235,000	139,000	22,000		396,000	0.592	234,432
2024				235,000	139,000	22,000		396,000	0.558	220,968
2025				235,000	139,000	22,000		396,000	0.527	208,692
2026				235,000	139,000	22,000		396,000	0.497	196,812
2027				235,000	139,000	22,000		396,000	0.469	185,724
2028				235,000	139,000	22,000		396,000	0.442	175,032
2029				235,000	139,000	22,000		396,000	0.417	165,132
2030				235,000	139,000	22,000		396,000	0.394	156,024
2031				235,000	139,000	22,000		396,000	0.371	146,916
2032				235,000	139,000	22,000		396,000	0.350	138,600
2033				235,000	139,000	22,000		396,000	0.331	131,076
2034				235,000	139,000	22,000		396,000	0.312	123,552
2035				235,000	139,000	22,000		396,000	0.294	116,424

Table 3-21 – Annual Costs of Project Alternative 2 (All costs in 2014 Dollars) Project: Pleasant Valley Well Alternative (2) Producing indirect potable reuse water										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2036				235,000	139,000	22,000		396,000	0.278	110,088
2037				235,000	139,000	22,000		396,000	0.262	103,752
2038				235,000	139,000	22,000		396,000	0.247	97,812
2039				235,000	139,000	22,000		396,000	0.233	92,268
2040				235,000	139,000	22,000		396,000	0.220	87,120
2041				235,000	139,000	22,000		396,000	0.207	81,972
2042				235,000	139,000	22,000		396,000	0.196	77,616
2043				235,000	139,000	22,000		396,000	0.185	73,260
2044				235,000	139,000	22,000		396,000	0.174	68,904
2045				117,500	69,500	11,000		198,000	0.164	32,472
Total Present Value of Discounted Costs (Sum of column (j))										$ 11,534,764
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

(personal communication T. Curson, Camrosa Water District, June 2014). Over the 30-year project life, this totals $11.5 million, or $4.9 million in present value. As shown in Table 3-7, the total cost of this alternative is approximately $18.5 million; in present value, the total cost is approximately $11.5 million. Producing water for indirect potable reuse faces regulatory hurdles, which adds some uncertainty to this alternative. Also, similar to obtaining imported water, this alternative differs from the project in that PVCWD would not decrease groundwater pumping in the southern portion of the PV Basin.

Summary

The physical benefits claimed for this project include increasing Camrosa's potable water supply by 1,000 AFY and decreasing the amount of salts imported into the Calleguas Creek Watershed. Though not quantified, the project also improves overall management of the critical PV Basin. The alternatives presented in the cost-effectiveness analysis included obtaining more imported water and producing indirect potable reuse water. The project was determined to be more cost effective than either alternative and provides a greater level of benefits.

References

These references are provided as Att3_DG_ProJust_3of5.zip. The pdf file is bookmarked so that all references can be easily located.

1. Bachman, Steven. 2013. Conejo Creek Project: Effects of Two Project Scenarios. December 12.
2. Calleguas Municipal Water District. 2012. Annual Water Quality Report. July.
3. Camrosa Water District. 2014. Agreement Between Camrosa Water District and Pleasant Valley County Water District For the Sale of Water Pursuant to State Water Resources Control Board Water Right Decision 1638. April 10.
4. Camrosa Water District. 2013. Camrosa Water Independent. Summer.
5. Camrosa Water District. 2011. 2010 Urban Water Management Plan. June 8.
6. Fox Canyon Groundwater Management Agency. 2014a. Fox Canyon Groundwater Management Agency. Resolution 2014-01, *A Resolution Establishing the Conejo Creek Water Pumping Program Involving Camrosa Water District and Pleasant Valley County Water District Using the Conejo Creek Diversion*. 26 March 2014.
7. Fox Canyon Groundwater Management Agency. 2014b. *Emergency Ordinance – E: An Emergency Ordinance Limiting Extractions from Groundwater Extraction Facilities, Suspending Use of Credits and Prohibiting Construction of Any Groundwater Extraction Facility and/or the Issuance of Any Permit Therefor.* 11 April 14.
8. Los Angeles Regional Water Quality Control Board. 2007. Proposed Amendment to the Water Quality Control Plan – Los Angeles Region to Incorporate the Total Maximum Daily Load for Boron, Chloride, Sulfate, and TDS (Salts) in the Calleguas Creek Watershed. Attachment A to Resolution No. R4-2007-016.

EL RIO RETROFITS FOR GROUNDWATER RECHARGE

This project is being implemented by the Ventura County Watershed Protection District (VCWPD).

PROJECT DESCRIPTION

Installation of pervious concrete gutters to capture dry- and wet-weather runoff from a 64-acre residential area for groundwater recharge.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects* provided on page 3-3.

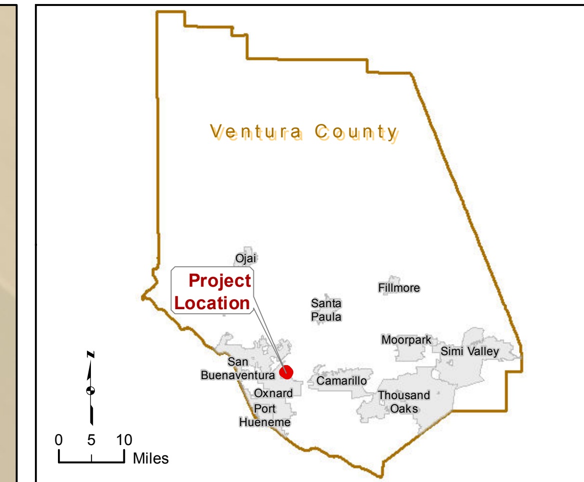
HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

This project will implement infiltration retrofits in the form of pervious concrete gutters, enabling capture, treatment, and recharge of dry- and wet-weather runoff from 64 acres of a residential area in the community of El Rio. Studies have shown that the project will enable recharge of 49 AFY to the Oxnard Plain Forebay. As a result, this project will provide a long-term and sustainable source for Oxnard Plain Forebay and Oxnard Plain Pressure Basin groundwater recharge and help prevent seawater intrusion.

The project will provide immediate regional drought preparedness. This project improves the sustainability of local groundwater supplies by enabling groundwater recharge of 49 AFY through capture of dry- and wet-weather runoff. This groundwater recharge is particularly critical to local groundwater basin management due to the significance of the Oxnard Plain Forebay and Oxnard Plain Pressure Basin as a drinking water and agricultural water supply source. In addition, recharge to the Oxnard Plain Forebay will increase pressure in the aquifers of the Oxnard Plain and help prevent seawater intrusion.

The project will increase local water supply reliability and the delivery of safe drinking water. This project will enable approximately 49 AFY to be recharged to the Oxnard Plain Forebay to help improve sustainability of local groundwater resources and enhance reliability of local water supplies. The Oxnard Plain Forebay and Oxnard Plain Pressure Basins are utilized as drinking water supplies by the cities of Oxnard and Port Hueneme, Naval Base Ventura County Point Mugu, Naval Base Ventura County Port Hueneme, and several mutual water companies in unincorporated Ventura County. The Oxnard Plain Pressure Basin is also the supply for a significant number of agricultural water users.

Expedited funding is needed. Conditions in the Oxnard Plain Basin (comprised of the Oxnard Plain Forebay and Oxnard Plain Pressure basins), the largest basin in Ventura County, are dire. Groundwater elevations are below sea level in the Forebay and at the coastline and continue to fall, which will accelerate seawater intrusion and increase the risk of subsidence across the Oxnard Plain Pressure Basin. Projects to recharge the basin, such as the El Rio Retrofits for Groundwater Recharge, are critical to maintaining the reliability of this valuable groundwater resource for Ventura County.



Legend

- Existing Catch Basins & Monitoring Locations
- Pervious Concrete Gutters, Estimated Locations (7,145 LF)
- El Rio Site Area
- Oxnard Plain Forebay

N

0 200 400
Feet

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

El Rio Retrofits for Groundwater Recharge

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWMEvents\20140602_Salinity\ElRioRetrofitsForGWR.mxd

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Increase in groundwater recharge by 49 AFY. This project will facilitate the infiltration of runoff into the Oxnard Plain Forebay through the installation of a pervious concrete gutter infiltration system in the El Rio neighborhood of Ventura County.
- An estimated 1.3E+12 Most Probable Number (MPN) per year reduction in *E. coli* fecal indicator bacteria transported to the Santa Clara River via runoff. This project will reduce the amount of runoff that reaches the Santa Clara River, thereby reducing associated pollutant loading. The Santa Clara River is 303(d)-listed for bacteria impairments and is subject to Bacteria TMDL requirements.
- An estimated 139 kg reduction in total nitrogen (TN) load transported to the Santa Clara River via runoff. The Santa Clara River is also 303(d)-listed for nutrient impairments and is subject to Nutrient TMDL requirements.

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefit is important to understanding the full value of this project:

- Educational and technology transfer benefits.

Technical Analysis of Physical Benefits Claimed

Benefit: Increased Groundwater Recharge of 49 AFY

This project includes the installation of a low-cost, low-maintenance pervious gutter system designed to capture dry-weather flows and "first flush"[14] stormwater runoff from a 64-acre single-family residential neighborhood. The project makes areas otherwise inaccessible for groundwater recharge usable by replacing impervious area along a county road right-of-way within the unincorporated area of El Rio. The improvements will capture, treat, and infiltrate an estimated 17 AFY of dry-weather runoff and an estimated 32 AFY during wet weather (49 AFY total). As described below, this will increase available groundwater supplies and help to reduce seawater intrusion and improve water quality.

<u>Technical Basis of the Project</u>

The County chose to implement a pervious gutter infiltration system at the project site based on previous experience with this Best Management Practice (BMP). In 2012, the County completed a pervious concrete gutter pilot project in two parking lots at the Government Center in Ventura. Phase II of the Government Center project is currently under construction, with completion estimated for August 2014. Together, Phases I and II will capture, treat, and infiltrate the first flush stormwater runoff and 100% of dry-weather flows from 39 acres of impervious parking lot area. Instead of replacing all of the impervious pavement parking lot with pervious pavement, the design of the Government Center project focused on improving only the parking lot perimeter gutters with a vertical storage and infiltration system. This design drastically decreases construction and long-term maintenance costs.

The project incorporates pervious concrete gutters atop aggregate filled infiltration trenches supplemented with drywells that are 1 foot in diameter and 15 feet deep. The drywells allow

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[14] "First flush" is the initial surface runoff of an individual rainstorm and it tends to contain the highest level of pollutants. The capacity of the infiltration system is approximately 0.85" of rain, so for the purposes of this proposal, this 0.85" is considered the first flush. Stormwater flows beyond 0.85" of rain may not be able to be handled by the infiltration system, depending on the rate of rainfall.

runoff to reach soils that have better infiltration rates. This unique vertical BMP design minimizes disturbance to existing infrastructure because it has a very small surface-level footprint. However, the underground infiltration trenches allow for mass storage of runoff. From the infiltration trenches, water flows down the drywells and infiltrates into the soil.

The project groundwater recharge system is designed to capture 99,273 cubic feet (2.3 acre-feet) of runoff from a 64-acre residential area for each storm event equal to or greater than 0.85”. For rainfall events smaller than 0.85” and for dry weather flows, the captured volume will be respectively less depending on the amount of runoff generated (Mutkowska and Kirby 2014, p.1).

Infiltration testing was completed at the El Rio project area in May 2014. Field percolation tests show soils with acceptable infiltration rates starting at approximately 12 feet below the existing surface (Fugro 2014, p.6). Average infiltration rates amounted to 238 inches per hour at this depth (Kirby 2014, p.3).

Recent and Historical Conditions

The Oxnard Plain Forebay is a key component of managing groundwater resources in the Oxnard Plain Basin (which is comprised of the Oxnard Plain Forebay and the Oxnard Plain Pressure Basin). The Oxnard Plain Forebay is the primary recharge area for the Oxnard Plain Pressure Basin. Changes in storage in the Forebay change the hydrostatic pressure in the Oxnard Plain Pressure Basin. When groundwater falls below sea level in the Forebay, there is significant seawater movement inland (United Water Conservation District 2014a, p.74-78 and 82-85).

Before the drought, the Forebay was considered to be in balance. In October 2011, groundwater elevations in a key index well were 40 feet above msl; in May 2014, groundwater elevations in the same well were 10 feet below msl (United Water Conservation District, 2014b, p.8). With continuing drought, the Forebay groundwater elevations will continue to decline and hydrostatic pressure in the Oxnard Plain Pressure Basin will fall and the inland migration of seawater will accelerate.

Declining groundwater levels in the Oxnard Plain Forebay have resulted in increased concentrations of nitrates and chloride in the local groundwater. This has caused a major concern about groundwater quality and water availability for agricultural and municipal uses. During very dry periods, such as near the end of a several year drought, nitrate levels in some wells can exceed 100 mg/L or, less commonly, even 200 mg/L (Milner-Villa Consulting 2011, p.56).[15] This is well above the Maximum Contaminant Level (MCL) for nitrates in drinking water of 10 mg/L.

Local agencies are taking action to protect the basin. For example, the Fox Canyon GMA, the agency with jurisdiction over the Oxnard Plain Forebay, recently adopted Emergency Ordinance E, which cuts back groundwater pumping allocations starting at 10% in July 2014, increasing to 20% by the first half of 2015.

In addition, the United Water Conservation District (United) recently issued a Drought Declaration (Resolution 2014-01) and has told its Pumping Trough Pipeline customers that due to declining groundwater levels in the Oxnard Plain Forebay, it will likely not deliver water after September 2014. In its Drought Declaration, United set priorities for water management. The highest priorities included dilution of nitrates in the groundwater extracted

[15] Although the stormwater runoff used for recharge will contain nitrates, it will not increase nitrate levels in the groundwater due to subsurface natural attenuation of nitrogen/nitrate (see discussion on total nitrogen below).

from El Rio well facilities to meet drinking water standards and recharge of the Oxnard Plain Forebay for the purpose of increasing groundwater levels to prevent seawater intrusion into area aquifers.

This project will complement these drought-related actions by providing a long-term and sustainable source for Oxnard Plain Forebay groundwater recharge and supporting prevention of seawater intrusion.

Estimates of Without Project Conditions.

If this project is not implemented, runoff from the 64-acre residential area would not be captured and used to recharge the Oxnard Plain Forebay. If drought conditions continue into 2015, it is likely that groundwater levels will reach and go below historic low levels in some parts of the County. Declining groundwater levels would further impact groundwater quality and exacerbate seawater intrusion.

Descriptions of Methods Used to Estimate Physical Benefits

To calculate this benefit, Ventura County estimated annual dry weather runoff and stormwater volumes for the 64-acre project area. They combined this information with data on capture and infiltration rates for the selected BMP and local soils respectively to estimate total groundwater recharge volume.

Method Used to Estimate Dry Weather Runoff Volumes

The project is designed to capture 100% of the dry-weather runoff for treatment and recharge. To quantify dry-weather runoff capture, the County estimated the amount of dry-weather runoff generated within the catchment area for the project. This estimate is based on monitoring data generated for storm drain outfalls in the residential area of Oak Park, California during Los Angeles County's Malibu Creek Bacteria TMDL special study, conducted in summer 2013. The study involved measuring dry-weather flow in storm drain outfalls. Flow measurements occurred in the morning on between one and five occasions at each outfall location. Average daily volumes per acre were calculated assuming continuous flow during 24 hours. The average daily runoff volume per acre was 31 cubic feet/acre/day (Secru 2014, p.1-2).

While dry-weather runoff volumes can vary based on local conditions, the Oak Park data are expected to be representative for the El Rio area because the drainage areas are similar. The El Rio drainage area is predominantly single family residential (plus one school), while the Oak Park drainage area is mostly single-family residential, with some apartments, multiplexes, condos, and townhouses, and to a lesser extent, schools and parks (excluding undeveloped areas which do not contribute dry-weather runoff) (Secru 2014, p.1-2).

The annual dry-weather runoff volume from the El Rio drainage area was estimated by multiplying the average daily runoff volume per acre (31 cubic feet per acre per day) measured in the Oak Park study by the El Rio drainage area (31 cubic feet per acre per day *x* 64 acres = 1,973 cubic feet per day = 17 AFY, Secru 2014, p.1-2).

Method Used to Estimate Stormwater Runoff Volume and Capture

To determine average annual stormwater capture and infiltration, the County first estimated the frequency and intensity of storm events expected to occur over the 20-year project life. This estimation was based on 20 years of daily rainfall data collected between October 1992 and October 2013 at gauge station 239 located at El Rio-United Spreading Grounds very near the project location.

Next, the County used engineering design estimates and field tests to determine the amount of stormwater that would be captured and infiltrated on an annual basis (estimated capture and infiltration rates are described above).

Based on the rainfall data collected at El Rio and the design storage capacity of the system, the County estimates that the project will capture an average of 32 AFY of stormwater runoff (Mutkowska and Kirby 2014, p.2).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical benefits

No additional facilities, policies, or actions are required in order to obtain this physical benefit of the project.

Description of Any Potential Adverse Physical Effects

Increased groundwater recharge in the Oxnard Plain Forebay is not expected to result in any adverse physical effects.

Summary of Benefit

As shown in Table 3-22, the project will result in an increase in groundwater recharge of 49 AFY, or 980 AF over the 20-year project life. This will help to alleviate drought conditions, improve water quality, and reduce seawater intrusion in the aquifer.

Table 3-22 – Annual Project Physical Benefits

Project Name: El Rio Retrofits for Groundwater Recharge
Type of Benefit Claimed: Groundwater recharge
Units of the Benefit Claimed: Acre-feet (AF)
Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	0	0
2016	0	49	49
2017	0	49	49
2018	0	. . . .	49
2035: Last Year of Project Life	0	49	49
Total	0	980	980

Comments: Project construction will be completed in December 2015. Physical benefits will begin to accrue in January 2016

Benefit: Reduction in *E. coli* Fecal Indicator Bacteria Load to Surface Water of 1.3E+12 MPN per Year

By capturing and treating non-point source flows, including both dry- and wet-weather flows, from the 64-acre El Rio neighborhood, the project will result in a reduction in *E. coli* bacteria loading to the Santa Clara River of 1.3E+12 Most Probable Number (MPN)[16] per year. This will improve water quality in the river and help to meet TMDL requirements associated with bacteria indicators.

Technical Basis of the Project

Monitoring data indicate that dry- and wet-weather urban runoff are the primary sources of elevated bacterial indicator densities in the Santa Clara River and Estuary (Los Angeles RWQCB 2010, p.48).

In 2001, the Regional Board updated the bacteria objectives for waters designated as REC-1 (one of the beneficial uses designated for the Santa Clara River) to be consistent with U.S. EPA's recommended criteria, which includes freshwater criteria for *E. coli* (Regional Board Resolution R01-018). The updated bacteria objectives were approved by the State Water Resources Control Board (State Board) on July 18, 2002 (State Board Resolution 2002-0142), the Office of Administrative Law (OAL) on September 19, 2002 (OAL File No. 02-0807-01-S), and the U.S. EPA on September 25, 2002. The revised objectives include geometric mean limits and single sample limits for total coliform, fecal coliform, *E. coli*, and enterococcus. They are also consistent with those contained in state law (California Code of Regulations, Title 17, Section 7958, which implements Assembly Bill 411 (1997 Stats. 765)).

El Rio Retrofits for Groundwater Recharge is located upstream of the Santa Clara River Estuary. This portion of the Santa Clara River is subject to a Bacteria TMDL (Los Angeles RWQCB 2010, p.48). By capturing non-point source runoff, this project will reduce *E. coli* loadings and enhance the ability of the community to meet TMDL requirements. Specifically, this project will aid in meeting wet-weather Waste Load Allocations (WLAs)[17] by capturing the "first flush" of wet weather discharges from the project area. The first flush carries approximately 58% of the bacterial contamination associated with runoff events (California Department of Transportation 2005, p.3).[18]

Estimates of Without Project Conditions

Without the project, the stormwater and dry-weather runoff from the El Rio area would continue to be discharged untreated into the storm drain system and impact surface water quality in the Santa Clara River due to high loading of *E. coli*.

Recent and Historical Conditions

The Santa Clara River is 303(d)-listed for bacteria impairments, and is subject to Bacteria TMDL requirements. Available monitoring data indicate that dry- and wet-weather runoff are the major contributors of bacteria loading to the Santa Clara River (Los Angeles RWQCB 2010. pg. 48). Further, surface runoff loads from urbanized areas via stormwater systems are the most significant source.

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[16] MPN is a measure of the upper and lower limit to the number of bacteria of a given sample. MPN is a standard means of measurement for *E. coli* and is used by the Regional Water Quality Control Board, California Department of Public Health, and US EPA.

[17] Waste Load Allocations are a component of TMDLs and are the maximum load of pollutants each discharger is allowed to release into a particular waterway.

[18] 50% of the pollutants can be reduced by treating first 20% of the flow. Assuming 58% for the El Rio Retrofits for Groundwater Recharge is conservative given the very high infiltration rates in the El Rio area.

Unlike many TMDLs where the critical condition is during low-flow conditions or summer months, the critical condition for bacteria loading is during wet weather. This is because intermittent or episodic loading from sources such as urban runoff can have maximum impact at high (i.e., storm) flows (Los Angeles RWQCB 2010, p.48).

Descriptions of Methods Used to Estimate Physical Benefits

E. coli loads are calculated as infiltrated water volume multiplied by estimated *E. coli* levels. For this project, the County estimated wet-weather *E. coli* levels based on median levels at similar residential land-use sites sampled between 2003 and 2005 as part of the Ventura Countywide Stormwater Quality Management Program. Dry weather *E. coli* levels were estimated based on the median of fecal coliform levels at similar land-use sites included in the Residential Runoff Reduction Study by the Municipal Water District of Orange County and the Irvine Ranch Water District. Fecal coliform levels were multiplied by 0.7 to obtain equivalent *E. coli* levels (Municipal Water District of Orange County, Irvine Ranch Water District 2004, p.4-8).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No additional facilities, policies, or actions are required in order to obtain this physical benefit of the project.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects are expected from reducing the *E. coli* bacteria load into the Santa Clara River.

Summary of Benefit

As shown in Table 3-23, the project will result in an annual reduction of 1.3E+12 MPN in *E. coli* bacteria loading into the Santa Clara River – a total reduction of 2.6E+13 MPN over the 20-year project life. This will help to meet TMDL requirements associated with bacteria impairments in the Santa Clara River.

Benefit: Reduction of Total Nitrogen (TN) Load to Surface Water of 139 KG Per-Year

This project will provide a reduction in total nitrogen loading to the Santa Clara River of 139 kg per year, or 2,780 kg total over the 20 year project life, by capturing and infiltrating dry- and wet-weather runoff from the El Rio neighborhood.

Technical Basis of the Project

El Rio Retrofits for Groundwater Recharge is located upstream of Santa Clara River Reach 1 and Estuary, which are included as part of the 2003 Nitrogen TMDL, as well as 303(d)-listed for nitrogen and nitrate impairments. According to the State Water Resources Control Board website, the TMDL for this listing will be developed by 2021.

This project will improve water quality and reduce the nitrogen/nitrate levels in urban runoff necessary for meeting stringent water quality goals of around 1 mg/L for total nitrogen and to address Santa Clara River Estuary water quality impairments for nitrogen and nitrate.

Table 3-23 – Annual Project Physical Benefits			
Project Name: El Rio Retrofits for Groundwater Recharge			
Type of Benefit Claimed: Reduction in *E. Coli* bacteria loading into the Santa Clara River			
Units of the Benefit Claimed: Most Probable Number (MPN)			
Additional Information About this Benefit: N/A			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0		
2016	0	1.3E+12	1.3E+12
2017	0	1.3E+12	1.3E+12
2018	0		
2035	0	1.3E+12	1.3E+12
2035: Last Year of Project Life	0	1.3E+12	1.3E+12
Total	0	2.6E+13	2.6E+13
Comments: Project construction will be completed in December 2015. Physical benefits will begin to accrue in January 2016.			

Recent and Historical Conditions

Two reaches of the Santa Clara River exceed the 1994 Basin Plan water quality objectives for nitrate plus nitrite. These data supported the 1998 303(d) listing for Santa Clara River Watershed for nitrate and nitrite. As part of the 303(d) listing, the County and cities in Ventura County are required to meet total nitrogen loadings for the Santa Clara River consistent with the Ventura County Municipal Stormwater Permit. Starting in 2010, thirteen TMDLs, including the TMDL for Nitrogen, have been included in the permit to provide an enforcement mechanism. The County and cities located within Ventura County have been working toward this permit goal by implementing a number of stormwater quality protection BMPs (personal communication E. Mutkowska, Stormwater Program Manager Ventura County, June 2014).

The current TMDL implementation plan requires the County of Ventura to meet interim WLAs for summer and winter dry-weather by March 2016 and final dry-weather WLAs by March 2023. This project is a necessary component of the plan to meet interim and final WLAs.

Estimates of Without Project Conditions

Without this project, wet- and dry-weather flows from the El Rio area would continue to run off into the Santa Clara River. Nitrogen loading into the Santa Clara River from the El Rio area would remain the same and progress would not be made toward meeting interim or final WLAs for nitrogen.

Descriptions of Methods Used to Estimate Physical Benefits

The County estimated the reduction in nitrogen loads resulting from this project by multiplying the amount of runoff that will be captured in wet and dry weather, respectively, by their estimated TN concentrations. Wet-weather TN concentrations were estimated as the median concentration from two residential land-use sites (R1 and R2) sampled between 1993 and 2004 by the Ventura Countywide Stormwater Quality Management Program (County of Ventura, 2013, data available vcwatershed.net/stormwater). Dry-weather TN concentrations were estimated as the median of TN concentrations at six pre- and post-treatment sites included in the Municipal Water District of Orange County and the Irvine Ranch Water District Residential Runoff Reduction Study (p.5-10).[19]

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No additional facilities, policies, or actions are required in order to obtain this physical benefit of the project.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects are expected from the reduction in nitrogen loading to the Santa Clara River.

Summary of Benefit

As shown in Table 3-24, the project will result in a 139 kg reduction in total nitrogen loading into the Santa Clara River each year – a total of 2,780 kg over the 20-year project life. This will help meet WLA associated with the nitrogen TMDL for the Santa Clara River.

Discussion of Non-Quantified Benefits

Educational and Technology Transfer Benefits

Although this approach to recharging dry- and wet-weather flows is well-established as effective (in Ventura County and elsewhere), the deployment of this technology has not occurred extensively in residential areas. Residential areas provide an excellent opportunity for pervious gutter retrofits and the success of El Rio Retrofits for Groundwater Recharge can help reinforce the ease of implementation and effectiveness of this strategy for integrating water quality improvement of dry- and wet-weather flows (thereby aiding in TMDL compliance) with enhancement of groundwater recharge.

Project results will be shared via appropriate professional and municipal organizations, and as a result, additional similar projects may be implemented in other areas of the County and beyond. The County has already identified an additional 992 acres in the El Rio area that is promising for future implementation. Unfortunately, there is no way to quantify the anticipated additional implementation of pervious gutters beyond that performed by this project.

[19] Specifically, dry weather TN concentrations were estimated as the median of TN concentrations at sites 1001, 1002, 1003, and 1005 (pre-treatment) and 1002 and 1003 (post-treatment) in the Residential Runoff Reduction Study by the Municipal Water District of Orange County and the Irvine Ranch Water District.

Table 3-24 – Annual Project Physical Benefits			
Project Name: El Rio Retrofits for Groundwater Recharge			
Type of Benefit Claimed: Reduction in nitrogen loading into the Santa Clara River			
Units of the Benefit Claimed: kilograms (kg)			
Additional Information About this Benefit: N/A			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	0	0
2016	0	139	139 kg
2017	0	139	139 kg
2018	0		
2035: Last Year of Project Life	0	139	139 kg
Total	0	2,780	2,780 kg
Comments: Project construction will be completed in December 2015. Physical benefits will begin to accrue in January 2016.			

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. The alternatives considered include: 1) constructing a subsurface infiltration system for Balboa Street (within the El Rio neighborhood), and 2) retrofitting the entire community with pervious pavements. Answers to the cost effectiveness analysis questions are presented in summary form in Table 3-25 with narrative description for each alternative provided below.

The present value capital construction costs for the El Rio Retrofits for Groundwater Recharge total $1,207,475. Project construction will take place in 2015 with some monitoring in 2014 and 2016. As is shown in Table 3-26, the total present value of project costs in 2014 dollars is $1,403,133.

<table>
<tr><th colspan="2">Table 3-25 – Cost Effectiveness Analysis
Project Name: El Rio Retrofits for Groundwater Recharge</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Tables 3-22, 3-23, and 3-24:
• Groundwater recharge of 49 AFY per year
• Reduction of E. Coli fecal indicator bacteria of 1.3E+12 MPN load to surface water
• Reduction of total nitrogen (TN) load to surface water of 139 kg per year</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
• Yes</td></tr>
<tr><td>If no, why?
• Not Applicable</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.

El Rio Retrofits for Groundwater Recharge has a total present value cost of $1.4 million. Alternative methods to achieve similar benefits include:
• Subsurface Infiltration System – Present value cost totaling $2.1 million
• Pervious Pavement Streets - Present value cost totaling $3 million (capital costs only)
The project was determined to be the least cost alternative.</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods
• Not applicable.</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

Table 3-26 – Annual Costs of Project (All costs in 2014 Dollars) Project: El Rio Retrofits for Groundwater Recharge											
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014	14,639							14,639	1.000	14,639
2015	1,213,008							1,213,008	0.943	1,143,867
2016	55,022				18,083			73,105	0.890	65,063
2017					18,083			18,083	0.840	15,190
2018					18,083			18,083	0.792	14,322
2019					18,083			18,083	0.747	13,508
2020					18,083			18,083	0.705	12,749
2021					18,083			18,083	0.665	12,025
2022					18,083			18,083	0.627	11,338
2023					18,083			18,083	0.592	10,705
2024					18,083			18,083	0.558	10,090
2025					18,083			18,083	0.527	9,530
2026					18,083			18,083	0.497	8,987
2027					18,083			18,083	0.469	8,481
2028					18,083			18,083	0.442	7,993
2029					18,083			18,083	0.417	7,541
2030					18,083			18,083	0.394	7,125
2031					18,083			18,083	0.371	6,709
2032					18,083			18,083	0.35	6,329
2033					18,083			18,083	0.331	5,985
2034					18,083			18,083	0.312	5,642

Table 3-26 – Annual Costs of Project (All costs in 2014 Dollars) **Project:** El Rio Retrofits for Groundwater Recharge										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2035: Last Year of Project Life					18,083			18,083	0.294	5,316
Total Present Value of Discounted Costs (Sum of column (j))										$ 1,403,133

Construct a Subsurface Infiltration System for Balboa Street

This alternative involves capturing runoff into a new infiltration system. A conceptual-level design for this type of project was completed for the Ventura County Government Center project site (Kirby 2014, p.1-3). This design included the installation of a 96-inch diameter, 88-foot-long perforated steel reinforced polyethylene subsurface storage basin over a gravel infiltration bed. This type of project would be technically feasible for use in this area, but it would require the use of a very large area. The area would also need to be close to the existing storm drain infrastructure so that it could be utilized as an overflow in case the system is overwhelmed by a large storm event. This means the system would need to be constructed in close proximity to an existing catch basin. The two existing catch basins in the project area are located on Balboa Street between Corsicana Drive and Helsam Avenue.

The Ventura Government Center design was developed for a 4.25-acre site with an estimated volume of 8,500 cubic feet; the El Rio site is much larger so the infiltration system would need to be proportionally larger as well (approximately 16 times larger). The extensive footprint required to infiltrate the large volume of surface runoff coming from the El Rio site with this design would be an issue as the only location available for construction is within the existing street (County right-of-way). This means there would be extensive existing utilities in the way. Additionally, the catch basins would have to be reconstructed with low-flow diversions and new storm drain piping constructed to convey the water to the subsurface infiltration system. This is required to ensure that during low-flow or dry weather events all flows would be directed to the infiltration system. During high flow rainfall events, only the low flow levels of the storm would be directed to the infiltration system; the high flows would bypass infiltration and be sent directly downstream.

In addition, the infiltration system would be constructed beneath the roadway. Per Ventura County ordinance, this would require full-width repaving. The additional cost of repaving, as well as the increased cost of traffic control and protection or relocation of existing subsurface infrastructure (electric, gas, water, telecommunications, and wastewater), makes this alternative more costly.

The present value of capital construction costs for this alternative amount to $1,937,811 in 2014 dollars.

Maintenance costs would be comparable to the project. Maintenance costs would include vacuum of the pretreatment system or potentially cartridge filter replacement for pretreatment to ensure that the infiltration bed does not clog with sediment. This would be needed at a minimum twice annually to ensure the system is operational before and after the rainy season. Annual maintenance costs are estimated to be $15,200.

As shown in Table 3-27, the present value of O&M costs for this alternative amount to $164,464 in 2014 dollars. The total present value cost of this project is therefore $2,102,275 ($1,937,811 in capital cost plus $164,464 in O&M costs).

Table 3-27 – Annual Costs of Avoided Projects (All avoided costs in 2014 dollars) **Project:** El Rio Retrofits for Groundwater Recharge						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Construct subsurface infiltration system in Balboa Street Avoided Project Description: Construct infiltration system in alternative location				Discount Factor(1)	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2014					1.000	
2015	2,054,943			2,054,943	0.943	1,937,811
2016			15,200	15,200	0.89	13,528
2017			15,200	15,200	0.84	12,768
2018			15,200	15,200	0.792	12,038
2019			15,200	15,200	0.747	11,354
2020			15,200	15,200	0.705	10,716
2021			15,200	15,200	0.665	10,108
2022			15,200	15,200	0.627	9,530
2023			15,200	15,200	0.592	8,998
2024			15,200	15,200	0.558	8,482
2025			15,200	15,200	0.527	8,010
2026			15,200	15,200	0.497	7,554
2027			15,200	15,200	0.469	7,129
2028			15,200	15,200	0.442	6,718
2029			15,200	15,200	0.417	6,338
2030			15,200	15,200	0.394	5,989
2031			15,200	15,200	0.371	5,639
2032			15,200	15,200	0.35	5,320
2033			15,200	15,200	0.331	5,031

Table 3-27 – Annual Costs of Avoided Projects (All avoided costs in 2014 dollars) **Project:** El Rio Retrofits for Groundwater Recharge						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Construct subsurface infiltration system in Balboa Street Avoided Project Description: Construct infiltration system in alternative location				Discount Factor[1]	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2034			15,200	15,200	0.312	4,742
2035			15,200	15,200	0.294	4,469
Total Present Value of Discounted Costs (Sum of Column (g))						$ 2,102,275
(%) Avoided Cost Claimed by Project						100%
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						$ 2,102,275
Comments:						

Retrofit Community with Pervious Pavement

VCWPD also considered retrofitting existing streets in El Rio with pervious pavement as an alternative to the project. The El Rio area selected for conversion to pervious pavement contains approximately 10,000 lineal feet of 35-foot-wide paved streets (this would infiltrate roughly the same amount of runoff as the project). This equals 350,000 square feet (SF) of paved surface area that would need to be replaced. Pervious pavements on average cost about $8 per square foot to construct[20], when adjusted to 2014 dollars using the Consumer Price Index. Utilizing this figure as an estimate of capital costs pushes project costs to almost $3 million (without including O&M costs). This alternative is therefore more expensive than the project and was not analyzed further.

Summary

The physical benefits claimed for this project include:

- Groundwater recharge of 49 AFY
- Reduction of *E. coli* fecal indicator bacteria of 1.3E+12 MPN load to surface water
- Reduction of total nitrogen (TN) load to surface water of 139 kg per year.

A non-quantified benefit of the project is the educational and technology transfer benefits. The alternatives presented in the cost-effectiveness analysis included constructing a subsurface infiltration system for Balboa Street and retrofitting the community with pervious pavement. The project was determined to be the most cost effective alternative.

References

These references, with the exception of Item 2 which is a online website, are provided as Att3_DG_ProJust_3of5.zip. The pdf file is bookmarked so that all references can be easily located.

1. California Department of Transportation. 2005. First Flush Study. August.
2. County of Ventura. 2013. Welcome to the data query site for the Ventura Countywide Stormwater Quality Management Program. Accessed 6/20/14. vcwatershed.net/stormwater
3. Fugro. 2014. Limited Geotechnical Investigation Report, Percolation Test Data, Urban LID Retrofit at El Rio, Ventura County, California. June 16.
4. Kirby, David. 2014. Memorandum: Design for El Rio Retrofits for Groundwater Recharge. Ventura County Watershed Protection District, Water and Environmental Resources Division. May 28.
5. Los Angeles Regional Water Quality Control Board (RWQCB). 2010. Total Maximum Daily Load for Indicator Bacteria in Santa Clara River Estuary and Reaches 3, 5, 6, and 7. Los Angeles Regional Water Quality Control Board. July 8.
6. McMillan, Tess. August 2007. Comparing Traditional Concrete to Permeable Concrete for a Community College Pavement Application. Bellevue Community College.

[20] Specific bids were cited in McMillan (2007) at $6.26 per square foot. Updating $6.26 per square foot from 2007 to 2014 dollars results in roughly $8 per square foot.

7. Milner-Villa Consulting. 2011. 2010. Urban Water Management Plan. Prepared for the United Water Conservation District.

8. Municipal Water District of Orange County, Irvine Ranch Water District, July 2004 Available http://www.ladpw.org/wmd/irwmp/docs/Step2IGA/03.%20Large%20Landscape%20Water%20Conservation...%20Project/_Large%20Landscape%20Water%20Conservation.pdf Accessed July 2014.

9. Mutkowska, Ewelina and David Kirby. 2014. Memorandum Summary of Stormwater Runoff Volume Estimation El Rio Retrofit for Groundwater Recharge Project. June 5.

10. Secru, Brum. 2014 Summary of Dry Weather Urban Runoff Volume Estimation. June.

11. United Water Conservation District (United). 2014a. Groundwater and Surface Water Conditions Report 2013.

12. United Water Conservation District (United). 2014b. May 2014 Hydrologic Conditions Report.

GROUNDWATER REPLENISHMENT AND REUSE PROJECT

This project is being implemented by the City of Oxnard (Oxnard).

PROJECT DESCRIPTION

Construction of an aquifer storage and recovery well (and related facilities) to inject 1,500 AFY of recycled water for non-potable and ultimately indirect potable reuse.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

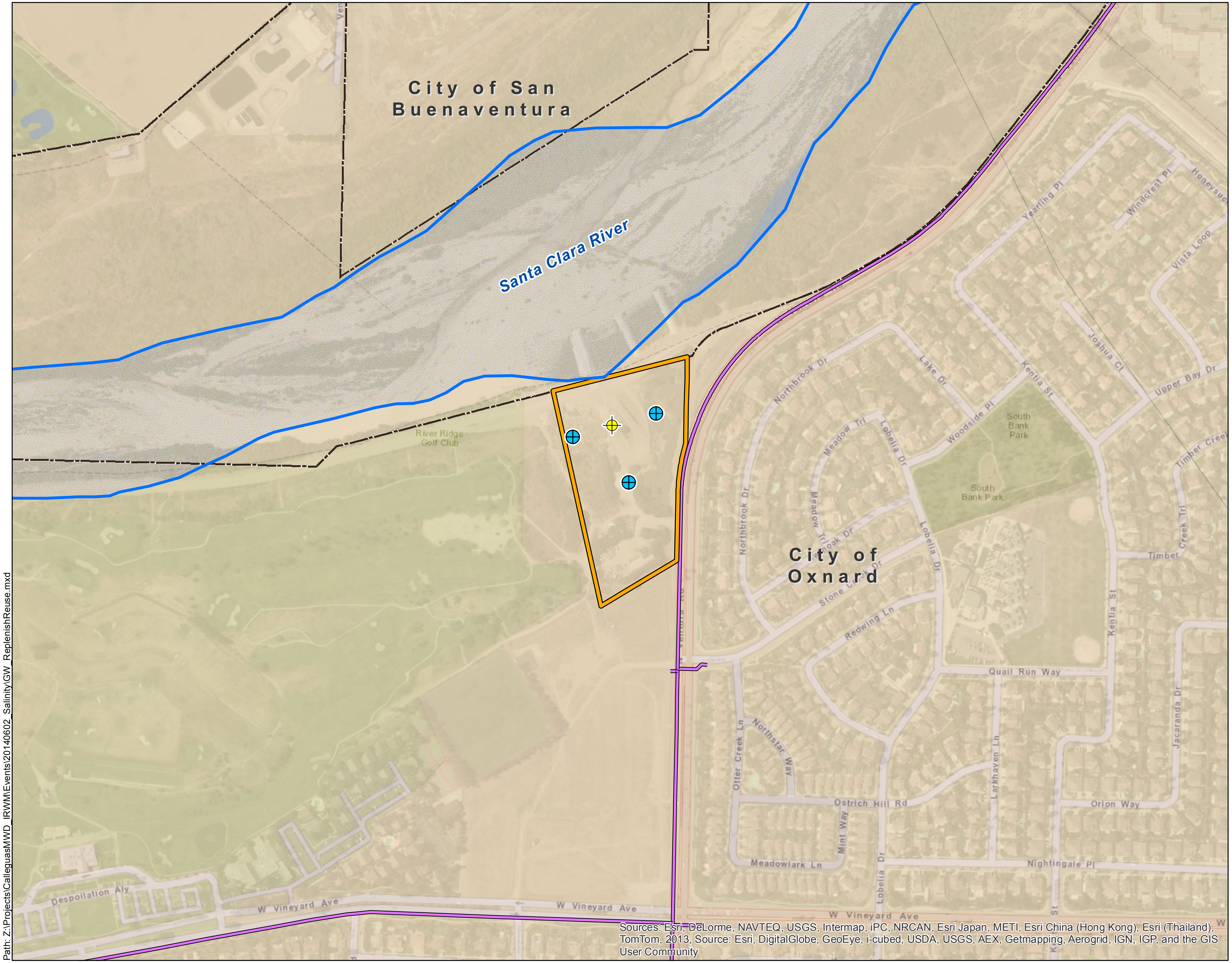
The City of Oxnard has moved forward aggressively with its Groundwater Recovery Enhancement and Treatment (GREAT) Program to diversify its water supply portfolio and enhance local water supply reliability. Phase 1 of the GREAT Program is complete and includes a system of recycled water mains (Recycled Water Backbone System) and the Advanced Water Purification Facility (AWPF), which produces 7,000 AFY of highly treated recycled water. Phase 2 of the GREAT Program includes this project, the Groundwater Replenishment and Reuse Project, which helps maximize the use of this resource by providing storage of recycled water and ultimately enabling indirect potable reuse. Without this project, 1,500 AFY of recycled water would otherwise be discharged to the ocean. The Groundwater Replenishment and Reuse Project includes:

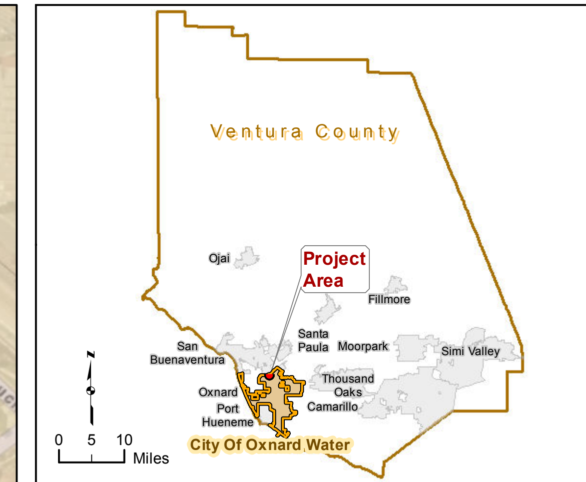
- An Aquifer Storage and Recovery (ASR) well
- Three nearby monitoring wells (necessary for testing, reporting, and permitting associated with indirect potable reuse)
- Connection to Oxnard's existing recycled water pipeline system

The project provides immediate drought preparedness. The ASR well creates a place to store water from the AWPF during the winter season when recycled water demand is low. Without this storage, excess recycled water (estimated to be 1,500 AFY) would have to be discharged to the ocean. This project means an additional 1,500 AFY will be kept in the system via groundwater recharge and will be available for later extraction and use. These benefits will be achieved immediately once the project goes into operation.

The project will increase local water supply reliability. This project will be the first indirect potable reuse project in Ventura County and sets a precedent whereby recycled water can be used for groundwater recharge and later reuse. As recycled water production increases in the County (including planned expansions of the AWPF), the opportunity for indirect potable reuse expands. This project is a necessary step in the process of making indirect potable reuse a reality in Ventura County.

The project will reduce water quality conflicts created by the drought. The current drought has already curtailed water supplies available to Ventura County groundwater users, and this problem will intensify with continued drought. This project enables 1,500 AFY of additional supply and will lessen the competition for dwindling groundwater supplies in the Oxnard Plain Pressure Basin and limited imported water.





Legend

- ASR Well
- Monitoring Well
- Project Area
- Oxnard Plain Forebay
- Existing Recycled Water Main
- Cities

N

0 200 400
Feet

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

Groundwater Replenishment and Reuse Project

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWM\Events\20140602_Salinity\GW_ReplenishReuse.mxd

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Increases water supply by 1,500 AFY through the storage and ultimate reuse of recycled water

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of the project:

- Greater AWPF operational efficiency
- Facilitation of indirect potable reuse

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Increases Water Supply by 1,500 AFY Through Storage and Use of Recycled Water

With the project, Oxnard will make productive use of 1,500 AFY of recycled water supply that would otherwise be discharged to the ocean due to a lack of winter demand. Initially, this water will be stored then extracted and used for non-potable purposes, like agricultural irrigation, landscape irrigation, and industrial processes. In the future, the water will be used for indirect potable reuse.

<u>Technical Basis of the Project</u>

During the winter, 1,500 AF will be transferred from the AWPF through Oxnard's Recycled Water Backbone System to the ASR well where the water will be injected. In the summer, when there is demand for recycled water from agriculture, landscaping, and industry, the water will be extracted and delivered to these users. In future years, once Oxnard has received permits to use the water for indirect potable reuse, the water will be extracted from a different well and be delivered via the potable water system.

<u>Recent and Historical Conditions</u>

The use of an ASR well is essential to maximize the benefits of Oxnard's AWPF. Currently, Oxnard does not have storage facilities for the recycled water the AWPF produces; so without the project, Oxnard would have to sell the water immediately, discharge it to the ocean, or shut down the AWPF during times of low water demand (in the winter).

Once operating, the AWPF's first phase is capable of producing 7,000 AFY of advanced treated recycled water (Kennedy/Jenks Consultants 2012, p.3-16). Up to three more phases may be undertaken, with each phase adding 7,000 AFY to the AWPF's recycled water production. The AWPF will have a maximum recycled water production of 28,000 AFY (Kennedy/Jenks Consultants 2012, p.3-16).

In 2010, Oxnard had a total water supply of 29,571 AF[21], comprised of groundwater and imported water (Kennedy/Jenks Consultants 2012, 3-1). Currently, Oxnard has two sources of groundwater: purchases from the United Water Conservation District (United) and pumping from its own groundwater facilities. In 2010, Oxnard purchased 10,852 AF from United and

[21] In the City of Oxnard 2010 Urban Water Management Plan, Table 3-1 Summary of Current and Projected Water Supplies lists Oxnard's total water supply as 28,317 AF (Kennedy/Jenks Consultants, 2012, 3-1). However, this figure does not include 1,254 AF of brine loss. The sum of groundwater and imported water purchased is therefore 29,571 AF, the number presented here.

pumped 7,442 AF from its own facilities (Kennedy/Jenks Consultants, 2012, 3-1). Of Oxnard's total supply of 29,571 AF, 18,294 AF, or almost 62%, was groundwater.

Obtaining the same quantity of groundwater in future years may be difficult as the Fox Canyon GMA has curtailed groundwater extraction in the Oxnard Plain Pressure Basin (Fox Canyon GMA, 2014, 1). The amount of extraction is reduced 10% as of July 1, 2014, with further cuts scheduled to reach 20% through the first half of 2015.

Oxnard's source of imported water is Calleguas Municipal Water District (Calleguas), a member agency of the Metropolitan Water District of Southern California (Metropolitan). In 2010, Oxnard purchased 11,277 AF of imported water, which was about 38% of Oxnard's total supply (Kennedy/Jenks Consultants, 2012, 3-1). Calleguas anticipates delivering 70% State Water Project (SWP) water and 30% Colorado River Aqueduct (CRA) water in 2014.

<u>Estimates of Without Project Conditions</u>

Without the project, 1,500 AFY of highly treated recycled water would either be discharged to the ocean or not produced and would therefore not be available for reuse. Oxnard would obtain 1,500 AFY from a combination of groundwater pumping and increased use of imported water, which due to the 5% allocation of SWP water, is primarily being taken out of limited surface storage. With both sources under increased constraints, meeting demands would become increasingly difficult. Additionally, without the project, advanced treated recycled water use could not be maximized, nor could Oxnard pursue indirect potable reuse.

<u>Descriptions of Methods Used to Estimate Physical Benefits</u>

The City of Oxnard has identified more than 7,000 AFY demand for recycled water (Kennedy/Jenks 2012, p.4-12). The Groundwater Replenishment and Reuse Project has an expected useful lifetime of 30 years. When the ASR well begins operation in 2015, 500 AF will be injected (and later extracted) because the well will be completed part way through the year. The well will be sized to inject and pump more than 1,500 AF in a six-month period (Hopkins Groundwater Consultants, 2014, p.1).

<u>Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits</u>

This project consists of an ASR well, three monitoring wells, and piping and valves to connect to Oxnard's existing recycled water system. To obtain benefits associated with storage and use of recycled water, no additional facilities are needed.

Before Oxnard can use the facilities for indirect potable reuse, Oxnard needs to submit an engineering report in compliance with Title 22 of the California Code of Regulations to the California Department of Public Health and the Regional Water Quality Control Board. In order to complete part of the report, Oxnard will inject potable water for three months to monitor and document residence times and the movement of the injected water, and to determine backwashing requirements to maintain well production capacity. The well is essential to pursuing indirect potable reuse but will serve an important function for recycled water storage while the permitting is in progress.

<u>Description of Any Potential Adverse Physical Effects</u>

No significant potential adverse physical effects from injecting recycled water into or extracting it from the ASR well are anticipated (Bureau of Reclamation 2009, p.1; CH2MHill, 2004, Appendix A p.A-1 and A-27 - A-29).

Summary of Benefit

By storing 1,500 AFY of recycled water during the winter in the ASR well for use in the summer, Oxnard reduces its need to pump groundwater or import water during summer months by 1,500 AFY, as shown in Table 3-28. Once the permitting is completed for indirect potable reuse, then the well will enable the delivery of 1,500 AFY of potable water supply via indirect potable reuse instead.

Table 3-28 – Annual Project Physical Benefits

Project Name: Groundwater Replenishment and Reuse Project

Type of Benefit Claimed: Increases water supply by 1,500 AFY through the storage and use of recycled water

Units of the Benefit Claimed: Acre-feet

Additional Information About this Benefit: In the early years, the 1,500 AF will be used for agricultural irrigation, landscape irrigation, and industrial processes. In later years, the 1,500 AF will be delivered to the potable water system via indirect potable reuse.

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	500	500
2016	0	1500	1500
2017	0	1500	1500
…….	0	1500	1500
2043	0	1500	1500
Last Year of the Project 2044	0	1500	1500

Comments: The ASR well has a project lifetime of 30 years, from 2015 to 2044. In 2015, 500 AF are extracted because the well will be completed part way through the year.

Discussion of Non-Quantified Benefits

Greater AWPF Operational Efficiency

By providing storage for water produced by the AWPF, the ASR well allows the AWPF to operate the entire year, resulting in greater operating efficiency and lower marginal costs for the production of recycled water. Currently, Oxnard does not have storage facilities for the recycled water that the AWPF produces. Due to the seasonal variation in demand for recycled water, it is not possible to deliver water year-round. Oxnard's ASR well will provide the necessary storage so that the AWPF can operate the entire year (rather than suspending production when recycled water demand is low) resulting in lower marginal costs for producing recycled water.

Facilitation of Indirect Potable Reuse

The Groundwater Replenishment and Reuse Project serves as a key building block for implementation of indirect potable reuse. In particular, Oxnard needs to submit an engineering report in compliance with Title 22 of the California Code of Regulations to the California Department of Public Health and the Regional Water Quality Control Board to proceed with indirect potable reuse. In order to complete part of the report, Oxnard needs this ASR well to inject potable water for three months to monitor and document residence times and the movement of the injected water and to determine backwashing requirements to maintain production capacity. Because the AWPF will have a maximum production of 28,000 AFY, indirect potable reuse could make up a large percentage of Oxnard's water supply in the future. If Oxnard can use indirect potable reuse for much of its water supply, Oxnard could drastically reduce its need to obtain water from overdrafted groundwater and limited imported supplies.

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. The alternative considered is creating a recharge basin to percolate the recycled water produced by AWPF into the groundwater. Answers to cost-effectiveness analysis questions are presented in summary form in Table 3-29 below, with narrative description provided below.

There are capital and annual costs associated with the Groundwater Replenishment and Reuse Project. The capital cost to construct the ASR well and other facilities is approximately $1.7 million; the capital cost in present value 2014 dollars is also about $1.7 million. The annual cost, which includes a cost of $1,400 per AF (GreenSource Inc. 2014, p.5) for producing the recycled water that is injected into the ASR well, is approximately $62.7 million. In present value, the annual cost is about $28.1 million. The total cost for the project is approximately $64.4 million; in present value terms, the total cost is approximately $29.7 million. These costs are shown in Table 3-30.

As an alternative, Oxnard could instead construct a recharge basin to percolate the recycled water produced by the AWPF into the groundwater. The recycled water would be placed into the recharge basin when agriculture, landscaping, and industrial users do not have sufficient demands to use all the water produced by the AWPF during the winter months. When there is higher demand (during the summer months), Oxnard could pump the water from the aquifer and deliver it to agriculture, landscaping, and industrial users. However, the recharge basin would not provide a mechanism to extract the recycled water from the groundwater; a well would still be needed.

The capital costs to construct a recharge basin is estimated to be approximately $2.2 million (Kennedy/Jenks Consultants, 2014), or about $2.1 million in present value. The annual operating costs for the 2015 to 2044 period total approximately $63.0 million (Kennedy/Jenks Consultants, 2014), or $28.2 million in present value. The total cost of this alternative is approximately $65.2 million; in present value terms, the total cost is approximately $30.3 million. These costs are shown in Table 3-31.

In addition to being a more expensive alternative, the recharge basin would not facilitate the implementation of indirect potable reuse, nor provide a means to access the recharged recycled water.

<table>
<tr><th colspan="2">Table 3-29 – Cost Effectiveness Analysis
Project name: Groundwater Replenishment and Reuse Project</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Table 3-28.
Increases water supply by 1,500 AFY through the storage and later use of recycled water</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
Yes</td></tr>
<tr><td>If no, why?
Not applicable.</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.

The Groundwater Replenishment and Reuse Project has a total present value cost of $29.7 million. Alternative methods to achieve similar benefits include:
Recharge Basin – Present value cost totaling $30.3 million
The project was determined to be the least cost alternative and provides significant additional benefits.</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative?
Not applicable.</td></tr>
</table>

Summary

The physical benefits claimed for this project include increasing Oxnard's water supply by 1,500 AFY through the storage and later use of recycled water. Non-quantified, but valuable, benefits of the project are allowing more cost effective operation of the AWPF and facilitating indirect potable reuse. The alternative presented in the cost-effectiveness analysis was constructing a recharge basin to percolate the recycled water produced by AWPF into the groundwater. The project was determined to be the more cost effective alternative and provides additional benefits.

Table 3-30 – Annual Costs of Project (All costs in 2014 Dollars) Project: Groundwater Replenishment and Reuse Project										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[(1)]	Annual Costs [(2)]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014	256,429							256,429	1.000	256,429
2015	1,472,211		10,800	710,000				2,193,011	0.943	2,068,010
2016	17,160		10,800	2,110,000				2,137,960	0.890	1,902,784
2017			10,800	2,110,000				2,120,800	0.840	1,781,472
2018			10,800	2,110,000				2,120,800	0.792	1,679,674
2019			10,800	2,110,000				2,120,800	0.747	1,584,238
2020			10,800	2,110,000				2,120,800	0.705	1,495,164
2021			10,800	2,110,000				2,120,800	0.665	1,410,332
2022			10,800	2,110,000	150,000			2,270,800	0.627	1,423,792
2023			10,800	2,110,000				2,120,800	0.592	1,255,514
2024			10,800	2,110,000				2,120,800	0.558	1,183,406
2025			10,800	2,110,000				2,120,800	0.527	1,117,662
2026			10,800	2,110,000				2,120,800	0.497	1,054,038
2027			10,800	2,110,000				2,120,800	0.469	994,655
2028			10,800	2,110,000				2,120,800	0.442	937,394
2029			10,800	2,110,000				2,270,800	0.417	884,374
2030			10,800	2,110,000	150,000			2,120,800	0.394	894,695
2031			10,800	2,110,000				2,120,800	0.371	786,817
2032			10,800	2,110,000				2,120,800	0.350	742,280
2033			10,800	2,110,000				2,120,800	0.331	701,985
2034			10,800	2,110,000				2,120,800	0.312	661,690
2035			10,800	2,110,000				2,120,800	0.294	623,515

Table 3-30 – Annual Costs of Project
(All costs in 2014 Dollars)
Project: Groundwater Replenishment and Reuse Project

	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2036			10,800	2,110,000				2,270,800	0.278	589,582
2037			10,800	2,110,000				2,120,800	0.262	555,650
2038			10,800	2,110,000	150,000			2,120,800	0.247	560,888
2039			10,800	2,110,000				2,120,800	0.233	494,146
2040			10,800	2,110,000				2,120,800	0.220	466,576
2041			10,800	2,110,000				2,120,800	0.207	439,006
2042			10,800	2,110,000				2,120,800	0.196	415,677
2043			10,800	2,110,000				2,120,800	0.185	392,348
2044			10,800	2,110,000				2,120,800	0.174	369,019
Total Present Value of Discounted Costs (Sum of column (j)										$ 29,722,808
Comments: Assumes cost to produce recycled water at AWPF is $1,400 per AF.										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-31 – Annual Costs of Project Alternative 1 - Recharge Basin (All costs in 2014 Dollars) Project: Groundwater Replenishment and Reuse Project										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	
2015	2,233,500			747,000				2,980,500	0.943	2,810,612
2016				2,147,000				2,147,000	0.890	1,910,830
2017				2,147,000				2,147,000	0.840	1,803,480
2018				2,147,000				2,147,000	0.792	1,700,424
2019				2,147,000				2,147,000	0.747	1,603,809
2020				2,147,000				2,147,000	0.705	1,513,635
2021				2,147,000				2,147,000	0.665	1,427,755
2022				2,147,000				2,147,000	0.627	1,346,169
2023				2,147,000				2,147,000	0.592	1,271,024
2024				2,147,000				2,147,000	0.558	1,198,026
2025				2,147,000				2,147,000	0.527	1,131,469
2026				2,147,000				2,147,000	0.497	1,067,059
2027				2,147,000				2,147,000	0.469	1,006,943
2028				2,147,000				2,147,000	0.442	948,974
2029				2,147,000				2,147,000	0.417	895,299
2030				2,147,000				2,147,000	0.394	845,918
2031				2,147,000				2,147,000	0.371	796,537
2032				2,147,000				2,147,000	0.350	751,450
2033				2,147,000				2,147,000	0.331	710,657
2034				2,147,000				2,147,000	0.312	669,864

Table 3-31 – Annual Costs of Project Alternative 1 - Recharge Basin
(All costs in 2014 Dollars)
Project: Groundwater Replenishment and Reuse Project

	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2035				2,147,000				2,147,000	0.294	631,218
2036				2,147,000				2,147,000	0.278	596,866
2037				2,147,000				2,147,000	0.262	562,514
2038				2,147,000				2,147,000	0.247	530,309
2039				2,147,000				2,147,000	0.233	500,251
2040				2,147,000				2,147,000	0.220	472,340
2041				2,147,000				2,147,000	0.207	444,429
2042				2,147,000				2,147,000	0.196	420,812
2043				2,147,000				2,147,000	0.185	397,195
2044				2,147,000				2,147,000	0.174	373,578
Total Present Value of Discounted Costs (Sum of column (j)										$ 30,339,446
Comments: Assumes cost to produce recycled water at AWPF is $1,400 per AF.										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

References

These references are provided as Att3_DG_ProJust_4of5.zip. The pdf file is bookmarked so that all references can be easily located.

1. Bureau of Reclamation. 2009. National Environmental Policy Act: Finding of No Significant Impact, Groundwater Recovery Enhancement and Treatment Program. December 8.
2. CH2MHill. 2004. Groundwater Recovery Enhancement and Treatment (GREAT) Program Final Program Environmental Impact Report, SCH # 2003011045, Appendix A Mitigation Monitoring and Reporting Plan. Prepared for City of Oxnard. May.
3. Fox Canyon Groundwater Management Agency (Fox Canyon GMA). 2014. Emergency Ordinance – E: An Emergency Ordinance Limiting Extractions from Groundwater Extraction Facilities, Suspending Use of Credits and Prohibiting Construction of Any Groundwater Extraction Facility and/or the Issuance of Any Permit Therefor. April 11.
4. Fox Canyon Groundwater Management Agency (Fox Canyon GMA). 2013a. Annual Basin Management Objectives Report.
5. Fox Canyon Groundwater Management Agency. 2013b. Resolution No. 2013-02 of the Fox Canyon Groundwater Management Agency: A Resolution Concerning the Implementation of First Phase of the City of Oxnard's Great Program and the Associated Recycled Water Management Plan. June 26.
6. GreenSource Inc. 2014. White Paper Prepared for Carollo Engineers on: Water Use From The Advanced Water Purification Facility in Agricultural Operations on the Oxnard Plain. June.
7. Hopkins Groundwater Consultants, Inc. 2014. Preliminary Assessment of Groundwater Mounding Benefit From GREAT Program ASR Storage. June 12.
8. Kennedy/Jenks Consultants. 2012. City of Oxnard 2010 Urban Water Management Plan. May 2012.
9. Kennedy/Jenks Consultants. 2014. Engineer's Estimate of Costs of Recharge Basin as Alternative to Oxnard ASR Well. Provided by Meredith Clement. June 19.
10. United Water Conservation District (United). 2014. Groundwater and Surface Water Conditions Report – 2013. May.

LAKE CASITAS AERATION

This project is being implemented by the Casitas Municipal Water District (Casitas).

PROJECT DESCRIPTION

Installation of an oxygenation system in Lake Casitas to improve water quality and ensure reliable potable water supply deliveries to western Ventura County.

PROJECT MAP

A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

Lake Casitas supplies water to 70,000 people and 56,000 acres of agriculture in western Ventura County. In addition to meeting demands during all conditions for many users, it also serves as the primary backup water supply for many others during dry conditions as local groundwater supplies diminish. Declining lake levels and increasing water quality impairments are threatening Lake Casitas. A lack of surface water inflows due to dry weather and increased demands have caused the lake to drop to nearly historic lows resulting in anoxic conditions and related water quality issues, including elevated manganese and algae blooms. Current treatment systems are not designed to handle declining lake water quality and may result in Casitas not meeting drinking water standards. Under such circumstances, drinking water delivery could be interrupted. Impaired water quality is also impacting the ecosystem of the lake and rendering the lake less suitable for aquatic life.

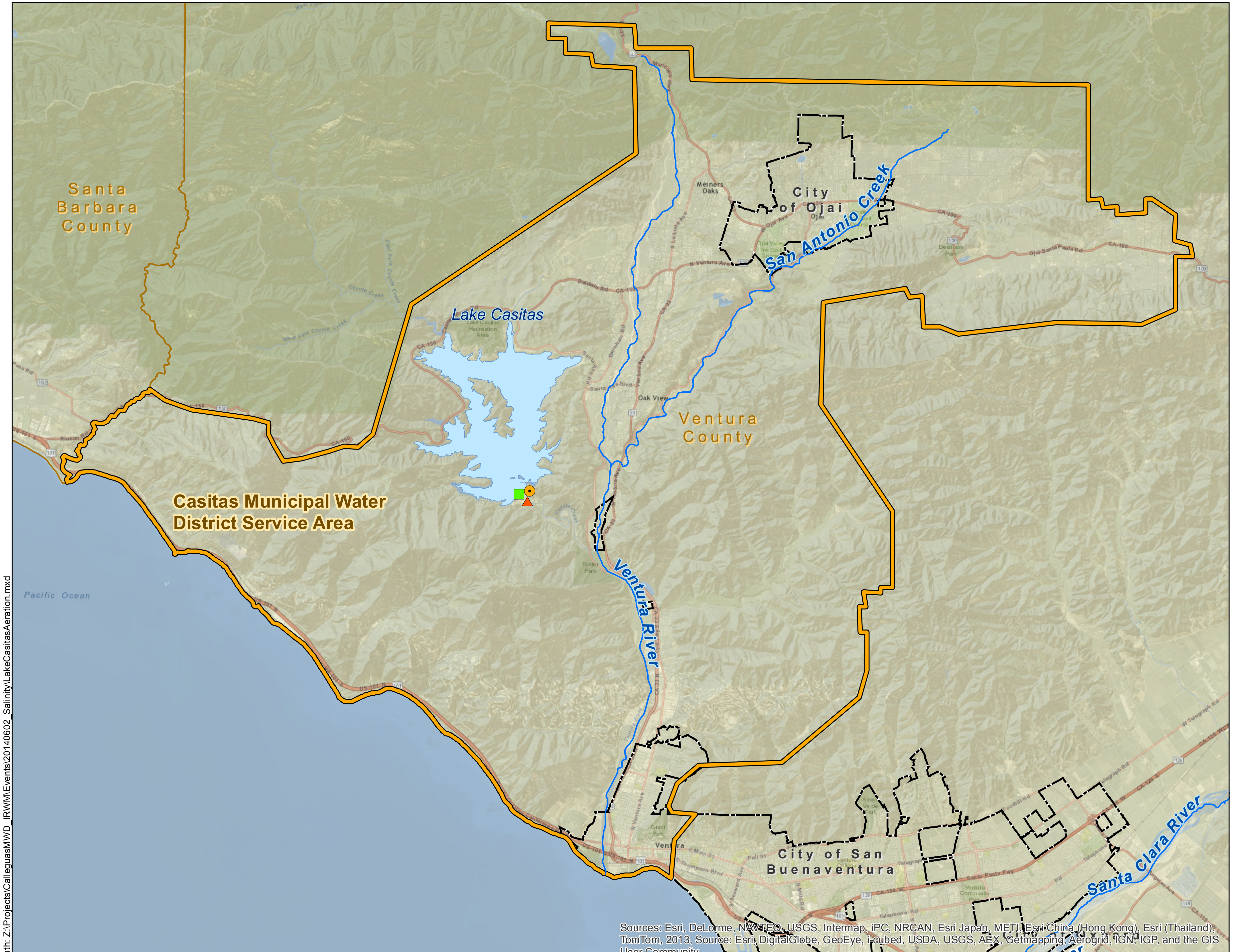
This project will install a hypolimnetic oxygenation system to prevent anoxic conditions. This project is critical to ensuring the reliability of Lake Casitas supplies by addressing water quality conditions that are posing threats to reliable delivery. Water quality improvements will augment fish and ecosystem habitat as well as enhance recreational use of the lake.

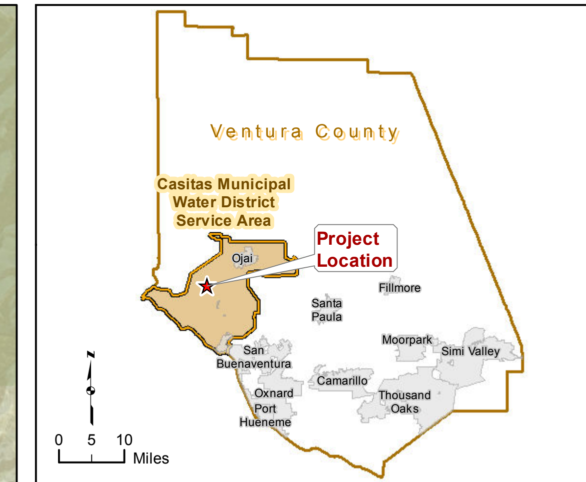
The project will provide immediate regional drought preparedness. Lake Casitas serves as the primary supply for many users in western Ventura County as well as the drought backup supply for additional users when their wells run dry. By improving lake water quality during dry conditions, the project will maintain reliable delivery of these supplies and provide critical drought preparedness for western Ventura County.

The project will increase local water supply reliability and the delivery of safe drinking water. Ongoing drought conditions and resulting low lake water levels will increasingly degrade lake water quality, thereby threatening Casitas' ability to deliver water of suitable quality. By improving water quality conditions in Lake Casitas, this project will help prevent disruption of potable water supplies in the short- and long-term.

The project will reduce water quality conflicts or ecosystem conflicts created by the drought. Lake Casitas delivers water to municipal and agricultural users and serves as a fishery habitat and a recreational resource. Drought conditions are threatening all users and competition among users will increase as the volume of the lake and water quality decline. By improving lake water quality, this project will enable lake water to continue to meet diverse needs, thereby minimizing potential conflict among users.

Expedited funding is needed. There is an immediate need to protect Lake Casitas supplies. Lake levels are expected to drop below 50% under ongoing drought conditions and, without the project, the quality of the water will decline to the point where the current water treatment plant will be insufficient to meet drinking water standards, and the lake fishery may collapse.





Legend

- Diffuser Location
- Oxygen Supply Facility
- Monitoring Location
- Casitas Municipal Water District Service Area
- Cities

N

0 4,500 9,000

Feet

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

Lake Casitas Aeration

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWM\Events\20140602_Salinity\LakeCasitasAeration.mxd

PROJECT PHYSICAL BENEFITS

The following quantifiable physical benefits are expected from this project:

- Additional 64,000 AF of hypolimnion[22] with greater than 1 mg/L of dissolved oxygen (elimination of anoxic conditions)
- 200 µg/L reduction in manganese in Lake Casitas water
- Secchi Disk depth increase of 0-4 feet

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of this project:

- Improved drinking water reliability
- Reduction in usage of chlorine for drinking water treatment
- Reduction in nutrient loading
- Reduction in methyl mercurization in fish

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Additional 64,000 AF of Lake Hypolimnion with Greater Than 1 mg/L of Dissolved Oxygen

Lake Casitas Aeration will reduce the amount of water in Lake Casitas under anoxic conditions (less than 1 mg/L of dissolved oxygen) from 65,000 AF to less than 1,000 AF.

<u>Technical Basis of the Project</u>

Lake Casitas is a deep-level lake, over 200 feet deep, that requires a more complex aeration system than shallow reservoirs. The current Lake Casitas aeration system, installed in 2005, doesn't address deeper hypolimnotic levels of the lake. Anoxic conditions in these layers create a variety of water quality issues involving iron, manganese, internal nutrient cycling, and algae blooms, and this either makes treatment more difficult and costly or prevents adequate treatment of the water entirely. The aeration system will oxygenate these lower levels of the lake that are currently more susceptible to water quality issues. The situation is complicated by the fact that the upper levels of the lake, particularly in warm weather, are prone to blue-green algae blooms.

Recent drought conditions will reduce Lake Casitas water levels to below 50% of full capacity for the first time since 1968, a period with significant thermal stratification and a large anoxic hypolimnion in the lake. Another dry year would likely reduce Lake Casitas to below 40% of full capacity. Under normal conditions, the intake ports providing water to the water treatment plant are selected to minimize the chance of pulling in the top layer of the lake (prone to algae blooms) and the lowest anoxic layers, which tend to be high in manganese. However, as the lake level drops, there may not be a lake layer that meets these criteria. The Casitas treatment plant is approaching a point where it may not be able to treat and deliver

[22] The hypolimnion is the dense, bottom layer of water in a thermally-stratified lake. Typically, warmer less dense water is found at the surface. Separation of the lake into these two layers is known as stratification. When the layers mix or turn over, the lake becomes destratified.

water that meets primary and secondary drinking water standards due to degraded water quality. Lake Casitas Aeration will prevent anoxic conditions and provide suitable influent water quality for the treatment plant to meet drinking water standards (WQS 2013, p.7).

Thermal stratification in Lake Casitas can also create an environment that is detrimental to fish. Ideal trout habitat can be defined by water that is less than 20˚C (68˚F) and has dissolved oxygen (DO) levels greater than 4 mg/L (Fast 1993, p.14). Lower DO levels can result in acute fish mortality, and higher temperatures present unsuitable habitat, especially during the spawning stage (SWRCB 2004, p.4-5). According to data from August to October 2013, conditions supporting fish in terms of both temperature and DO level could not be found at the sample station near the intake structure where the maximum depth is found. The water at the surface had acceptable DO levels, but the temperature was greater than 68˚F. In the deeper water, the temperature met the criteria, but the DO levels were below 4 mg/L. While acute fish mortality has not yet been observed, Lake Casitas expects fish deaths if drought conditions persist and no aeration system is installed.

Recent and Historical Conditions

Lake Casitas is a significant potable water supply source for the City of Ventura in addition to serving the majority of the residents of the City of Ojai. Interruption during drought periods is a problem for agricultural customers who maintain roughly 56,000 planted acres. Since orchards comprise approximately 95% of this area, recovery from a lack of adequate water supply due to drought could take as long as five years. Additionally, as discussed in Attachment 2, as wells in the Ventura River Basin have run dry, more users who ordinarily rely upon groundwater have become increasingly dependent on water from Lake Casitas.

Over the past three years, there has been a significant increase in anoxic conditions in Lake Casitas. Dry conditions brought by recent drought have also caused the lake to become stratified earlier than usual, which disrupts natural oxygen cycling to the middle portions of the lake. The DO concentration has been dropping at a rate of approximately 2 mg/L per year, as measured during the same time of year near the Lake Casitas dam. The DO concentration was 6 mg/L during May 2012, 4 mg/L in May 2013, and 2 mg/L on May 7, 2014. The DO level started from a lower base in 2014 because the lake did not stay destratified for long enough, and the DO level was close to zero in the hypolimnion as of June 2014 (personal communication S. McMahon, Casitas Municipal Water District, June 2014).

Estimates of Without Project Conditions

Without a deep water aeration system, 64,000 AF in Lake Casitas would continue to have DO levels of less than one percent. There would continue to be water supply reliability and fish habitat issues due to water quality conditions arising from lack of dissolved oxygen in the hypolimnion.

Descriptions of Methods Used to Estimate Physical Benefits

The most recent data in a 2013 water quality study of Lake Casitas estimates the size of the anoxic zone (volume with DO less than 1 mg/L) at 65,000 AF (FSI 2013, p.9). Since the aeration system will be placed at the bottom of the lake, it will aerate nearly all of the hypolimnion. Since the system will not oxygenate exactly 100% of the anoxic layer, it is assumed that approximately 1,000 AF of the lake will still exhibit anoxic conditions.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No new facilities, policies, or actions are required to obtain physical benefits.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects are anticipated as a result of this project.

Summary of Benefit

The deep water aeration system will reduce the amount of water with a DO concentration of less than 1 mg/L from 65,000 AF to less than 1,000 AF, a reduction of approximately 64,000 AF (see Table 3-32). The increased DO concentrations will improve water quality and allow the water treatment plant to draw from multiple intake ports. This improved flexibility will yield a more reliable supply of potable water for the cities of Ventura and Ojai and the other customers of Casitas Municipal Water District.

Table 3-32 – Annual Project Physical Benefits			
Project Name: Lake Casitas Aeration			
Type of Benefit Claimed: Decrease in Lake Hypolimnion with < 1 mg/L of Dissolved Oxygen			
Units of the Benefit Claimed: Acre-Feet			
Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	65,000	65,000	0
2015	65,000	65,000	0
2016	65,000	< 1,000	64,000
...	65,000	< 1,000	64,000
2025 (Last Year of Project Life)	65,000	< 1,000	64,000
Comments:			

Benefit: 200 µg/L Reduction in Manganese in Lake Casitas Water

Lake Casitas Aeration will improve water quality in Lake Casitas by reducing manganese concentrations from more than 250 µg/L to less than 50 µg/L.

Technical Basis of the Project

One of the primary water quality concerns associated with low DO concentrations in Lake Casitas is manganese, which can cause color, taste, and staining problems. Anoxic conditions facilitate the conversion of manganese from insoluble particulate oxide forms in bottom sediments into soluble manganese ions through bacterial action (FSI 2013, p.14). This is shown in 2006-2011 DO measurements taken at the bottom of the lake and manganese measurements from multiple intake ports (FSI 2013, Appendix A Figures A.1 & A.3). The increases in manganese levels taken at intake ports in the hypolimnion coincide with low annual DO levels at the bottom of Lake Casitas, demonstrating the contribution of sediment release to soluble manganese in the lake.

Additionally, a study of an aeration system installed in 2002 in the Upper San Leandro Reservoir showed that increased DO levels from oxygenation are associated with reduced manganese levels in addition to other water quality benefits (Mobley et al. 2003, p.4).

Recent and Historical Conditions

Reductions in water levels due to drought conditions have expanded anoxic conditions in Lake Casitas. This spread of water with low DO concentrations and corresponding higher manganese concentrations at higher elevations in the water column have created water quality issues at more of the water treatment plant intake ports. Current measurements have indicated manganese levels greater than 250 µg/L, which exceeds the secondary standard established by California drinking water regulations of 50 µg/L (CDPH 2014, p.146). The treatment plant is not designed for manganese removal and therefore drinking water standards could be exceeded.

Estimates of Without Project Conditions

Without a new deep water oxygenation system, water with low DO concentrations and higher manganese concentrations would continue to permeate higher levels of the water column presenting water quality issues at more treatment intake ports. If low lake levels persist, and the project is not implemented, Lake Casitas would have manganese concentrations in excess of limits established by the California Department of Public Health.

Descriptions of Methods Used to Estimate Physical Benefits

Recent data has shown manganese level spikes in excess of 250 µg/L during periods of high anoxic conditions in Lake Casitas (FSI, 2013 Appendix A Figure A.3). Installation of a deep water aeration system will help restore DO at intake ports to levels associated with pre-spike manganese concentrations, often below 50 µg/L. The project has been designed to achieve water quality standards and will target a decrease in manganese of at least 200 µg/L, the minimum needed (250 µg/L – 50 µg/L).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No new facilities, policies, or actions are required to obtain physical benefits.

Description of Any Potential Adverse Physical Effects

There are no potential adverse physical effects as a result of this project.

Summary of Benefit

Lake Casitas Aeration will reduce manganese levels by at least 200 µg/L during highly anoxic periods (see Table 3-33). This will reduce water quality issues associated with taste, color, and staining and enable Casitas to reliably deliver water that meets drinking water standards.

Table 3-33 – Annual Project Physical Benefits

Project Name: Lake Casitas Aeration

Type of Benefit Claimed: Decrease in Manganese Concentration

Units of the Benefit Claimed: micrograms of manganese per liter of water

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	> 250	> 250	0
2015	> 250	> 250	0
2016	> 250	< 50	200
…	> 250	< 50	200
2025 (Last Year of Project Life)	> 250	< 50	200
Comments:			

Benefit: Secchi Disk Depth Increase of 0-4 Feet

Lake Casitas Aeration will decrease the size and frequency of algal blooms, which will increase surface and near-surface water quality conditions, such that Secchi Disks will be visible an additional 0-4 feet below current April to November levels.

Technical Basis of the Project

Secchi Disks are inexpensive, commonly used black and white pattered disks lowered by hand to measure surface water transparency (i.e., lack of turbidity). The measured depth is simply the point at which the user can no longer see the disk. Deeper Secchi measurements are therefore indicative of better surface water conditions.

Lake Casitas algal blooms typically occur in the spring and, to a lesser extent, the fall, causing taste and odor issues for domestic water supply. While spring blooms are typically heavier, fall blooms present more difficulty since treatment plants are forced to take water from intake ports closer to the surface where algal blooms cause water quality issues. A deep water aeration system will allow the treatment plant to avoid taking water with taste and odor concerns by utilizing intake ports deeper in the lake.

A hypolimnotic aeration system will also help prevent the detrimental positive feedback loop between algal blooms and anoxic conditions lower in the lake. Bacterial decay from algal blooms consumes oxygen, and therefore increases anoxic conditions which in turn produce larger and more frequent algal blooms. Additionally, algal blooms and turbidity near the surface of Lake Casitas pose a threat to surface fish habitat.

Recent and Historical Conditions

Algal blooms in Lake Casitas have worsened anoxic conditions in Lake Casitas over the past three years as drought has reduced lake levels. Measurements of Secchi depth from 2011 to 2013 show a fluctuation from 13 ft to as low as 6 ft during the algal growth season between April and November (FSI 2013, p.11). This trend is confirmed by measurements of surface particulate matter. *Chlorophyll a* concentrations increased by 13 µg/L between June 19, 2012 and August 7, 2012, from 3 µg/L to 16 µg/L (FSI 2013, p.11). The spread of water with decreased levels of DO has only increased the problems associated with more frequent and larger algal blooms. Water quality concerns associated with anoxic water have forced the treatment plant to take water closer to the surface where algal blooms create taste and odor issues. Data from 2003 shows that taste and odor complaints coincide with fall lake turnover or spring algae blooms with 2012 seeing the highest number of complaints in the past ten years. Additionally, using water closer to the surface causes issues with meeting effluent turbidity standards due to higher differential pressures in filters and the frequency of backwashing increasing as filters load up.

Despite the current aeration system improving thermal stratification by transporting deep water to the surface and vice-versa, this process also transfers surface algae to lower, more anoxic layers of the lake, thereby exacerbating the naturally occurring increase in algal blooms. The new aeration system will avoid this problem.

Estimates of Without Project Conditions

If the deep water aeration system is not installed, the water treatment plant would continue to take in water from surface or near-surface ports where algal blooms cause taste and odor issues. Algal blooms would worsen due to anoxic conditions by cycling bacterial decay and increasing anoxic conditions.

Descriptions of Methods Used to Estimate Physical Benefits

Estimates of Secchi Disk depth are based on disk depth data from 2011-2013 (FSI 2013, p.16). Secchi disks are the standard method for measuring turbidity in ponds, lakes, bays, estuaries, and oceans (Gregorio 2010, p.1).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No new facilities, policies, or actions are required to obtain physical benefits.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects are anticipated as a result of this project.

Summary of Benefit

The hypolimnotic aeration system will prevent the positive feedback system of algal blooms and improve lake surface water conditions. While there might be some variation in benefits between wet and dry years due to corresponding lake levels, wet years also correspond to increased organic matter that can foster algae growth. See Table 3-34.

Table 3-34 – Annual Project Physical Benefits			
Project Name: Lake Casitas Aeration			
Type of Benefit Claimed: Increase in Secchi Disk Depth (April to November)			
Units of the Benefit Claimed: Feet below surface			
Additional Information About this Benefit:			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	6	6	0
2015	6	6	0
2016	6	> 6	0-4
…	6	> 6	0-4
2025 (Last Year of Project Life)	6	> 6	0-4
Comments:			

Discussion of Non-Quantified Benefits

Improved Drinking Water Reliability

Lake Casitas supplies water to 70,000 people and 56,000 acres of agriculture in western Ventura County. In addition to meeting demands during all conditions for many users, it also serves as the primary backup water supply for many others during dry conditions as local groundwater supplies diminish. Declining lake levels and increasing water quality impairments are threatening Lake Casitas. A lack of surface water inflows due to dry weather and increased demands have caused the lake to drop to nearly historic lows resulting in anoxic conditions and related water quality issues including elevated manganese and algae blooms. Current treatment systems are not designed to handle declining lake water quality and may result in Casitas not meeting drinking water standards. Under such circumstances, drinking water delivery could be interrupted. By improving lake water quality during dry conditions, the project will maintain reliable delivery of these supplies and provide critical drought preparedness for western Ventura County.

Reduction in Usage of Chlorine for Drinking Water Treatment

The Lake Casitas treatment plant currently uses chlorine to treat for manganese and hydrogen sulfide, both of which increase when anoxic conditions are present in the lake. By increasing DO concentrations at lower levels of the lake, less chlorine will be required by the treatment plant to oxidize manganese and hydrogen sulfide. A similar hypolimnotic oxygenation system installed in the Upper San Leandro Reservoir in 2002 reduced chlorine use by 18% (Mobley et al. 2003, p.6).

Reduction in Nutrient Loading

In addition to increasing manganese and hydrogen sulfide concentrations, lower DO concentrations foster sediment release of nutrients, particularly nitrogen and phosphorus. Reducing anoxic conditions will therefore help to reduce nutrient loading during the stratification period.

Reduction in Methyl Mercurization in Fish

Lake Casitas was placed on the 303(d) list for mercury impairment based on fish tissue sampling (SWRCB 2010, webpage). While mercury occurs in the hydrological cycle naturally, anoxic conditions stimulate methylation in fish and eventually bioaccumulation of mercury in the food chain. By increasing DO levels, the hypolimnotic aeration system will reduce mercury levels in fish tissue.

Cost Effectiveness Analysis

This section presents a cost-effectiveness analysis comparing relevant alternatives to the project. Lake Casitas Aeration will use a Dissolved Oxygen System (DOS), which is comprised of soaker hoses placed in the hypolimnion that deliver oxygen bubbles to the water. Air for the system will be supplied from a tank placed on land (in this case on the downstream side of Casitas Dam). There are other methods to oxygenate the lake; the two alternatives considered are a Speece Cone and a SDOX® system. Answers to the cost effectiveness questions are presented in summary form in Table 3-35 below with narrative description for each alternative provided below.

The capital costs for the DOS are $1.47 million. Operations and maintenance costs are estimated to be $182,580 per year. As is shown in Table 3-36, the present value of combined capital and O&M costs over the expected 10-year life of the project totals $2.65 million in 2014 dollars.

One alternative that was investigated is installation of a Speece Cone, which mixes hypolimnotic water with oxygen in a pressurized chamber. The resulting super-saturated water is then pumped back out into the reservoir. Speece Cones need to be installed towards the bottom of the lake making them more suitable for shallow reservoirs and infeasible for Lake Casitas due to the technical challenges of supplying adequate energy and performing maintenance on a system deep underwater. The Speece Cone was eliminated for technical reasons, and therefore costs for the Speece Cone alternative are not provided here.

Another alternative to the hypolimnotic aeration system is an SDOX® system, which is similar to a Speece Cone in that it mixes water and oxygen in a highly pressurized chamber. Unlike the Speece Cone, water is pumped from the lake to the SDOX® chamber which is placed on land or on a barge, and then the supersaturated water is returned to the lake. SDOX® systems require a large amount of energy, and therefore incur high operating costs. Additionally, the system would need to be placed on a barge to deal with varying water levels at Lake Casitas, which greatly adds to maintenance costs. SDOX® would not aerate the same volume of the hypolimnion as the DOS; DOS diffuser lines are closer to the sediment and would cover a larger area. Therefore, SDOX® would not provide the same level of oxygenation benefits, nor the same reduction in nutrient release from sediments, despite being more expensive. Nonetheless, costs for the SDOX® system are shown here for comparative purposes. Capital costs for the alternative total $2.8 million, and annual operations and maintenance costs are estimated to be $194,500. As in shown in Table 3-37, the present value of capital and O&M costs for the SDOX® system total $4.0 million in 2014 dollars.

<table>
<tr><th colspan="2">Table 3-35 – Cost Effectiveness Analysis
Project name: Lake Casitas Aeration Project</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Tables 3-32, 3-33, and 3-34:
• Additional 64,000 AF of hypolimnion with greater than 1 mg/L of dissolved oxygen
• 200 µg/L reduction in manganese levels
• Increase in Secchi Disk depth measurement of 0-4 feet</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
• Yes</td></tr>
<tr><td>If no, why?
• Not Applicable</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.

Lake Casitas Aeration has a total present value cost of $2.65 million. Alternative methods to achieve similar benefits include:
• Speece Cone - No cost estimate due to infeasibility
• SDOX system – Present value cost totaling $4.0 million
The project was determined to be the least cost alternative, and provides significant additional benefits.</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
• Not applicable</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

Table 3-36 – Annual Costs of Project (All costs in 2014 Dollars) Project: Lake Casitas Aeration										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	0
2015	1,465,106							1,465,106	0.943	1,382,175
2016				182,580				182,580	0.890	162,496
2017				182,580				182,580	0.840	153,298
2018				182,580				182,580	0.792	144,620
2019				182,580				182,580	0.747	136,434
2020				182,580				182,580	0.705	128,712
2021				182,580				182,580	0.665	121,426
2022				182,580				182,580	0.627	114,553
2023				182,580				182,580	0.592	108,069
2024				182,580				182,580	0.558	101,952
2025 (Last Year of Project Life)				182,580				182,580	0.527	96,181
Total Present Value of Discounted Costs (Sum of column (j))										$ 2,649,916
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 3-37 – Annual Costs of Project Alternative - SDOX System
(All costs in 2014 Dollars)

Project: Lake Casitas Aeration

	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014									1.000	0
2015	2,769,000							2,769,000	0.943	2,612,264
2016				194,500				194,500	0.890	173,104
2017				194,500				194,500	0.840	163,306
2018				194,500				194,500	0.792	154,062
2019				194,500				194,500	0.747	145,342
2020				194,500				194,500	0.705	137,115
2021				194,500				194,500	0.665	129,354
2022				194,500				194,500	0.627	122,032
2023				194,500				194,500	0.592	115,124
2024				194,500				194,500	0.558	108,608
2025 (Last Year of Project Life)				194,500				194,500	0.527	102,460
Total Present Value of Discounted Costs (Sum of column (j))										$ 3,962,771
Comments: SDOX System										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Summary

The physical benefits claimed for this project include an additional 64,000 AF of hypolimnion with DO concentrations greater than 1 mg/L, a 200 µg/L reduction in manganese concentrations, and an increase in Secchi Disk depth of 0-4 feet between April and November. Non-quantified benefits include improved drinking water reliability, reduction in usage of chlorine for drinking water treatment, reduction in nutrient loading, and reduction in methyl mercurization in fish. The alternatives presented in the cost-effectiveness analysis were a Speece Cone and SDOX® system. A Speece Cone system was deemed infeasible due to the depth of Lake Casitas, and the DOS system is more cost-effective than an SDOX® system, and provides a greater level of benefits.

References

These references are provided as Att3_DG_ProJust_4of5.zip. The pdf file is bookmarked so that all references can be easily located.

1. California Department of Public Health (CDPH). 2014. California Regulations Related to Drinking Water. California Department of Public Health. July.
2. Fast, Arlo W. 1993. Distributions of Rainbow Trout, Largemouth Bass and Threadfin Shad in Lake Casitas, California, With Artificial Aeration. *California Fish and Game 79(1):13-27.*
3. FSI, 2013. Lake Casitas Water Quality Study. Flow Science Incorporated. Prepared for Casitas Municipal Water District. March.
4. Gregorio, Dominic, 2010. Standard Operating Procedure 3.1.5.1. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment. State Water Resources Control Board. March.
5. Mobley M., R. Jung, and H. Hubert Lai. 2003. Upper San Leandro Hypolimnetic Oxygenation System. NALMS. November.
6. State Water Resources Control Board (SWRCB). 2004. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment. State Water Resources Control Board. September.
7. State Water Resources Control Board (SWRCB). 2010. Final California 010 Integrated Report (303(d) List/305(b) Report). http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/02516.shtml. Accessed June, 2014.
8. WQS, 2013. Feasibility Study of a Hypolimnetic Oxygenation System for Lake Casitas. Water Quality Solutions. Performed for Casitas Municipal Water District. September.

SAN ANTONIO CREEK ARUNDO REMOVAL

This project is being implemented by the Ojai Valley Land Conservancy.

PROJECT DESCRIPTION

Arundo will be removed from the last 5 miles of San Antonio Creek and be followed by 10 acres of revegetation with native species.

PROJECT MAP

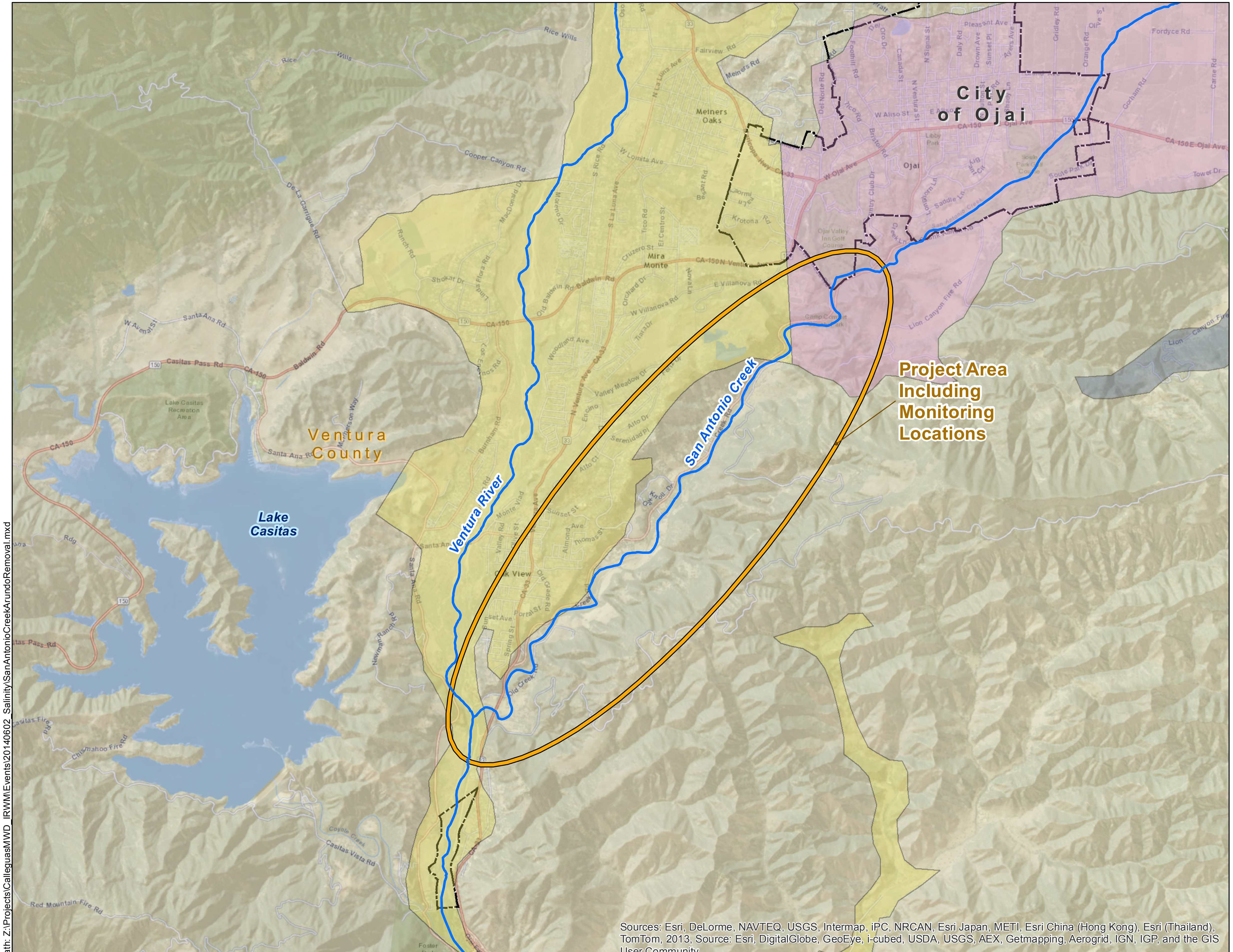
A project map is provided on the following page. The project is also shown on the regional map, *WCVC 2014 IRWMP Drought Grant Projects,* provided on page 3-3.

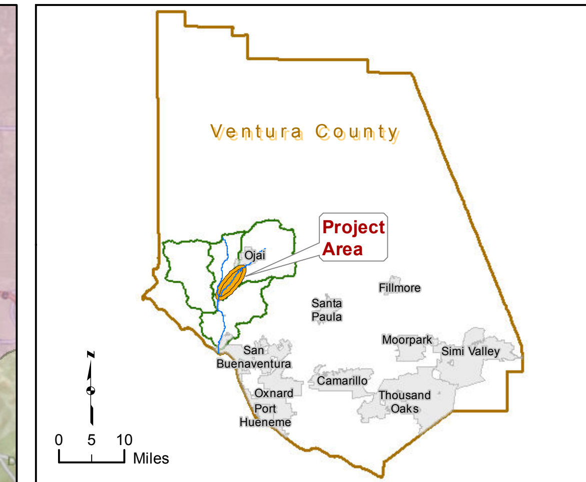
HOW THE PROJECT ALLEVIATES DROUGHT IMPACTS

Increase local water supply reliability and the delivery of safe drinking water. The ongoing drought in the Ventura River Watershed has stressed local wells, including those located in the bed of the Ventura River downstream of the San Antonio Creek confluence that provide water for the City of Ventura. These wells are primed by flow in the Ventura River. Drought has caused well levels to drop substantially. The City of Ventura is only getting 30% of its normal supply from its Ventura River wells and is purchasing larger amounts of Casitas water. Lake Casitas is expected to drop below 50% capacity this fall and would be the primary source for much of the Ventura River Watershed if groundwater supplies continue to decline due to drought. In this event, the rate at which stored water is being used would increase substantially. The project will leave an additional 320 AFY currently being used by invasive arundo in the Ventura River, increase the reliability of wells in the Ventura River, and reduce the need to draw from the limited amount of water stored in Lake Casitas.

The project will reduce water quality conflicts or ecosystem conflicts created by the drought. Drought has had substantial impacts on endangered steelhead in the Ventura River Watershed and in San Antonio Creek specifically. Low flows in the streams make it more difficult for fish to migrate to spawning grounds and survive long, hot summers. Low water volume is also associated with higher water temperatures and lower dissolved oxygen concentrations. Since the start of the drought, surveys of steelhead spawning showed the lowest nest counts since monitoring efforts by California Department of Fish and Wildlife began in 2010. Allowing more water to remain in the stream rather than losing it to invasive arundo will improve fish migration abilities and thermal buffers and increase the rearing capacity throughout the project reach and downstream. The additional water created by the project will reduce ecosystem and water quality conflicts.

Expedited funding is needed. Municipal and ecosystem water demands are already not being met from the Ventura River. Ecosystem resources, particularly endangered steelhead, may be lost if immediate action is not taken to reduce unnecessary loss of water to invasive arundo.





Legend

- Ventura River and San Antonio Creek
- Project Area Including Monitoring Locations

B118 Groundwater Basins

- OJAI VALLEY
- UPPER OJAI VALLEY
- VENTURA RIVER VALLEY
- Cities

N

0 2,000 4,000
Feet

Kennedy/Jenks Consultants

Watersheds Coalition of Ventura County
2014 IRWMP Drought Solicitation
Ventura County, California

San Antonio Creek
Arundo Removal

K/J 1444212.00
July 2014

Path: Z:\Projects\CalleguasMWD_IRWMEvents\20140602_Salinity\SanAntonioCreekArundoRemoval.mxd

PROJECT PHYSICAL BENEFITS

San Antonio Creek Arundo Removal will remove 16 acres of *Arundo donax* (arundo) along lower San Antonio Creek. The 10 acres most denuded following removal will be revegetated; the remaining 6 acres have site conditions conductive to natural revegetatation. This is part of a multi-agency and multi-organization effort to remove arundo from the Ventura River Watershed that began in 2007 upstream of Matilija Dam. Since then, work has progressed downstream in a 3-mile section of the Ventura River Preserve, along tributaries of the Ventura River as well as along the main stem, and in the upper San Antonio Creek drainage.

The following quantifiable physical benefits are expected from this project:

- 320 AFY of water savings from arundo removal
- 10 acres of restored riparian habitat
- 0.68 miles of stream with improved shade cover

In addition to the physically quantified benefits expected from this project, the following non-quantifiable benefits are important to understanding the full value of this project:

- Reduced fire risk
- Improved habitat for endangered fish and bird species

Each benefit is discussed in further detail below.

Technical Analysis of Physical Benefits Claimed

Benefit: Water Savings of 320 AFY Left in Stream

This project will eradicate arundo from 16 acres along lower San Antonio Creek. Each acre of arundo that is removed will save approximately 20 AFY of water resulting in a total of 320 AFY of water savings over the entire 16 acres.

<u>Technical Basis of the Project</u>

Arundo is a large, non-native reed that has caused a range of ecosystem and human-related issues in many coastal watersheds in central and Southern California. Arundo's water consumption rate has been recorded as high as 48 AFY/acre and has become the most problematic invasive species in the Ventura River Watershed due to its ability to both grow and spread at rapid rates (CIPC 2011, p.48). Threats to habitats, water supplies, and fire and flood prone properties caused by arundo have galvanized a multi-agency and multi-organization effort to remove the plant from the Watershed. Since arundo primarily travels downstream, most projects are designed to remove arundo upstream first with exceptions where immediate removal of arundo can remove a near-term flood risk or eliminate threats to wildlife habitat. For this reason, coordination among participating groups and landowners is essential to achieve the benefits associated with removing this invasive reed. Post-treatment monitoring of arundo removal in Matilija Creek, one of the first sites for arundo removal, showed a high level of success in reducing the cover in both woodland and scrub habitats (Hunt & Assoc. 2009, p.14).

Arundo needs to be removed by cutting the stock and then spraying herbicide on the remaining portion of the plant. This is a fairly labor-intensive practice but is the most effective since arundo grows when rhizome balls receive direct sunlight, and there are often latent rhizomes shaded by existing arundo stalks. After the initial treatment, the areas often need to be re-treated with herbicide at least once in order to kill any remaining rhizomes.

Retreatments are required to prevent arundo from reviving. Consecutive retreatments decline in both effort and cost, and several re-treatments can be applied in a single season (the first can occur within 4-6 weeks after initial work).

Recent and Historical Conditions

The Ventura River system and groundwater system serve many beneficial uses including water supply and fishery habitat. Residential, commercial, and agricultural customers rely on variable surface water and groundwater supplies with limited opportunity for groundwater recharge provided by precipitation infiltration (Cardno Entrix 2012, p.2-37). Multiple water providers such as the City of Ventura, Meiners Oaks Water District, and Ventura River County Water District pump water from the Ventura River system to supply customers.

The largest downstream water provider is the City of Ventura. The City of Ventura's Foster Park facilities extract groundwater by means of a shallow well system. Operational staff has adopted a production schedule that limits pumping based on annual rainfall conditions. The 50-year production average for the City beginning in 1960 was 6,000 AFY; however, recent operations have been restricted to 30% of average, a loss of 4,200 AFY in supply. Ventura River water supply available to the City of Ventura could drop significantly based on future regulatory and environmental considerations (RBF Consulting 2013, p.4-5). Lack of groundwater supplies in this and recent drought years has forced the City of Ventura to increase their purchase of Lake Casitas supplies (personal communication S. Rungren City of Ventura, June 2014).

Lake Casitas, which provides backup water to the City of Ventura and eight other local water purveyors, is experiencing unprecedented stress on surface water supplies due to drought conditions and recent increases in demand. Lake levels are anticipated to fall below 50% of full capacity for the first time since 1968, exacerbating water quality challenges (see Lake Casitas Aeration), and the City of Ventura is considering its own water supply restrictions. Thus additional supplies made available by arundo removal can have an immediate impact on relieving drought stress for the City of Ventura.

Reduced Ventura River flows have also had a significant impact on endangered steelhead populations. Recent monitoring of Southern California Steelhead nests (redds) in San Antonio Creek connects low flow to failure of steelhead to reach desirable spawning areas (Bankston et al. 2013, p.14). This is a major concern because the historically abundant steelhead is the only species of Pacific Salmon that naturally reproduces in Southern California watersheds, and has been classified as an endangered species since 1997 (NOAA 2012, p.2). Due to low flows in the Ventura River, San Antonio Creek offers one of the only suitable spawning grounds in the Ventura River Watershed.

Additionally, the Ventura River Watershed has been experiencing water quality problems associated with drought conditions. Low flow conditions have compounded water quality problems related to eutrophication. Decreased summer flows and elevated nutrient concentrations in the Ventura River have contributed to excessive algal biomass growth and thus low dissolved oxygen conditions which result in eutrophication (US EPA 2012, p.15).

At the same time that these decreased flows present water quality issues and limited spawning conditions for steelhead, they also prevent steelhead from transiting back downstream, forcing them to survive in pools along the mainstem with associated water quality issues, higher temperatures, and competition with other fish for an increasingly limited food supply (US EPA 2012, p.10).

Estimates of Without Project Conditions

Without this project, arundo would continue to consume 320 AFY of water that could be used for wildlife habitat and municipal water supply. This would continue to create water resource conflicts between municipal water uses and the ecosystem. Additionally, failing to complete the removal of arundo from the riparian areas of San Antonio Creek would likely result in arundo spreading downstream, thereby increasing the amount of water consumed and exacerbating these resource conflicts.

Without water savings achieved through arundo removal, low river flows would continue to degrade steelhead rearing habitat as well as continue to harm aquatic and amphibian life through eutrophication and increased nutrient loading. Continued low flows may also force the City of Ventura to completely shut off wells at their Foster Park facility, which would further increase reliance on diminishing surface water supplies.

Descriptions of Methods Used to Estimate Physical Benefits

The California Invasive Plant Council conducted a study in 2012 of arundo removal projects across California and found that removing the invasive reed saves, on average, approximately 20 AFY of water per acre of arundo removed. This is the most recent, technically advanced, and complete scientific study of water savings from arundo removal that has been conducted. This water savings estimate was calculated based on 20 different areas ranging from 15 to 2,534 acres of arundo removed. The Ventura River Watershed was included in this study and the removal specific to the Ventura River yielded net water savings of 19.99 AF per acre (CIPC 2011, p.49). Despite recorded arundo water consumption rates as high as 48 AFY/acre, physiological water transpiration limits suggest that 24 AFY/acre is a more realistic estimate for arundo. Given that the likely replacement vegetation combination of shrubs, trees, and herbs consume water at a rate of 4 AFY/acre, the net water savings is 20 AFY per acre of arundo removed (CIPC 2011, p.48).

The savings estimated by CIPC is the savings projected from net acreage of arundo after considering the density of arundo per acre. For this project, areas with 100% arundo density have been selected. With a total of 20 AFY/acre water saved due to arundo removal, this project will save 320 AFY of water (16 acres multiplied by 20 AFY per acre equals 320 AFY).

If initial treatments, re-treatments, and monitoring are done effectively, benefits can last indefinitely. For the purposes of this project, it has been conservatively assumed that the project lifetime will be 50 years. This seems reasonable given the high participation rate of numerous agencies and landowners who will continue to have a vested interest in monitoring and re-treating if necessary.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

No facilities or policies are required in order to obtain the physical benefits from the project, other than those included as part of the project. However, the project proponent will need to consistently monitor for the presence of arundo in the project area in the long-term and, if necessary, re-treat removal areas. Successful completion of these tasks is likely given that costs have been built into the budget for short-term monitoring, and the fact that there are numerous organizations in addition to the Ojai Valley Land Conservancy, such as the Ventura County Watershed Protection District, Ventura Hillsides Conservancy, Concerned Resource Environmental Workers (CREW), the California Conservation Corps, and Friends of the Ventura River, that perform long-term monitoring for arundo as part of their mission.

Description of Any Potential Adverse Physical Effects

No long-term adverse effects are anticipated as a result of the project. There will be a temporary loss of vegetation in the areas where arundo is the predominant plant life. However, these are the areas that will be actively re-vegetated within three seasons of the initial arundo removal. Furthermore, these large areas of arundo can be removed in phases thereby limiting any degradation to native vegetation or existing wildlife habitat.

The initial clearing of arundo stalks naturally produces a lot of biomass that could cause concern during high flows or flooding, but any biomass produced during treatment will be removed from the river area and therefore will not cause any adverse physical effects.

Summary of Benefit

As is shown in Table 3-38, San Antonio Creek Arundo Removal will achieve water savings of 320 AFY, roughly the equivalent to the annual consumption of over 200 households. While not all of the water savings will directly accrue to municipal users, production from the City of Ventura's Foster Park wells depends on local hydrology and storage capacity in the Ventura River alluvium and upstream diversions, which will directly benefit from these water savings (RBF Consulting 2013, p.53). Extraction from these wells typically increases in drought or drier years unless groundwater levels are so low that the wells must be shut off and supplies instead taken from Lake Casitas. Consequently, any increase in groundwater supply for shallow wells ultimately reduces reliance on Lake Casitas supplies during drought periods.

Table 3-38 – Annual Project Physical Benefits

Project Name: San Antonio Creek Arundo Removal
Type of Benefit Claimed: Water savings
Units of the Benefit Claimed: Acre-Feet
Additional Information About this Benefit:

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	107	107
2016	0	320	320
...	0	320	320
2064	0	320	320
2065 (Last Year of Project Life)	0	213	213

Comments: First implementation phase is from 5/1/15 to 8/30/15 so full benefits only realized for 1/3 of 2015 (resulting in 2/3 benefits in final year).

Water savings benefits achieved through this project will also support state and federal recovery strategies for Southern California Steelhead. By allowing 320 AFY to remain in San Antonio Creek, higher river flow will allow for natural spawning, rearing, and nesting grounds for the endangered steelhead as well as other wildlife that rely on an abundance of water in the Creek. Water directly restored to the stream will not only reverse recent habitat degradation but increase water levels used further downstream for groundwater or surface water extraction, thereby further reducing resource conflicts between humans and wildlife during drought.

Benefit: 10 Acres of Restored Riparian Habitat

In total, 16 acres of arundo will be removed by the project. Ten of the acres where arundo will be removed will also be replanted with native vegetation. Native plants will help prevent the return of arundo and provide suitable wildlife habitat for numerous native species whose natural habitat has been displaced by arundo growth. The remaining 6 acres are expected to revegetate naturally.

Technical Basis of the Project

Arundo colonies threaten native riparian habitats and the wildlife that depends upon these habitats by excluding native plants by reducing growing space and sunlight, monopolizing water resources, reducing critical shading, and altering flood regimes critical to the establishment of native riparian vegetation (Bell 1997, p.53-58; Dudley 2000, p.103-113). Arundo reduces habitat quality and food supply for native wildlife including insects and bird species (Bell 1997, p.103-113; Dudley 2000, p.53-58). Insects and other grazers are unable to use arundo as a food source due to the noxious chemicals it contains and its defensive cellular structure (Bell 1997, p.53-58). This is particularly important for federal and state listed species, such as least Bell's vireo and southwestern willow flycatcher, which utilize insects as a food source. Documented decreases in wildlife usage of riparian areas have occurred due to massive stands of arundo (Dudley 2000, p.53-58).

Emerging native vegetation provides suitable habitat for the southwest willow flycatcher and least Bell's vireo, both of which are endangered species of birds. In addition, a recent survey of wildlife in the project area found significant observations of Pacific Pond turtles, which directly benefit from any increase in water levels (Bankston et al. 2013, p.12).

Recent and Historical Conditions

Loss of riparian habitats over time has already led to the decline of several local bird species including the federal- and state-listed endangered least Bell's vireo and southwestern willow flycatcher. Amphibian and fish habitats have also been degraded due to arundo infestations, but restoration of these areas can return the lost habitats.

Estimates of Without Project Conditions

If the project is not implemented, ten acres of native vegetation would not be replanted, and riparian habitat would not be improved in these areas.

Descriptions of Methods Used To Estimate Physical Benefits

The Ventura County Watershed Protection District used geographic information system (GIS) data and mapping to identify the 10 acres of high-density and contiguous arundo infestations being targeted. These areas are simultaneously the best spots for active revegetation of native species as well as the most likely to be re-infested with arundo or other non-native species after arundo is removed. The remaining six acres from which arundo will be removed have site characteristics where natural revegetation is anticipated.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

There are no new facilities, policies, or actions required to obtain this benefit. However, the project proponent will need to consistently monitor for the presence of arundo in project area in the long-term and, if necessary, re-treat removal areas. Successful completion of these tasks is likely given that costs have been built into the budget for short-term monitoring, and the fact that there are numerous organizations in addition to the Ojai Valley Land Conservancy, such as the Ventura County Watershed Protection District, Ventura Hillsides Conservancy, Concerned Resource Environmental Workers (CREW), the California Conservation Corps, and Friends of the Ventura River, that perform long-term monitoring for arundo as part of their mission.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects associated with restoring native vegetation are anticipated.

Summary of Benefit

As is shown in Table 3-39, replacing 10 acres with native vegetation will return habitat for numerous species that are not supported by arundo.

Table 3-39 – Annual Project Physical Benefits

Project Name: San Antonio Creek Arundo Removal
Type of Benefit Claimed: Restored riparian habitat
Units of the Benefit Claimed: Acres
Additional Information About this Benefit:

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	10	10
2019	0	0	0
...	0	0	0
2065	0	0	0
2066 (Last Year of Project Life)	0	0	0

Comments: Re-vegetation will occur three years after the initial treatment

Benefit: 0.68 Miles of Stream with Improved Shade Cover

Restored riparian habitat along San Antonio Creek will result in increased shade cover along 0.68 miles of the stream.

Technical Basis of the Project

Native vegetation can aid in-stream habitats through improved shade cover. In a 2012 TMDL and water quality report for the Ventura River, the US EPA states the following:

> "Favorable conditions for algal growth depend on the availability of nutrients, the form of nutrients, light, and other factors or "cofactors" including pH, temperature, oxygen, canopy cover, and flow. Favorable algal growth conditions may be enhanced by degraded or reduced riparian habitat where limited canopy cover allows more sunlight and increases water temperatures…This can severely affect fish specifically with greater oxygen demand requirements, such as Steelhead Trout, by impacting growth, development, swimming, feeding, and reproductive ability of juvenile and adult." (US EPA 2012, p.15)

Despite a fast growth rate and ability to spread quickly, arundo does not provide adequate shade cover for San Antonio Creek and allows direct sunlight to degrade water quality (CPIC 2011, p.28). Low flows have not only limited suitable spawning grounds to San Antonio Creek but also limited the mobility of steelhead to these areas that need improved canopy cover.

Recent and Historical Conditions

Emergence of arundo as the dominant plant life along certain sections of lower San Antonio Creek has prevented natural vegetation from providing shade cover for the stream. This has increased eutrophication at a time when stream flows are at historic lows and fish and amphibian species, such as the endangered Southern Californian Steelhead, are already experiencing habitat degradation.

Estimates of Without Project Conditions

Without this project, arundo would continue to be the dominant species in the areas designated for removal along the banks of San Antonio Creek. This length of stream would continue to receive direct sunlight and would continue to experience eutrophication, which harms wildlife.

Descriptions of Methods Used to Estimate Physical Benefits

Ventura County used a GIS tool and project maps that delineate the physical extent of the 10 acres of riparian habitat restoration to estimate the length of the San Antonio Creek that will have increased native vegetation as a result of this project.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

There are no new facilities, policies, or actions required to obtain this benefit. However, the project proponent will need to consistently monitor for the presence of arundo in project area in the long-term and, if necessary, re-treat removal areas. Successful completion of these tasks is likely given that costs have been built into the budget for short-term monitoring, and the fact that there are numerous organizations in addition to the Ojai Valley Land Conservancy, such as the Ventura County Watershed Protection District, Ventura Hillsides Conservancy, Concerned Resource Environmental Workers (CREW), the California Conservation Corps, and Friends of the Ventura River, that perform long-term monitoring for arundo as part of their mission.

Description of Any Potential Adverse Physical Effects

There are no anticipated adverse physical effects associated with providing additional shade for the stream.

Summary of Benefit

As is shown in Table 3-40, re-emergence of native vegetation directly along the stream bank will yield the additional benefit of producing 0.68 miles of shade along San Antonio Creek. As long as the native vegetation remains, this shade will reduce stream temperatures thereby reducing eutrophication. Prevented algal growth will have positive benefits for any wildlife that depend on the creek for survival.

Table 3-40 – Annual Project Physical Benefits

Project Name: San Antonio Creek Arundo Removal

Type of Benefit Claimed: Length of stream with improved shade cover

Units of the Benefit Claimed: Miles

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
		Physical Benefits	
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0.68	0.68
2019	0	0	0
...	0	0	0
2065	0	0	0
2066 (Last Year of Project Life)	0	0	0

Comments: Re-vegetation will occur three years after the initial treatment

Discussion of Non-Quantified Benefits

Reduced Fire Hazard

Removal of arundo in the project area will contribute to reduced fire hazard. The Ventura River system includes steep-walled canyons of flammable flora, and the area is already prone to rapidly spreading fires. Under natural conditions, riparian areas act as firebreaks, but as they are overcome by invasive species, they enable wildfires to spread more rapidly. Arundo, in particular, is highly flammable and burns more intensely than native riparian vegetation even when green (Dudley 2000, p.103-113). The height and flammability of arundo reeds reduces the role of these natural firebreaks by allowing the fire to jump over the rivers. Arundo-infested areas of natural vegetation can experience devastating habitat destruction if the arundo catches fire. Additionally, dense areas of arundo have high fuel loads and can be initial sources of fires if ignited (CIPC 2011, p.127).

Improved Habitat for Endangered Bird Species and Other Species

The project fosters steelhead and pond turtle habitats through increased flow and improves habitat by providing native plant species for at least two endangered bird species (least Bell's vireo and southwestern willow flycatcher). Water savings and habitat restoration will produce greater biodiversity by promoting nesting and breeding for several other fish, amphibian, and bird species.

Cost Effectiveness Analysis

Answers to the cost-effectiveness analysis questions are presented in summary form in Table 3-41 with narrative description provided below. No projects comparable to arundo removal were identified. Removal of other water-consuming invasive species or household-level water conservation measures could be considered alternatives, but neither provides the benefits comparable to those provided by arundo removal.

<table>
<tr><th colspan="2">Table 3-41 – Cost Effectiveness Analysis
Project Name: San Antonio Creek Arundo Removal</th></tr>
<tr><td>Question 1</td><td>Types of benefits provided as shown in Tables 3-38, 3-39, 3-40:
• Additional 320 AFY left in stream
• 10 acres of restored riparian habitat
• 0.68 miles of additional stream shade cover</td></tr>
<tr><td rowspan="3">Question 2</td><td>Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?
• No</td></tr>
<tr><td>If no, why?
• There are no other vegetation-based alternatives that achieve the same water savings or habitat benefits, and any demand-side municipal water conservation projects would not yield water savings directly to the stream and therefore would not yield the same habitat benefits.</td></tr>
<tr><td>If yes, list the methods (including the proposed project) and estimated costs.
• Not Applicable</td></tr>
<tr><td>Question 3</td><td>If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
• Not applicable.</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

Arundo removal will provide 16,000 AF in water savings over the 50-year expected lifetime of the project. Table 3-42 shows the present value of project costs in 2014 dollars. At a total present value project cost of $1,105,640, this project will yield water savings at a rate of $69/AF ($1,105,640/16,000 AF equals $69 per AF). Implementation costs will be incurred

Table 3-42 – Annual Costs of Project (All costs in 2014 Dollars) Project: San Antonio Creek Arundo Removal										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2014								0	1.000	**0**
2015	238,889							238,889	0.943	**225,367**
2016	238,889							238,889	0.890	212,610
2017	358,333							358,333	0.840	300,863
2018	238,889							238,889	0.792	189,222
2019	119,444							119,444	0.747	89,256
2020					40,000			40,000	0.705	28,198
2021					35,000			35,000	0.665	23,277
2022					30,000			30,000	0.627	18,822
2023					20,000			20,000	0.592	11,838
2024					10,000			10,000	0.558	5,584
2025								0	0.527	
2026								0	0.497	
2027								0	0.469	
2028								0	0.442	
2029								0	0.417	
2030								0	0.394	
2031								0	0.371	
2032								0	0.350	
2033								0	0.331	
2034								0	0.312	

Table 3-42 – Annual Costs of Project (All costs in 2014 Dollars) Project: San Antonio Creek Arundo Removal										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2035					1,000			1000	0.294	294
2036								0	0.278	
2037								0	0.262	
2038								0	0.247	
2039								0	0.233	
2040								0	0.220	
2041								0	0.207	
2042								0	0.196	
2043								0	0.185	
2044								0	0.174	
2045					1,000			1000	0.164	164
2046								0	0.155	
2047								0	0.146	
2048								0	0.138	
2049								0	0.130	
2050								0	0.123	
2051								0	0.116	
2052								0	0.109	
2053								0	0.103	
2054								0	0.097	
2055					1,000			1000	0.092	92
2056								0	0.087	
2057								0	0.082	

Table 3-42 – Annual Costs of Project (All costs in 2014 Dollars) Project: San Antonio Creek Arundo Removal										
	Initial Costs Grand Total Cost	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2058								0	0.077	
2059								0	0.073	
2060								0	0.069	
2061								0	0.065	
2062								0	0.061	
2063								0	0.058	
2064								0	0.054	
2065 (Last Year of Project Life)					1,000			1000	0.051	51
Total Present Value of Discounted Costs (Sum of column (j))										$1,105,640
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

over five years starting in 2015 with increases in capital spending over the third and fourth years as cleared areas are revegetated. Costs for the project include monitoring and re-application of herbicide on any re-growth of arundo. This becomes cheaper after the initial cutting and herbicide applications since nearly all of the arundo is removed during that initial phase. The area should be completely free of arundo after 4-5 years; however, some re-treatment might be necessary after the initial phase is complete. A re-treatment cost of $1,000 every ten years over the assumed project lifetime is included in the present value calculations.

In terms of vegetation-based approaches to water conservation, arundo removal is the only feasible option. No other invasive or native species have close to the same water consumption rate as arundo. Tamarisk (also known as salt cedar) and Russian thistle are two other invasive species that are prevalent in the Ventura River Watershed. However, their water consumption rates are much lower than that of arundo and would not achieve comparatively significant water savings if replaced by native vegetation. Tamarisk consumes about double the amount of water that native vegetation uses, whereas arundo consumes about 5 times the amount of water as native vegetation (VCRCD 2006, p.14; CIPC 2011, p.48).

Summary

The physical benefits claimed for this project include water savings of 320 AFY, ten acres of restored riparian habitat, and 0.68 miles of stream with improved shade cover. There are no viable vegetation-based water conservation measures that will provide the same benefits, and demand-side municipal projects will not provide the same recharge, habitat, and water quality benefits as arundo removal.

References

These references are provided as Att3_DG_ProJust_5of5.zip. The pdf file is bookmarked so that all references can be easily located.

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11. Ventura County Resource Conservation District (VCRCD). 2006. Upper Santa Clara River Watershed Arundo and Tamarisk Removal Program Long-Term Implementation Plan. Ventura County Resource Conservation District.