SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

BOARD OF DIRECTORS WORKSHOP - RESOURCES/ENGINEERING
2:00 pm Tuesday, July 9, 2024

In Person:
380 East Vanderbilt Way
San Bernardino, CA 92408

Online via Zoom:
https://sbvmwd.zoom.us/s/82492309440
Meeting ID: 824 9230 9440
PASSCODE: 3802020

By Telephone:
Dial-in Info: (877) 853 5247 US Toll-free
Meeting ID: 824 9230 9440
PASSCODE:3802020

If you are unable to participate online or by telephone, you may also submit your comments and questions in writing for the District's consideration by sending them to comments@sbvmwd.com with the subject line "Public Comment Item #" (insert the agenda item number relevant to your comment) or "Public Comment Non-Agenda Item". Submit your written comments by 6:00 p.m.on Monday, July 8, 2024. All public comments will be provided to the Board President and may be read into the record or compiled as part of the record.

IMPORTANT PRIVACY NOTE: Online participants MUST log in with a Zoom account. The Zoom app is a free download. Please keep in mind: (1) This is a public meeting; as such, the virtual meeting information is published on the World Wide Web and available to everyone. (2) Should you participate remotely via telephone, your telephone number will be your "identifier" during the meeting and available to all meeting participants; there is no way to protect your privacy if you elect to call in to the meeting.

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AGENDA

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
380 E. Vanderbilt Way, San Bernardino, CA 92408

BOARD OF DIRECTORS' WORKSHOP - RESOURCES/ENGINEERING
2:00 PM Tuesday, July 9, 2024

CALL TO ORDER

1) INTRODUCTIONS

2) PUBLIC COMMENT
Members of the public may address the Board regarding any item within the subject matter jurisdiction of the Board; however, no action may be taken on off-agenda items except as authorized by law. Each speaker is limited to a maximum of three (3) minutes.

3) CONSENT CALENDAR

3.1 Consider a Services Agreement with Retrofit Service Company, Inc. for Fiscal Year 2024-25
Staff Memo - Consider a Services Agreement with Retrofit Service Company, Inc. for Fiscal Year 2024-25 (2 min) - Page 3
RSC HVAC Proposal for FY 2024-25

4) DISCUSSION AND POSSIBLE ACTION ITEMS

4.1 Consider a Professional Services Agreement with Scheevel Engineering for Engineering Consulting Services for FY24-25 (20 min) - Page 6
Staff Memo - Consider a Professional Services Agreement with Scheevel Engineering for Engineering Consulting Services for Fiscal Year 24-25
Scheevel Engineering Project Technical Assist Proposal

4.2 Quarterly Groundwater Management Update (30 min) - Page 10
Staff Memo - Quarterly Groundwater Management Update
Quarterly Groundwater Management Update to BTAC
Rialto Decree Letter Water Year 2023-2024
Yucaipa SGMA Withdrawal Notice from Redlands

4.3 Consider Second Amendment to Partnership Agreement for Joint Active Recharge Project Development under the Upper Santa Ana River Habitat Conservation Plan (20 min) - Page 12
Staff Memo - Second Amendment to Partnership Agreement with SBVWCD Partnership Agreement and the First Amendment for Joint Active Recharge Project Development under the River HCP with SBVWCD
Second Amendment to Partnership Agreement for Joint Active Recharge Project

Development

4.4 Consider an Agreement with University of California San Diego for Preliminary Viability Assessment of Forecast Informed Reservoir Operations at Seven Oaks Dam (20 min) - Page 87
Staff Memo - Consider an Agreement with University of California San Diego for Preliminary Viability Assessment of Forecast Informed Reservoir Operations at Seven Oaks Dam
Work Plan for Seven Oaks Dam Forecast Informed Reservoir Operations (June 2024) Proposal from UC San Diego for Development of Preliminary Viability Assessment

5) FUTURE BUSINESS

6) ADJOURNMENT

SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

DATE: July 9, 2024

TO: Board of Directors' Workshop – Resources/Engineering

FROM: David McArthur, Water Operations Manager
Leo Ferrando, Assistant Chief Engineer

SUBJECT: Consider a Services Agreement with Retrofit Service Company, Inc. for Fiscal Year 2024-25

Staff Recommendation

Staff recommends the Board of Directors (BOD) authorize the CEO/General Manager to execute a Services Agreement with Retrofit Service Company, Inc. (RSC) for Heating, Ventilation, and Air Conditioning (HVAC) preventive maintenance services in an amount not to exceed $43,580 for Fiscal Year 2024-25.

Summary

The district operates multiple facilities across our service area, each equipped with HVAC units. For the FY 24-25, staff solicited bids from local companies, including Burgeson's Heating and Air, Ontario Refrigeration, Redlands Plumbing Heating and Air, A-Avis Home Services Plumbing, Heating and Air, and Sanborn's Heating and Air. Bids were received from Ontario Refrigeration and RSC, with RSC submitting the lowest bid at $43,580. Staff recommends awarding the contract to RSC.

Background

The HVAC units located at the District's facilities, such as the Administrative Building, Foothill Pump Station, Redlands Pump Station, and Warehouse, require preventive maintenance and routine repairs to ensure reliable and effective operations. Staff solicited bids for HVAC services for Fiscal Year 24-25 and received the lowest bid from RSC, Inc. at a not-to-exceed amount of $43,580, which includes routine inspections, troubleshooting, and repairs. This agreement will provide a comprehensive and cost-effective program with experienced and qualified technicians for nine (9) sites. Staff recommends that the Board of Directors authorize the CEO/General Manager to execute a Services Agreement with RSC, Inc. for HVAC preventive maintenance services in an amount up to $43,580.

District Strategic Plan Application

This proposed effort supports the District's strategic goals of proactively maximizing operational flexibility and developing technological tools to provide efficient, cost-effective solutions.

Fiscal Impact

The fiscal impact of this project is an amount up to $43,580. Funds for this expenditure are included in the approved 2024/2025 General Fund Budget under Line Item 6470, Maintenance and Repairs. Approximately 24% of the $43,580, or $10,460, will be reimbursed by the San Gorgonio Pass Water Agency based on the East Branch Extension Participation Agreement.

Attachment

Quote Proposal for Preventive Maintenance and Repair by Retrofit Service Company, Inc. (RSC)

Retrofit Service Co., Inc.

HVAC Service / Mechanical / Controls
License C-10, C-20, C-38 760432
www.retrofitsc.com / rsc@retrofitsc.com

May 24, 2024

Mike Rodriguez
San Bernardino Municipal Water District
380 East Vanderbilt Way
San Bernardino, CA 92408

Mike,

Thank you for the opportunity to bid the HVAC preventive maintenance for your nine locations, and for your time to take me to all to the locations.

Please find all nine proposals for the period of July 1, 2024 – June 30, 2025 attached.

I have also summarized the pricing below.

Please review and let me know if you have any questions. We look forward to the possibility of working with you soon.

Administration Building	$4,688.00 per year	$1,172.00 per quarter
EBX Comm. Building	$1,576.00 per year	$ 394.00 per quarter
Redlands Pump Station	$5,836.00 per year	$1,459.00 per quarter
Citrus Pump Station	$5,652.00 per year	$1,413.00 per quarter
Foothill Pump Station	$5,116.00 per year	$1,279.00 per quarter
Greenspot Pump Station	$6,388.00 per year	$1,597.00 per quarter
Tate Pump Station	$2,148.00 per year	$ 537.00 per quarter
Crafton Hills Pump Station	$9,316.00 per year	$2,329.00 per quarter
Cherry Valley Pump Station	$2,860.00 per year	$ 715.00 per quarter
Total	**$43,580.00 per year**	**$10,895.00 per quarter**

Sincerely,

Charlie Grammer
HVAC Business Development

SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

DATE: July 9, 2024

TO: Board of Directors' Workshop – Resources/Engineering

FROM: Leo Ferrando, Assistant Chief Engineer
Wen Huang, Chief Operating Officer/ Assistant General Manager

SUBJECT: Consider a Professional Services Agreement with Scheevel Engineering for Engineering Consulting Services for Fiscal Year 24-25

Staff Recommendation

Staff recommends that the Board of Directors (BOD) consider authorizing the CEO/General Manager to execute a consulting services contract with Scheevel Engineering for Engineering Consulting Services up to an estimated fee of $300,000.

Summary

San Bernardino Valley's Engineering staff is led by our Chief Operating Officer and includes one Assistant Chief Engineer, two Project Managers, and one Associate Engineer; additionally, in the last few fiscal years, the Board of Directors approved a staff augmentation contract with Scheevel Engineering to provide on-call consulting services for the Engineering and Environmental Teams for a wide variety of engineering-based tasks and assignments. To continue to support the substantial engineering workload planned for this upcoming fiscal year, Staff recommends the BOD consider engaging with Scheevel Engineering to provide professional engineering services for FY 24-25.

Background

During the BOD's Budget Workshop on June 20, 2024, the Board approved the FY 24-25 General Fund Budget, which, among other things, included a budget for several projects during FY 24-25, including the continued construction of the Santa Ana River (SAR) Enhanced Recharge Phase 1B and the construction of the Tributaries Restoration Project at Anza and Hidden Valley Creeks. As the District has done historically, Engineering Staff will handle the construction management and inspection in-house for most of the upcoming Projects. Due to the engineering staff's limited time and the number of projects in construction, in-house staff resources will have limited capacity to focus on keeping design and engineering moving forward.

Staff recommends that the Board continue to engage Scheevel Engineering to continue providing engineering and design services for several ongoing projects, including Devil & Sweetwater Basins, County Line Recharge, Active Recharge (including PERC projects), Central Feeder—EBX Intertie, Cactus Basin Connector Project, and SAR Tributaries Restoration at Anza Creek and Hidden Valley Creek, and technical work related to annual maintenance/operations of recharge basins.

Nate Scheevel, the principal of Scheevel Engineering, has been working with Valley District on many projects in years past, including the preliminary design and feasibility studies for the Active Recharge Projects, evaluation of the Riverside North Aquifer Storage and Recovery Project (a.k.a. Rubber Dam Project), Santa Ana Sucker Habitat Pilot Study, and development of an operation and maintenance manual for the SAR Enhanced Recharge Project. Given the types of upcoming projects we need assistance with, Mr. Scheevel is a uniquely qualified and trusted entity that performs duties as an extension of staff and our engineering team. Staff recommends that the Board of Directors consider entering into a professional services agreement with Scheevel Engineering for a not-to-exceed fee of $300,000. Mr. Scheevel's time will be tracked at the project level; consequently, other project partners will reimburse a portion of his invoices accordingly.

District Strategic Plan Application

This proposed effort supports nearly all of the District's strategic goals of proactively maximizing and managing a diverse, adaptable water supply portfolio to maximize the value of the region's water assets and infrastructure.

Fiscal Impact

The estimated cost for the scope of services for an amount not-to-exceed of $300,000 was included in Line Item 6360 Consultants in the approved FY 24-25 General Fund Budget. A portion of this amount will be reimbursed by project partners based on the specific projects worked on during the year.

Attachment

Professional Engineering Services Proposal by Scheevel Engineering dated June 24, 2024.

June 24, 2024

San Bernardino Valley Municipal Water District
Attn: Leonardo Ferrando, PE, PMP, Assistant Chief Engineer
380 East Vanderbilt Way
San Bernardino, CA 92408

RE: Professional Engineering Services Proposal

Dear Mr. Ferrando:

Scheevel Engineering is pleased to present this proposal to the San Bernardino Valley Municipal Water District (Valley District) for professional engineering consulting services. Scheevel Engineering provides a wide variety of consulting and field services unique to water resource projects. These services include project management, field inspection, feasibility analysis, operation and maintenance optimization, preliminary design, 3D CFD modeling, final design, construction management, water quality analysis, environmental restoration and performance enhancement consulting for water resources and groundwater recharge system projects.

Scheevel Engineering has prepared this proposal to provide professional engineering consulting services for engineering design, consulting, project management, field services and other technical services for current and future projects as directed by Valley District. The specialized services offered by Scheevel Engineering will include the tasks outlined below in Table 1: Scope of Work.

Scheevel Engineering will provide engineering services on a wide variety of projects. The projects may include, but may not be limited to Devil & Sweetwater Basins, County Line Recharge, Active Recharge, Central Feeder – EBX Intertie, Cactus Basin Connector, and SAR Tributaries Restoration. The schedule for each project is independent and expected to vary, and Scheevel will make every reasonable effort to accommodate the project schedules as they change. Scheevel is prepared to expand its resources (with subconsultants or other staffing) for projects or task that require resources beyond Scheevel's current capacity.

Table 1: Scope of Work

Scope Item Description
Engineering Design, Technical & Consulting Services – Provide engineering, technical support and project management services for field testing, planning, designing, bidding, construction and monitoring of multiple Valley District projects. Scheevel Engineering has identified Mr. Nate Scheevel for this engagement. Mr. Scheevel is a registered PE in CA with extensive field testing, planning, design, bidding, construction and monitoring experience. His experience can be found in the attached resume. Scheevel will provide its own vehicle, cell phone, laptop, general office supplies, computer software, flow measurement, pump monitoring and water quality monitoring equipment.

Upon your review of the above scope of work please let me know if you would like any additions or subtractions. Scheevel Engineering provides all services at an hourly rate of $300.00. Scheevel Engineering proposes to provide approximately 1,041 hours of consulting services on

Scheevel Engineering ● P.O. Box 28745 ● Anaheim, CA 92809 ● Phone: (714) 470-9045 ● Email: nathanscheevel@yahoo.com

a time and materials bases for a not to exceed fee of $300,000. All sub-consultant fees will be invoiced at-cost with no markup by Scheevel. Scheevel's travel time is free of charge and no additional fees or charges apply unless approved by Valley District. The fees associated with the above scope of work equals **$300,000.00 (three-hundred thousand dollars)**. A breakdown of the fees associated with the proposed scope of work is illustrated in Table 2: Schedule of Fees.

Table 2: Schedule of Fees

Scope Item Description		Rate	Fee
Scope Items			
1) Engineering Design, Technical & Consulting Services (Scheevel)		$300/hr	$ 238,500.00
2) Engineering Design, Technical & Consulting Services Estimate (Subconsultant)		$250/hr (average)	$ 61,500.00
Total			**$ 300,000.00**

This proposal is valid for 30 days. Scheevel Engineering is prepared to start work on projects immediately and can modify the scope, proposed fees and schedule to meet Valley District's needs. Thank you for the opportunity to provide professional consulting services to San Bernardino Valley Municipal Water District.

Sincerely,
Scheevel Engineering

Nate Scheevel, P.E.
President/Principal

Scheevel Engineering ● P.O. Box 28745 ● Anaheim, CA 92809 ● Phone: (714) 470-9045 ● Email: nathanscheevel@yahoo.com

SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

DATE: July 9, 2024

TO: Board of Directors' Workshop – Resources/Engineering

FROM: Michael Plinski, Chief of Water Resources
Adekunle Ojo, Manager of Integrative Planning

SUBJECT: Quarterly Groundwater Management Update

Staff Recommendation

Informational Item; Receive and File.

Summary

At the upcoming workshop, staff will provide an update on the conditions of groundwater basins in the San Bernardino Valley service area and the activities of their respective basin management bodies since the last update to the Board at the Board of Directors' Workshop – Resources/Engineering on March 12, 2024. The key developments since March are:

- **Rialto-Colton Basin:** The average spring-high water levels for the Rialto Basin index wells decreased by 7.7 feet from last year's average. Based on the 1961 Rialto Decree, the pumping restrictions for Water Year 2023-2024 equates to a 49% reduction in pumping. Staff is working with the Rialto Basin Groundwater Council and the County of San Bernardino towards long-term sustainability and facilitating imported water recharge at the Cactus Basins.
- **San Bernardino Basin:** The framework agreement establishing the San Bernardino Basin Groundwater Council was extended for one year in May 2023 and will expire on June 30, 2024. While the remaining imported water deliveries will continue through calendar year 2024, the discussion on a replacement groundwater stewardship framework will take place as part of the San Bernardino Basin Optimization and Stewardship Program. In addition, San Bernardino Valley and Western Water staff are currently preparing the 2023 Western-San Bernardino Watermaster Report, which is due to the Superior Court for the Riverside County by August 1, 2024; the report covers the San Bernardino Basin Area, Colton Basin Area, and Riverside Basin Area.

- **Yucaipa Basin:** On June 4, 2024, the Redlands City Council approved leaving the Yucaipa Sustainable Groundwater Management Agency (Yucaipa SGMA); the ninety (90) day withdrawal period will conclude on September 5, 2024. Water purveyors are responsible for 75% of Yucaipa SGMA's cost and the regional water and land use agencies are responsible for 25%. Redlands withdrawal will increase the cost share of San Bernardino Valley, Pass Agency, and the City of Yucaipa from 6.25% to 8.3% or from $2,210 to $2,935 for each agency.

Background

At the start of 2024, the Board of Directors asked for a periodic or quarterly update on groundwater basins in the San Bernardino Valley service area and their respective basin management bodies namely the Western-San Bernardino Watermaster and the San Bernardino Basin Groundwater Council for the San Bernardino Basin Area, the Rialto Basin Groundwater Council for the Rialto Basin, and the Yucaipa Sustainable Groundwater Management Agency for the Yucaipa Basin.

Summary

The update aligns with the District's mission of working collaboratively to provide a reliable and sustainable water supply to support the changing needs of our region's people and environment.

Fiscal Impact

There is no fiscal impact related to this update.

Attachments

Quarterly Groundwater Management Update to BTAC
Rialto Decree Letter
Yucaipa SGMA Withdrawal Notice from Redlands

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DATE: June 3, 2024

TO: Basin Technical Advisory Committee (BTAC)

FROM: Adekunle Ojo, Manager of Water Resources
Michael Plinski, Chief of Water Resources

SUBJECT: Groundwater Management Update

Recommendation

Informational Item; Receive and File.

Summary

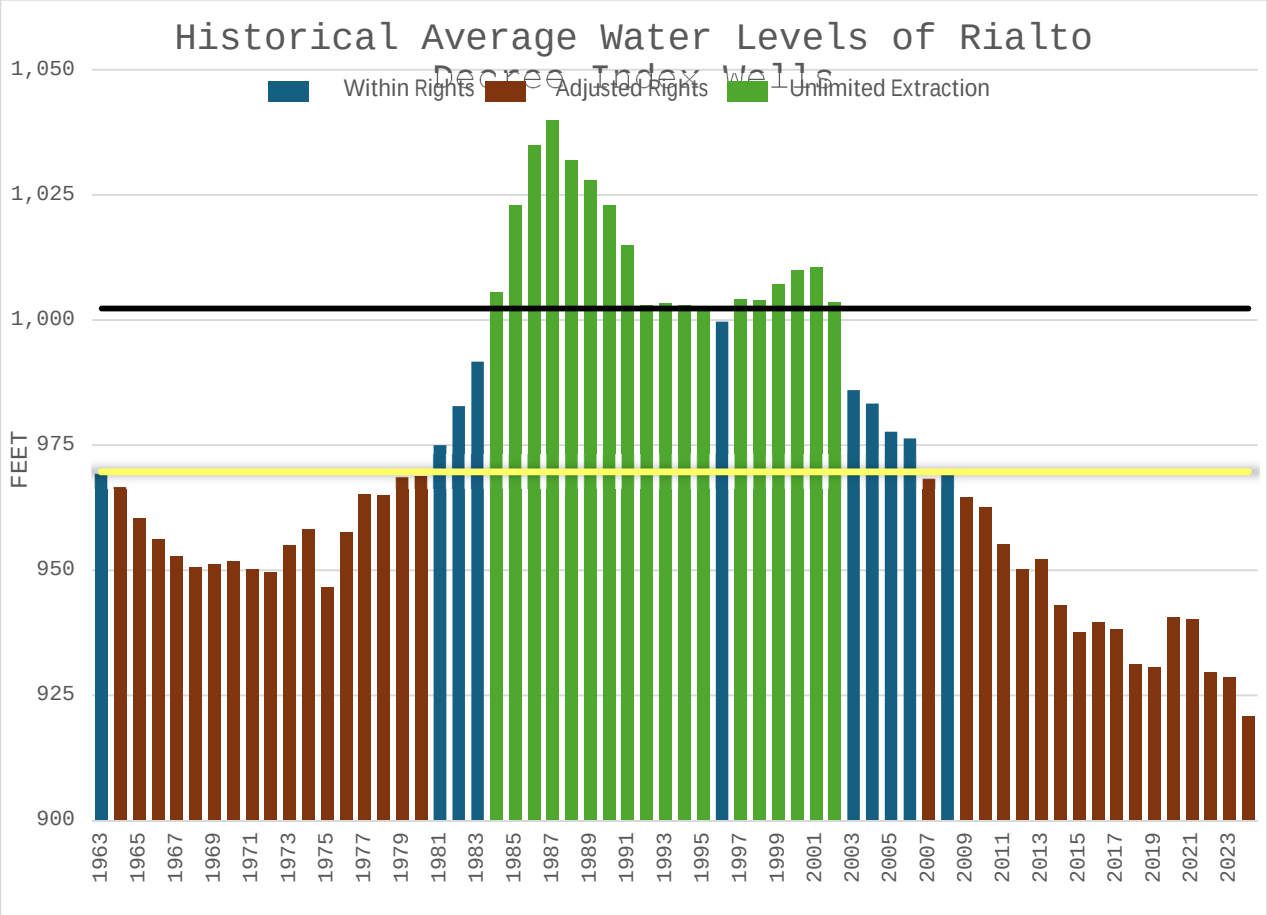
This report summarizes the conditions of groundwater basins in the San Bernardino Valley service area and the activities of their basin management bodies since the last update to BTAC on February 5, 2024.

Rialto-Colton Basin

The Rialto-Colton Basin is on the west side of the San Bernardino Valley service area, with the upper portion known as the Rialto Basin and the lower portion known as the Colton Basin. The principal natural recharge areas are Lytle Creek adjacent to the northwestern part of the Rialto Basin, and Reche Canyon and Santa Ana River in the southeastern and southcentral parts of the Colton Basin respectively. Lesser amounts of recharge are provided by percolation of precipitation to the valley floor, underflow from neighboring basins, and to a small extent irrigation and septic returns.

Since 2009, the average spring high water levels in the Rialto Basin have been consistently below the threshold set in the 1961 Rialto Decree. When this occurs, groundwater production is reduced by one percent (1%) for each one (1) foot that the said average is below 969.7 feet above mean sea level for the subsequent water year; the maximum reduction is capped at 50%. Despite reduced groundwater production since 2009 starting at 5% and reaching 41% reduction in 2023, the average spring high water levels has not rebounded which is an indication of the long-term drought (decline in natural recharge) as shown in the figure below and an acute need for artificial recharge. A team from San Bernardino Valley met with County of San Bernardino leaders and Basin producers on

April 24, 2024 regarding the recharge of imported water at Cactus Basins. The engagement with San Bernardino County will continue on a Memorandum of Understanding to facilitate collaboration on this effort and initiating the Technical Advisory Group that would be formed for the retail water agencies, regulatory agencies, and other entities to guide the development of an Adaptive Management Plan.



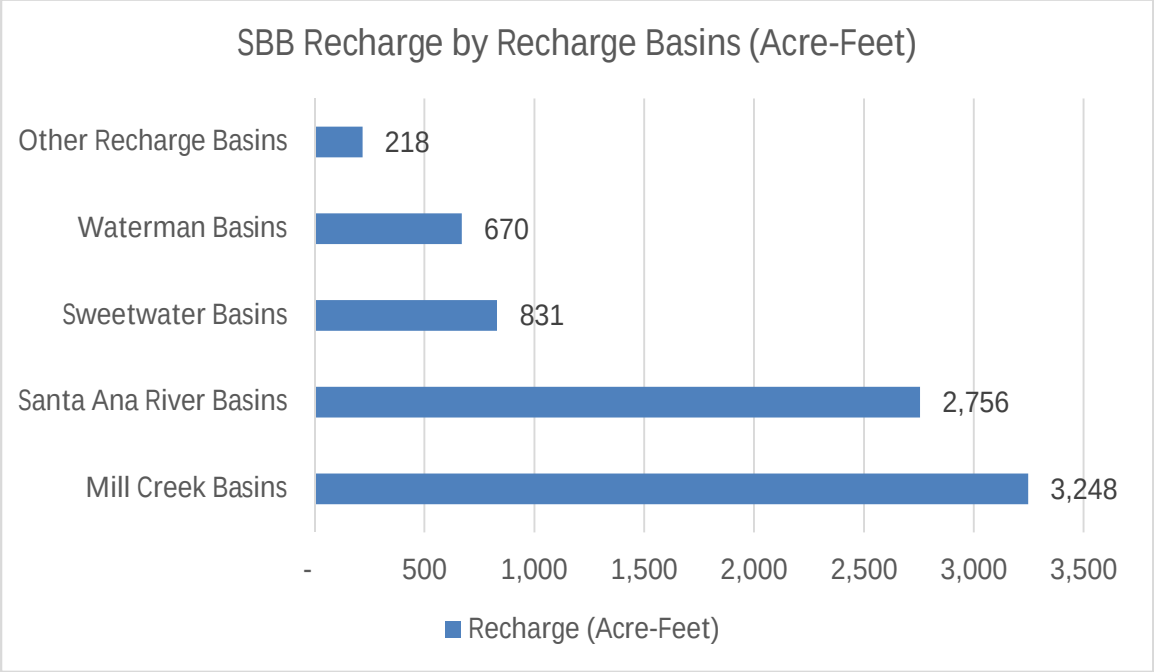
San Bernardino Basin

The San Bernardino Basin is the largest groundwater basin within the San Bernardino Valley service area. Natural recharge to the Basin comes largely from infiltration of runoff from the San Gabriel and San Bernardino Mountains; according to the U.S. Geological Survey, the Santa Ana River, Mill Creek, and Lytle Creek contribute more than 60% of the total recharge to the groundwater system. Lesser contributors include Cajon Creek, Plunge Creek, and most of the creeks flowing southward out of the San Bernardino Mountains. In addition to natural replenishment by deep percolation of water from precipitation and resulting runoff, the Basin is also recharged artificially in streambeds and spreading grounds using local stormwater capture, imported water (State Water Project), and recycled water. Some of the recent developments include:

- **Weaver Basins:** The Sterling Natural Resource Center started operation in January 2024, and it can produce up to 8 million gallons of indirect potable reuse water every day.

Currently, the water recycling plant is producing and delivering about 6 to 6.5 million gallons of recycled water per day, which is conveyed through a regional recycled water pipeline and delivered to the Weaver Basins for recharge. In the future, the San Bernardino Municipal Water Department will connect to the regional recycled water pipeline and deliver its recycled water for recharge. This drought-proof recharge of recycled water, coupled with stormwater and imported water recharge upstream of this location, is expected to contribute to the long-term resilience of the Basin.

- **Santa Ana River Spreading Grounds (Enhanced Recharge Project Phase 1B):** This project is crucial for large-scale stormwater capture on the Santa Ana River and some of the habitat conservation required for water supply projects. Work on the main channel within the "B" Basins are completed and all 11 basins within this sector are online and operational. Construction is ongoing on the channel and basins in the "A" Basins; overall, the project continues to be ahead of schedule and within budget. The construction of these facilities is necessary to utilize the water rights secured by San Bernardino Valley and Western Water that allows for the diversion of up to 200,000 acre-feet of water of Santa Ana River flow made possible by the construction of the Seven Oaks Dam. Depending on local hydrology and recharge conditions, imported water can also be recharged at these basins.
- **Santa Ana River Diversions:** 5,531 acre-feet have been diverted and recharged through the end of April after the Water Conservation District reached its 8,300 acre-feet diversion limit. The permits jointly held by San Bernardino Valley and Western Water provides access to water in excess of licenses held by the San Bernardino Valley Water Conservation District totaling 10,400 acre-feet (first 8,300 acre-feet from January to May and first 2,100 acre-feet from October to December; San Bernardino Valley and Western Water have permits to divert any excess in excess of these licenses and all available water, subject to permit conditions, between June and September).
- **Imported Water Recharge:** The Seven Oaks Accord requires the spreading of native water before imported water. Recharge of imported water has been constrained by the recharge of local surface water, construction related to Enhanced Recharge Phase 1B, and reduced infiltration rates due to mounding. Nonetheless, 7,782 acre-feet of imported water was recharged through the end of April, which represents approximately 20% of the Basin's recharge orders; the total planned SWP recharge for 2024 is 39,594 acre-feet. 28,560 acre-feet of the recharge orders and deliveries are for the San Bernardino Basin Groundwater Council (GC) and represents the remaining deliveries under the framework agreement that established the GC. With additional recharge basins coming online as the Enhanced Recharge Phase 1B is being completed and local surface water dwindling during the summer months, the capacity to recharge imported is expected to increase for the next couple of months.



Yucaipa Basin

The Yucaipa Basin occupies the eastern part of the San Bernardino Valley service area and a portion of it extends into Riverside County, an area within the San Gorgonio Pass Water Agency service area; therefore, both State Water Contractors and local cities and water agencies established the Yucaipa Sustainable Groundwater Management Agency (Yucaipa SGMA) to manage the Basin. At its April 24 meeting, the Yucaipa SGMA Board received updates on the Water Year 2024 conditions in addition to other updates and discussions. For the first six (6) months of the water year, total precipitation has exceeded the mean annual rainfall. Groundwater levels are stable or increasing across the four management areas from a combination of abundant rainfall and reduced pumping.

One major development within the Basin is the County Line Recharge Project, which will recharge the Calimesa Management Area. San Bernardino Valley (State Water Contractor on the San Bernardino County side of the Basin), San Gorgonio Pass Water Agency (State Water Contractor on the Riverside County side of the Basin), and the South Mesa Company are collaborating on the project. The Calimesa Management Area has limited natural recharge and currently has no access to artificial replenishment from an outside source of water. The project will be done in two phases comprising of a pipeline and basin in the fall of 2024 and a second phase consisting of construction of State Water Project turnout and related facilities in 2025. The Riverside County Board of Supervisors recently authorized $3.1 million of its American Rescue Plan Act (ARPA) funding for the project thanks to support by Supervisor Gutierrez and the San Gorgonio Pass Water Agency Board.

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MUNICIPAL WATER DISTRICT
380 East Vanderbilt Way
San Bernardino, CA 92408
909.387.9200 | sbvmwd.com

June 5, 2024 ***Sent via email***

Mr. Brian Dickinson Director of Public Works and Utility Services City of Colton 150 South Tenth Street Colton, CA 92324-3406	Telephone	(909) 370-6196
Mr. Martin E. Zvirbulis Vice President – Water Resources Fontana Water Company Post Office Box 987 Fontana, CA 92334	Telephone	(909) 822-2201
Ms. Toyasha Sebbag Assistant to the City Manager City of Rialto 150 S. Palm Avenue Rialto, CA 92376-5842	Telephone	(909) 820-2525 Ext. 2062
Ms. Stephanee Valencia Operations Supervisor Veolia Water/Rialto Water Services 325 West Rialto Avenue Rialto, CA 92376	Telephone	(909) 301-1338
Mr. John Thiel General Manager West Valley Water District Post Office Box 920 Rialto, CA 92377-0920	Telephone	(909) 875-1804

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Ladies and Gentlemen:

On December 22, 1961, a DECREE, a stipulated judgment, was entered for The Lytle Creek Water and Improvement Company, a corporation, vs. Fontana Ranchos Water Company, a corporation, et al., San Bernardino County Superior Court Case Number 81264. Several of the stipulating parties requested San Bernardino Valley Municipal Water District (San Bernardino Valley) to monitor the compliance with the Decree.

The Decree specifies that each of three (3) index wells in the Rialto Basin shall be measured in March, April, and May of each year. The enclosed table illustrates the measurements of the Rialto Basin index wells for each of the months of March 2024, April 2024, and May 2024 for the October 1, 2023 through September 30, 2024 water year. These measurements are furnished by the respective owner of each of the index wells.

In March 2024, West Valley Water District (WVWD) experienced issues measuring water levels in one of the three index wells, Willow Street Well (1S/5W-2K1, Well No. 11). In accordance with Section 6 of the Decree, WVWD approached the stipulating parties to discuss the best approach forward. The parties, including the City of Colton, Fontana Water Company, the City of Rialto, and WVWD agreed to forgo the March water level measurements in the well, mainly because the April and May water levels have historically been higher than the March water levels. Subsequently in late April 2024, WVWD cleared the blockage in the sounding tube and air vent in the well so it could continue to serve as an index well. As a result, WVWD was able to collect the April and May water level measurements for the Willow Street Well.

The water level elevations above mean sea level, the apparent spring-high water level elevation for each well, and the average of the elevations of the spring-high water level elevations are shown in the attached table and figure. The average of the spring-high water level elevations determined in accordance with the Decree is 921.0 feet above mean sea level for the October 1, 2023 through September 30, 2024 year.

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Paragraph 7 of the Decree sets forth specified limits on the amount of groundwater extractions allowed by the stipulating parties from the Rialto Basin based on the average of the elevations of the spring-high water level elevations. The average of the elevations of the spring-high water level elevations for the October 1, 2023 through September 30, 2024 water year is 921.0 feet above mean sea level, or 48.7 feet below elevation 969.7 feet above mean sea level. Paragraph 7 of the Decree specifies that for this condition; "*... the amount of water which the stipulating parties shall be entitled to pump from the Basin during such year shall be reduced one percent (1%) for each one (1) foot that the said average is below 969.7 feet above mean sea level...*" Accordingly, the amounts of water to which the stipulating parties are respectively entitled to extract from the Basin as specified in Paragraph 5 of the decree, should be reduced by forty-nine percent (49%) for the October 1, 2023 through September 30, 2024 water year.

If you have any questions, please contact me at (909) 387-9256 or Michael Plinski at (909) 387-9230.

Sincerely,

Heather Dyer, M.S., MBA
CEO/General Manager

Enclosure:
Table – Average of Spring–High Water Surface Elevations of Rialto Basin Index Wells
Figure – Average of Spring-High Water Surface Elevations of Rialto Basin Index Wells

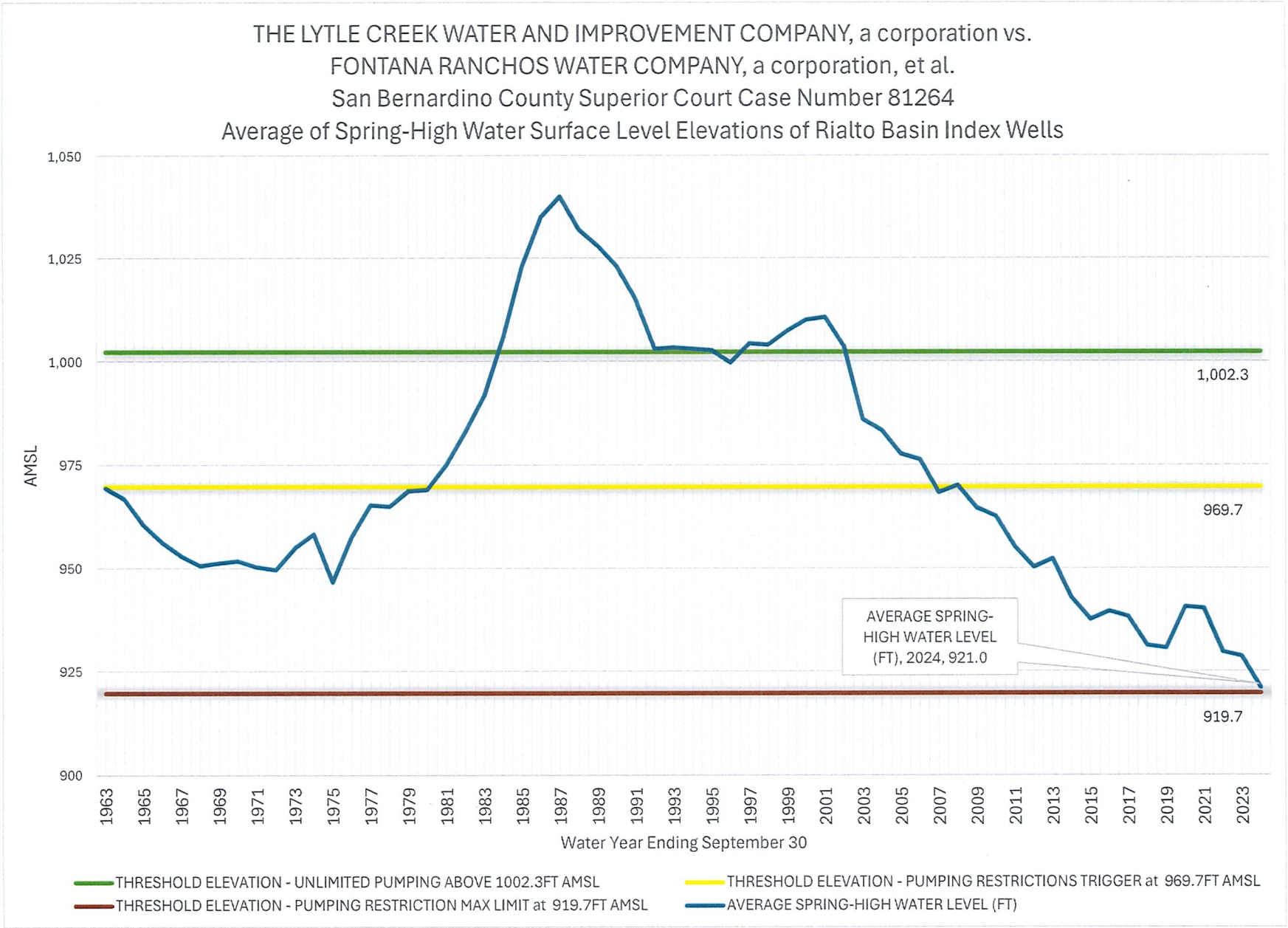
THE LYTLE CREEK WATER AND IMPROVEMENT COMPANY, a corporation vs.
FONTANA RANCHOS WATER COMPANY, a corporation, et al.
San Bernardino County Superior Court Case Number 81264

Rialto Basin Index Wells

	City of Rialto		WSBCWD No. 11		WSBCWD No. 16	
Well Name:	Duncan Well		Willow Street Well		Boyd Well	
State Well No:	1S/5W-3A1		1S/5W-2K1		1S/5W-12L1	
Elevation:	1352.79		1287.00		1177.19	
	Depth to Water	Water Surface Elevation	Depth to Water	Water Surface Elevation	Depth to Water	Water Surface Elevation
2024						
March	415.00	937.79	---*	---*	284.00	893.19
April	415.00	937.79	359.00	928.00	280.00	897.19
May	415.00	937.79	359.00	928.00	283.00	894.19
"spring-high water level"		937.79		928.00		897.19

Average elevation of "spring-high water level"	920.99

* Please note West Valley Water District (WVWD) experienced issues measuring the March 2024 water level in Willow Street Well (1S/5W-2K1, Well No. 11). All stipulating parties agreed to forgo the March water level measurements in the well. In April 2024, WVWD cleared the blockage in the sounding tube and air vent so the well could continue to serve as an index well.


THE LYTLE CREEK WATER AND IMPROVEMENT COMPANY, a corporation vs.
FONTANA RANCHOS WATER COMPANY, a corporation, et al.
San Bernardino County Superior Court Case Number 81264
Average of Spring-High Water Surface Level Elevations of Rialto Basin Index Wells
AMSL
1,050
1,025
1,000
975
950
925
900
1,002.3
969.7
919.7
AVERAGE SPRING-HIGH WATER LEVEL (FT), 2024, 921.0
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
Water Year Ending September 30
THRESHOLD ELEVATION - UNLIMITED PUMPING ABOVE 1002.3FT AMSL
THRESHOLD ELEVATION - PUMPING RESTRICTIONS TRIGGER at 969.7FT AMSL
THRESHOLD ELEVATION - PUMPING RESTRICTION MAX LIMIT at 919.7FT AMSL
AVERAGE SPRING-HIGH WATER LEVEL (FT)

City of
REDLANDS
Incorporated 1888
Municipal Utilities & Engineering Department
35 Cajon Street, Suite 15A
Redlands, CA 92373
909-798-7698

JOHN R. HARRIS
Director

June 5, 2024

Yucaipa Sustainable Groundwater Agency
Attn: Mark Iverson
c/o City of Yucaipa
34272 Yucaipa Boulevard
Yucaipa, CA 92399

RE: City of Redlands Withdrawal from the Yucaipa Sustainable Groundwater Agency

Mr. Iverson –

On June 4, 2024, the Redlands City Council approved Resolution No. 8587 (attached) to withdraw from the Yucaipa Sustainable Groundwater Agency (Yucaipa GSA). This resolution rescinded Resolution No. 7735 (attached) and directs City staff to submit a formal withdrawal notice in accordance with Section IX of the *Memorandum of Agreement to form a GSA for the Yucaipa Sub-Basin (Sub-basin No. 8-02.07)*. Please accept this correspondence as our formal ninety (90) day written withdrawal notice to all Yucaipa GSA Parties subject to the conditions of Section IX of the MOA.

Feel free to contact me directly with any questions.

Sincerely,

John R. Harris
City of Redlands
Municipal Utilities and Engineering Director
jharris@cityofredlands.org
(909) 798-7658

Attachments:
City of Redlands Resolution No. 8587
City of Redlands Resolution No. 7735

RESOLUTION NO. 8587

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF REDLANDS TO WITHDRAW FROM THE YUCAIPA GROUNDWATER SUSTAINABILITY AGENCY

WHEREAS, in September 2014, Governor Jerry Brown signed into law the Sustainable Groundwater Management Act (SGMA), which went into effect on January 1, 2015; and

WHEREAS, the legislative intent of the SGMA is to, among other goals, provide for sustainable management of groundwater basins and sub-basins defined by the California Department of Water Resources (DWR), to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide specified local agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, Water Code Section 10723(a) authorizes a local agency with water supply, water management, or local land use responsibilities, or a combination of local agencies overlaying a groundwater basin to elect to become a Groundwater Sustainability Agency (GSA) under the SGMA; and

WHEREAS, the City of Redlands (City), as depicted in the map attached hereto as Exhibit "A", overlies portions of the basin, identified by the California DWR Bulletin 118 as Sub-basin No. 8-02.07 of the Upper Santa Ana Valley Groundwater Basin; and

WHEREAS, on June 6, 2017, the City Council adopted Resolution No. 7735 approving a Memorandum of Agreement (MOA) to jointly form a GSA for the Yucaipa Sub-Basin No. 8-02.07 with the intent of developing a Groundwater Sustainability Plan (GSP) cooperatively with other agencies within the Yucaipa Sub-Basin; and

WHEREAS, on January 18, 2022, the City Council adopted Resolution No. 8290 to adopt the Yucaipa Sub-Basin GSP; and

WHEREAS, the City does not currently extract groundwater from any portion of the Yucaipa Sub-Basin No. 8-02.07 and is bound by the requirements and restrictions detailed in the Yucaipa Sub-Basin GSP if it extracts groundwater from the Yucaipa Sub-Basin in the future.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Redlands as follows:

Section 1. The City Council hereby rescinds Resolution No. 7735 and elects to withdraw from the Yucaipa GSA.

Section 2. City staff is hereby directed to submit to the Yucaipa GSA a formal notice of withdrawal in accordance with Section IX of the MOA to form a GSA for the Yucaipa Sub-Basin (Sub-Basin No. 8-02.07).

Section 3. The City Council further determines that approval of this Resolution is exempt from environmental review pursuant to Section 15061(b) of the State's guidelines implementing the California Environmental Quality Act (CEQA) which provides that CEQA applies only to projects which have the potential for causing a significant effect on the environment. This City Council finds with certainty that there is no possibility the approval of this Resolution may have a significant effect on the environment.

Section 4. This resolution shall be effective upon its adoption.

ADOPTED, SIGNED AND APPROVED this 4th day of June, 2024.

Eddie Tejeda, Mayor

ATTEST:

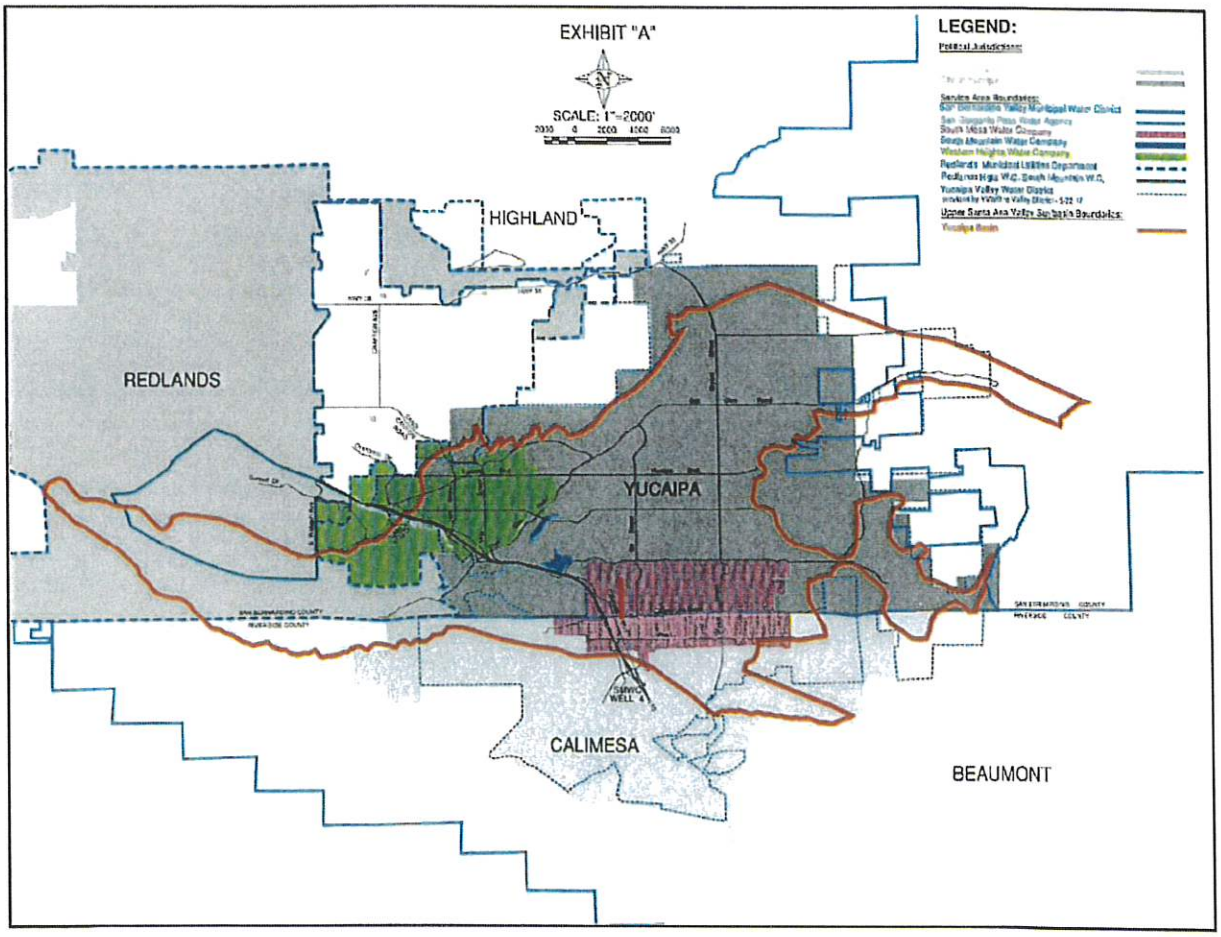
Jeanne Donaldson, City Clerk

I, Jeanne Donaldson, City Clerk of the City of Redlands, hereby certify that the foregoing resolution was duly adopted by the City Council at a regular meeting thereof held on the 4th day of June, 2024, by the following vote:

AYES:	Councilmembers Guzman-Lowery, Saucedo; Mayor Tejeda
NOES:	Councilmember Barich and Davis
ABSENT:	None
ABSTAINED:	None

Jeanne Donaldson, City Clerk

EXHIBIT "A"



I:\Resolutions\Res 8500-8599\8587 Withdraw from Yucaipa Groundwater Sustainability Agency.docx-ms

RESOLUTION NO. 7735

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF REDLANDS APPROVING A MEMORANDUM OF AGREEMENT TO JOINTLY FORM A GROUNDWATER SUSTAINABILITY AGENCY FOR THE YUCAIPA SUB-BASIN NO. 8-02.07 AND TO COORDINATE WITH OTHER GROUNDWATER SUSTAINABILITY AGENCIES

WHEREAS, in September 2014, Governor Jerry Brown signed into law the Sustainable Groundwater Management Act (SGMA), which went into effect on January 1, 2015; and

WHEREAS, the legislative intent of the SGMA is to, among other goals, provide for sustainable management of groundwater basins and sub-basins defined by the California Department of Water Resources (DWR), to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide specified local agencies with the authority and technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, Water Code Section 10723(a) authorizes a local agency with water supply, water management, or local land use responsibilities, or a combination of local agencies, overlaying a groundwater basin to elect to become a Groundwater Sustainability Agency (GSA) under the SGMA; and

WHEREAS, the City of Redlands (City), as depicted in the map attached hereto is Exhibit "A", overlies portions of the basin, and is identified by the California DWR Bulletin 118 as Sub-basin No. 8-02.07 of the Upper Santa Ana Valley Groundwater Basin; and

WHEREAS, in accordance with Water Code Section 10723(b) and Government Code Section 6066, a notice of public hearing was published in a newspaper of general circulation regarding the City's intent to become a GSA for the Yucaipa Sub-basin, as described in the notice; and

WHEREAS, becoming a GSA supports the City's ongoing efforts to use local water supplies in a way that increases its availability for future generations within the region and to ensure groundwater and drinking water sustainability within the area served;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Redlands as follows:

Section 1. The City hereby elects to adopt the MOA for the geographical area depicted on the map in Exhibit "A," attached to this Resolution.

Section 2. City staff is hereby directed to submit to DWR by June 30th, 2017, the MOA attached to this Resolution as Exhibit "B."

Section 3. This City further determines that approval of this Resolution is exempt from review under California Environmental Quality Act ("CEQA") pursuant to CEQA Guidelines Section 15061(b) which provides that CEQA applies only to projects which have the potential for causing a significant effect on the environment. This City Council finds with certainty that

there is no possibility the approval of this Resolution may have a significant effect on the environment.

Section 4. This Resolution shall be effective upon its adoption.

ADOPTED, SIGNED AND APPROVED this 6th day of June, 2017.

Paul W. Foster, Mayor

ATTEST:

Jeanne Donaldson, City Clerk

I, Jeanne Donaldson, City Clerk of the City of Redlands, hereby certify that the foregoing Resolution was duly adopted by the City Council at a regular meeting thereof, held on the 6th day of June, 2017, by the following vote:

AYES:	Councilmembers Harrison, Gilbreath, Barich, Tejeda; Mayor Foster
NOES:	None
ABSTAIN:	None
ABSENT:	None

Jeanne Donaldson, City Clerk

Exhibit A

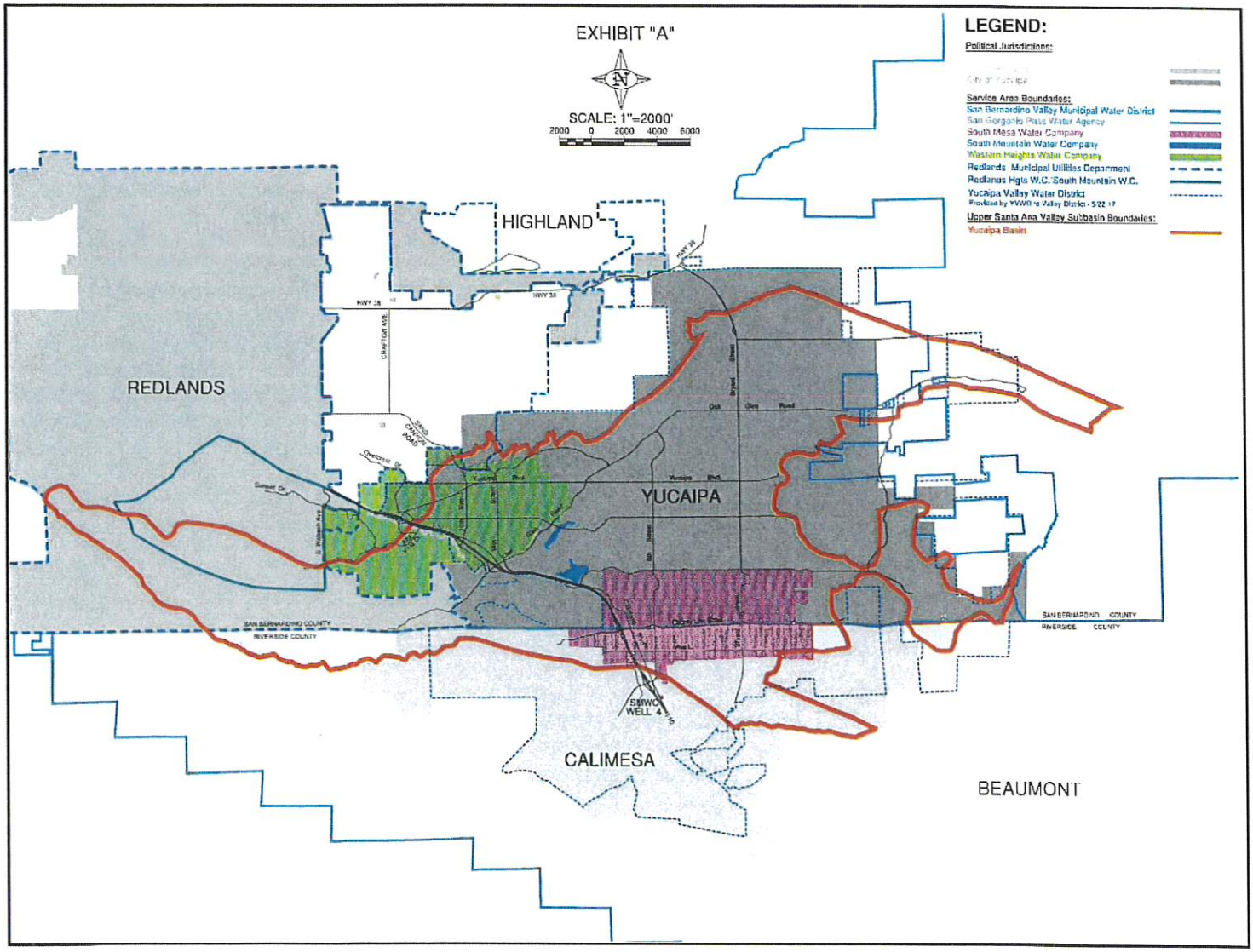


EXHIBIT "A"
SCALE: 1"=2000'
2000 0 2000 4000 6000
LEGEND:
Political Jurisdictions:
Service Area Boundaries:
San Bernardino Valley Municipal Water District
San Gorgonio Pass Water Agency
South Mesa Water Company
South Mountain Water Company
Western Heights Water Company
Redlands Municipal Utilities Department
Redlands Hgts W.C./South Mountain W.C.
Yucaipa Valley Water District
Upper Santa Ana Valley Subbasin Boundaries:
Yucaipa Basin
HIGHLAND
REDLANDS
YUCAIPA
CALIMESA
BEAUMONT
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
SMWC WELL 4

Exhibit B to Resolution No. 7735

Memorandum of Agreement to Form a
Groundwater Sustainability Agency for
the Yucaipa Sub-Basin (Sub-basin No. 8-02.07)

MEMORANDUM OF AGREEMENT TO FORM A GROUNDWATER SUSTAINABILITY AGENCY FOR THE YUCAIPA SUB-BASIN (Sub-basin No. 8-02.07)

This 2017 Memorandum of Agreement ("MOA") is entered into by and among: South Mesa Water Company ("SOUTH MESA"), South Mountain Water Company ("SOUTH MOUNTAIN"), Western Heights Water Company ("WESTERN HEIGHTS") and Yucaipa Valley Water District ("YVWD"), herein collectively referred to as the "WATER PURVEYORS"; and, the City of Calimesa ("CALIMESA"), the City of Redlands ("REDLANDS") and the City of Yucaipa ("YUCAIPA"), herein collectively referred to as the "MUNICIPALITIES"; and, the San Bernardino Valley Municipal Water District ("SAN BERNARDINO VALLEY MUNICIPAL") and the San Gorgonio Pass Water Agency ("SAN GORGONIO"), herein collectively referred to as the "REGIONALS." The MUNICIPALITIES are sometimes herein collectively referred to as the "LAND USE AGENCIES." Each of the above-described entities is individually referred to as a "Party" and are collectively referred to as the "Parties". For purposes of this MOA, SOUTH MESA, SOUTH MOUNTAIN and WESTERN HEIGHTS are collectively referred to as the "MUTUALS"; and, the Parties other than the MUTUALS are collectively referred to as the "LOCAL AGENCIES."

Pursuant to the Sustainable Groundwater Management Act ("SGMA") and as further set forth herein, the purpose of this MOA is to form a Groundwater Sustainability Agency ("GSA") for the entire Yucaipa Sub-basin (Basin or Sub-Basin No. 8-02.07), in order to preserve local management and control of the Basin as set forth under SGMA.

The County of Riverside ("RIVERSIDE") and the County of San Bernardino ("SAN BERNARDINO"), collectively "COUNTIES," shall be considered "Stakeholders" but not Parties to this MOA.

Recitals

WHEREAS, on September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319, and Assembly Bill 1739, collectively known as the Sustainable Groundwater Management Act ("SGMA"), codified in certain provisions of the California Government Code, including commencing with Section 65350.5, and codified in Part 2.74 of Division 6 of the California *Water Code*, commencing with Section 10720, and amending other provisions of the California *Government Code* and California *Water Code*; and

WHEREAS, SGMA went into effect on January 1, 2015; and,

WHEREAS, various clarifying amendments to SGMA were signed into law in 2015, including Senate Bills 13 and 226, and Assembly Bills 617 and 939, which were codified in part in California *Water Code* Section 10723.6(a), authorizing a combination of local agencies to form a GSA pursuant to a joint powers agreement, a memorandum of agreement, or other legal agreement; and, California *Water Code* Section 10723.6(b), authorizing water corporations regulated by the California Public Utilities Commission and mutual water companies to participate in a GSA through a memorandum of agreement or other legal agreement; and

WHEREAS, the legislative intent and effect of SGMA, as set forth in California *Water Code* Section 10720.1, includes the following: (1) to provide for the sustainable management of groundwater basins; (2) to enhance local management of groundwater consistent with rights to use or store groundwater and Section 2 of Article X of the California Constitution, and to preserve the security of water rights in the state to the greatest extent possible consistent with the sustainable management of groundwater; (3) to establish minimum standards for sustainable groundwater management; (4) to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater; (5) to avoid or minimize subsidence; (6) to improve data collection and understanding about groundwater; (7) to increase groundwater storage and remove impediments to recharge; (8) to manage groundwater basins through the actions of local governmental agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner; and (9) to provide a more efficient and cost-effective groundwater adjudication process that protects water rights, ensures due process, prevents unnecessary delay, and furthers the objectives of SGMA; and,

WHEREAS, SGMA affords GSAs specific powers to manage groundwater in addition to existing legal authorities, which powers may be used to provide the maximum degree of local control and flexibility consistent with the sustainability goals of SGMA; and,

WHEREAS, SGMA includes several un-codified findings by the California Legislature, including the determination that the people of the state have a primary interest in the protection, management, and reasonable beneficial use of the water resources of the state, both surface and underground, and that the integrated management of the state's water resources is essential to meeting its water management goals; and,

WHEREAS, the Basin, as depicted in **Exhibit A** to this MOA, is identified by the California Department of Water Resources Bulletin 118 as Sub-basin No. 8-02.07 of the Upper Santa Ana Valley Groundwater Basin, and is designated by DWR as medium-priority; and,

WHEREAS, California *Water Code* Section 10720.7 requires the Basin, as a medium-priority basin that is not designated by DWR as being subject to critical conditions of overdraft, to be managed by a Groundwater Sustainability Plan ("GSP") or coordinated GSPs by January 31, 2022; and,

WHEREAS, in order to avoid designation as a probationary basin and become subject to direct intervention and management by the State Water Board, California *Water Code* Section 10735.2 requires that, by June 30, 2017 a collection of local agencies must form a GSA or prepare agreements to develop one or more GSPs that will collectively serve as a GSP for the entire Basin, in the event that a local agency has not decided to become a GSA that intends to develop a GSP for the entire Basin; and,

WHEREAS, the LOCAL AGENCIES have water supply, water management, and/or land use responsibilities for their respective jurisdictional areas overlying the Basin and are local agencies as defined by SGMA in California *Water Code* Section 10721(n), and thus each is authorized by SGMA to become or form a GSA; and,

WHEREAS, the LOCAL AGENCIES' individually have jurisdictional and/or service areas within and their collective jurisdictional areas and/or service areas cover the entirety of the Basin, with no gaps in coverage; and,

WHEREAS, the WATER PURVEYORS, including the MUTUALS, produce groundwater and provide water service within the Basin, and it is the Parties' shared intent to provide for management-level participation by the MUTUALS in the GSA to the maximum extent allowed by law without limiting any powers afforded to a GSA under SGMA; and,

WHEREAS, the REGIONALS are State Water Contractors, and have the rights and duties of such, including for the delivery of State Water Project Water within the Basin; and,

WHEREAS, in accordance with the terms of this MOA, and in furtherance of the shared intent of the Parties to maximize funding opportunities for the Basin and avoid potential intervention in the Basin by the State Water Board, the Parties agree that the YUCAIPA-GSA formed by this MOA will cover the entire Basin; and,

WHEREAS, the Parties mutually desire and intend to work with local stakeholders and interested parties in the Basin that are not Parties to this MOA, to carry out the policy, purposes, and requirements of SGMA in the Basin.

Agreement

NOW, THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, it is mutually understood and agreed as follows:

I. **Incorporation of Recitals.** The Recitals stated above are incorporated herein by reference.

II. **Purposes.** The purposes of this MOA is to form the YUCAIPA-GSA for the Basin as specified herein pursuant to applicable provisions and requirements of SGMA, including but not limited to California *Water Code* Sections 10723 and 10723.6.

III. **Approval of MOA and Formation of the YUCAIPA-GSA.** Approval of this MOA and formation of the YUCAIPA-GSA shall be accomplished by the LOCAL AGENCIES each holding its own noticed public hearing pursuant to California *Water Code* Section 10723(b) and California *Government Code* Section 6066 and at such hearing will consider approval of a Resolution by its governing board to enter this MOA and jointly form the YUCAIPA-GSA as specified in this MOA. Approval of this MOA by the MUTUALS shall be accomplished through their respective governing boards' duly authorized procedures.

IV. **Definitions.** The following terms, whether used in the singular or plural, and when used with initial capitalization, shall have the meanings specified herein. The Parties agree that any definitions set forth herein are intended to be consistent with SGMA, and in the event of any discrepancy between a defined term in this MOA and a defined term in SGMA, the terms of SGMA shall control.

A. "Basin" refers to the Yucaipa Sub-basin, designated by the California Department of Water Resources Bulletin 118 as Sub-basin No. 8-02.07, as depicted in **Exhibit A** to this MOA.

B. "DWR" means the California Department of Water Resources.

C. "GSA" means a Groundwater Sustainability Agency, as defined by SGMA.

D. "GSP" means a Groundwater Sustainability Plan, as defined by SGMA.

E. "Memorandum of Agreement" or "MOA" refers to this Memorandum of Agreement.

F. "SGMA" refers to the Sustainable Groundwater Management Act, of 2014, as amended.

G. "State Water Board" means the California State Water Resources Control Board.

H. "YUCAIPA-GSA" refers to the Yucaipa Sub-basin GSA formed under this MOA.

V. Coordination and Cooperation

A. Continued Cooperation. The Parties to this MOA will continue to meet, confer, coordinate, and collaborate to discuss and develop technical, managerial, financial, and other criteria and procedures for the preparation, governance, and implementation of a GSP or coordinated GSPs in the Basin and to carry out the policy, purposes, and requirements of SGMA in the Basin.

B. Points of Contact. Each Party shall designate a principal contact person for that Party, who may be changed from time to time at the sole discretion of the designating Party. The principal contact person for each Party shall be responsible for coordinating with the principal contact persons for the other Parties in scheduling meetings and other activities under this MOA.

C. Voting Methodology. The voting structure for matters pertaining to the establishment and implementation of the administrative components of the YUCAIPA-GSA shall be by simple majority (51%) of the voting Parties, wherein each WATER PURVEYOR, MUNICIPALITY and REGIONAL holds a single vote.

VI. Roles and Responsibilities

A. The YUCAIPA-GSA shall be controlled by a Governing Board comprised of one representative of each of the Parties to this MOA.

B. The Parties agree to jointly establish their specific roles and responsibilities for implementing this MOA, including through the adoption of organizational documents, management policies, rules and procedures.

C. The Parties agree to jointly develop and implement a GSP or coordinated GSPs for the Basin in accordance with SGMA.

D. The Parties agree to work in good faith and coordinate all activities to carry out the purposes of this MOA in implementing the policy, purposes, and requirements of SGMA in the Basin, including continuing to meet, confer, coordinate, and collaborate to discuss and develop governance, management, technical, financial, and other matters, including respective roles and responsibilities for activities such as, but not limited to, the following: modeling;

metering; monitoring; hiring consultants; developing and maintaining list of interested persons under California *Water Code* Section 10723.4; budgeting; and other initial tasks as determined by the Parties.

E. The LOCAL AGENCIES shall coordinate with each other to cause all applicable noticing and submission of required information to DWR regarding formation of the YUCAIPA-GSA.

VII. Funding and Budgeting. The Parties shall work together to identify the costs, funding needs and funding sources for the administration of the YUCAIPA-GSA and the development and implementation of the GSP. To the extent not otherwise funded in accordance with or inconsistent with SGMA's provisions regarding GSA funding, the PURVEYORS shall collectively bear seventy-five percent (75%) and the MUNICIPALITIES and REGIONALS shall collectively bear twenty-five percent (25%) of the cost of the creation and administration of the YUCAIPA-GSA; and within each group, the Parties shall equally share in the costs of the creation and administration of the YUCAIPA-GSA. Nothing in this provision shall obligate any party to bear any portion of the attorneys' fees and legal costs of another Party.

VIII. Stakeholders. The initially designated stakeholders are the COUNTIES. The Parties agree to work together in ensuring public outreach and involvement of the public and other interested stakeholders throughout the SGMA process, including but not limited to all beneficial uses and users of groundwater as provided in SGMA Section 10723.2. Stakeholders have no voting rights under Section V.C. and no cost sharing obligations under Section VII of this MOA.

IX. Term, Termination, and Withdrawal.

A. Term. This MOA shall continue and remain in effect unless and until terminated by the unanimous written consent of the Parties, or as otherwise provided in this MOA or as authorized by law.

B. Withdrawal. After the YUCAIPA-GSA is officially established as the GSA for the Basin, any Party may decide, in its sole discretion, to withdraw from this MOA by providing ninety (90) days written notice to the other Parties. A Party that withdraws from this MOA shall remain obligated to pay its share of costs and expenses incurred or accrued under this MOA and any related cost-sharing agreement or arrangement up to the date the Party provides its notice of withdrawal as provided herein. Withdrawal by a Party shall not cause or require the termination of this MOA or the existence of the YUCAIPA-GSA with respect to the non-withdrawing Parties. In the event of withdrawal by one of the LOCAL AGENCIES, the Parties shall meet and confer during the 90-day notice period regarding: (i) whether the withdrawing Party wishes to seek GSA status for a portion of the Basin underlying the jurisdictional area or service area of the withdrawing Party; (ii) whether, as a result of the withdrawal, a co-GSA management or other arrangement with the withdrawing Party is necessary to satisfy the requirements of SGMA; and (iii) any other issues and steps that are necessary to avoid triggering probationary status of the Basin and State Water Board intervention. Any resolution of issues pertaining to withdrawal and any

other GSA issues shall be undertaken in a manner that satisfies all requirements of SGMA and DWR, including any requirement to file new GSA notices.

X. Notice Provisions

All notices required by this MOA shall be made in writing and delivered to the respective representatives of the Parties at their respective addresses as follows:

PARTIES:

PURVEYORS:

South Mesa Water Company
391 West Avenue L
Calimesa, California 92320
Attn: Dave Armstrong, General Manager
Email: smwc@verizon.net

South Mountain Water Company
35 Cajon Street
Redlands, California 92373
Attn: Cecilia Griego, Water Resources Specialist
Email: cgriego@cityofredlands.org

Western Heights Water Company
32352 Avenue D
Yucaipa, California 92399
Attn: William Brown, General Manager
Email: w.brown@westernheightswater.org

Yucaipa Valley Water District
12770 Second Street
Yucaipa, California 92399
Attn: Joseph, Zoba, General Manager
Email: jzoba@yvwd.dst.ca.us

MUNICIPALS:

City of Calimesa
908 Park Avenue
Calimesa, California 92399
Attn: Bonnie Johnson, City Manager
Email: bjohnson@cityofcalimesa.net

City of Redlands
35 Cajon Street
Redlands, California 92373
Attn: Chris Diggs, Municipal Utilities and Engineering Director
Email: cdiggs@cityofredlands.org

City of Yucaipa
34272 Yucaipa Boulevard
Yucaipa, California 92399
Attn: Ray Casey, City Manager
Email: rcasey@yucaipa.org

REGIONALS:

San Bernardino Valley Municipal Water District
380 E. Vanderbilt Way
San Bernardino, CA 92408
Attn: Douglas Headrick, General Manager & Chief Engineer
Email: douglash@sbvmwd.com

San Gorgonio Pass Water Agency
1210 Beaumont Avenue
Beaumont, CA 92223
Attn: Jeff Davis, General Manager and Chief Engineer
Email: jdavis@sgpwa.com

STAKEHOLDERS:

COUNTIES:

County of Riverside
4080 Lemon Street
Riverside, CA 92501
Attn: Steve Horn, Senior Management Analyst, Executive Office
Email: shorn@rceo.org

County of San Bernardino
385 N. Arrowhead Avenue
San Bernardino, CA 92415-0120
Attn: Bob Page, Principal Management Analyst, Special Projects
Email: bpage@sbcounty.gov

Any Party or Stakeholder may change the address to which notices are to be given under this MOA by providing all other Parties with written notice of such change at least fifteen (15) calendar days prior to the effective date of the change. All notices shall be effective upon receipt and shall be deemed received upon confirmed personal service, confirmed facsimile delivery, confirmed courier service, or on the fifth (5^{th}) calendar day following deposit of the notice in registered first class mail.

XI. General Terms

A. Amendments. Amendments to this MOA require the unanimous written consent of all Parties and approval by the Parties' respective governing boards.

B. Successors and Assigns. The terms of this MOA shall be binding upon and inure to the benefit of the successors-in-interest and assigns of each Party; provided, however, that no transfer or assignment shall be effective until approved by the

Parties in accordance with the provisions of Section V.C. of this MOA. Once succession and/or assignment has been approved, a former Party shall have no further rights or obligations under this MOA.

C. Waiver. No waiver of any provision of this MOA by any Party shall be construed as a further or continuing waiver of such provision or any other provision of this MOA by the waiving Party or any other Party.

D. Authorized Representatives. Each person executing this MOA on behalf of a Party hereto affirmatively represents that such person has the requisite authority to sign this MOA on behalf of the respective Party.

E. Exemption from CEQA. The Parties recognize and agree that, pursuant to SGMA Section 10728.6, neither this MOA nor the preparation or adoption of a GSP constitute a "project" or approval of a project under the California Environmental Quality Act (CEQA) or the State CEQA Guidelines, and therefore this MOA is expressly exempt from CEQA review.

F. Governing Law and Venue. This MOA shall be governed by and construed in accordance with the laws of the State of California. Any suit, action, or proceeding brought under the scope of this MOA shall be brought and maintained to the extent allowed by law in the County of San Bernardino, California.

G. Attorney's Fees, Costs, and Expenses. In the event of a dispute among any or all of the Parties arising under this MOA, each Party shall assume and be responsible for its own attorney's fees, costs, and expenses.

H. Entire Agreement/Integration. This MOA constitutes the entire agreement among the Parties regarding the specific provisions of this MOA, and the Parties hereto have made no agreements, representations or warranties relating to the specific provisions of this MOA that are not set forth herein.

I. Construction and Interpretation. The Parties agree and acknowledge that this MOA has been developed through a negotiated process among the Parties, and that each Party has had a full and fair opportunity to review the terms of this MOA with the advice of its own legal counsel and to revise the terms of this MOA, such that each Party constitutes a drafting Party to this MOA. Consequently, the Parties understand and agree that no rule of construction shall be applied to resolve any ambiguities against any particular Party as the drafting Party in construing or interpreting this MOA.

J. Force Majeure. No Party shall be liable for the consequences of any unforeseeable force majeure event that (1) is beyond its reasonable control, (2) is not caused by the fault or negligence of such Party, (3) causes such Party to be unable to perform its obligations under this MOA, and (4) cannot be overcome by the exercise of due diligence. In the event of the occurrence of a force majeure event, the Party unable to perform shall promptly notify the other Parties in writing to the extent practicable. It shall further pursue its best efforts to resume its obligations under this MOA as quickly as possible and shall suspend performance only for such period of time as is necessary as a result of the force majeure event.

K. Execution in Counterparts. This MOA may be executed in counterparts, each of which shall be deemed an original and all of which when taken together shall constitute one and the same instrument.

L. No Third Party Beneficiaries. This MOA is not intended, and will not be construed, to confer a benefit or create any right on a third party or the power or right of any third party to bring an action to enforce any of the terms of this MOA.

M. Timing and Captions. Any provision of this MOA referencing a time, number of days, or period for performance shall be measured in calendar days. The captions of the various articles, sections, and paragraphs of this MOA are for convenience and ease of reference only, and do not define, limit, augment, or describe the scope, content, terms, or intent of this MOA.

IN WITNESS WHEREOF, the Parties hereto have approved and executed this MOA as of the respective dates specified in the adopting Resolution of each Party as provided above in Article III of this MOA.

[Signature Pages Follow]

Water Purveyor Party:

SOUTH MESA WATER COMPANY

By: _____
President, Board of Directors

Attest:

_____
Secretary, Board of Directors

Approved as to form:

_____
Counsel, South Mesa Water Company

Notices for the South Mesa Water Company shall be sent as follows:

Attention: General Manager
391 West Avenue L
Calimesa, California 92320

With copies to:

Michael Duane Davis, Esq.
GRESHAM SAVAGE NOLAN & TILDEN, PC
550 East Hospitality Lane
Third Floor
San Bernardino, CA 92408

Water Purveyor Party:

SOUTH MOUNTAIN WATER COMPANY

By: _____
President, Board of Directors

Attest:

_____
Secretary, Board of Directors

Approved as to form:

_____
Counsel, South Mountain Water Company

Notices for the South Mountain Water Company shall be sent as follows:

Attention: General Manager
35 Cajon Street
Redlands, California 92373

With copies to:

_____
_____
_____
_____

Water Purveyor Party:

WESTERN HEIGHTS WATER COMPANY

By: _____
President, Board of Directors

Attest:

_____
Secretary, Board of Directors

Approved as to form:

_____
Counsel, Western Heights Water Company

Notices for the Western Heights Water Company shall be sent as follows:

Attention: General Manager
32352 Avenue D
Yucaipa, California 92399

With copies to:

Michael Duane Davis, Esq.
GRESHAM SAVAGE NOLAN & TILDEN, PC
550 East Hospitality Lane
Third Floor
San Bernardino, CA 92408

Water Purveyor Party:

YUCAIPA VALLEY WATER DISTRICT

By: _____
President, Board of Directors

Attest:

_____
Secretary, Board of Directors

Approved as to form:

_____
Counsel, Yucaipa Valley Water District

Notices for the Yucaipa Valley Water District shall be sent as follows:

Attention: General Manager
12770 Second Street
Yucaipa, California 92399

With copies to:

_____
_____
_____
_____

Municipality Party:

CITY OF CALIMESA

By: _____
Mayor, City Council

Attest:

_____
Secretary, City Council

Approved as to form:

_____
Counsel, City of Calimesa

Notices for the City of Calimesa shall be sent as follows:

Attention: City Manager
908 Park Avenue
Calimesa, California 92320

With copies to:

_____
_____
_____
_____

Municipality Party:

CITY OF REDLANDS

By: _____
Mayor, City Council

Attest:

_____
Secretary, City Council

Approved as to form:

_____
Counsel, City of Redlands

Notices for the City of Redlands shall be sent as follows:

Attention: City Manager
35 Cajon Street
Redlands, California 92373

With copies to:

_____
_____
_____
_____

Municipality Party:

CITY OF YUCAIPA

By: _____
Mayor, City Council

Attest:

_____
Secretary, City Council

Approved as to form:

_____
Counsel, City of Yucaipa

Notices for the City of Yucaipa shall be sent as follows:

Attention: City Manager
34272 Yucaipa Boulevard
Yucaipa, California 92399

With copies to:

_____
_____
_____
_____

Regional Party:

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

By: _____

President, Board of Directors

Attest:

_____

Secretary, Board of Directors

Approved as to form:

_____

Counsel, San Bernardino Valley Municipal Water District

Notices for the San Bernardino Valley Municipal Water District shall be sent as follows:

Attention: General Manager
380 E. Vanderbilt Way
San Bernardino, California 92408

With copies to:

_____
_____
_____
_____

Regional Party:

SAN GORGONIO PASS WATER AGENCY

By: _____
President, Board of Directors

Attest:

_____
Secretary, Board of Directors

Approved as to form:

_____
Counsel, San Gorgonio Pass Water Agency

Notices for the San Gorgonio Pass Water Agency shall be sent as follows:

Attention: General Manager
1210 Beaumont Avenue
Beaumont, California 92223

With copies to:

_____
_____
_____
_____

Stakeholder:

COUNTY OF RIVERSIDE

By: _____

Chair, Board of Supervisors

Attest:

_____

Secretary, Board of Supervisors

Approved as to form:

_____

Counsel, County of Riverside

Notices for the County of Riverside shall be sent as follows:

Attention: General Manager
4080 Lemon Street
Riverside, California 92501

With copies to:

_____
_____
_____
_____

Stakeholder:

COUNTY OF SAN BERNARDINO

By: _____
Chair, Board of Supervisors

Attest:

_____
Secretary, Board of Supervisors

Approved as to form:

_____
Counsel, County of San Bernardino

Notices for the County of San Bernardino shall be sent as follows:

Attention: General Manager
385 N. Arrowhead Avenue
San Bernardino, California 92415-0120

With copies to:

_____
_____
_____
_____

SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

DATE: July 9, 2024

TO: Board of Directors' Workshop – Resources/Engineering

FROM: Wen Huang, Chief Operating Officer/Assistant General Manager

SUBJECT: Consider Second Amendment to Partnership Agreement for Joint Active Recharge Project Development under the Upper Santa Ana River Habitat Conservation Plan

Staff Recommendation

Approve the Second Amendment to the Partnership Agreement for Joint Active Recharge Project Development under the Upper Santa Ana River Habitat Conservation Plan with San Bernardino Valley Water Conservation District (Conservation District) and authorize the Board President to execute the Amendment.

Summary

The Partnership Agreement created an important partnership between San Bernardino Valley and San Bernardino Valley Water Conservation District (Conservation District) in advancing the Active Recharge Projects and the Upper Santa Ana River Habitat Conservation Plan. The Second Amendment contemplates a representative to the "Partnership Agreement Policy Committee" originally to be appointed by the Groundwater Council now to be appointed by the Basin Technical Advisory Committee instead.

Background

On January 8, 2019, the Board approved the Partnership Agreement with Conservation District for Joint Active Recharge Project Development under the Upper Santa Ana River Habitat Conservation Plan ("River HCP"). This agreement created an important partnership between the two agencies, providing conservation easements on Conservation District-owned lands to satisfy anticipated habitat mitigation requirements for the River HCP in exchange for funds dedicated to development of additional stormwater capture and groundwater recharge in accordance with the Conservation District's mission. The agreement specified certain planned Active Recharge Projects to be transferred from San Bernardino Valley to Conservation District for analysis, design, and construction, and recognized the ability of Conservation District to utilize the conservation easement funds for related land acquisitions, water quality or supply facilities development, and

other related projects with similar benefits within the jurisdictional boundaries of at least one of the two parties.

The Projects transferred as part of the Agreement were initially termed the Active Recharge Transfer Projects (ARTP) and are now rebranded as the Program for the Expansion of Recharge Capacity (PERC). The original five-year agreement term was set to expire in January 2024. The First Amendment to extend its term for 5 years to January 2029 was approved by both Boards in December 2023.

Under the Agreement, the parties formed a "Partnership Agreement Policy Committee," which comprised of the general managers and one Board appointed member of both agencies, or their designees, and one representative of the San Bernardino Basin Groundwater Council. Given the Groundwater Council was not extended beyond its original five-year and a one-year extension term, at a meeting on June 4, 2024, the Partnership Agreement Policy Committee determined that the member originally to be appointed by the Groundwater Council should instead be appointed by the Basin Technical Advisory Committee, which will continue in existence beyond the tenure of the Groundwater Council. The attached Second Amendment to the Original Agreement was therefore prepared for consideration by the Board of Directors to effectuate the change.

District Strategic Plan Application

The effort is consistent with the Mission Statement to work collaboratively to provide a reliable and sustainable water supply to support the changing needs of our region's people and environment, specifically through driving science-based decision-making, proactive risk management, and effective communication and engagement.

Fiscal Impact

There is no additional fiscal impact to the District as a result of approving this amendment with Conservation District's continuation of the PERC effort.

Attachments

1. Partnership Agreement and the First Amendment for Joint Active Recharge Project Development under the River HCP with San Bernardino Valley Water Conservation District
2. Second Amendment to Partnership Agreement for Joint Active Recharge Project Development under the River HCP

PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN

This PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN ("Agreement") is entered into this 8th day of January, 2019, by and between the SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT ("Conservation District") and SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT ("Valley District"), in consideration of all of the following:

RECITALS:

WHEREAS, the Conservation District and Valley District (individually sometimes referred to herein as a "party," or collectively "parties") enjoy a strong, recent history of cooperation and pooling of resources toward regional betterment of the availability, quality and flexibility of groundwater supplies and management, including all of the following:

1. Entering into an "Easement and License Agreement" on or about April 2008, whereby the Conservation District and Valley District agreed to cooperate in the sharing of available recharge facilities, and the development of additional facilities and the sharing of maintenance costs in connection with same;

2. Entering into an "Agreement to Develop and Operate Enhanced Recharge Facilities" on or about October 2012, under which Valley District leased facilities of the Conservation District, and the parties delineated responsibilities for the operation and maintenance of existing spreading basins and opportunities for the development, ownership, and operation of new facilities; and

3. Assuming joint lead organizational responsibilities leading to the "San Bernardino Basin Groundwater Council Framework Agreement," an initiative which formed a multi-agency forum for assessment, planning, and funding for balancing the availability of local native water supplies with imported water supplies, and balancing commitments under prior water adjudications with historical and evolving current groundwater production demands, while striking an equitable balance for prospective funding and planning for long-term groundwater resource sustainability;

WHEREAS, the Conservation District has for some time been formulating, sponsoring, coordinating, and serving as lead agency for the Upper Santa Ana River Wash Land Management and Habitat Conservation Plan ("Wash Plan"), under which it has undertaken extensive habitat modeling development, field surveys and verifications, habitat assessments, formulations of habitat management plans and funding estimates for same, and otherwise

conducted negotiations with resource protection agencies, including the United States Fish and Wildlife Service and the California Department of Fish and Wildlife, to establish reasonable and responsible criteria for the balancing of habitat preservation and management needs with the demands for the public benefits resulting from public work projects and other "Covered Activities" under the Wash Plan;

WHEREAS, through the efforts of the Wash Plan, the Conservation District, acting in coordination with the resource protection agencies, has developed habitat surveys, habitat assessment tools, and proposed management plans and programs which are anticipated to serve as the basis of a successful approval of the Wash Plan, and implementation of a multi-agency Incidental Take Permit, along with a habitat conservation plan to offset impacts to endangered and threatened species and their critical habitats from covered activities included within the Wash Plan;

WHEREAS, Valley District has been a supportive member and investor of the Wash Plan;

WHEREAS, Valley District has, in its own right and in conjunction with public agency partners, including the Conservation District, undertaken the Upper Santa Ana River Habitat Conservation Plan ("River HCP"), as part of its mission to expand and improve the region's capacity to divert, store, and recharge water. The governance of the River HCP is still in the process of being negotiated, but its participants presently anticipate a Joint Powers Authority or some similar mechanism. The River HCP's covered activities will include the proposed Active Recharge Projects, which will expand available facilities for increased regional groundwater management, including accommodation of both native water and imported water supplies on a regionally cooperative basis;

WHEREAS, the Conservation District as a partner in and member of the River HCP has participated in review of the Active Recharge Projects, especially the Mill Creek Project;

WHEREAS, both Valley District and the Conservation District seek to build upon the positive work done in the Wash Plan, and the positive working relationships with resource protection agencies fostered thereby, in advancing the Active Recharge Projects and the River HCP;

WHEREAS, Valley District and its River HCP partners have estimated that mitigation requirements for the River HCP, including Active Recharge Projects, may call for substantial amounts of acreage of San Bernardino kangaroo rat or other species habitat to be placed under conservation easements in mitigation of effects from River HCP covered activities;

WHEREAS, the Conservation District and Valley District now wish to draw upon their strong and productive recent history of cooperation to combine their resources and expertise in service of the advancement and effectuation of the River HCP and Active Recharge Projects, while at the same time ensuring that the fiscal and other benefits flowing from the necessary

habitat preservation and mitigation components of those efforts redound to the benefit of, and stay within the purview of, local regional water interests, to serve the joint constituencies of the Conservation District and Valley District;

WHEREAS, the Conservation District has identified that it owns approximately two hundred ninety five (295) acres of lands it believes constitute suitable San Bernardino kangaroo rat or other species' habitat, which may be appropriate for use in conjunction with the anticipated habitat mitigation requirements expected for the River HCP, including Active Recharge Projects; and

WHEREAS, both the Conservation District and Valley District realize that available San Bernardino kangaroo rat and other species' habitat could be purchased from, or sold to, private development or other interests, at varying costs, and by varying purchasing agencies. However, both Conservation District and Valley District believe that coordinating the available habitat owned by one water agency to the use and benefit of another agency, in furtherance of projects which will improve the overall capacity of the region they both serve to preserve, manage, and maximize groundwater supplies, is in their mutual best interest, and more importantly in the best interest of their joint constituencies.

NOW THEREFORE, IN CONSIDERATION OF ALL OF THE FOREGOING, THE PARTIES DO HEREBY AGREE AS FOLLOWS:

I. HABITAT AREA

The property to which this Agreement pertains consists of the approximately two hundred ninety five (295) acres of property designated as "neutral lands" under the Wash Plan, and area in portions of the Conservation District's Mill Creek spreading grounds, or other areas owned by the District within the designated Critical Habitat of the San Bernardino Kangaroo Rat, or other threatened or endangered species ("Habitat Area"). The Habitat Area is depicted in Exhibit A, hereto. The parties understand that formal legal description will be required for all component properties of the Habitat Area, for the successful recordation of a conservation easement. Consequently, the parties agree to identify the Habitat Area for present purposes by way of general reference and mapping, and agree to meet and confer as may be necessary to share the responsibility and cost of delineating with more precision the areas to be included in the Habitat Area, with the objective being to assure it includes the contemplated two hundred ninety five (295) acres within SBKR or other species' Critical Habitat in all or portions of the following parcels: 016831106, 029705102, 029701107, 029707113, 029707108, 029707103, 029707116, 029707110, 029705106, 029707102, 029705105, 029705101, 016832110, 016832102, 016838102, 016834104, 016834204, 016834209, 016834206, 030213114 or in other lands owned by the District.

II. DUE DILIGENCE PERIOD FOR REVIEW AND ASSESSMENT OF HABITAT AREA

Although significant information on the biological and habitat status of the Habitat Areas have been developed by the Conservation District through the Wash Plan and the Mill Creek Habitat Evaluation, both conducted in cooperation with SBVMWD, the Conservation District makes no warranty, guarantee, or representation that the Habitat Area, or any part of it, is suitable for Valley District's purposes in connection with the habitat requirements of the River HCP. Beginning on the date that this Agreement is signed by both parties, and continuing for a period of one hundred twenty (120) days thereafter, Valley District shall have the right to enter on, though, and over the Habitat Area, and to perform any such surveys, mapping, species observation or trapping, soil sampling, or other reviews and investigations of the Habitat Area as it may, in its discretion, deem necessary or appropriate to determine for its own purposes whether these areas of critical habitat are suitable for potential application as habitat mitigation for covered activities under the River HCP. Valley District shall defend, indemnify, and hold harmless the Conservation District from any claim for injury or damage, whether to persons or to property, arising out of the exercise by Valley District, or any of its consultants, employees, contractors, or assignees, of this right of entry. Both parties acknowledge Conservation District has made available to Valley District existing mapping, GIS files, and habitat surveys or models performed, and Conservation District will provide at no cost other literature reviews or summaries, assessments, or other reports or data within its possession and control which Valley District may reasonably request, in order that Valley District may verify for its own purposes that these areas of the Habitat Area are suitable for River HCP mitigation purposes. After such 120 day period, if Valley District determines that the Habitat Area is not suitable for mitigation purposes for the River HCP, it shall so notify the Conservation District in writing, and this Agreement shall thereupon terminate, with no further obligation of either party to the other. Any such notice must pertain to the entire two hundred ninety five (295) acres of Habitat Area, and Valley District may not opt to accept some but not all of such area, or divide the Habitat Area, though in the event the due diligence investigations indicate the parties' present presumptions regarding the suitability and amenability of the Habitat Area prove to be incorrect, the due diligence period may be extended by mutual written agreement of the parties for their exploration of potential modification of the scope or location of the constituent properties of the Habitat Area. Absent such rejection notice from Valley District to the Conservation District, however, at expiration of the due diligence period (as may be extended), Valley District shall be deemed to have satisfied itself regarding the physical condition, habitat suitability, and amenability of the Habitat Area for use as prospective mitigation for the covered activities under the River HCP.

III. CONSERVATION EASEMENT FUNDING

Within thirty (30) days of the expiration of the due diligence period, Valley District shall pay to Conservation District the sum of EIGHTEEN MILLION FOUR HUNDRED THIRTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($18,437,500.00), which represents a unit

price of $125,000 per acre for 147.5 acres or one half of the two hundred ninety five (295) acres of Habitat Area to be set aside and reserved for satisfying the anticipated habitat mitigation requirements for the River HCP ("Initial Conservation Easement Funding"). The remaining EIGHTEEN MILLION FOUR HUNDRED THIRTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($18,437,500.00), half of the Conservation Easement Funding ("Subsequent Conservation Easement Funding") shall be remitted by Valley District to Conservation District upon the occurrence of the first of the following :

- The governance entity for the River HCP or Valley District commits to the use of acreage from the Habitat Area in excess of 147.5 acres in the aggregate, pursuant to any habitat conservation plan, incidental take or other environmental regulatory permit application
- The Conservation District is requested to commit in writing to agree to the imposition of conservation easements serving the River HCP over acreage from the Habitat Area in excess of 147.5 acres in the aggregate,
- Valley District and Conservation District both agree that, regardless of the status of environmental or other processing on the River HCP, Conservation District requires funding in excess of the initial one-half payment of the Conservation Easement Funding to meet financial demands of water conservation efforts, including "Transfer Projects" as defined below, or related land acquisitions, water quality or supply facilities development, and other related projects.
- Thirty-Six (36) months following the Effective Date of this Agreement

Both the Initial Conservation Easement Funding and Subsequent Conservation Easement Funding shall be remitted in cash, and shall be paid in a single, lump-sum payment. Immediately upon receipt of the Initial Conservation Easement Funding, the Conservation District will revise its reserve policy to segregate the entire amount in a separate fund, and shall not commingle any Conservation Easement Funding with any other reserves, funds, or monies of the Conservation District. Conservation District shall provide to Valley District, upon reasonable request by Valley District but no more than once in any twelve month period, an accounting of the amount of the Conservation Easement Funding remaining, and any application of Conservation Easement Funding to any purpose since the date of the last accounting.

IV. RESTRICTED USE OF CONSERVATION EASEMENT FUNDS

Conservation District shall hold and administer the Conservation Easement Funding, and shall have the authority, in its discretion, to invest all or any part consistent with the Conservation District's then-applicable statement of investment policy. All interest or other revenues that may be earned thereon shall accrue to the Conservation District and shall designate a share of said interest to be utilized to offset the staff and overhead expenses associated with the development and administration of the Transfer Projects incurred by the Conservation District. Notwithstanding the foregoing, Conservation District shall not pledge, encumber, or otherwise hypothecate any portion of the Conservation Easement Funding principal, except as may be

specifically permitted herein. Conservation District shall hold, apply, and use the Conservation Easement Funding principal only in the furtherance of water conservation efforts, including "Transfer Projects" (defined below) or related land acquisitions, water quality or supply facilities development, and other related projects contemplated hereunder with similar benefits, which projects are located within the jurisdictional boundaries of at least one of the two parties hereto.

V. PARTNERSHIP AGREEMENT POLICY COMMITTEE

The parties shall form a "Partnership Agreement Policy Committee" consisting of the general managers and one Board appointed member of both the Conservation District and Valley District, or their designees, and one representative of the San Bernardino Basin Groundwater Council, to be appointed by the San Bernardino Basin Groundwater Council pursuant to procedures it shall determine. The Partnership Agreement Policy Committee shall meet regularly, no less than quarterly, to review and advise the Conservation District on the status and commitment of the Conservation Easement Funding to capital projects and its interest revenues, and implementation of renewal, upgrade, relocation, rehabilitation, or maintenance projects to which the Conservation Easement Funding is to be devoted, including the Transfer Projects. The Partnership Agreement Policy committee's advice and recommendations shall be provided to the Conservation District and Valley District in writing, with a copy to be delivered to the Groundwater Council. All actions taken by the Partnership Agreement Policy committee shall be based on unanimous agreement. The Partnership Agreement Policy Committee may make recommendations, but except as otherwise provided in this Agreement, may not itself bind the legislative bodies of either the Conservation District or Valley District.

VI. RESERVATION OF HABITAT AREA FOR CONSERVATION EASEMENT

From and after the receipt of the Initial Conservation Easement Funding by the Conservation District, the Conservation District shall reserve two hundred ninety five (295) acres of conservation easement capacity within the Habitat Area in trust on behalf of water conservation and supply projects for all formally participating agencies of the River HCP (whether through a joint powers agency or other cooperative agreement or mechanism), for the purpose of the dedication, use, and ultimate commitment under conservation easements of the property included therein for mitigation requirements for the River HCP. From and after the receipt by the Conservation District of the Initial Conservation Easement Funding, and continuing until the recordation of conservation easements on the entirety of the Habitat Area, or the other termination of this Agreement, the Conservation District shall not encumber, hypothecate, pledge, sell, lease, or otherwise transfer or assign any right, title, or interest in any portion of the Habitat Area that might reduce the potential use of the Habitat Area for habitat mitigation purposes for the River HCP, such that the useable portion of the Habitat Area falls below the two hundred ninety five (295) acres. Conservation District shall continue to use reasonable diligence in the oversight of the Habitat Area during the time the Habitat Area is so reserved, and shall continue to take reasonable measures to protect such areas from trespass, spoliation, or destructive unauthorized use which would prevent its use for habitat mitigation, in

accordance with existing Conservation District land stewardship policies. Likewise, during the time the Habitat Area is so reserved, the Conservation District shall undertake no activity on, over, or within the Habitat Area that destroys, derogates, or eliminates the habitat qualities of the Habitat Area, including grading, scraping, or intentional introduction of destructive, non-native plant or animal species.

VII. CONSERVATION EASEMENT – PLEDGE AND RECORDATION

To the extent that the Conservation Easement Funding has been paid to the Conservation District (either through the Initial Conservation Easement Funding as to 147.5 acres of the Habitat Area, or the Subsequent Conservation Easement Funding as to any acreage in the Habitat Area in excess of 147.5 acres), upon approval of the River HCP, and at such time as incidental take permits or other permits requiring mitigation from the Habitat Area are ready to issue, or at any such earlier time as may be agreed to by both parties hereto, Conservation District shall record conservation easements over the Habitat Area, up to and including the full two hundred ninety five (295) acres of the Habitat Area. The form of such conservation easement shall be subject to the reasonable approval of the applicable permitting agencies, the Conservation District, and Conservation Trust, which approval shall not be unreasonably withheld or delayed.

VIII. VALLEY DISTRICT HABITAT OBLIGATIONS

The Conservation Easement Funding is intended as consideration to the Conservation District for making the Habitat Area available for conservation easements, and its cooperation in facilitating recorded conservation easements over the same. It shall be the sole responsibility of Valley District, at its cost and expense, to absorb the cost of any Habitat Area surveys, mapping, trapping or other habitat tracking, assessment, characterization, or any physical site preparation work that may be required by the applicable permitting agencies as a condition to the acceptance of the Habitat Area as appropriate offsetting mitigation to impacts from River HCP covered activities. Further, it shall be the responsibility of Valley District, at its sole cost and expense, to fund any initial treatment, or management efforts, on the habitat Area, and to fund the non-wasting or other endowment that will be required by applicable permitting agencies to sustain the permanent habitat mitigation management programs that may ultimately be approved as part of the River HCP for the Habitat Area. The parties contemplate that the non-wasting or other endowment shall be held by the Conservation Trust, a 501(c) (3) nonprofit corporation, in compliance with California Department of Fish and Wildlife requirements and regulations.

IX. SAN BERNARDINO VALLEY CONSERVATION TRUST

Both Conservation District and Valley District contemplate that the conservation easements will be held by the San Bernardino Valley Conservation Trust, who will also administer non-wasting or other endowment that will be required and approved as part of the River HCP. Valley District and the San Bernardino Valley Conservation Trust may enter into any such agreements, memoranda of understanding, or other contracts governing the details of Valley District's payment of non-wasting or other endowments, habitat management plan

compliance and reporting of same, or other matters, as may be necessary or convenient to assure the smooth, efficient implementation of habitat management plan responsibilities, and funding for meeting such responsibilities that would be carried out on up to the two hundred ninety five (295) acres of Habitat Area under Conservation Easements by the San Bernardino Valley Conservation Trust. Both Conservation District and Valley District will petition the San Bernardino Valley Conservation Trust for an expansion of its board of directors, to include one representative selected by Valley District. Notwithstanding the statements of intention of the parties herein, the Conservation Trust is not intended to be, and is not, a third party beneficiary of this Agreement.

X. TRANSFER PROJECTS

Conservation District and Valley District have identified the following conceptual projects contemplated to be included as part of the covered activities of the River HCP as "Transfer Projects." Conservation Easement Funding will be applied to these conceptual projects or to projects which achieve similar benefits to the "Transfer Projects", and the ownership and responsibility for them will be allocated as provided herein:

(a) Plunge Creek Basins 1 and 2 construction

(b) City Creek Basins construction

(c) Waterman Basin reconstruction and maintenance

(d) Twin Creek Basin repairs and maintenance

(e) Mill Creek Diversion Expansion Construction

Additional description of these conceptual projects, their estimated costs, and a diagram showing the general location of the Transfer Projects is attached hereto as Exhibit B. The Transfer Projects are at this time conceptual, and their costs are estimated. They are listed herein as examples of projects to which the Conservation Easement Funding will be applied, pending further identification of scope, timing, and available funding between the parties hereto, and the ultimate approval of the River HCP. The Transfer Project listing is not exclusive as to projects for which the Conservation Easement Funding may be applied, nor is it a commitment on the part of the Conservation District herein to fund, construct, or manage such Transfer Projects, or any of them.

XI. TRANSFER PROJECT PROCESSING.

Valley District will continue to have responsibility for permitting the Transfer Projects, to the extent such approval is part of the River HCP. To the extent additional permitting, in addition to or beyond that provided by the approvals attendant to the River HCP, is required prior to implementation of the Transfer Projects, Conservation District may, but is not obliged to, require that Valley District serve as lead agency for the filing, prosecution, funding, and

completion of all such additional permitting applications or procedures, including but not limited to processing under NEPA or CEQA. For those Transfer Projects the Conservation District does decide to proceed to fund in whole or in part with proceeds from the Conservation Easement Funding, in consultation with Valley District through the Partnership Agreement Policy Committee, Conservation District will assume the lead role in feasibility studies, engineering design, construction plan development, construction permitting, advertising, bidding, award, property or right of way acquisition, scheduling, construction, and maintenance and operation of the Transfer Projects, as may be required for each. Prior to initiating any Transfer Project, the parties shall meet and confer regarding its planning, engineering, award, bidding, and construction costs. Conservation District shall, prior to putting any Transfer Project out to bid, present the final construction engineering drawings, contract specifications, construction cost estimates, construction schedules, and the advertising and bid package ("Construction Package") to the Partnership Agreement Policy Committee for their review and concurrence. To the extent the planning, engineering, award, bidding, and construction costs of a Transfer Project undertaken by the parties hereunder cannot be fully funded by the proceeds of the Conservation Easement Funding, the parties shall determine, before undertaking the Transfer Project, whether Valley District will advance or reimburse the Conservation District for the additional project costs above available Conservation Easement Funding for the completion of the applicable Transfer Project, whether other funding is available to meet any shortfall, or whether a reduced or modified scope of the Transfer Project is appropriate to secure the highest available benefit to preserve, manage, and maximize groundwater supplies within existing available funding. Upon concurrence by the Partnership Agreement Policy Committee with the Construction Package, the Conservation District will undertake construction of the Transfer Project, and shall pursue it diligently to completion. The Conservation District shall report of the progress of any Transfer Project construction to the parties at all meetings of the Partnership Agreement Policy Committee, including schedules, budgeting, change orders or changes in scope, and any disputes or potential disputes with the contractor. To the extent the Valley District believes through the course of a Transfer Project's construction that the Conservation District is proceeding at a pace which exhibits bad faith delay, or the Conservation District's construction management and oversight is substantially below the prevailing standards of skill, competence, or timeliness in the professional construction fields generally given the scope and nature of the applicable Transfer Project ("Construction Default") , Valley District shall present written documentation supporting such belief at a meeting of the Partnership Agreement Policy Committee, and the parties shall thereupon proceed to Dispute Resolution under Section XVII below. If such processes fail to yield resolution, the parties agree that either may pursue any legal remedy at law or in equity, and specifically agree that among such equitable remedies, a court or other agreed tribunal may upon making an independent judgment finding of the existence of a Construction Default by the Conservation District, permit Valley District to assume control of the supervision of and completion of the construction of the Transfer Project, in which event Valley District may utilize those portions of the Conservation Easement Funding budgeted and concurred in by the Partnership Agreement Policy Committee for the applicable Transfer Project, towards such completion. Upon completion of each of the Transfer Projects, Conservation District shall maintain and operate such projects. The application of Conservation Easement Funding toward

capital construction of the Transfer Projects, and the relative priority of application of such funding to the Transfer Projects, shall be determined by the Conservation District, with input by Valley District in the forum of the Partnership Agreement Policy Committee.

XII. ADDITIONAL PARTNERSHIP ON TRANSFER PROJECTS

To the extent that any Transfer Project develops "new water" under the Western Judgment, the Riverside County entities benefitting from such "new water" may participate in the Transfer Projects, up to 27.95% of the costs paid to the Conservation District, upon such terms and conditions as all participants may agree. In the event the Riverside County entities choose not to join a Transfer Project at inception, but later determine to participate in such projects, such terms and conditions will include an escalation rate to reflect the time value of funds invested by the parties hereto, and other prior contributions to the applicable Transfer Project by the participants in same up to that point, as all participants may agree.

XIII. LAFCO APPROVAL

To the extent that implementation of any of the Transfer Projects by the Conservation District may require approval of the San Bernardino County Local Agency Formation Commission ("LAFCO"), whether through activation of latent powers or the adjustment of jurisdictional boundaries of the Conservation District, or otherwise, Conservation District and Valley District agree to present a joint application for such LAFCO approval, agree to cooperate reasonably in supporting such application to effectuate the purposes hereof, and shall share evenly in the costs of any such proceeding.

XIV. STATE WATER BOARD PETITION

To the extent that a request to the State Water Resources Control Board is required for any change in diversion location to any prior water right, whether held by Valley District or Conservation District, in order to effectuate the Transfer Projects, the River HCP, or the effective habitat mitigation plan ultimately approved for the Habitat Area as part of the River HCP, and so long as not in derogation of the cooperating party's own existing water rights, each party agrees to cooperate reasonably with the other to develop such an application, and agrees to cooperate reasonably in supporting such application to effectuate the purposes hereof.

XV. TERM

This Agreement shall take effect immediately upon its approval by both parties, and shall continue in full force and effect for a period of five (5) years thereafter, except those provisions relating to the transfer of the Transfer Projects to the Conservation District, which in the event such Transfer Projects are funded and implemented, the Conservation District obligations with respect to such Transfer Projects will survive the termination of this Agreement. In the event the River HCP is not approved within the five (5) year term of this Agreement, the parties may agree

in writing to an additional extension, up to and including an additional five (5) years, for a total of ten (10) years. In the event the River HCP effort is discontinued or abandoned by the River HCP partners, prior to the expiration of the term of this Agreement, and prior to the recordation of conservation easements on the Habitat Area, this Agreement may be terminated earlier than the expiration of its term, by mutual agreement of the parties.

XVI. RELEASE OF HABITAT AREA IF RIVER HCP FAILS OR IS ABANDONED

In the event the River HCP does not come to fruition, and either fails to secure approval from the applicable regulatory agencies, or is otherwise abandoned by the River HCP partners, prior to the expiration of the term of this Agreement and prior to the recordation of conservation easements on the Habitat Area, Conservation District may, but is not obligated to, release the Habitat Area from its reservation for River HCP mitigation purposes. In the event there is a factual dispute regarding whether the River HCP effort has been discontinued or abandoned by the River HCP partners, the matter shall be referred to dispute resolution processes as provided under Section XVI below. If the Conservation District attempts to exercise this right prior to the expiration of this Agreement, it must provide written notice to Valley District for one (1) year prior to the effective date of any release from reservation of any then-remaining, undedicated portions of Habitat Area, which are not then under conservation easements, and for which no non-wasting or other endowment has been paid. The one-year period shall be tolled during the pendency of dispute resolution proceedings regarding any factual dispute regarding whether the River HCP effort has been discontinued or abandoned by the River HCP partners. On or before the expiration of the one year period following such notice, Conservation District shall refund to Valley District the amount of $125,000 per acre of all then-undedicated areas of Habitat Area, which are not then under conservation easements and for which no non-wasting or other endowment has been paid, and for which either the Initial Conservation Easement Funding or the Subsequent Conservation Easement Funding has been paid by Valley District to Conservation District, as a precondition to removing such areas from reservation. Notwithstanding any of the foregoing, however, the sum of five million dollars ($5,000,000.00) from the Initial Conservation Easement Funding shall be exempt from any refund by the Conservation District to Valley District, and shall be restricted only by the requirement for Conservation District to use such funds as specified in Section IV above. In the event the Conservation District exercises the right hereunder before the River HCP has received dedication or the benefit of Conservation Easements of at least forty (40) acres of the Habitat Area, the parties shall meet and confer to identify a proportionate amount of undedicated acreage from the Habitat Area which shall be made available to Valley District for other projects meeting the project objectives of the use restrictions of Sections IV above. In no event, however, shall the amount of Habitat Area made available for Conservation Easements to Valley District from the Habitat Area be less than forty (40) acres, once the Initial Conservation Easement Funding has been paid.

XVII. DISPUTE RESOLUTION

The Parties recognize that there may be disputes regarding the obligations of the Parties or the interpretation of this Agreement. The Parties agree that they may attempt to resolve disputes as follows:

A. Statement Describing Alleged Violation of Agreement

A party alleging a violation of this Agreement (the "Initiating Party") shall provide a written statement describing all facts that it believes constitute a violation of this Agreement to the other party alleged to have violated the terms of this Agreement (the "Responding Party").

B. Response to Statement of Alleged Violation

The Responding Party shall have sixty (60) days from the date of the written statement to prepare a written response to the allegation of a violation of this Agreement and serve that response on the Initiating Party or to cure the alleged violation to the reasonable satisfaction of the Initiating Party. The Initiating Party and the Responding Party shall then meet within thirty (30) days of the date of the response to attempt to resolve the dispute amicably.

C. Mediation of Dispute

If the Initiating Party and the Responding Party cannot resolve the dispute within ninety (90) days of the date of the written response, they shall engage a mediator, experienced in water-related disputes, to attempt to resolve the dispute. Each party shall ensure that it is represented at the mediation by a Director or other representative with authority to settle. These representatives of the Initiating Party and the Responding Party may consult with staff and/or technical consultants during the mediation and such staff and/or technical consultants may be present during the mediation. The costs of the mediator shall be divided evenly between the Initiating Party and the Responding Party. The decision of the mediator shall be non-binding.

D. Reservation of Rights

Subject to the above requirements, in the event that mediation fails, each party retains and may exercise all legal and equitable rights and remedies it may have to enforce the terms of this Agreement; provided, that prior to commencing litigation, a party shall provide at least five (5) calendar days' written notice of its intent to sue.

XVIII. RELATIONSHIP TO WATER RIGHTS IN PRIOR AGREEMENTS

Nothing in this Agreement is intended to modify the water rights of the parties, whether existing under a judgment, proceedings of the State Water Resources Control Board, or the common law. Nothing in this Agreement is intended to modify any existing agreements between

the parties, unless expressly stated herein. Nothing in this Agreement shall be construed as an admission by any party regarding any water right or priority of either of the parties, and the parties agree that this Agreement, to the extent allowed by law, preserves all rights of the parties as they may exist as of the effective date of this Agreement. Nothing in this Agreement is to be construed as altering the priorities or entitlements of water right holders among themselves to water from the Santa Ana River, Mill Creek, or any other source.

XIX. MISCELLANEOUS

A. Authority

Each signatory of this Agreement represents that s/he is authorized to execute this Agreement on behalf of the party for which s/he signs. Each party represents that it has legal authority to enter into this Agreement and to perform all obligations under this Agreement, and that by doing so; such party is not in breach or violation of any other agreement or contract.

B. Amendment

This Agreement may be amended or modified only by a written instrument approved by both parties.

C. Jurisdiction and Venue

This Agreement shall be governed by and construed in accordance with the laws of the State of California, except for its conflicts of law rules. Any suit, action, or proceeding brought under the scope of this Agreement shall be brought and maintained to the extent allowed by law in the County of San Bernardino, California.

D. Headings

The paragraph headings used in this Agreement are intended for convenience only and shall not be used in interpreting this Agreement or in determining any of the rights or obligations of the Parties to this Agreement.

E. Construction and Interpretation

This Agreement has been arrived at through negotiations, and each party has had a full and fair opportunity to draft, review, and revise the terms of this Agreement. As a result, the normal rule of construction that any ambiguities are to be resolved against the drafting party shall not apply in the construction or interpretation of this Agreement.

F. Entire Agreement

This Agreement constitutes the entire agreement of the parties with respect to its subject matter, and supersedes any prior oral or written agreement, understanding, or representation relating to the subject matter of this Agreement.

G. Partial Invalidity

If, after the date of execution of this Agreement, any provision of this Agreement is held to be illegal, invalid, or unenforceable under present or future laws or adjudicatory decisions effective during the term of this Agreement, such provision shall be fully severable. However, in lieu thereof; there shall be added a provision as similar in terms to such illegal, invalid or unenforceable provision as may be possible and be legal, valid and enforceable.

H. Successors and Assigns

To the extent authorized by law, this Agreement shall be binding on and inure to the benefit of the successors and assigns of the respective parties to this Agreement. No party may assign its interests in or obligations under this Agreement without the written consent of the other party, which consent shall not be unreasonably withheld or delayed.

I. Waivers

Waiver of any breach or default hereunder shall not constitute a continuing waiver or a waiver of any subsequent breach either of the same or of another provision of this Agreement, and forbearance to enforce one or more of the remedies provided in this Agreement shall not be deemed to be a waiver of that remedy.

J. Attorneys' Fees and Costs

The prevailing party in any litigation or other action to enforce or interpret this Agreement shall be entitled to reasonable attorneys' fees, expert witnesses' fees, costs of suit, and other and necessary disbursements, in addition to any other relief deemed appropriate by a court of competent jurisdiction.

K. Necessary Actions

Each party agrees to execute and deliver additional documents and instruments and to take any additional actions as may be reasonably required to carry out the purposes of this Agreement.

L. Compliance with Law

In performing their respective obligations under this Agreement, the parties shall comply with and conform to all applicable laws, rules, regulations and ordinances.

M. Notices

All notices, requests, demands or other communications required or permitted under this Agreement shall be in writing unless provided otherwise in this Agreement and shall be deemed to have been duly given and received on: (i) the date of service if served personally or served by facsimile transmission on the Party by delivery to the person(s) at the address(es) designated below, which designation may be changed from time to time by a Party in writing; (ii) on the first day after mailing, if mailed by Federal Express, U.S. Express Mail, or other similar overnight courier service, postage prepaid, and addressed as provided below, or (iii) on the third day after mailing if mailed to the Party to whom notice is to be given by first class mail, registered or certified, postage prepaid, addressed as follows:

To SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT:	SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT Attn: Douglas Headrick, General Manager 380 E. Vanderbilt Way San Bernardino, CA 92408
To SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT:	SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT Attn: Daniel Cozad, General Manager 1630 West Redlands Blvd., Suite A Redlands, California 92373

N. Counterparts

This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original, but all of which together shall constitute but one and the same instrument.

SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

By: Richard Corneille
Richard Corneille
Its: Board President

ATTEST:

By:

APPROVED AS TO FORM:

RUTAN & TUCKER, LLP

By:
David B. Cosgrove,
General Counsel

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

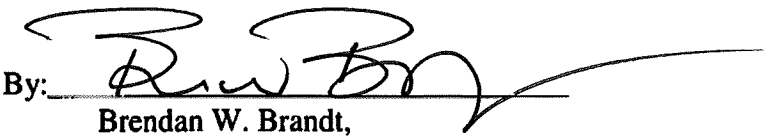
By:
T. Milford Harrison
Its: Board President

ATTEST:

By: Douglas D. Headrick
Douglas Headrick
Board Secretary

APPROVED AS TO FORM:

VARNER & BRANDT LLP

By: 

Brendan W. Brandt,
General Counsel

EXHIBIT A

HABITAT AREA

Exhibit A: Habitat Area

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD. CASIL, SBVMWD
GIS Contact: Katelyn Scholte
M:\Habitat Lands Outside Wash Plan
December 11, 2018

San Bernardino Valley
Water Conservation District
Helping Nature Store Our Water

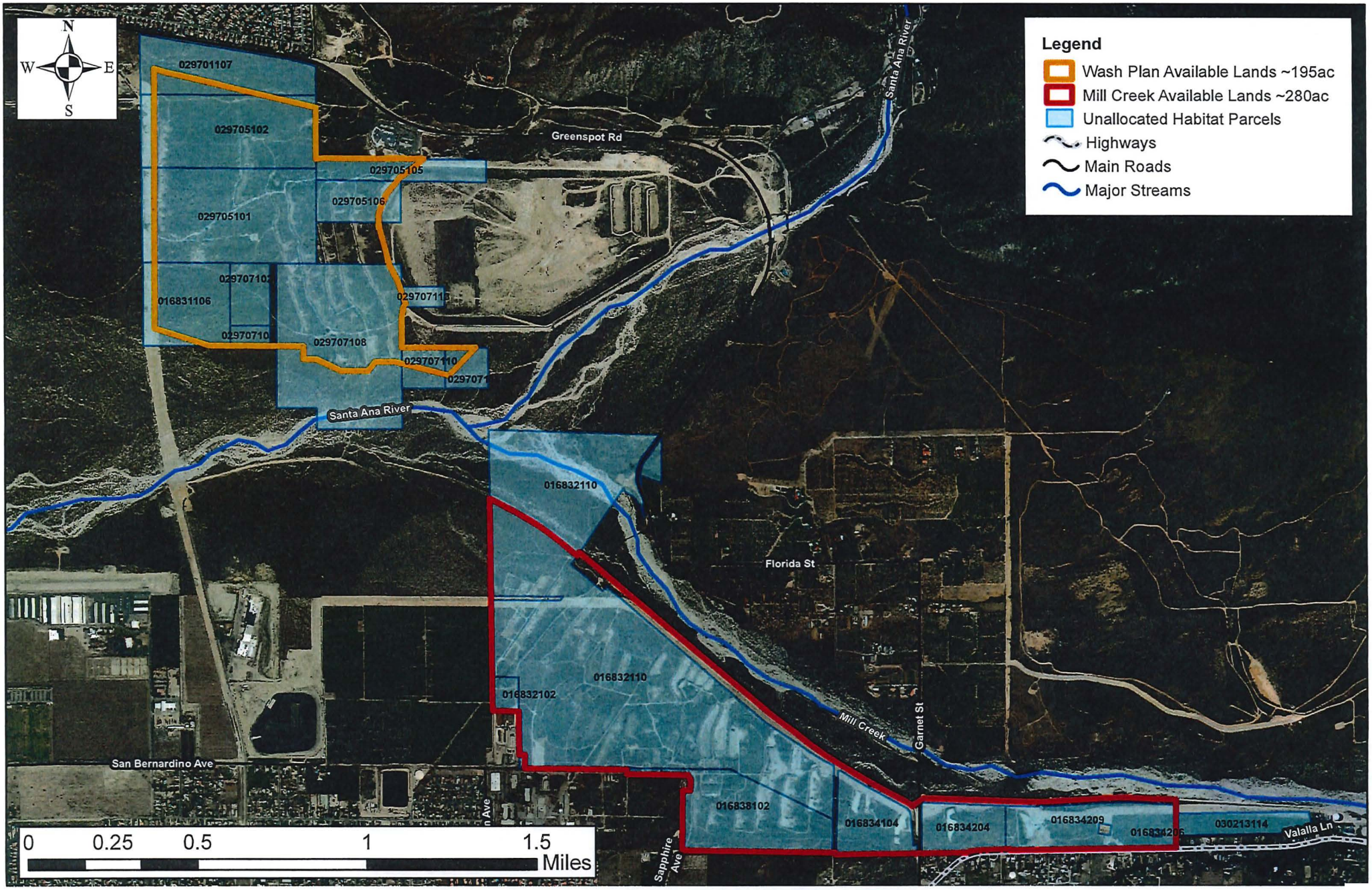


EXHIBIT B

Transfer Projects Conceptual Description and Diagram

Mill Creek:

Location: SBVWCD's existing Mill Creek Diversion structure east of Garnet Street and north canal diversion gate west of Garnet Street

Description: Increase the flow capacity of the North Canal from approximately 55 CFS to 210 CFS. The conceptual improvements would demolish the existing inlet and reconstruct the canal inlet structure in order to increase the north canal capacity to 210 CFS. Additionally, the bypass outlet structure will be re-designed and re-constructed to increase the sediment bypass function by adding an additional sediment bypass gate and channel within the inlet structure. The downstream entrance of the north canal into the spreading facility through the Army Corps of Engineers (USACOE) Mill Creek Flood Control Levee would also need to be reconstructed to handle 210 CFS. All facilities would require Section 408 permitting by the USACOE.

Mill Creek North Canal Project (210 CFS)	
Project Footprint	0.1 Acres
Diversion Capacity	385 CFS
Average Annual Flow Captured	6,096 AF
Pre-construction Cost Estimate	$65,000
Construction Cost Estimate	$2,530,025

Plunge Creek Basin 1:

Location: 800 feet northwest of the Orange Street Plunge Creek Crossing in the City of Highland within the existing flow path of Plunge Creek.

Description: Conceptual improvements include the construction of an 8 ft x 165 ft rubber dam and diversion structure within plunge creek. The singular basin will have perimeter berms along the south-east and south-west sides approximately 10 ft in height with a maximum operating water level of 8ft. There will be a total wetted area of 6 acres and a storage volume of 40 AF and a diversion capacity of 250 CFS. The basin will also have an overflow structure and 36-inch diameter drain.

Plunge Creek Basin 1	
Project Footprint	10 Acres
Diversion Capacity	250 CFS
Average Annual Flow Captured	2,481 AF
Pre-construction Cost Estimate	$225,000
Construction Cost Estimate	$10,675,345

Plunge Creek Basin 2:

Location: 350 feet west of the 210 freeway Plunge Creek Crossing in the City of Highland within the existing flow path of Plunge Creek. The northern edge of this basin is adjacent to the City Creek Project described below.

Description: Conceptual improvements at Plunge Creek site 2 for the ARP is to construct two basins, an approximately 7' diameter by 90' long rubber dam and a diversion structure within Plunge Creek. The southern edge of the new basin will act as a levee to channelize high flows past the basin. The south-east corner of the conceptual basin will be the point at which the basin berm constricts Plunge Creek; this will also be the location for the construction of an inflatable rubber dam diversion. The basin will be split into two smaller basins with one basin will have a volume of approximately 16 AF and the other approximately 50 AF. Basin berms will be approximately 10 feet high with 8 foot operating level for a total wetted area of about 11 acres and storage volume of 66 AF and a diversion capacity of 350 CFS. The basin will also have a basin overflow structure and a 36-inch basin drain.

Plunge Creek Basin 2	
Project Footprint	29 Acres
Diversion Capacity	350 CFS
Average Annual Flow Captured	1,050 AF
Pre-construction Cost Estimate	$225,000
Construction Cost Estimate	$12,583,867

City Creek Basin:

Location: Project is located along City Creek and is bordered by Baseline Ave due to the north and Plunge Creek to the South. The southern edge of the City Creek project borders the northern edge of the Plunge Creek 2 project described above.

Description: The conceptual improvements are to construct an inflatable rubber dam diversion across City Creek and a series of approximately 9 basins from Baseline Avenue extending southwest 6,200 feet. The basin layout has been developed to utilize a gravity conveyance system and to maximize usage of the available area on the site while maintaining adequate flood control capacity in City Creek Channel. Improvements include approximately 38 acres of basins with basin transfer structures, over flow structures, 36-inch basin drains, a 60' x 8' inflatable rubber dam, construction of approximately 500 CFS diversion structure, an approximately 500 CFS conveyance under Boulder Ave, an approximately 250 CFS crossing under the 210 freeway and a 250 CFS crossing under West 5th street.

City Creek Basin	
Project Footprint	64 Acres
Diversion Capacity	500 CFS
Average Annual Flow Captured	5,247 AF
Pre-construction Cost Estimate	$330,000
Construction Cost Estimate	$32,493,285

Waterman Basin Improvements:

Location: The Waterman Basins site is located along the west branch of Waterman Creek and is bordered by North Waterman Avenue to the west and East 40th Street to the south. The basins are an existing SBCFCD facility located approximately 3 miles north-east of the 210 Freeway/215 Freeway interchange.

Description: Conceptual improvements are to construct an inflatable armored dam diversion across the west branch Waterman Creek bypass channel. The existing radial gate will also be refurbished. A new operational plan would need to be implemented with SBCFCD and existing basins would need to be cleaned to remove existing silt and clay deposits. The total wetted area is about 32 acres with a storage volume of approximately 180 AF with an expected diversion capacity of about 1,000 CFS. Physical improvements include construction of two 17' x 8' spillway gates, refurbishment of the existing radial gates, refurbishment of 3 inner-basin surface transfer structures as well as 10 low-level outlets and drains.

Waterman Basin Improvements	
Project Footprint	0.25 Acres
Diversion Capacity	1,000 CFS
Average Annual Flow Captured	1,675 AF
Pre-construction Cost Estimate	$235,000
Construction Cost Estimate	$9,972,218

Twin Creek Spreading Ground Improvements:

Location: Spreading grounds within Twin Creek bordered by Harrison Street to the east and E 40th Street to the north. The spreading grounds are an existing SBCFCD facility located approximately 3 miles north-east of the 210 Freeway/215 Freeway interchange.

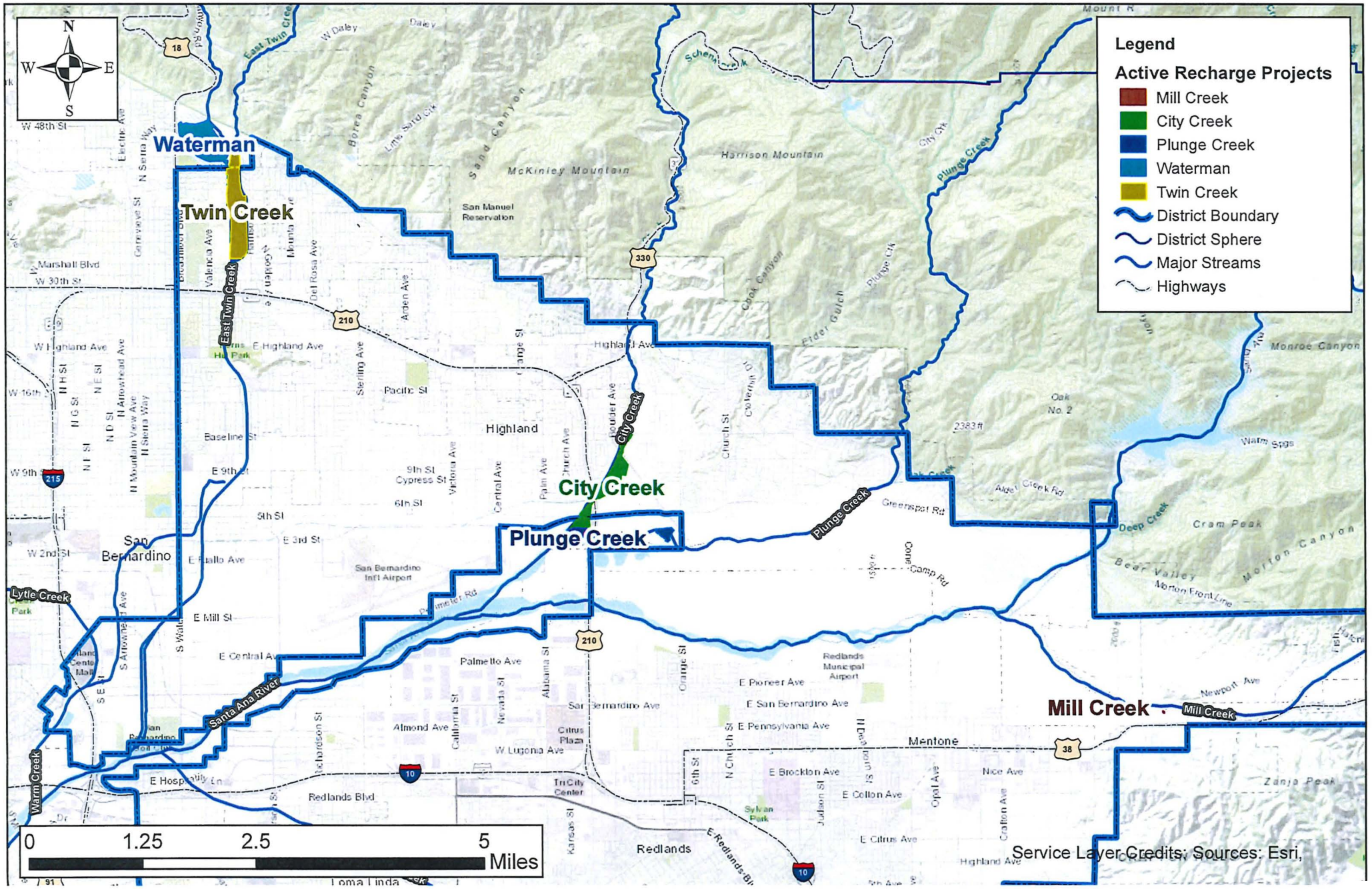
Description: Improvements would include reconstructing and armoring the berms between each basin that are currently in disrepair as well as adding low level outlets and drains to each basin. A new operational plan would need to be implemented with SBCFCD and existing basins would need to be cleaned to remove existing silt and clay deposits. The total wetted area is approximately 70 acres with a storage volume of about 370 AF. There is no diversion structure associated with this project. The physical improvements include re-construction and armoring of the 7 existing berms, construction of 1 new water conservation berm above East 40th Street, construction of approximately 8 new low-level outlets/drains and basin re-grading.

Twin Creek Spreading Grounds Improvements	
Project Footprint	145 Acres
Diversion Capacity	NA
Average Annual Flow Captured	4,087 AF
Pre-construction Cost Estimate	$350,000
Construction Cost Estimate	$16,327,990

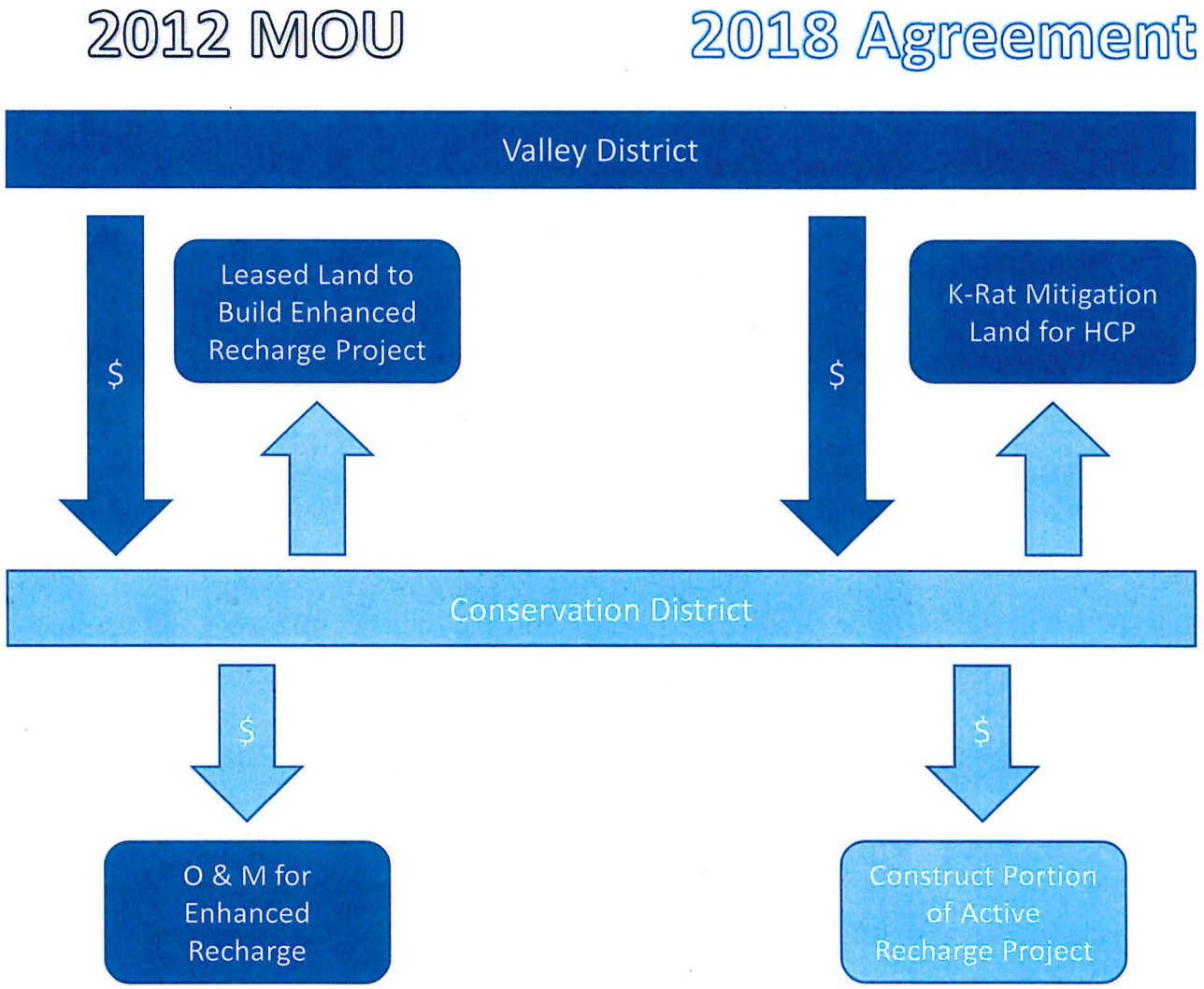
Exhibit B: Transferring Active Recharge Projects

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD. CASIL, SBVMWD
GIS Contact: Katelyn Scholte
M:\Active Recharge
December 11, 2018

San Bernardino Valley Water Conservation District
Helping Nature Store Our Water



Service Layer Credits: Sources: Esri,


2012 MOU
2018 Agreement
Valley District
$
Leased Land to Build Enhanced Recharge Project
$
K-Rat Mitigation Land for HCP
Conservation District
$
O & M for Enhanced Recharge
$
Construct Portion of Active Recharge Project

FIRST AMENDMENT TO PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN

This FIRST AMENDMENT TO PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN ("Amendment") is entered into this 13th day of December, 2023, by and between the SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT ("Conservation District") and SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT ("Valley District"), in consideration of all of the following:

RECITALS:

WHEREAS, on or about January 8, 2019, the Conservation District and Valley District (individually sometimes referred to herein as a "party," or collectively "parties") entered that certain "PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN;" ("Original Agreement") and

WHEREAS, the Conservation District and Valley District have, throughout the term of and pursuant to the Original Agreement, advanced a series of cooperative efforts designed to identify, assess, and conceptualize the use of existing and potential new facilities within the San Bernardino Basin area for the capture, diversion, storage, and recharge of storm flows and other native and imported water supplies, to enhance resiliency of local water supplies and to serve a regional strategy of strengthening groundwater supply availability as a hedge against drought conditions, and the potential challenges of a capturing intermittent but substantial precipitation through atmospheric river rainfall events; and

WHEREAS, the under the Original Agreement, the Conservation District agreed to reserve up to two hundred ninety-five (295) acres of denominated "Habitat Area" potentially suitable for habitat for the San Bernardino kangaroo rat and other species, which might serve as mitigation for the anticipated impacts of the Upper Santa Ana River Habitat Conservation Plan ("River HCP"), and Valley District agreed, subject to its review and due diligence of the suitability of the defined Habitat Area, to pay to the Conservation District, in two installments, the aggregate sum of Thirty Six Million Nine Hundred Fifty Thousand dollars ($36,950,000) in consideration for same (the "Conservation Easement Funding"); and

WHEREAS the Conservation Easement Funding has been paid in full; and

WHEREAS, pursuant to the Original Agreement the Conservation District and Valley District have formed a Partnership Agreement Policy Committee, which meets quarterly to review and advise the parties regarding the progress of the River HCP, and receive updates upon, and provide advice to the parties regarding, the status and commitment of the Conservation Easement Funding to capital projects and its interest revenues, and implementation of renewal, upgrade,

relocation, rehabilitation, or maintenance projects to which the Conservation Easement Funding is to be devoted, including the Transfer Projects.

WHEREAS, since the inception of the Original Agreement, the parties have advanced the identified "Transfer Projects" in a number of ways, including preparing a Program Management Plan, adopting memoranda of understanding with San Bernardino County Flood Control District, undertaken feasibility studies for Waterman, Lynwood, and Twin Creek spreading grounds, developed appropriate hydraulic modeling, conducted geotechnical testing, retained feasibility support services for assessment of Mill, Bledsoe, and Cook Creek facilities, and undertaken feasibility support services for Plunge Creek and Oak Creek, among other things; and

WHEREAS, these cooperative efforts have been productive and ongoing, and look to yield a clearer picture of the proper integration of regionally expanded groundwater supply recharge facilities with the preservation and enhancement of sensitive species habitat; and

WHEREAS, over the course of the performance of the Original Agreement, the Project's name was changed to the "Program for Expansion of Recharge Capacity," to more accurately convey the project's purposes and goals; and

WHEREAS, the term of the Original Agreement was five (5) years, and will expire on January 8, 2024; and

WHEREAS, the Original Agreement contemplated a potential additional five-year extension term, if the River HCP was not approved during the original term; and efforts to secure approval of the River HCP remain ongoing; and

WHEREAS, the Partnership Agreement Policy Committee considered a potential extension of the Original Agreement at its meeting of September 12, 2023, and unanimously recommended that both signatory parties agree to such an extension; and

WHEREAS, the parties now wish to memorialize their agreement to such a five-year extension by way of this Amendment.

NOW THEREFORE, IN CONSIDERATION OF ALL OF THE FOREGOING, THE PARTIES DO HEREBY AGREE AS FOLLOWS:

1. Section XV of the Original Agreement is hereby amended to add the following:

"Notwithstanding the preceding, the term of this Agreement is hereby extended through January 8, 2029. In the event the River HCP is not approved by January 8, 2029, the parties may agree in writing to a second extension, up to an additional five (5) years, for a total aggregate term of fifteen (15) years from the effective date of this Agreement."

2. Section XIX(M) of the Original Agreement is hereby deleted in its entirety and replaced as follows:

"M. **Notices**

"All notices, requests, demands or other communications required or permitted under this Agreement shall be in writing unless provided otherwise in this Agreement and shall be deemed to have been duly given and received on: (i) the date of service if served personally or served by facsimile transmission on the Party by delivery to the person(s) at the address(es) designated below, which designation may be changed from time to time by a Party in writing; (ii) on the first day after mailing, if mailed by Federal Express, U.S. Express Mail, or other similar overnight courier service, postage prepaid, and addressed as provided below, or (iii) on the third day after mailing if mailed to the Party to whom notice is to be given by first class mail, registered or certified, postage prepaid, addressed as follows:

"To SAN BERNARDINO VALLEY "MUNICIPAL WATER DISTRICT	SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT "Attn: Heather Dyer, CEO/General Manager "380 E. Vanderbilt Way "San Bernardino, CA 92408
"To SAN BERNARDINO VALLEY "WATER CONSERVATION DISTRICT	SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT "Attn: Betsy Miller, General Manager "1630 W. Redlands Blvd., Ste. A "Redlands, CA 92373"

3. Except as specifically amended herein, the Original Agreement shall remain in full force and effect, unless further amended in a written instrument signed by both parties.

SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT

By: _____
Melody McDonald
Its: Board President

ATTEST:

By: _____
Betsy Miller
General Manager/Secretary to the
Board

APPROVED AS TO FORM:

By: _____
David B. Cosgrove,
General Counsel

SAN BERNARDINO VALLEY
MUNICIPAL WATER DISTRICT

By: _____
Paul Kielhold
Its: Board President

ATTEST:

By: _____
Heather Dyer
CEO/General Manager/Board Secretary

APPROVED AS TO FORM:

By: _____
Bradley E. Neufeld,
General Counsel

ATTEST:

By:_____
Betsy Miller
General Manager/Secretary to the
Board

APPROVED AS TO FORM:

By: _____
David B. Cosgrove,
General Counsel

SAN BERNARDINO VALLEY
MUNICIPAL WATER DISTRICT

By: Paul Kielhold
Paul Kielhold
Its: Board President

ATTEST:

By: Heather Dyer
Heather Dyer
Board Secretary

APPROVED AS TO FORM:

By _____
Bradley E. Neufeld,
General Counsel

SECOND AMENDMENT TO PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN

This SECOND AMENDMENT TO PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN ("Amendment") is entered into this __th day of _____, 2024, by and between the SAN BERNARDINO VALLEY WATER CONSERVATION DISTRICT ("Conservation District") and SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT ("Valley District"), in consideration of all of the following:

RECITALS:

WHEREAS, on or about January 8, 2019, the Conservation District and Valley District (individually sometimes referred to herein as a "party," or collectively "parties") entered that certain "PARTNERSHIP AGREEMENT FOR JOINT ACTIVE RECHARGE PROJECT DEVELOPMENT UNDER THE UPPER SANTA ANA RIVER HABITAT CONSERVATION PLAN;" ("Original Agreement") and

WHEREAS, on or about December 13, 2024, the Conservation District and Valley District amended the Original Agreement to modify Section XV to extend its effective term to January 8, 2029, with the possibility for the parties to agree in writing to a second extension, up to an additional five (5) years, for a total aggregate term of fifteen (15) years from the effective date of the Original Agreement; and

WHEREAS, the under the Original Agreement, Section V, the parties formed a "Partnership Agreement Policy Committee," comprised of the general managers and one Board appointed member of both the Conservation District and Valley District, or their designees, and one representative of the San Bernardino Basin Groundwater Council, to be appointed by the San Bernardino Basin Groundwater Council pursuant to procedures it was to determine; and

WHEREAS the Groundwater Council was not extended beyond its original five year term and a single extension term, and therefore appears that it will be disbanded, or otherwise reconstituted in a different form; and

WHEREAS, at a meeting held June 4, 2024, the Partnership Agreement Policy Committee determined that the member originally to be appointed by the Groundwater Council should instead be appointed by the Basin Technical Advisory Committee, which will continue in existence beyond the tenure of the Groundwater Council, and directed that an amendment to the Original Agreement be prepared and presented to the legislative bodies of the two parties, to effectuate the change;

.

NOW THEREFORE, IN CONSIDERATION OF ALL OF THE FOREGOING, THE PARTIES DO HEREBY AGREE AS FOLLOWS:

1. Section V of the Original Agreement is hereby amended to read, in its entirety, as follows:

V. PARTNERSHIP AGREEMENT POLICY COMMITTEE

The parties shall form a "Partnership Agreement Policy Committee" consisting of the general managers and one Board appointed member of both the Conservation District and Valley District, or their designees, and one representative of the Basin Technical Advisory Committee, to be appointed by the Basin Technical Advisory Committee pursuant to procedures it shall determine. The Partnership Agreement Policy Committee shall meet regularly, no less than quarterly, to review and advise the Conservation District on the status and commitment of the Conservation Easement Funding to capital projects and its interest revenues, and implementation of renewal, upgrade, relocation, rehabilitation, or maintenance projects to which the Conservation Easement Funding is to be devoted, including the Transfer Projects. The Partnership Agreement Policy Committee's advice and recommendations shall be provided to the Conservation District and Valley District in writing, with a copy to be delivered to the Basin Technical Advisory Committee. All actions taken by the Partnership Agreement Policy committee shall be based on unanimous agreement. The Partnership Agreement Policy Committee may make recommendations, but except as otherwise provided in this Agreement, may not itself bind the legislative bodies of either the Conservation District or Valley District.

2. Except as specifically amended herein, and in the First Amendment to the Original Agreement, the Original Agreement shall remain in full force and effect, unless further amended in a written instrument signed by both parties.

SAN BERNARDINO VALLEY WATER
CONSERVATION DISTRICT

By:_____
Melody McDonald
Its: Board President

ATTEST:

By:_____
Betsy Miller
General Manager/Secretary to the
Board

APPROVED AS TO FORM:

By: _____
David B. Cosgrove,
General Counsel

SAN BERNARDINO VALLEY
MUNICIPAL WATER DISTRICT

By:_____
Paul Kielhold
Its: Board President

ATTEST:

By:_____
Heather Dyer
CEO/General Manager/Board Secretary

APPROVED AS TO FORM:

By: _____
Bradley E. Neufeld,
General Counsel

SAN BERNARDINO VALLEY | A REGIONAL WATER AGENCY SINCE 1954

DATE: July 9, 2024

TO: Board of Directors' Workshop – Resources/Engineering

FROM: Greg Woodside, Chief of Planning and Watershed Resilience
Wen Huang, Chief Operating Officer/ Assistant General Manager

SUBJECT: Consider an Agreement with University of California San Diego for Preliminary Viability Assessment of Forecast Informed Reservoir Operations at Seven Oaks Dam

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Staff Recommendations

Staff recommends that the Board of Directors authorize the CEO/General Manager to execute an agreement with the University of California San Diego for an amount not to exceed $1,071,000 to prepare the Preliminary Viability Assessment of Forecast Informed Reservoir Operations at Seven Oaks Dam over a two-year period.

Summary

District staff have been collaborating with the Local Sponsors of Seven Oaks Dam, the Army Corps of Engineers, the Center for Western Weather and Water Extremes (CW3E) at the Scripps Institution of Oceanography (Scripps), Western Water, the resources agencies, environmental non-profit organizations and other stakeholders to prepare the Work Plan for assessment of Forecast Informed Reservoir Operations (FIRO) at Seven Oaks Dam. The Work Plan has been completed and was published by the Steering Committee and Scripps in June 2024. The Work Plan provides the scope of work for the Preliminary Viability Assessment (PVA) of FIRO at Seven Oaks Dam. The period of performance for the agreement to conduct the PVA is for two years, with a total cost of $1,071,000.

Description of FIRO Study

FIRO is a reservoir-operations strategy that better informs decisions to retain or release water from dams by integrating additional flexibility in operations policies and rules with enhanced

monitoring and improved weather and water forecasts (American Meteorological Society, 2020). FIRO utilizes weather forecasting, streamflow modeling, and watershed monitoring to help water managers selectively retain or release water from reservoirs that reflects current and forecasted conditions, and that adapts to weather extremes.

Seven Oaks Dam is owned and operated by the three flood control districts in the Santa Ana Watershed. The three flood control districts in Orange County, Riverside County and San Bernardino County are collectively referred to as the 'Local Sponsors' for the Santa Ana River Mainstem Project, which includes Seven Oaks Dam. The Local Sponsors and the Army Corps of Engineers will need to approve proposed operational changes to Seven Oaks Dam that are developed to implement FIRO.

The Steering Committee for FIRO at Seven Oaks Dam oversees the assessment of FIRO at Seven Oaks Dam. The Steering Committee includes representatives of the Local Sponsors, Army Corps, and other stakeholders. The Steering Committee is co-chaired by Heather Dyer, Dr. Marty Ralph (Scripps/CW3E), and Dr. Cary Talbot (Army Corps of Engineers).

The Local Sponsors operate and maintain Seven Oaks Dam in accordance with the dam's Water Control Manual developed by the Army Corps of Engineers. After construction of the dam was completed by the Army Corps, ownership, maintenance and operation of the dam was turned over to the Local Sponsors. The purpose of Seven Oaks Dam is to provide flood risk management benefits.

Consideration of potential changes to the Water Control Manual to implement FIRO involves multiple complex considerations, including:

- Maintaining the flood risk management capacity and purpose of the dam
- Addressing environmental considerations, such as potential impacts on endangered species and their habitat
- Assessing how potential changes in the release rates to implement FIRO relate to operations and maintenance requirements for the dam
- Assessing if any modifications may be needed to the dam
- Assessing potential water quality considerations, such as the potential impact on water quality of holding water longer in the pool behind the dam

Summary of Work Plan

The Steering Committee met four times during development of the Work Plan. Additionally, workshops and workgroup meetings were held to explore and define technical issues such as dam operations, water supply management and groundwater recharge, and environmental considerations.

The Work Plan was published by Scripps and the Steering Committee in June 2024 (copy attached). The Work Plan provides the scope of work for the assessment of the viability of FIRO at Seven Oaks Dam.

While Seven Oaks Dam is currently not authorized for water conservation, the FIRO study will explore the potential for allowing water conservation to increase groundwater recharge for regional water reliability and to enhance habitat for protected species, while maintaining, if not enhancing, flood risk management. The ultimate goal is to update the Water Control Manual to implement FIRO.

The Work Plan outlines the technical work needed to assess the viability of FIRO at Seven Oaks Dam, including the following elements:

- Observations (of streamflow, soil moisture, rainfall, snowfall and other relevant parameters)
- Meteorology (particularly the impact of atmospheric rivers on extreme precipitation)
- Hydrology (forecasting of streamflow rates)
- Forecast verification (assessing the accuracy of precipitation forecasting by numerical weather models)
- Water resources engineering (the operation and maintenance of the dam and potential to modify operations to implement FIRO)
- Decision Support tools (providing information and data management tools to the operator of the dam so that they can readily assess real time conditions and forecast information)
- Environmental (potential changes to the environment associated with theoretical modifications of the dam's release rate based on FIRO; modifying the dam's release rate will change reservoir water surface elevations, reservoir area duration of inundation and downstream flow rates).

Preparation of Preliminary Viability Assessment

Scripps/CW3E has submitted a proposal to the District to prepare the PVA and related tasks (copy attached). Preparation of the PVA will be led by Dr. Marty Ralph at Scripps/CW3E. The following table summarizes some of the key topics that will be addressed in the PVA:

Category	Key Topics
Meteorology	• The fraction of extreme precipitation events over the Seven Oaks basin that is associated with landfalling ARs • The meteorological processes that influence spatial and temporal variability in precipitation during landfalling ARs or other non-AR events • The meteorological processes that produce challenges to precipitation forecast skill during extreme events
Hydrology	• The ability to forecast the rate of inflow into Seven Oaks Dam
Forecast Verification	• The forecast skill with respect to the timing of landfall, intensity, and position for ARs making landfall near the Seven Oaks basin • The forecast skill of the volume of precipitation falling as rain or snow during key events
Water Resources Engineering	• Develop a numerical model of how Seven Oaks Dam is operated • Use the model of Seven Oaks Dam to evaluate alternative operational scenarios for the dam that incorporate weather and streamflow forecasting • Assess if the alternative scenarios maintain flood risk management objectives • Assess potential water supply availability and environmental benefits of the alternative scenarios
Environmental	• Assess the potential environmental effects of changes in the dam's release rate in the reservoir (pool) area and downstream of the dam. • Assess potential downstream environmental benefits of varying release rates from the dam.

The PVA will be prepared based on the scope of work defined in the Work Plan. It is anticipated that the PVA will be prepared over a two-year period. The time period provides for the technical work to be completed, reviewed, and documented in the PVA Report.

The proposal from Scripps is summarized in the table below:

Task	Description	Year 1 ($)	Year 2 ($)	Total ($)
1	FIRO Steering Committee Leadership	85,000	91,000	176,000
2	Preliminary Viability Assessment Report	160,000	172,000	332,000
3	Plan and Execute FIRO meetings and Workshops	40,000	43,000	83,000
4	Technical studies	285,000	195,000	480,000
Total		570,000	501,000	1,071,000

The costs shown in the above table are shared with Western Water. A cost-share agreement between the District and Western for this work will be brought to the board in September.

On-Going Technical Studies

As part of our current contract with CW3E that extends through October 30, 2024, technical studies related to meteorology are being conducted by CW3E at this time. The technical studies include analysis of atmospheric river storms impacting the Santa Ana Watershed at Seven Oaks Dam and the ability to forecast these storms and their impact on runoff.

Additional technical studies will be conducted as part of Task 4 of the proposed two-year work effort. The technical studies are targeted to focus on enhanced monitoring and snow-level forecasting for FIRO at Seven Oaks Dam. A majority of the mountainous watershed tributary to Seven Oaks Dam is exposed to freezing temperatures during precipitation events and understanding freezing level variability is an important component to improving precipitation and streamflow forecast skill.

Observations are a critical component to forecast verification, model evaluation, and in-situ decision support tools to support FIRO. Reliable observations available in near-real time are required to support FIRO. Preliminary results of the Technical Studies in the current CW3E

contract identified gaps in the observations network including snow, soil, and discharge measurements. The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with near real time monitoring stations.

Freezing level forecast uncertainty influences water management strategies because it can affect the timing and intensity of streamflow. There is often a time-lag of infiltration and runoff generation from snow versus rainwater due to differing melt/accumulation rates.

Preliminary Timeline for Implementation of FIRO

The following table describes the schedule for the implementation of FIRO at Seven Oaks Dam:

Phase	**Activity**	**Schedule**
Work Plan	Prepare FIRO Viability Assessment Work Plan	June 2024 (complete)
Preliminary Technical Studies	Complete preliminary technical studies	September 2024
Preliminary Viability Assessment	Prepare FIRO PVA Report	2026
Final Viability Assessment	Prepare FIRO Final Viability Assessment Report	2028
Post-FVA	FIRO incorporated into Seven Oaks Dam Water Control Manual	To be determined

Technical work regarding dam safety, maintaining flood risk management and related items to support a deviation request will be conducted during the PVA. If this work and related work provides favorable results, it is anticipated that a ‘deviation’ request for Seven Oaks Dam could be submitted to the Local Sponsors and Army Corps during the later stages of the Preliminary Viability Assessment. A ‘deviation’ is a limited-term change from the Water Control Manual for the dam. In this case, the deviation request would be to test implementation of FIRO at Seven Oaks Dam for a multi-year period (say three to five years). The Army Corps has ultimate approval authority of a request for a deviation.

District Strategic Plan Application

FIRO aligns with the San Bernardino Valley Strategic Plan Foundation and Goals and Objectives by developing additional supplies for stormwater capture at Seven Oaks Dam for recharge into the Bunker Hill Basin. Implementation of FIRO supports Goal 1.1 'Ensure Agency facilities, infrastructure, assets, and habitat investments are resistant or resilient to impacts from changing climate conditions.' and its related objective 'Develop a comprehensive strategy to identify long-term uncertainties and adaptive management measures to ensure reliable water supply and protection of habitat investments under climate change conditions.' FIRO also supports Goal 2.2 'Increase local water supplies.'

Fiscal Impact

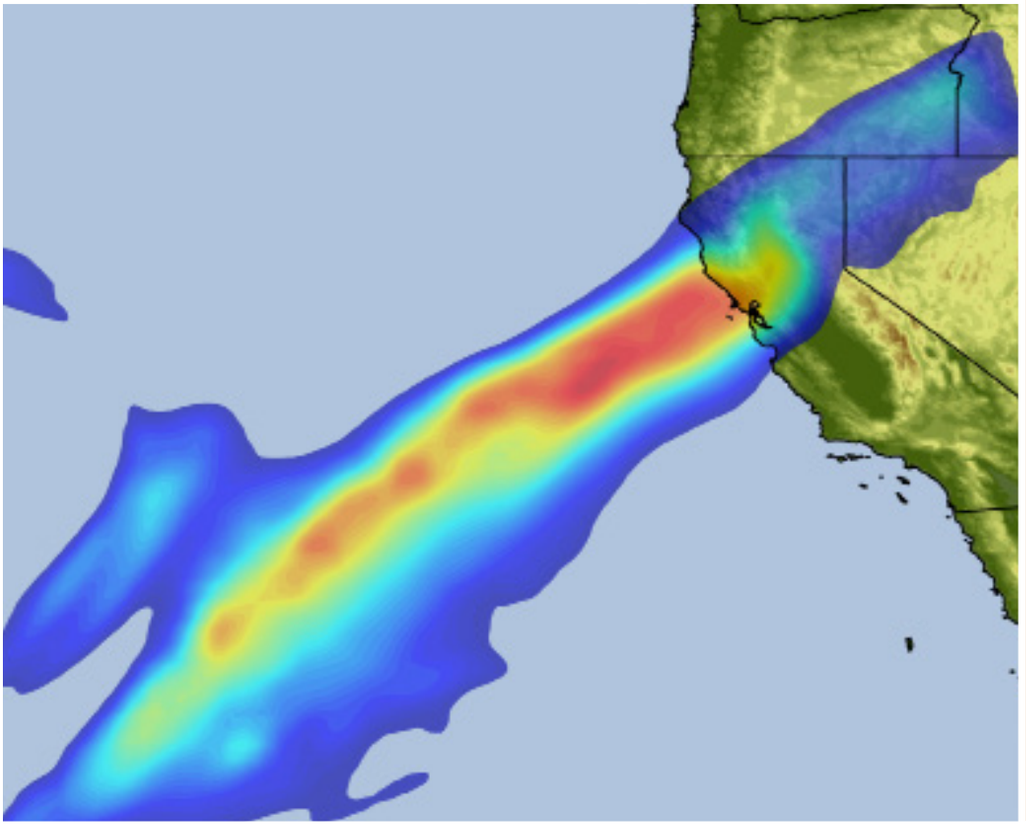
The total cost of the agreement with UC San Diego/Scripps over the two-year performance period is $1,071,000.00. This cost will be shared with Western Water, subject to the District and Western Water approving a cost-share agreement. The proposed FIRO Cost Share Agreement with Western will split the cost of the Scripps/UC San Diego FIRO agreement per the Western-San Bernardino Watermaster cost allocation formula of 72.05% for San Bernardino Valley and 27.95% for the Plaintiffs. The proposed cost share is summarized in the table below:

Item	Cost
UC San Diego FIRO Assessment	$1,071,000
San Bernardino Valley Cost Share (72.05%)	$771,656
Western (representing Plaintiffs) Cost Share (27.95%)	$299,344

Attachments:

- Work Plan for Seven Oaks Dam Forecast Informed Reservoir Operations (June 2024)
- Proposal from UC San Diego for Development of Preliminary Viability Assessment

Work Plan for Seven Oaks Dam
FORECAST INFORMED RESERVOIR OPERATIONS (FIRO)
June 2024



Steering Committee

- **F. Martin Ralph:** CW3E (Co-chair)
- **Cary Talbot:** USACE, Engineer Research and Development Center (ERDC) (Co-chair)
- **Heather Dyer:** San Bernardino Valley (Co-chair)
- Tim Fairbank: USACE
- Jayme Laber: NOAA National Weather Service
- Michael Anderson: California Department of Water Resources
- Rollie White: USFWS
- Lisa Haney: Orange County Water District
- Joseph Forbis: ERDC
- James Tyler: Orange County Public Works
- Michael Fam: San Bernardino County Public Works
- Betsy Miller: San Bernardino Valley Water Conservation District
- Mallory O'Conor: Western Municipal Water District

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

NOAA

SAN BERNARDINO COUNTY

San Bernardino Valley Water Conservation District

SCRIPPS INSTITUTION OF OCEANOGRAPHY

WESTERN WATER

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Seven Oaks Dam Steering Committee Co-chairs

- **F. Martin Ralph:** Director, Center for Western Weather and Water Extremes (CW3E), Scripps Institution of Oceanography, UC San Diego
- **Cary Talbot:** National Lead, Forecast-Informed Reservoir Operations Program, Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers (USACE)
- **Heather Dyer:** Chief Executive Officer/General Manager, San Bernardino Valley Municipal Water District

Seven Oaks Dam Steering Committee Members

- **Tim Fairbank:** Chief, Hydrology & Hydraulics Branch, USACE Los Angeles District
- **Jayme Laber:** Hydrologist, National Oceanic and Atmospheric Administration (NOAA) National Weather Service; Analyze, Forecast, Support Office; Forecast Services Division; Water Resources Services Branch
- **Michael Anderson:** State Climatologist, California Department of Water Resources
- **Rollie White:** Assistant Field Supervisor, U.S. Fish and Wildlife Service (USFWS)
- **Lisa Haney:** Executive Director of Planning and Natural Resources, Orange County Water District
- **Joseph Forbis:** USACE Water Management Integration Lead, ERDC
- **James Tyler:** Manager, Flood Programs Division, Orange County Public Works
- **Michael Fam:** Engineering Manager/Division Chief, Flood Control Planning/Water Resources Division, San Bernardino County Public Works
- **Betsy Miller:** General Manager, San Bernardino Valley Water Conservation District
- **Mallory O'Conor:** Water Resources Specialist, Western Municipal Water District

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Abbreviations

For brevity, this document uses the following abbreviations:

Abbreviation	Definition
ac-ft	acre-feet
AR	atmospheric river
BO	Biological Opinion
cfs	cubic feet per second
CNRFC	California Nevada River Forecast Center
CW3E	Center for Western Weather and Water Extremes
DST	decision support tool
EIR	Environmental Impact Report
ERDC	Engineer Research and Development Center
FIRO	Forecast Informed Reservoir Operations
FVA	Final Viability Assessment
HEFS	Hydrologic Ensemble Forecast System
HEMP	hydrologic engineering management plan
MAP	mean areal precipitation
NOAA	National Oceanic and Atmospheric Administration
PoT	peaks-over-threshold
PVA	Preliminary Viability Assessment
QPE	quantitative precipitation estimation
QPF	qualitative precipitation forecast
RAFSS	Riversidean alluvial fan sage scrub
RAOP	Research And Operations Partnership
RCP	representative concentration pathway
SARM	Santa Ana River Mainstem
SBVMWD	San Bernardino Municipal Water District
SBKR	San Bernardino kangaroo rat

Abbreviation	Definition
SOD	Seven Oaks Dam
SSC	Species of Special Concern
SSP	shared socioeconomic pathway
SWP	State Water Project
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WCM	Water Control Manual
WCP	Water Control Plan
West-WRF	Western Weather Research and Forecasting
WRE	Water Resources Engineering
WSPA	Santa Ana River Woolly Star Preserve Area

Section 1. Introduction

California has one of the most variable climates in the United States, and it's getting more extreme, increasingly marked by long periods of warm, dry conditions punctuated by stronger and wetter atmospheric river (AR) storms.

ARs are responsible for more than half of all beneficial precipitation and over 90 percent of flood damage in California. Long, narrow bands of concentrated moisture, ARs stretch thousands of miles across the Pacific Ocean. When ARs make landfall, they can release a staggering amount of rain and snow: for example, during a particularly active AR season from November 2022 to April 2023, 17 ARs produced an average of 29 inches of precipitation in the Santa Ana River watershed (Figure **1-1**).

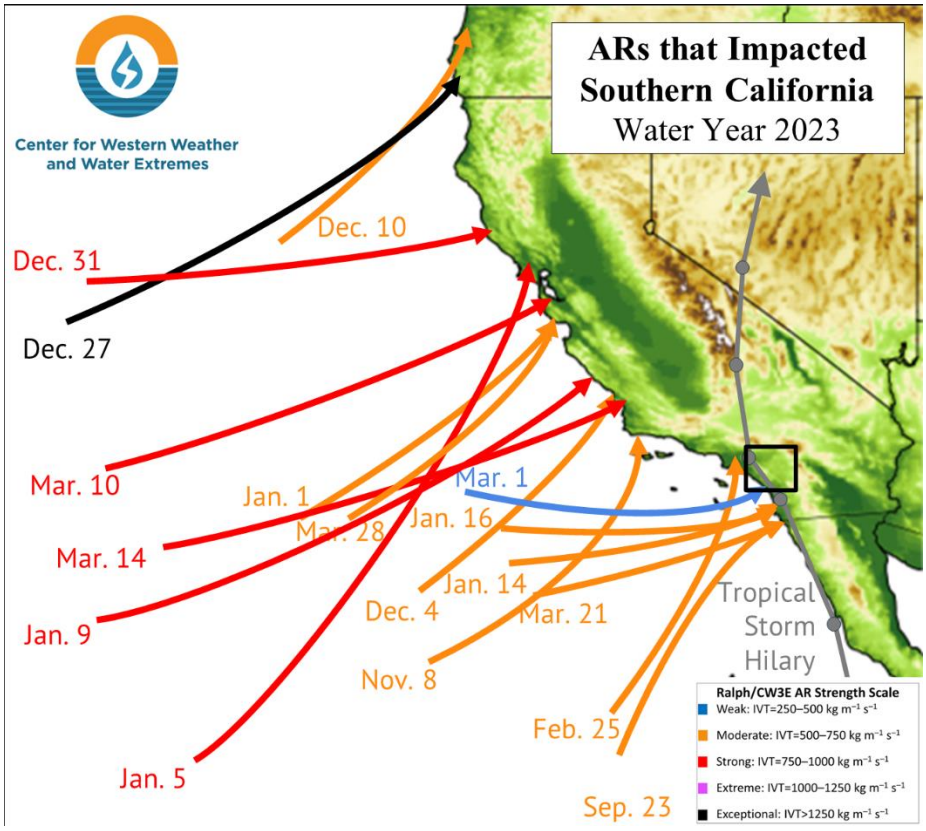

Figure 1-1*. Seventeen ARs and a tropical cyclone brought record-breaking snowfall to the region in water year 23. The ARs dropped more than 240 inches of snow at Big Bear. Note: ARs making landfall outside the Santa Ana watershed still affect the watershed, as they move along the coast.*

Since ARs are the main driver of floods, and the absence of ARs is often associated with droughts, improved AR forecasts are essential for Forecast Informed Reservoir Operations (FIRO). The Center for Western Weather and Water Extremes' (CW3E's) focused work to improve AR forecasts puts the "F" in FIRO. Recognizing the importance of ARs in a changing climate, the San Bernardino Valley Municipal Water District (San Bernardino Valley) initiated a project to explore the potential for FIRO at Seven Oaks Dam. FIRO is a flexible water

management strategy that uses improved weather and runoff forecasts to help water managers retain or release reservoir water to increase resilience to droughts and floods. This FIRO project's main objective is to explore options for increasing water conservation for habitat and water supply reliability, while maintaining or possibly improving flood risk management objectives.

Early FIRO results at Lake Mendocino show that reservoir operators can use forecast information and tools to store up to 20 percent more water when forecasts indicate low risk of flooding. At Prado Dam, about 35 miles downstream of Seven Oaks Dam (**Figure 1-2**), FIRO operations can result in 8 to 11 percent more recharge, on average.

The Seven Oaks Dam FIRO project is the first FIRO project that (1) is significantly snowmelt-fed, (2) includes habitat enhancement as a primary objective, and (3) incorporates consideration for several protected species. Lessons learned in the Lake Mendocino and Prado Dam watersheds, where habitat was also a major consideration, will inform the Seven Oaks Dam FIRO viability assessment.

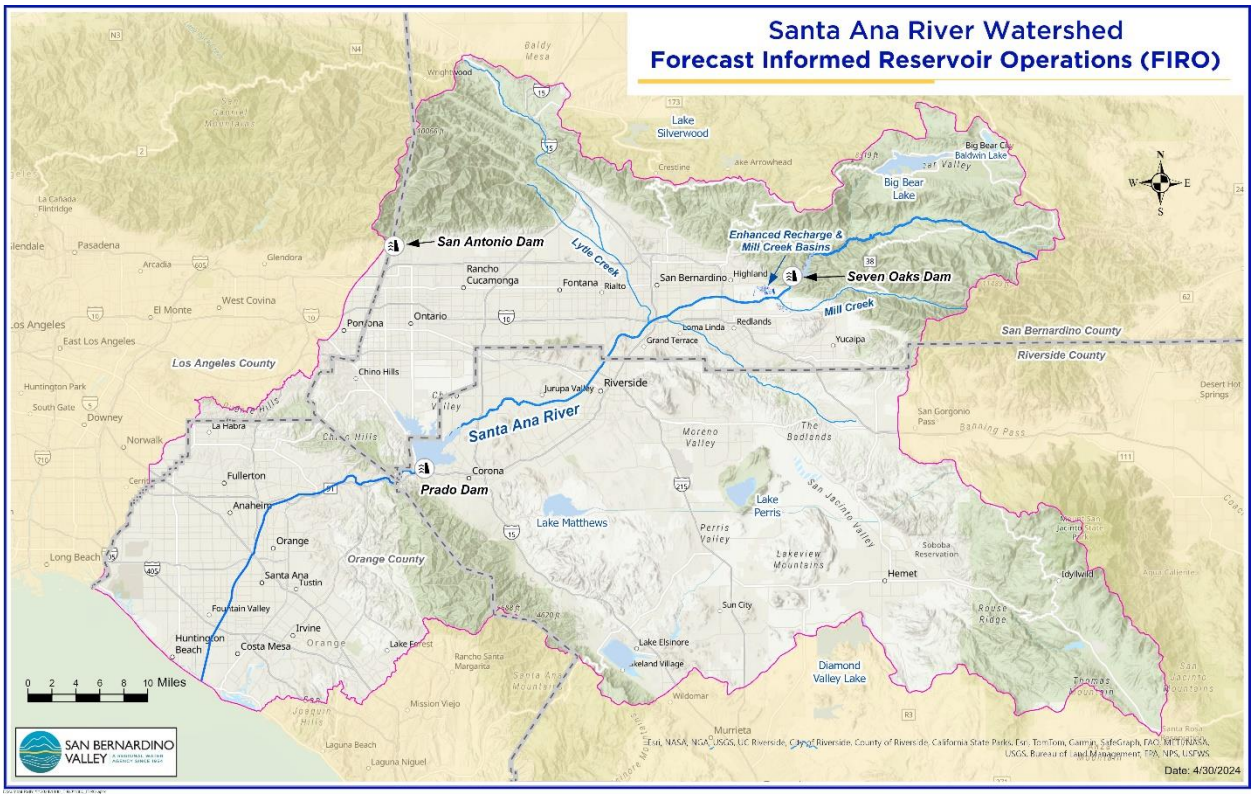

Figure 1-2. *Santa Ana River Watershed, showing the locations of Seven Oaks Dam in the upper watershed and Prado Dam in the lower watershed. (Credit: San Bernardino Valley.)*

FIRO at Seven Oaks Dam is a "Research And Operations Partnership (RAOP)," a term coined for FIRO projects to convey the symbiotic relationship between research and water operations. Research is driven by water managers' needs; research findings inform, and feed directly into, operational decisions. RAOP consists of researchers, water managers, dam operators, and environmental scientists with vested interests in improving dam operations for multiple benefits.

A Seven Oaks Dam FIRO Steering Committee was formed to represent these interests. Members are listed below.

Seven Oaks Dam FIRO Steering Committee

Co-Chairs:

- **F. Martin Ralph:** Director, CW3E, Scripps Institution of Oceanography, UC San Diego
- **Cary Talbot:** National Lead, FIRO Program, Engineer Research and Development Center (ERDC), United States Army Corps of Engineers (USACE)
- **Heather Dyer:** Chief Executive Officer/General Manager, San Bernardino Valley Municipal Water District

Members:

- **Tim Fairbank:** Chief, Hydrology & Hydraulics Branch, USACE Los Angeles District
- **Jayme Laber:** Hydrologist, National Oceanic and Atmospheric Administration National Weather Service, Water Resources Services Branch
- **Michael Anderson**: State Climatologist, California Department of Water Resources
- **Rollie White:** Assistant Field Supervisor, U.S. Fish and Wildlife Service
- **Lisa Haney:** Executive Director of Planning and Natural Resources, Orange County Water District
- **Joseph Forbis:** USACE Water Management Integration Lead, ERDC
- **James Tyler:** Manager, Flood Programs Division, Orange County Public Works
- **Michael Fam:** Engineering Manager/Division Chief, Flood Control Planning/Water Resources Division, San Bernardino County Public Works
- **Betsy Miller:** General Manager, San Bernardino Valley Water Conservation District
- **Mallory O'Conor:** Water Resources Specialist, Western Municipal Water District

The Steering Committee is supported by eight work teams, each addressing one of the following aspects of the FIRO workplan and viability assessment:

- Meteorology
- Hydrology
- Forecast verification
- Observations
- Environment
- Water resources engineering
- Decision support tools
- Communications

Steering Committee and work team members work together, as agreed upon in the Seven Oaks Dam FIRO Steering Committee Terms of Reference, to assess FIRO operations.

Their assessment includes two considerations particular to Seven Oaks Dam:

- While Seven Oaks Dam is currently not authorized for water conservation, this FIRO study will explore the potential for allowing water conservation to increase groundwater recharge for regional water reliability and to enhance habitat for protected species (see text box), while maintaining, if not enhancing, flood risk management.
- Unlike Prado Dam, on the lower Santa Ana River, Seven Oaks Dam has snow upstream. This project considers that important difference.

This workplan lays out a process and scope for assessing the viability of FIRO at Seven Oaks Dam (Figure **1-3**). This process seeks to answer a key question: Can current and improved forecasts of individual and series of landfalling atmospheric rivers and other storm types and their associated precipitation, temperature, and runoff be used to inform flexible reservoir operations at Seven Oaks Dam to increase water conservation and to enhance and protect habitat through strategic releases, while maintaining flood risk management objectives?

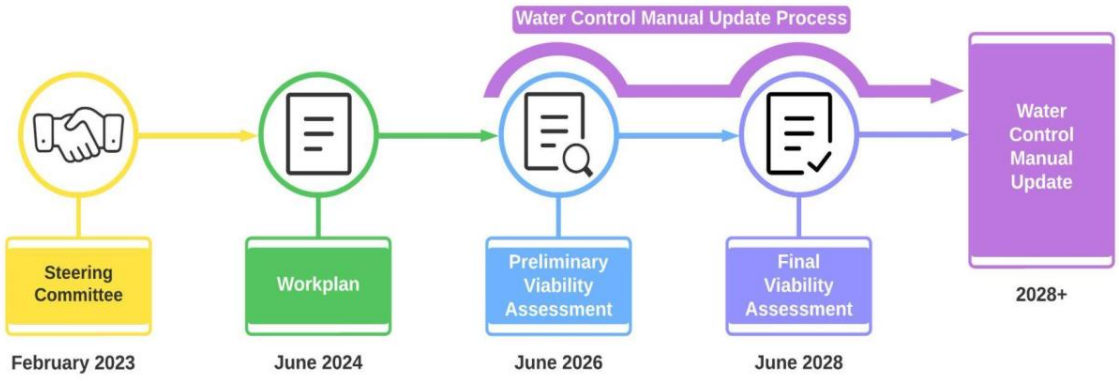

***Figure 1-3**. FIRO viability is assessed according to a systematic process. If FIRO is viable, the body of work produced by this process will inform an update to the USACE Water Control Manual, which governs dam operations.*

Section 2. Background and Context

2.1 Santa Ana River Watershed

The Santa Ana River watershed is the largest in Southern California's coastal region. It encompasses about 2,700 square miles and parts of San Bernardino, Riverside, Orange, and Los Angeles Counties. The upper watershed is ringed by the San Gabriel, San Bernardino, and San Jacinto Mountain ranges, with elevations over 10,000 feet. These mountains form a barrier to atmospheric river (AR) storms that originate in the Pacific and make landfall in Southern California, forcing moist flow upward and generating clouds and precipitation. Lowlands consist mainly of dry alluvial valleys. The watershed has over 10 vegetation zones, including alpine and subalpine areas in high elevations and pine, lodgepole, and oak forests at mid-elevation. Chaparral and coastal sage scrub are common in lower elevations, and riparian forest and marshes can be found along the riverbed.

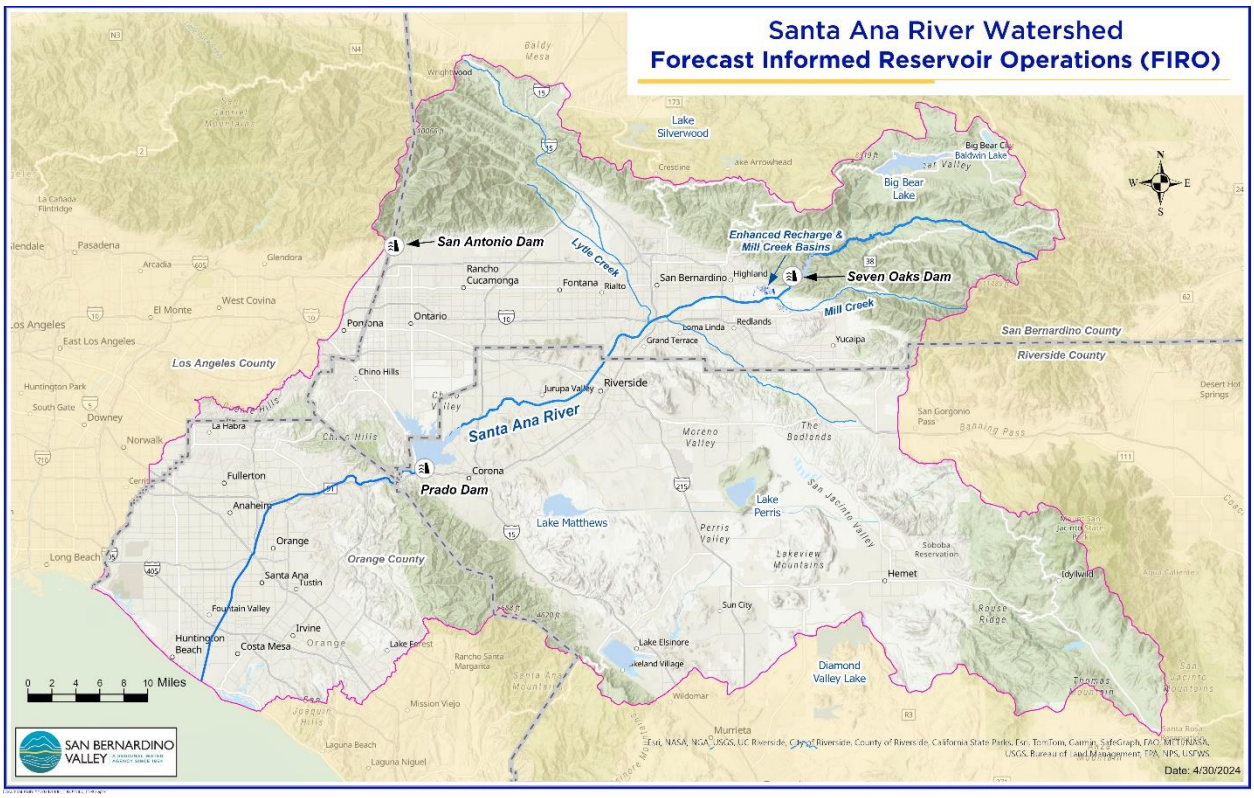

Figure 2-1*. The Santa Ana River Watershed. Seventy-four percent of the watershed area above Seven Oaks Dam is at an elevation higher than 1,900 meters (6,234 feet) above mean sea level. (Credit: San Bernardino Valley.)*

About 6 million people live in the Santa Ana River watershed. Water supply reservoirs within the watershed include Lake Mathews, Lake Perris, Lake Skinner, Diamond Valley Lake, and Irvine Lake. In addition, Prado Dam, constructed for flood risk management, is also operated to facilitate groundwater recharge under certain conditions, providing valuable water supply for Orange County Water District.

Most of the watershed area above Seven Oaks Dam is within the San Bernardino National Forest. The Santa Ana River above Seven Oaks Dam is free-flowing, with a steep gradient (300 feet per mile) and highly erodible soil. Below Seven Oaks Dam, as the river enters the lower basin, much of the flow is diverted for municipal and agricultural water supply and groundwater recharge. Flow downstream of San Bernardino during the non-storm season is dominated by effluent from nine wastewater treatment plants. Stormwater runoff in the lower basin is collected in the Prado Dam Basin. Below Prado Dam, Orange County Water District diverts, on average, approximately 150,000 acre-feet (ac-ft) per year from Prado Dam releases into recharge basins, which provides about one third of its municipal water supply yearly.

2.2 San Bernardino Valley Municipal Water District

San Bernardino Valley Municipal Water District (San Bernardino Valley) is a wholesale water and groundwater management agency; its service area covers over 350 square miles and serves around 714,000 customers. The service area covers the eastern two-thirds of the San Bernardino Valley, Crafton Hills, and part of the Yucaipa Valley (including the cities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Highland, Grand Terrace, and Yucaipa, part of the city of Fontana, and unincorporated areas in San Bernardino County, including Bloomington and Mentone). San Bernardino Valley obtains water from the State Water Project (SWP) from the east branch of the state aqueduct via Lake Silverwood. In addition to other water rights holders, San Bernardino Valley and the Western Municipal Water District (Western Water) have water rights permits to divert and use up to 198,000 ac-ft per year of water from the Santa Ana River. San Bernardino Valley and Western Water also have rights to store up to 50,000 ac-ft of Santa Ana River water at Seven Oaks Dam.

A portion of the Santa Ana River flows released from Seven Oaks Dam are recharged into the groundwater basin directly downstream of the dam by the San Bernardino Valley Water Conservation District. The groundwater basin is identified by the California Department of Water Resources as Basin 8-002.06, the "Upper Santa Ana Valley–San Bernardino Subbasin" (Department of Water Resources Bulletin 118). The subbasin, together with adjacent subbasins, is referred to as the San Bernardino Basin Area.

San Bernardino Valley, Western Water, the city of Riverside, and other entities in Riverside County are parties to the judgment in the case of *Western Municipal Water District v. East San Bernardino County Water District, et al.,* Riverside Superior Court No. 78426, which established water rights and responsibilities for management of the San Bernardino Basin Area. The judgment is administered and enforced by a court-appointed watermaster, consisting of a committee of two persons—one representative nominated by San Bernardino Valley and one by Western Water. About a million people in Riverside and San Bernardino Counties rely on the San Bernardino Basin Area for their principal water supply.

In 1960, San Bernardino Valley signed an agreement with the California Department of Water Resources to contract for SWP supplies. San Bernardino Valley's allocation of SWP supplies is 102,600 ac-ft per year. The amount of water provided by the SWP to the San Bernardino Valley each year varies, based on hydrologic conditions, environmental considerations, and other factors. In years when northern California is wet, 70 to 100 percent of the allocation of SWP may be available to San Bernardino Valley. In dry years, the allocation has historically been as low as 5 percent.

The population of San Bernardino and Riverside Counties is projected to grow by 15–20 percent by 2045 (California Department of Finance 2024). This will increase demand for water. **Table 2-1** shows sources and volumes of water supply to meet existing and future needs within the San Bernardino Valley service area.

Table 2-1. *Water supply sources in the San Bernardino Basin Area.*

Sources of Supply	Range in Current Supply (ac-ft/Year)	Range in Estimated Future Water Supply (ac-ft/Year)
SWP: groundwater recharge	0 to 70,000	0 to 70,000
SWP: delivery to treatment plants	5,000 to 33,000	5,000 to 33,000
Groundwater pumping	190,000 to 220,000	190,000 to 270,000
Direct delivery of treated local surface water	5,000 to 20,000	5,000 to 30,000
Direct delivery of surface water to irrigation	1,000 to 10,000	1,000 to 10,000
Groundwater recharge from Santa Ana River water released from Seven Oaks Dam (sustains groundwater pumping)	Up to about 100,000 in a wet year	Up to 200,000 in a wet year
Notes: Groundwater pumping is sustained by recharging Santa Ana River water, other local recharge, and SWP supplies. Values are ranges and not intended to be summed.		

2.3 Seven Oaks Dam and Reservoir

2.3.1 History and Authorized Uses

Orange County suffered major damage during the historic 1938 flood. In response, Prado Dam was built in 1941. The Corps later determined that another dam was needed at the base of the San Bernardino Mountains, as part of the Santa Ana River Mainstem (SARM) project, authorized by Congress in 1986. The SARM project extends about 75 miles from the upper Santa Ana River Canyon in the San Bernardino Mountains downstream to its confluence with the Pacific Ocean at Newport Beach. The $2 billion project provides flood protection for over two million people and hundreds of square miles of developed lands within Orange, Riverside and San Bernardino Counties. It includes construction of Seven Oaks Dam, raising Prado Dam, improving channels downstream of Prado Dam, and acquiring land and land easements.

Figure 2-2. *Seven Oaks Dam. (Credit: Steve Schumaker via Wikimedia Commons, released under CC BY-SA 1.0.)*

Table 2-2. *Seven Oaks Dam quick facts from Orange County Public Works.*

Storage	
Height	550 feet
Top width	40 feet
Base width	Over 2,200 feet
Crest length	2,760 feet
Slope	Upstream slope = 1:2.2 (vertical to horizontal) Downstream slope = 1:1.8 (vertical to horizontal)
Embankment volume	37,626,983 cubic yards
Drainage area	177 square miles
Spillway type	Trapezoidal rock cut with concrete sill; total width 500 feet

Debris capacity	3,128 ac-ft
At spillway	147,970 ac-ft
At top of dam	174,609 ac-ft
Spillway	
Crest elevation	2,580 feet
Crest length	500 feet
Elevation of max. water surface	2,604 feet
Intake elevation	2,265 feet
Reservoir	
Area at spillway	780 acres
Gross capacity (at spillway crest)	145,600 ac-ft.
Storage Allocation Below Spillway Crest	
Flood control	113,600 ac-ft
Sedimentation (100-year storage)	32,000 ac-ft
Reservoir Design (General Storm)	
Total volume	115,000 ac-ft
Peak inflow	85,000 ft/sec
Peak outflow	7,000 ft/sec
Design Flood (350-year Recurrence)	
Total volume (four-day)	115,000 ac-ft
Peak inflow	85,000 cubic feet per second (cfs)
Peak outflow (no spillway)	7,000 cfs

Maximum Probable Flood	
Total volume	326,000 ac-ft
Peak inflow	185,000 cfs
Peak outflow	180,000 cfs

Construction of Seven Oaks Dam began in 1993 and was completed in 2000. The 550-foot high earth and rockfill embankment dam, 35 miles upstream of Prado Dam in the upper portion of the watershed, was built at a cost of about $450 million; 764 acres of habitat were set aside for three protected species, Santa Ana River woolly-star, the San Bernardino kangaroo rat (SBKR), and slender-horned spineflower. USACE's non-federal project sponsors included Orange County Flood Control District, San Bernardino Flood Control District, and Riverside County Flood Control and Water Conservation District. Since it was built, San Bernardino Valley and Western Water have been interested in operating the dam to capture and release water for recharge during or after storm events to enhance water reliability in the basin for human use and for habitat enhancement.

Currently, the dam is authorized for flood risk management only. A feasibility study by USACE, a Section 203 report, or an act of Congress would be required to authorize the dam for water conservation. In 1997, a feasibility study concluded that water could be seasonally stored at Seven Oaks Dam without impairing flood risk management. However, implementation stalled during the National Environmental Policy Act process because the Environmental Impact Report did not fully address potential project impacts on the then-newly federally listed endangered SBKR.

The Water Control Manual [USACE 2003, page 8-06) briefly mentions incidental water conservation:

> *The Water Control Plan currently does not include or preclude regulation for water supply purposes. The plan may be modified in the future to accommodate water conservation. The contemplated operation of the dam within the debris pool was negotiated with the downstream water users during the preparation of the Phase II General Design Memorandum (GDM) to address the impacts of the flood control operation on those users. Releases made from the debris pool during the flood season, and the draining of the debris pool during the summer months, are anticipated to address the impacts to downstream water users caused by building the debris pool during the flood season. Above the debris pool, temporary impoundment of water occurs during wet years. This water, which would have discharged from the canyon at much larger rates under natural conditions, could also incidentally enhance water conservation.*

2.3.2 Existing Operations

Seven Oaks Dam is operated and maintained by the abovementioned project sponsors (Orange County Flood Control District, San Bernardino County Flood Control District, and Riverside

County Flood Control and Water Conservation District). Operations are conducted by Orange County Flood Control District staff, in accordance with the USACE 2003 Water Control Manual.

The dam can function to store "incidental" water within the intermediate pool. When water is in this pool, releases can be delayed, and the release rates modified if hydrologic conditions warrant, to support downstream habitat mitigation and enhancement plans. This allows San Bernardino Valley and Western Water to opportunistically capture and recharge as much water as possible as it is released from the dam, within the constraints of the current Water Control Manual. The amount of water captured for groundwater recharge varies yearly, depending on precipitation and runoff generated and downstream water levels.

See **Figure 2-3** for a simplified storage allocation diagram from the Seven Oaks Dam Water Control Plan (USACE 2003, plate 7-01A).

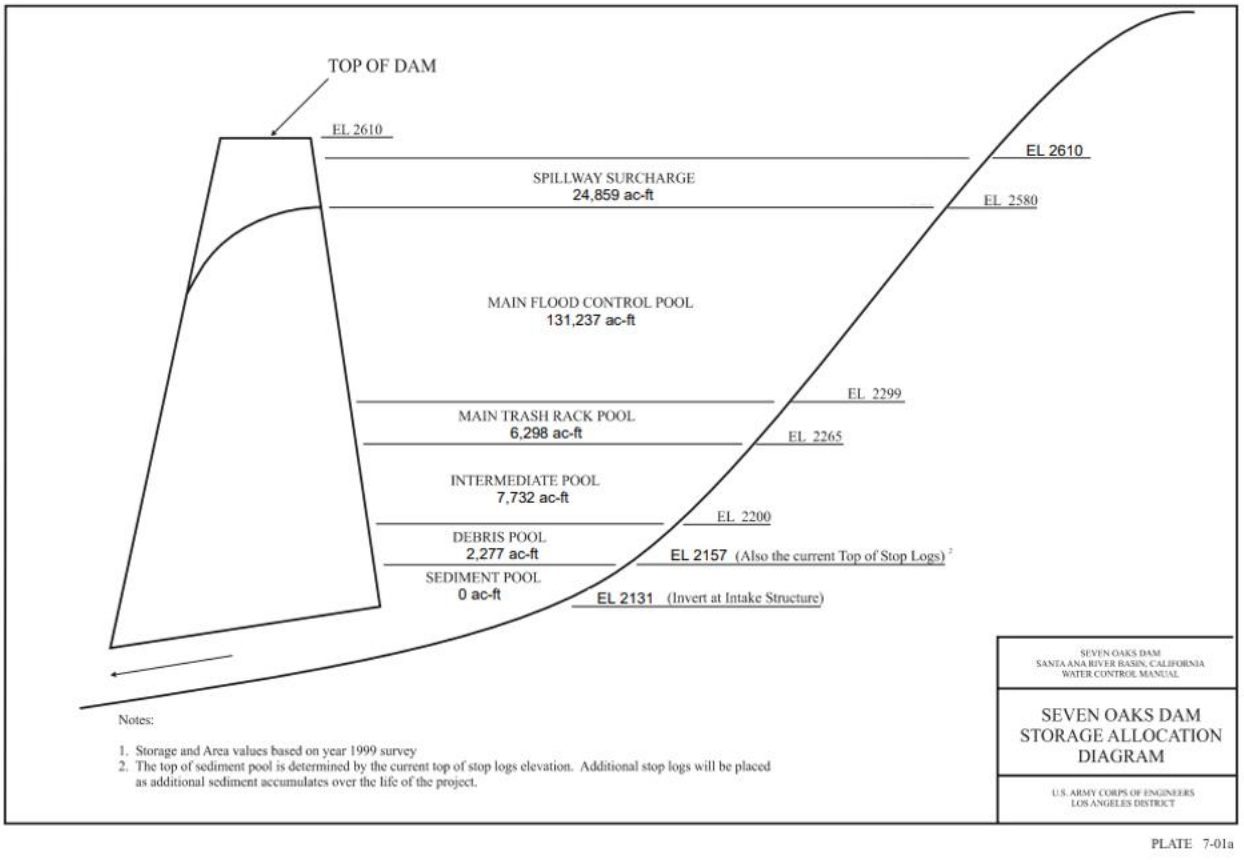

Figure 2-3. *Simplified storage allocation diagram from the Seven Oaks Dam Water Control Plan (plate 7-01A). Volumes shown here were based on prior surveys. Current storage volumes have changed due to sediments from recent storms and will be updated after completion of a new reservoir and sediment survey. (Credit: USACE Los Angeles District.)*

Currently, Orange County Flood Control District uses forecasts provided by the National Weather Service to inform future releases. Reasonably accurate precipitation forecasts are generally available within a week before the storm event, and release decisions are adjusted as the storm event approaches to lower the water surface elevation for as much effective storage as possible within the available time to prepare. Release flow rates are dictated according to the schedule shown in the appendix (Section 6.1), but releases at 500 cfs or less are optimal for

recharge, and 3 cfs is needed for downstream minimum flow requirements. To maximize recharge, slow-release rates over a long time during the winter and into spring are most effective, but current operations do not yet follow this practice. Discharges can be adjusted to meet public safety concerns, environmental mitigation, and/or maintenance requirements. Typically, the operational goal is to allow the water surface elevation to build up during the storm season (November to April). Then, from April to September, the goal is to empty the reservoir below the intermediate pool by September 1. Once the storm season ends, the operational goal shifts to emptying the reservoir to the sediment pool, to provide the required dry conditions for any maintenance; this drawdown should begin directly after the storm season ends, and no later than September 1 to allow at least a month and a half for maintenance work.

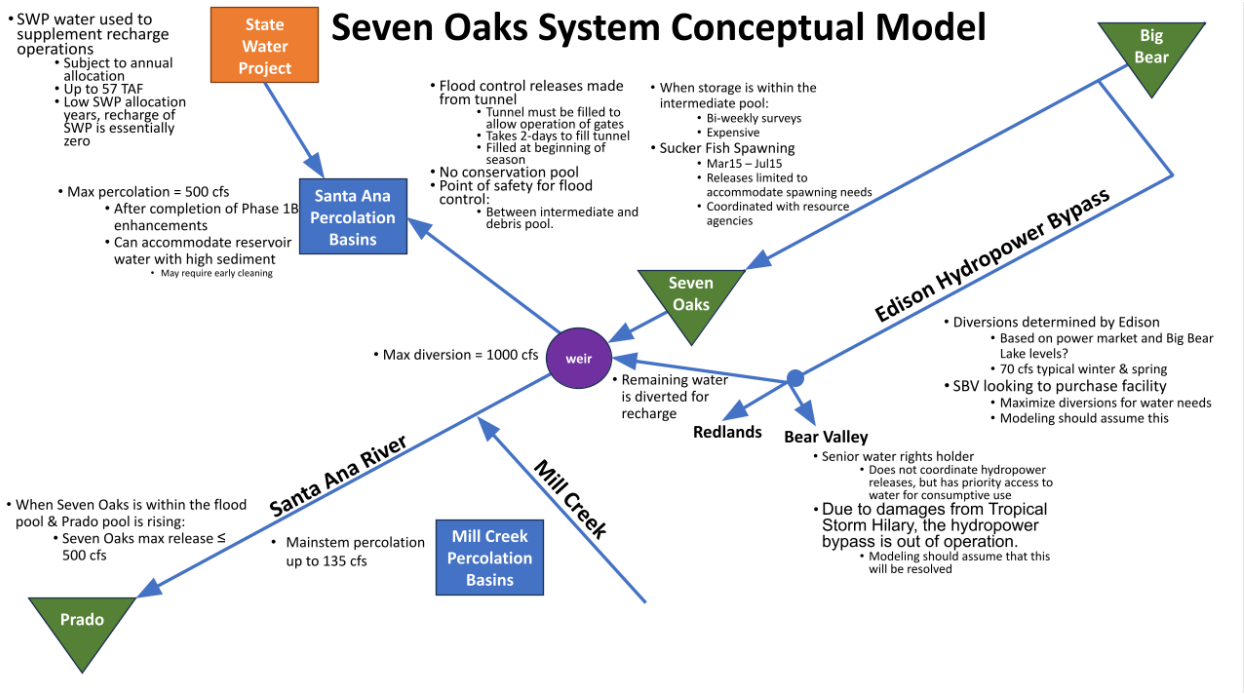

Figure 2-4. *Seven Oaks system conceptual model. (Hydropower bypass is non-consumptive use. SWP recharge is a secondary priority; Santa Ana River water is the priority for recharge basins.)*

2.3.3 Seven Oaks and Prado Dam Coordinated Operations

When the water level is low enough that water stays within the main flood control pool, releases from Seven Oaks Dam must be coordinated with Prado Dam. During flood events, Seven Oaks Dam will store water if the reservoir pool at the Prado reservoir is rising and the pool at Seven Oaks Dam is not approaching the spillway. When Prado Dam water is rising, releases from Seven Oaks Dam are capped at 500 cfs. Once water levels in the Prado Dam pool begin to recede, release rates from Seven Oaks can vary but are capped at 7,000 cfs.

2.4 Infrastructure

2.4.1 Existing Infrastructure

Facilities located upstream of the dam, within the reservoir and watershed, include service roads that provide access for the U.S. Forest Service, Southern California Edison, U.S. Fish and

Wildlife Service (USFWS), and water operators. Southern California Edison owns two hydroelectric powerhouses, and associated flume system and transmission lines, in the watershed. Several gauging stations with associated infrastructure are also located upstream of the dam. The dam facility itself has several operational components, as shown in **Figure 2-5**.

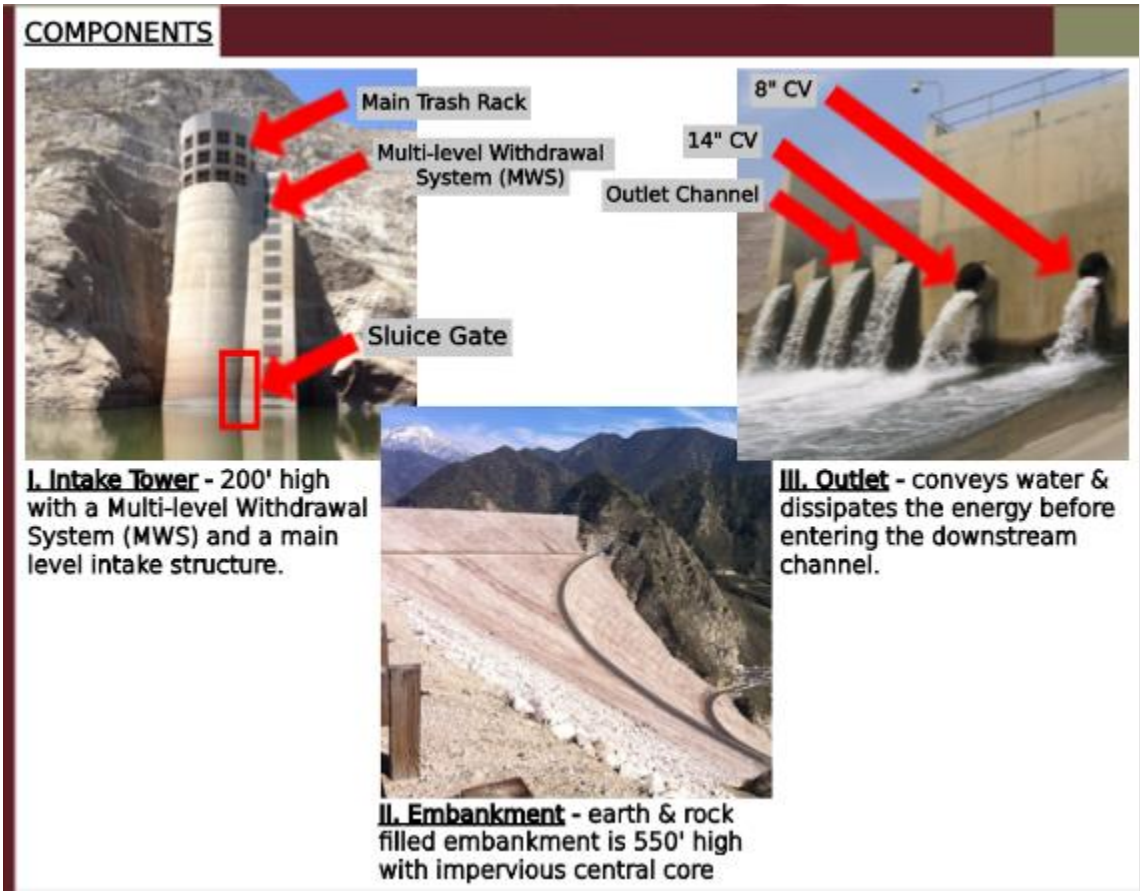

Figure 2-5. *Components of the Seven Oaks Dam system. (Credit: Orange County Public Works.)*

Downstream infrastructure (**Figure 2-6**) consists of a main intake structure, a tunnel, an additional minimum discharge line and gate system with control valves, and a plunge pool that water passes through before discharging to the Santa Ana River below the dam. The system is designed to regulate reservoir levels and downstream flows according to the USACE Water Control Plan, which requires a minimum pool elevation of 2,200 feet be maintained from October 15 through April 15 and dictates seasonal cfs limitations on releases to empty the debris pool by August 31. The 100-year debris pool target elevation is 2,200 feet. Flood control releases are restricted to a maximum of 500 cfs at elevations between 2,200 and 2,265 feet but can vary from 50 cfs to 2,000 cfs as specified in the release flow rate schedule (see Section 6.1 for more information). Typically, from October through April (and when no major floods are occurring), releases are made up to 500 cfs. Flood control releases can vary over a wider range depending on conditions. During flood events, releases can increase up to 7,000 cfs to meet the target elevation. Under Main Flood Control Pool conditions, Seven Oaks Dam operations are coordinated with elevations at downstream Prado Dam, and Seven Oaks releases are held at 500 cfs until the flood peak passes Prado Dam. For more information on the system hydrology and engineering, refer to Sections 4.3 and 4.5, respectively.

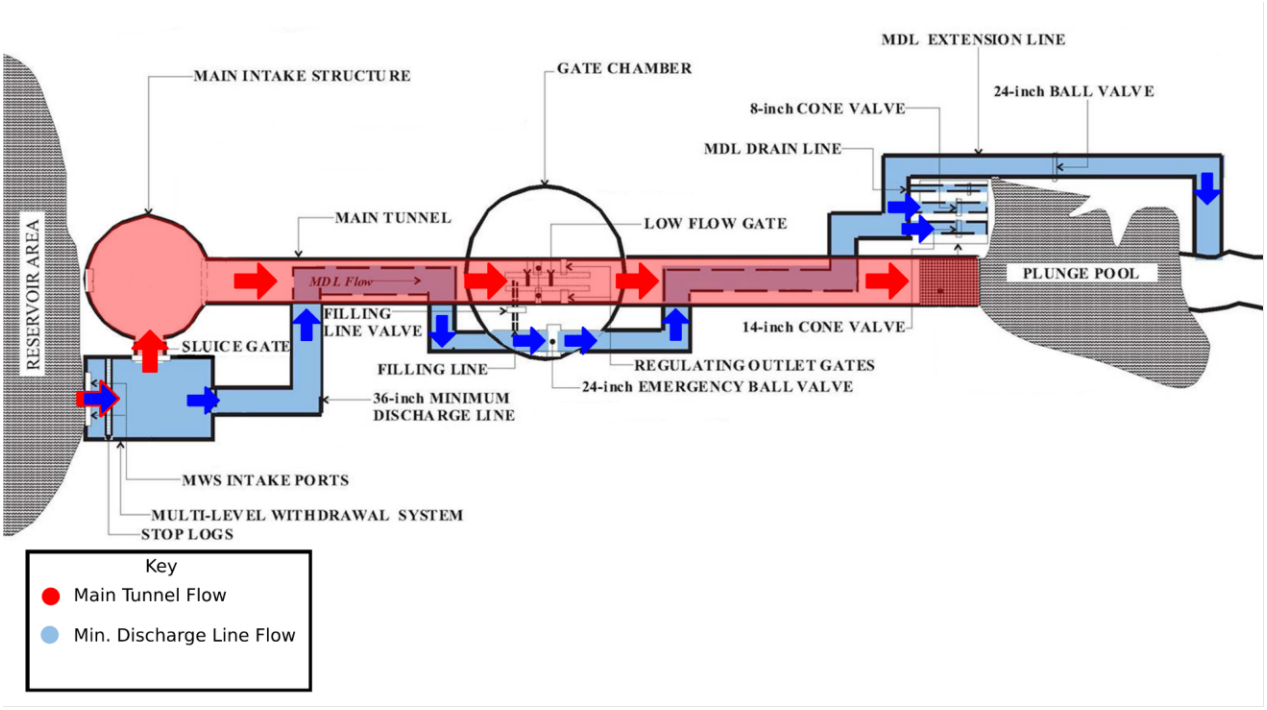

Figure 2-6. *Seven Oaks Dam reservoir downstream infrastructure. (Credit: Orange County Public Works.)*

The San Bernardino Valley Water Conservation District recharges Santa Ana River water released from Seven Oaks Dam. The capacity of the existing recharge facilities is 195 cfs, which can decrease by half due to sediment accumulation and/or groundwater mounding following high recharge years. The Conservation District conducts facilities maintenance to optimize recharge capacity during dry periods, typically in the summer and fall. The facilities used to recharge Santa Ana River flows released from Seven Oaks Dam are shown in **Figure 2-8**.

2.4.2 Future Infrastructure and Enhancements

The Seven Oaks Dam water conservation feasibility report (USACE 1997) considered four alternatives (in addition to a "no action" alternative) for increasing water conservation at Seven Oaks Dam (see Section 4.5 for more information). While increasing the elevation of the intermediate pool may be an option considered in the FIRO viability assessment, it may also be possible to increase groundwater recharge by varying the release rate and/or keeping water levels in the intermediate pool later in the season. Certain infrastructure improvements would likely be needed for additional storage regardless of how that is achieved. The Santa Ana River draft Environmental Impact Report (EIR) (San Bernardino Valley Municipal Water District & Western Municipal Water District 2004) shows several improvements that may be needed to retain water at elevations above 2,265 feet (**Figure 2-7**).

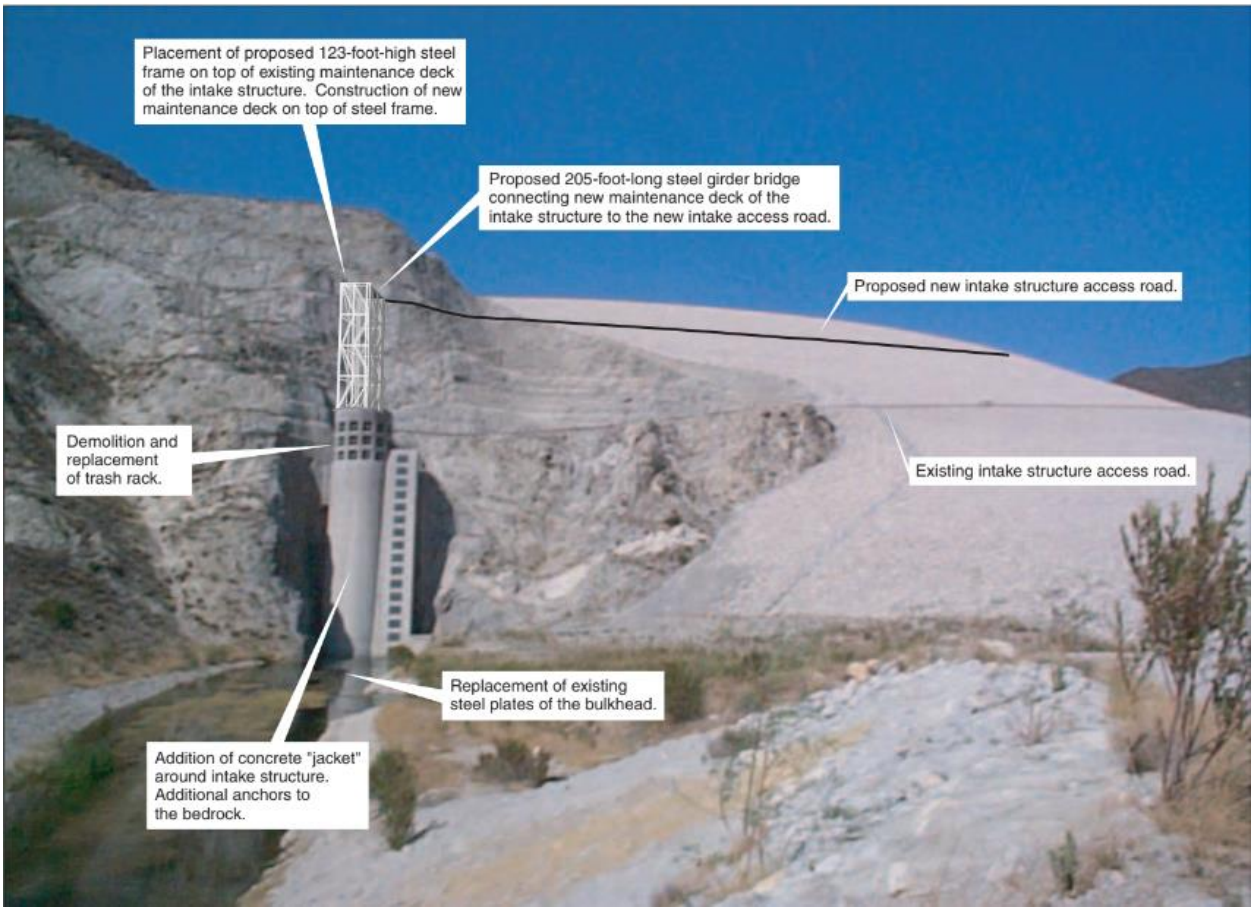

Figure 2-7. *Visual simulation of modifications to Seven Oaks Dam intake structure and access road needed to accommodate additional water storage behind the dam. (Figure from San Bernardino Valley Municipal Water District & Western Municipal Water District 2004.)*

Efforts are underway to expand the recharge basin capacity to capture additional runoff. San Bernardino Valley, in collaboration with Western Water, is constructing the Enhanced Recharge Project Phase 1B, which will add 80 acres of new recharge basins to the existing facilities. These recharge basins are being constructed on Conservation District land and will be operated by the Conservation District upon completion. The addition of the new recharge basins will expand the recharge capacity from 195 cfs to 500 cfs, allowing the expanded facility to recharge up to an additional 80,000 ac-ft per year when enough water is available. The construction of the new recharge basins is projected to be completed by the end of 2024 (**Figure 2-8**). In addition, system enhancements from the Enhanced Recharge project allow San Bernardino Valley to convey Santa Ana River water from the Phase 1A sedimentation basin afterbay through their existing system for spreading at San Bernardino County Flood Control's Waterman Basins.

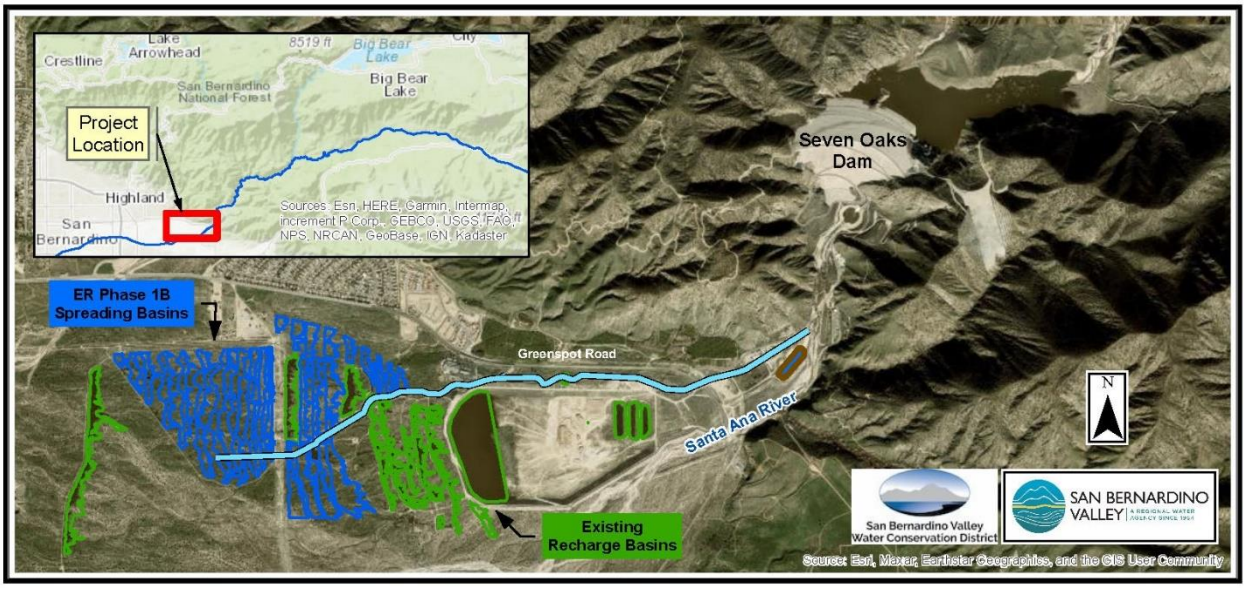

***Figure 2-8**. Map of existing and expanded recharge basins. (Credit: San Bernardino Valley.)*

2.5 Environmental Objectives

Habitat protection and enhancement are central to the Seven Oaks Dam FIRO project, and the FIRO viability assessment will explore a range of operational modifications that could provide additional water conservation and habitat benefits, in accordance with governing documents and management plans described below.

2.5.1 Governing Documents

Environmental impacts and mitigation associated with construction of the SARM project, including Seven Oaks Dam, were addressed in the 1988 Supplemental Environmental Impact Statement associated with the Phase II General Design Memorandum on the SARM (USACE 1988). USACE prepared biological assessments and consulted with USFWS pursuant to section 7(a)(2) of the Federal Endangered Species Act to account for federally listed species and critical habitat within the project area.

USFWS Biological Opinions (BOs) in 1989 and 2002 determined that the SARM and operation of Seven Oaks Dam would not jeopardize the continued existence of the least Bell's vireo, Santa Ana River woolly-star, slender-horned spineflower, or SBKR or adversely modify SBKR critical habitat with compensatory mitigation and conservation measures.

The 1989 BO addresses compensation, reasonable and prudent measures, and conservation recommendations specific to Santa Ana River woolly-star and least Bell's vireo. As a result of the 1989 BO, 764 acres were purchased by USACE's non-federal project sponsors (Orange County Flood Control District, San Bernardino Flood Control District, and Riverside County Flood Control & Water Conservation District) and set aside in perpetuity as the Santa Ana River Woolly Star Preserve Area (WSPA) to mitigate potential impacts of Seven Oaks Dam (Figure 2-9).

The 2002 BO addresses impacts from Seven Oaks Dam operations on additional federally listed species and included conservation measures to sustain SBKR, slender-horned spineflower, and

Santa Ana River woolly-star on WSPA lands (USFWS 2002). The 2002 BO also included a requirement to enable large releases from Seven Oaks Dam when and if necessary to sustain endangered species habitat within the WSPA, which was incorporated in the 2003 Water Control Manual.

USACE prepared a Multi-Species Habitat Management Plan in 2012 to coordinate and adaptively manage WSPA lands to sustain the three covered species and their habitats during the life of the SARM project. The management plan identifies a detailed strategy and plan of action, including monitoring the covered species' populations, monitoring habitat conditions, and taking management measures as appropriate (which may include "environmental enhancement releases" from Seven Oaks Dam).

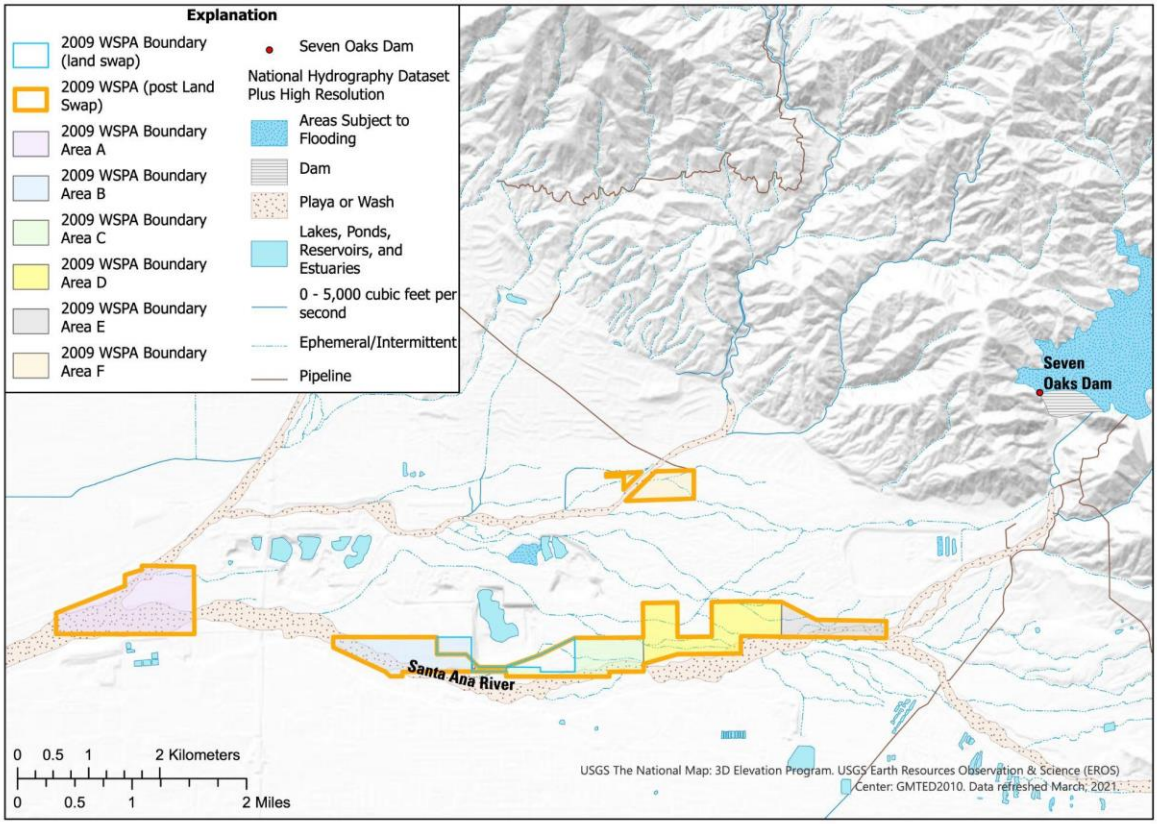

Figure 2-9. The Santa Ana River Woolly Star Preserve Area.

2.5.2 Water Quality

After construction of Seven Oaks Dam, water agencies that treat water released from the dam for delivery as potable water reported changes in water quality. A report from Camp Dresser & McKee (2005) indicates that the quality of water entering treatment plants downstream of the dam deteriorated with respect to turbidity and other constituents including overall organic content, algal blooms, iron, and manganese.

The USACE Engineer Research and Development Center (ERDC) conducted water quality studies related to this issue. ERDC produced a series of interim reports, including *Water Quality in Seven Oaks Reservoir and Influences on Receiving Waters of the Santa Ana River, California*

(ERDC 2011). This report monitored water quality during a year when flood water was purposefully held in order to test dam functionality during a high-flow release. The report states:

> *The Seven Oaks Dam [SOD] flood control project on the Santa Ana River has unavoidably altered the hydrology and water quality of the river. Turbid storm water that used to pass downstream in a matter of days, with destructive effects downstream, is now retained for several weeks or months in the SOD reservoir pool before being released in accordance with an established regulation schedule. The overall effect of impounding flood water by SOD is to remove (by settling) a large fraction of the flood-related sediment (and associated material) that enters the pool from upstream. Because the project attenuates the peaks of flood discharges and traps sediment, the total mass of material and turbidity transported downstream of the impoundment is greatly reduced. This is particularly evident when comparing reservoir discharges to historic peak flood levels. However, as a tradeoff, turbidity in the downstream release may be elevated above low-flow, background levels for extended periods (e.g., weeks) after a flood. The dam and its pool of impounded river water also create an opportunity for biological processes in the impounded water to process (biochemically transform) organic matter and nutrients associated with the flood waters, and to create chemical conditions that mobilize undesirable constituents from the bottom sediments of the reservoir. However, none of these effects or processes had been quantitatively evaluated in SOD prior to 2006 and therefore, to better identify and quantify the various potential effects on water quality of the SOD impoundment and to explore possible approaches to improve downstream water quality at SOD, staff of the ERDC in 2006 began collecting water quality field data in collaboration with San Bernardino County Flood Control Staff and conducted numeric model simulations of water quality in the SOD system.*

USACE's Los Angeles District also investigated water quality issues and published a draft report titled Post-authorization Change Report, Santa Ana River Mainstem Project, Seven Oaks Dam Water Quality Study, San Bernardino County, California (USACE 2010). The purpose of the report was "to investigate any post-construction water quality issues related to the construction of Seven Oaks Dam." The report also evaluates alternatives and presented a Tentatively Selected Plan. The Tentatively Selected Plan in the draft report was modification of the Water Control Plan to eliminate the "full-time" debris pool during the flood season. The work to complete the interim report was not conducted and no changes were made to the Water Control Plan.

The EIR for San Bernardino Valley and Western Water's Santa Ana River Water Rights Application also discusses the water quality issue (San Bernardino Valley Municipal Water District & Western Municipal Water District 2007). The EIR states:

> *The quality of water impounded in the Debris Pool for flood control was impaired during the summer of 2004 by the development of anaerobic conditions. Water impounded in the reservoir for flood control purposes in 2005 contained high levels of suspended solids and was unsuitable for use.*

The State Water Resources Control Board issued water rights permits to San Bernardino Valley and Western Water to recharge water in the Santa Ana River below Seven Oaks Dam and to

store up to 50,000 ac-ft of water in the reservoir. The permits issued by the board include the following terms:

- To prevent degradation of the quality of water released to the Santa Ana River from storage at Seven Oaks Dam, the board may modify the permits to set conditions that apply water quality objectives to any release from storage.
- No water shall be released from storage of Seven Oaks Dam for re-diversion by the permittee until the permittee has consulted with the Chief Deputy Director for Water Quality or their delegate and the Chief Deputy Director has determined that the releases will be consistent with applicable water quality objectives. The releases shall be consistent with any conditions the Chief Deputy Director determines are necessary to ensure compliance with applicable water quality objectives.

2.5.3 Habitat Restoration and Conservation

The Western Riverside County Multiple Species Natural Community Conservation Plan and Habitat Conservation Plan (WRC MSHCP), a comprehensive regional natural community conservation plan/habitat conservation plan, was adopted in June 2003. The WRC MSHCP provides mitigation for future county projects, particularly transportation and development projects in the covered area of western Riverside County. There are 146 covered species in the WRC MSHCP, including the four covered by the 2002 BO.

USFWS permitted the Upper Santa Ana River Wash HCP in 2020. This plan has a planning area of 4,892 acres in the alluvial plain downstream of Seven Oaks Dam. Its primary goal is to balance the ground-disturbing effects of groundwater recharge and other activities with the conservation of natural communities and populations of Santa Ana River woolly-star, slender-horned spineflower, and SBKR, among others.

Protected Species of Interest to FIRO at Seven Oaks Dam

- Cactus wren
- Coastal California gnatcatcher
- Least Bell's vireo
- Southwestern willow flycatcher
- Yellow-breasted chat
- San Bernardino kangaroo rat
- Los Angeles pocket mouse
- Western spadefoot toad
- Arroyo chub
- Santa Ana sucker
- Slender-horned spineflower
- Santa Ana River woolly-star

The Upper Santa Ana River Habitat Conservation Plan (Upper SAR HCP), which encompasses about 862,966 acres in San Bernardino and Riverside Counties, is currently being developed to protect, enhance, and restore habitat, while streamlining Federal Endangered Species Act permitting for water resource management projects at a regional scale. Covered activities under this plan include diversions for groundwater recharge, water infrastructure development, and flood control. The Upper SAR HCP covers 20 species, including the four covered by the 2002 BO.

All three habitat conservation plans (shown in **Figure 2-10**) have, or will have, restoration projects and monitoring programs intended to track metrics related to restoration success, relevant geophysical processes, and covered species.

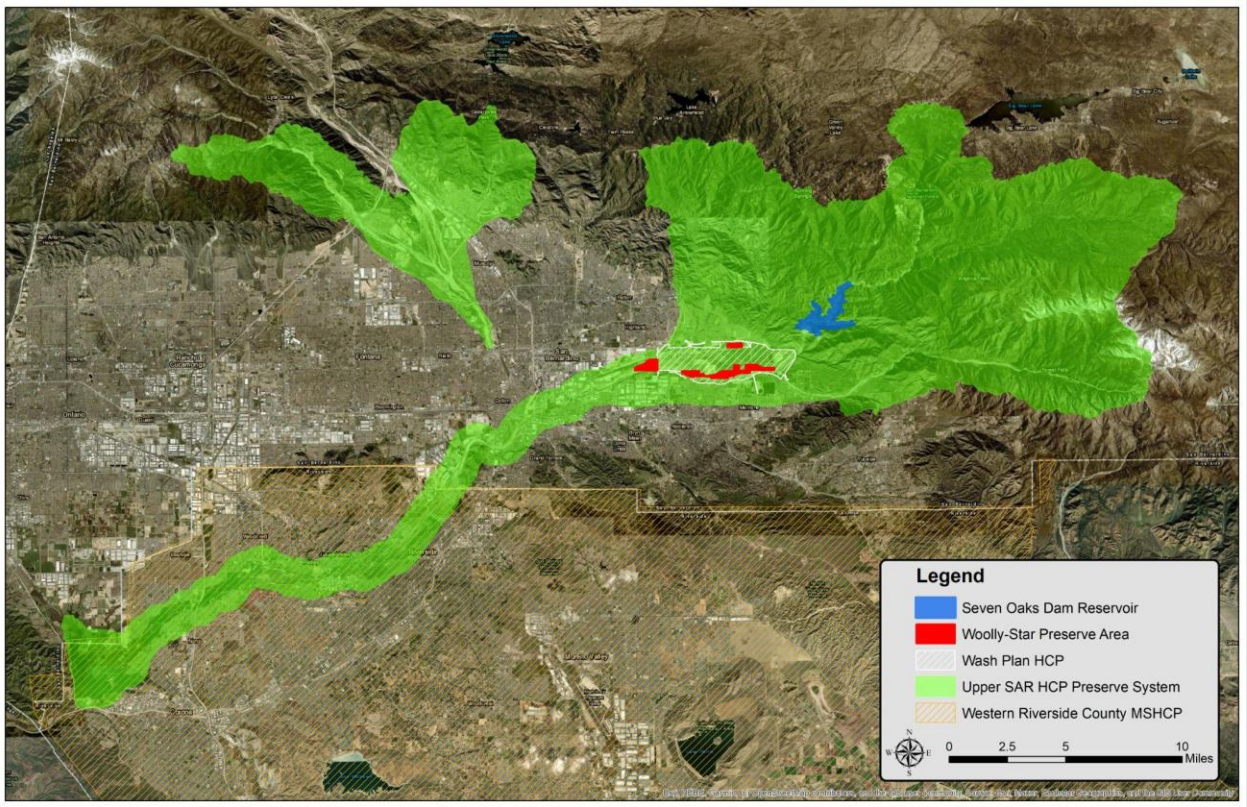

Figure 2-10. *Habitat conservation plans relevant to FIRO at Seven Oaks Dam. (Credit: San Bernardino Valley.)*

2.6 References

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Section 3. Preliminary Technical Studies Plan

The Forecast Informed Reservoir Operations (FIRO) concept fundamentally requires an understanding of forecast skill as it relates to reservoir operations at Seven Oaks Dam. The overarching goal of the preliminary technical studies is to understand the role of atmospheric reiver (AR) storms impacting Santa Ana River watershed. The results of these studies will be important to understanding forecast errors and being able to forecast extreme precipitation events and their impact on runoff within the Seven Oaks Dam watershed. This evolution of forecast errors will motivate future work targeted at minimizing these errors, and hence improve forecast skill. In addition, results will further the understanding of how ARs contribute to projected changes in precipitation frequency at the Santa Ana River watershed under the "business-as-usual" climate change scenario. As water managers adapt to climate change, it is important that they gain insights into how the effects of climate change may manifest as event occurrences within the Santa Ana River watershed. The preliminary technical studies will be complete in October 2024. Sections 3.1 and 3.2 briefly describe the methodology and preliminary results of these studies.

3.1 Extreme Precipitation Events and Their Impact on Runoff

Preliminary technical studies related to extreme precipitation events in the Seven Oaks basin will seek to evaluate the storm characteristics responsible for variability in forecast error. These characteristics can drive variability in and impact on streamflow and runoff in the basin. Studies of storm characteristics were divided into two categories: to better understand both the processes associated with extreme precipitation and its forecast skill (Section 3.1.1), and to analyze freezing level uncertainty and its forecast skill (Section 3.1.2).

3.1.1 Better Understand Extreme Precipitation and Forecast Skill

In order to better understand extreme precipitation and its forecast skill, the FIRO team aims to utilize a dataset developed for the Santa Ana River watershed containing data spanning watershed mean areal values of quantitative precipitation forecasts (QPF), quantitative precipitation estimates (QPE), and the near-coastal characteristics of landfalling ARs. After confirming a strong correlation between the precipitation over the upper portion of the Santa Ana River watershed containing the Seven Oaks catchment compared to the mean areal precipitation (MAP) for the entire basin (**Figure 3-1**), a methodology was constructed to identify AR-related storms during water years 2012–2022 that featured large cool-season (i.e., October–April) QPF errors at several lead times during landfalling ARs (**Figure 3-2**).

The dates associated with storms that were forecast as too wet or too dry as a function of lead time were analyzed to find 23 storms that were incorrectly forecast in three or more lead times, as shown in **Figure 3-2**. The FIRO team plans to next assess the characteristics of these 23 storms to determine processes that influenced the relatively poor forecast skill. In the following list of three items to be investigated for these storms, both (1) and (2) have experienced significant progress over the last decade, with (3) remaining for additional study through the period of performance:

1. Landfalling AR characteristics, including intensity, duration, and orientation relative to terrain features.

2. Small-scale features responsible for spatial and/or temporal variability in precipitation and its prediction, such as narrow cold frontal rainbands or convection.

3. Large-scale features responsible for spatial and/or temporal variability in precipitation and its prediction related to landfalling ARs, such as intensity, duration, and landfall location.

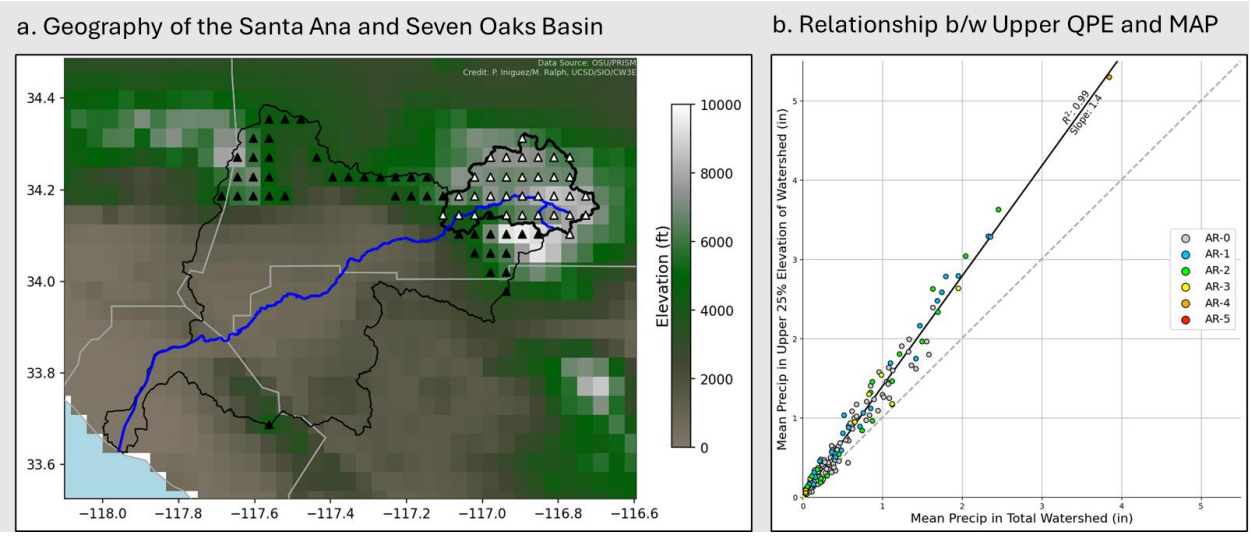

Figure 3-1*. Left: Panel (a) shows the geography of the Santa Ana (thin black line) and Seven Oaks (thick black line) basins with topography shaded at the 4-kilometer grid resolution. The grids in the upper 25 percent elevation of the Santa Ana basin are black and white triangles, whereas the grids in the Seven Oaks basin are white triangles. Right: The relationship between the MAP for the entire Santa Ana basin as compared to the upper 25 percent elevation is shown in panel (b) with a correlation (r^2) of 0.99.*

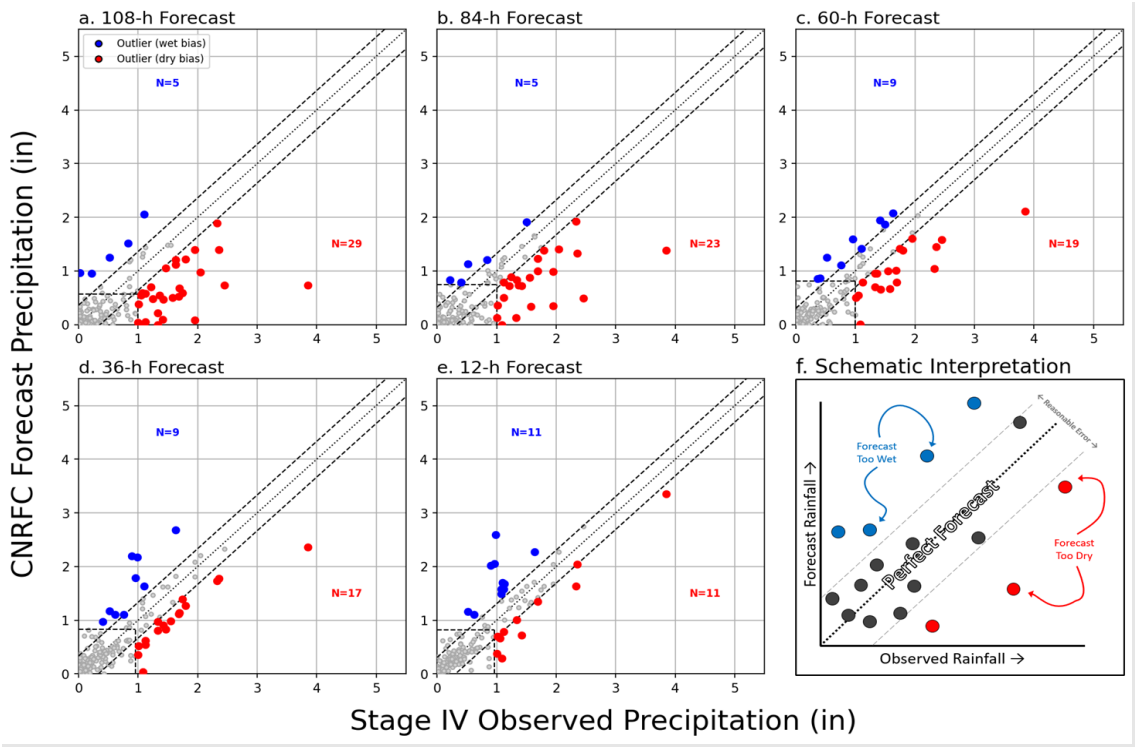

***Figure 3-2**. Comparison of the California Nevada River Forecast Center (CNRFC) precipitation forecast (in; y-axis) with the observed Stage IV precipitation (in; x-axis) as a function of lead time (a) 108 hours through (e) 12 hours. Blue circles represent forecasts that were too wet relative to a "reasonable margin of error" and red circles represent forecasts that were too dry as depicted by the schematic interpretation in panel (f). The reasonable margin of error was an 80 percent confidence interval relative to overall QPF bias.*

3.1.2 Better Understand Freezing Level Uncertainty and Its Forecast Skill

Freezing level uncertainty within a watershed is often associated with uncertainty in expected runoff generation rates when the precipitation is falling as rain or snow. When more of the watershed is exposed to freezing temperatures, the resulting snow often has a slower runoff generation response. In turn, the timelines associated with reservoir fill can be impacted due to different runoff volumes occurring at different rates (e.g., Sumargo et al. 2021). This task aims to support the investigations of forecasted freezing level uncertainty as it pertains to runoff generation.

Figure 3-3 below shows the relationship between freezing level distributions and the Seven Oaks basin elevation distribution over an 11-year period of record using CNRFC gridded observations and forecasts. During periods of precipitation near Seven Oaks Dam, the freezing level (i.e., 0 °C isotherm height) spans 450 meters to 3,900 meters. This range exceeds the minimum and maximum elevations found in the Seven Oaks basin, indicating that freezing level can impact all extents of the basin. More importantly, over half the time when precipitation is falling near Seven Oaks Dam, 75 percent of the watershed is exposed to freezing temperatures. In other words, freezing level often impacts most of the basin during precipitation events. This analysis indicates that freezing level is a key meteorological factor for Seven Oaks and should be investigated for its impact on precipitation partitioning and reservoir volume generation.

Using freezing level forecasts to identify the amount of water volume falling as snow versus rain is another key aspect of the technical studies effort. Gridded precipitation totals can be converted into total water volume falling within the basin and compared to water only falling within the area of basin above the freezing level elevation. Figure 3-4 (left) shows an example of the comparison between the observed 24-hour total precipitation volume within the Seven Oaks basin and precipitation falling within the bounds of the observed freezing level elevation valid at 00Z 2021-12-29. This analysis assumes all precipitation falling above the freezing level is snow. The total basin volume is approximately 2,300 acre-feet (ac-ft) and 75.7 percent of the total volume is falling at an elevation higher than the freezing level. A large ensemble regional forecast model can also show the 24-hour forecast variability of the daily basin volume and the fraction of volume above the freezing level to quantify the uncertainty in the volume partitioning.

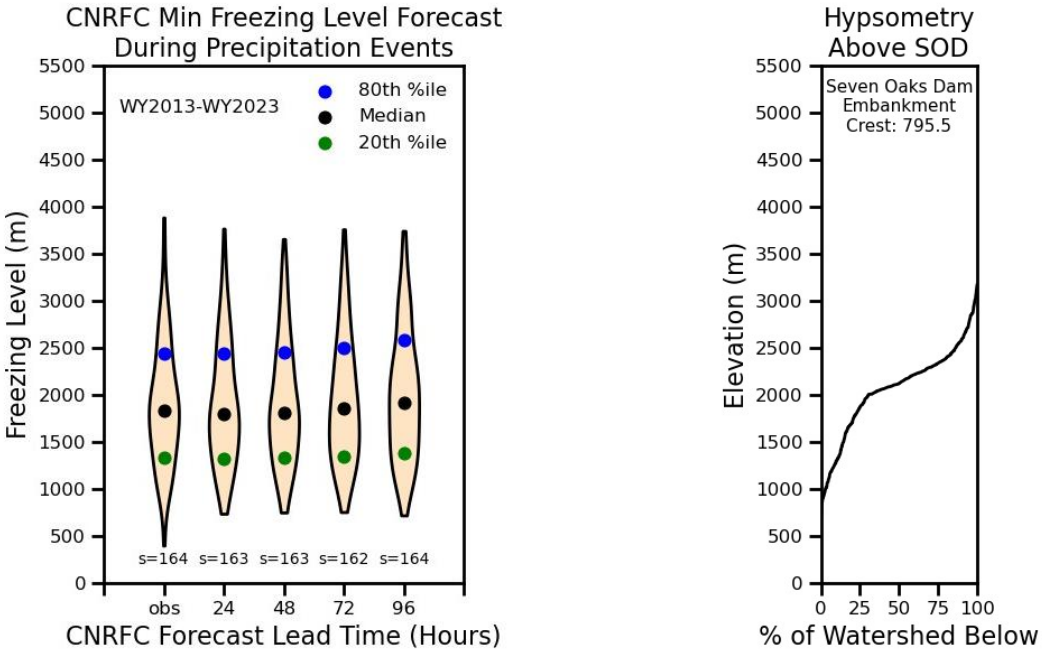

***Figure 3-3**. Left: Distributions of freezing level (i.e., 0 °C isotherm heights) using CNRFC gridded observations and forecasts at lead times of 24, 48, 72, and 96 hours using data between 2013–2023 at times when precipitation was falling near Seven Oaks Dam. The yellow shaded area represents the density of the freezing level distribution where the height of the edges represents the minima and maxima, respectively. The blue dot corresponds to the 80th percentile value of the distribution, the black dot to the 50th percentile (i.e., median), and the green dot to the 20th percentile value of the distribution. Right: Elevation hypsometry above Seven Oaks Dam. The height of the dam embankment is given in the upper corner of the plot.*

The right panel of **Figure 3-4** below shows that the 200 different ensemble 24-hour forecasts from the Center for Western Weather and Water Extremes' (CW3E's) Western Weather Research and Forecasting (West-WRF) ensemble was predicting total basin volumes between 1,000 and 6,000 ac-ft, with the vast majority (72–89 percent) of that precipitation volume falling above the freezing level elevation. The FIRO team will continue to evaluate this metric for robustness and analyze if freezing level forecasts depend on volume partitioning. In addition, the FIRO team will also utilize alternative observations to the CNRFC, namely the

vertical profiling radar data that estimate the rain-snow elevation and quantify the difference between the observation types.

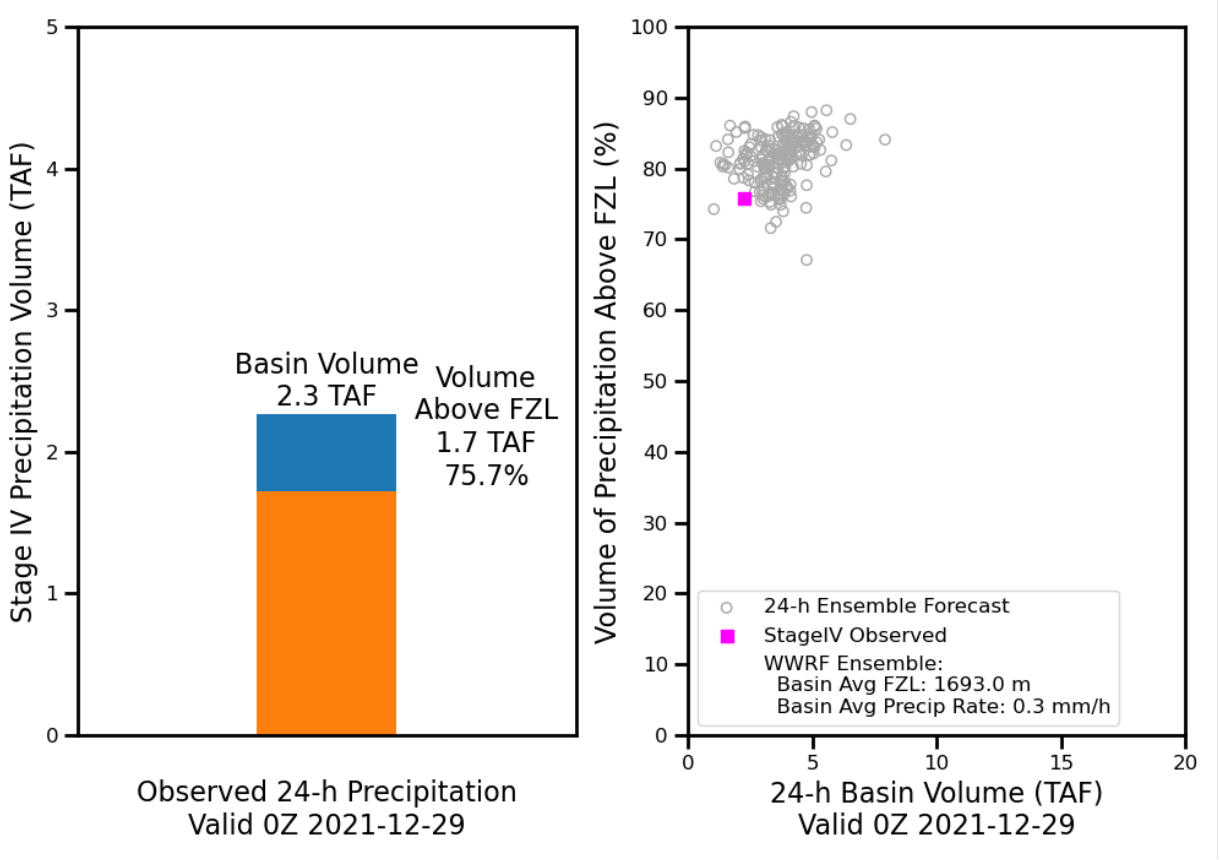

Figure 3-4. *Left: Observed basin 24-hour total precipitation volume within the Seven Oaks basin (height of blue bar) and precipitation that falling within the bounds of the observed freezing level elevation (height of orange bar) valid at 00Z 2021-12-29. The percentage of the volume falling above the freezing level elevation is given in the inset as FZL. Right: Scatter plot of the daily basin volume (thousands of ac-ft) versus the percent of volume above the freezing level using observations (pink square) and 24-hour forecasts from CW3E's 200-member West-WRF ensemble (gray circles).*

The technical studies on freezing level forecast skill and uncertainty will continue to address and investigate:

1. Variability in observed volume partitioning across several case studies of ARs impacting the Seven Oaks basin.

2. How to identify freezing level variability and skill across case studies using ensembles.

3. Differences between measures to quantify the rain-snow elevation (i.e., differences between 0°C isotherm and observations made by vertical profiling radars).

3.1.3 Assessment of Existing Meteorological and Hydrological Observation Sites

Observations are a critical component to forecast verification, model evaluation, and in situ decision support tools to support FIRO objectives. Reliable and accurate observations available in near real-time are required to support these efforts. To better understand the spatial distribution, temporal coverage, and reliability of existing observations in the network, the observations team aims to conduct an observations network analysis. As of this writing, the Seven Oaks basin has few active monitoring stations.

The network analysis for this study will focus on observation types most relevant to FIRO objectives. For the watershed above Seven Oaks Dam, the network analysis will include precipitation amount, precipitation phase, snow depth and snow water equivalent, soil moisture, and discharge. The observations team will compile an inventory of all active and online stations measuring the observation types of interest from MesoWest and the California Data Exchange Center and include notes on inactive or discontinued stations. In addition to summarizing station metadata, the team will conduct a spatial cluster analysis of watershed characteristics, including elevation, slope, aspect, climatological precipitation (from PRISM), and land use. The spatial cluster analysis uses K-means clustering to classify different areas of the watershed based on relevant watershed characteristics. The number and type of monitoring stations in each cluster will help identify under-represented regions or characteristics of the watershed. The team will also evaluate the elevation distribution of monitoring stations relative to the hypsometry of the basin to ensure monitoring station coverage is proportional to the distribution of elevations in the basin. Data quality and reliability are a significant consideration for how well the monitoring network represents the landscape.

To assess the quality of the current observations network, the team will use a select number of precipitation events to determine monitoring station reliability, availability, and data quality during events with different precipitation amounts and phases. Data quality and reliability will also be cross-referenced with forecast verification analyses for areas with the largest precipitation forecast errors and freezing level forecast errors. These analyses aim to identify strengths and weaknesses of the existing monitoring network, particularly how well the network can support FIRO goals. The results can then inform where additional observations are needed, what types of observations are needed, and suggestions to improve existing monitoring stations.

3.1.4 Key Findings and Summary

Key Findings

- Thirty-six storms were identified that contained large forecast errors across multiple lead times during water years 2012–2022.
- Freezing level has often impacted most of the Seven Oaks basin during precipitation events over the last 11 years.
- Ensemble forecasts can be used to quantify the uncertainty in predicted partitioning of the precipitation volume between totals of rain versus snow.
- Limited observations of relevant snow, soil, and discharge measurements are available in the watershed.

Summary:

- Methods have been developed to analyze precipitation forecast skill for events over the Seven Oaks basin.
- The FIRO team will explore landfalling AR and precipitation characteristics, terrain blocking, and upstream storm evolution in more detail to identify the sources of forecast error.
- Methods have been developed to quantify the partitioning of precipitation volume between totals of rain versus snow to account for potential runoff into Seven Oaks.

3.2 Projected Changes in Precipitation Frequency Under the "Business-as-Usual" Climate Change Scenario

3.2.1 Data

3.2.1.1 Historical Observations:

Daily precipitation totals from rain gauges (Menne et al. 2012) are interpolated to a 6-by-6-kilometer grid (Pierce et al. 2021) across the entire conterminous United States in a manner that respects topography and daily volatility. The FIRO team considers the observations to be reliable from the year 1948 onwards.

3.2.1.2 Downscaled Model Output:

Statistical downscaling of the most recent generation of global climate models, CMIP6, has recently been completed for three climate change scenarios: shared socioeconomic pathway (SSP) 245 (moderate anthropogenic forcing), SSP 370 (moderate to high anthropogenic forcing), and SSP 585 (high anthropogenic forcing). There are 27 models, some with up to 10 realizations in each scenario. Model runs are about 150 years spanning the years 1950–2100 (Pierce et al. 2023).

3.2.2 Methods

For most analysis, the FIRO team will aggregate over the Santa Ana River watershed by averaging over the 6-by-6-kilometer grid cells, which are at least partially contained by the Santa Ana River watershed, according to the tributary area spatial extent selection method of the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections download page.

3.2.2.1 Traditional Peaks-Over-Threshold (PoT) Extreme Value Analysis

The probability distribution of daily precipitation on days with heavy precipitation (those above the locally determined 75th percentile of nonzero precipitation) will be reviewed in terms of a standard PoT analysis (Coles 2001). In the study region, daily precipitation is volatile as described in Kozubowski et al. 2008: exceedance probabilities of large values decay with a power law (i.e., heavy) tail, so large "outliers" are common.

3.2.2.2 Holistic Extreme Event Analysis

The FIRO team will extend traditional PoT analysis to consider precipitation events of random durations, as described in (Weyant et al., in preparation). "Precipitation events" are runs of

consecutive time steps—in this case, days—in which heavy precipitation is observed. The team will summarize these events in terms of their duration, maximum daily intensity, and total accumulation. A trivariate probability distribution with four parameters is fit to these event summaries.

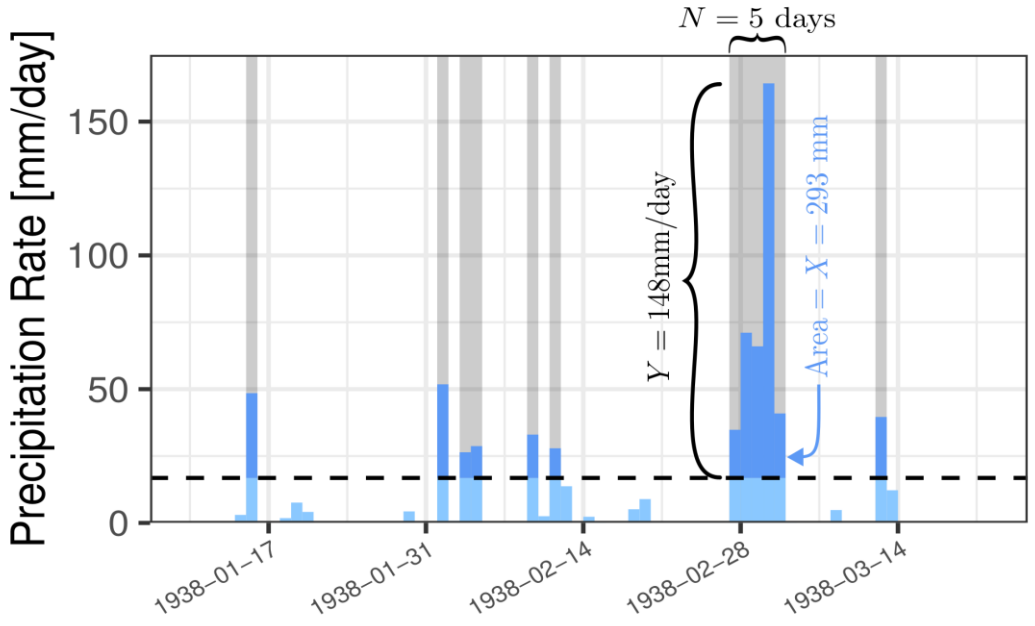

Figure 3-5. *Schematic showing how precipitation events are defined and identified in a series of daily precipitation accumulations at San Gabriel Canyon Pumphouse, California. Accumulations above a threshold are shown in dark blue. Seven separate events are visible, each with its own duration (width of gray shaded region), maximum intensity (maximum height of dark blue region), and magnitude (area of the dark blue region). (Credit: Weyant et al., in preparation.)*

3.2.3 A First Look at Projections

The effects of climate change may manifest as a change in the frequency of event occurrences and/or changes in any of the four parameters of the trivariate distribution. Figure **3-6** below shows the inconclusive results from our first-look projections, which utilized previous generation LOCA-downscaled climate models (CMIP5) with only a single realization of each model downscaled.

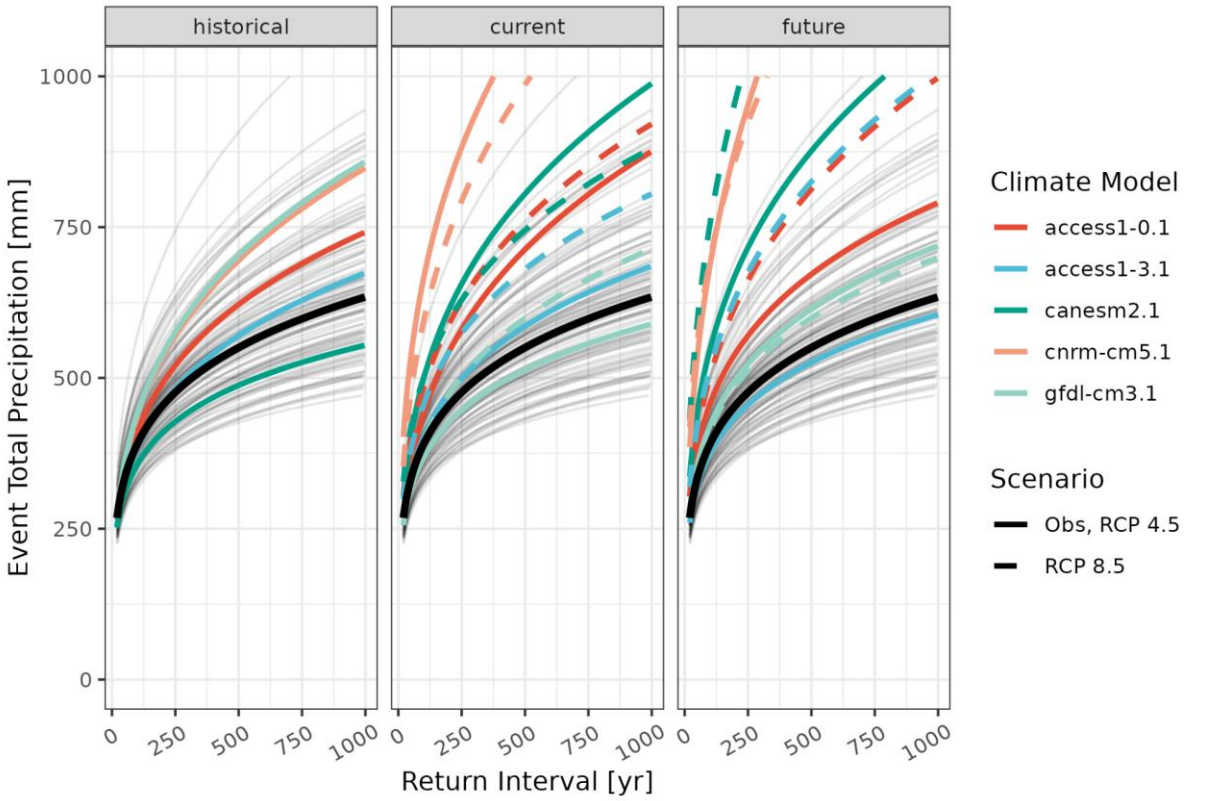

Figure 3-6. *Return levels of event total precipitation estimated from observations and five CMIP5 models, selected for their ability to realistically simulate ARs (Gershunov et al. 2019). Estimates are based on maximum likelihood estimation of the parameters of the trivariate event distribution (Weyant et al., unpublished), and panels show 50-year periods over which parameters are estimated: historical (1950, 1999), current (2000, 2049), and future (2050, 2099). Two emissions scenarios, representative concentration pathway (RCP) 4.5 and RCP 8.5, are compared to observations from the historical period. Sampling uncertainty in the observations is shown in the gray curves, which are the result of bootstrapping (i.e., sampling with replacement) the events, then re-estimating the parameters of the trivariate distribution 500 times. In this study, the FIRO team used atmospheric models (ACCESS1-0.1, ACCESS1-3.1, CANESM2.1, CNRM-CM5.1 and GFDL-CM3.1) to develop additional climate simulations to provide an ensemble of model runs on future climates under different scenarios.*

Running the downscaled CMIP6 ensemble will provide a clearer look at the actual signal within each model. To reiterate, the key difference between this analysis and the previous analysis is the use of the small ensemble of each model, which was previously unavailable. Using new and more sophisticated methods is also possible. Work by the FIRO team's statistician colleagues is well underway to develop a generalized linear model of these parameters (a nontrivial problem), which will help better explain any local changes in terms of larger-scale phenomena (such as El Niño–Southern Oscillation).

3.2.4 Preliminary Results

The LOCA-downscaled CMIP5 model runs of the historical period provide a reasonable description of precipitation events. Durations of model runs of days with heavy precipitation as well as totals over these runs are reasonable and well within the envelope of uncertainty

gleaned from observations. However, there is only one downscaled realization of each CMIP5 model run for each emissions scenario, and Figure 3-6 shows that the presence or magnitude of projected changes vary too much for the FIRO team to draw conclusions. In addition, the drastic changes in the frequency of massive precipitation event totals projected by climate models CNRM-CM5.1 and CANESM2.1 are concerning. Furthermore, the level of forcing (i.e., the severity of the emissions scenario) does not always correspond to a stronger response. A small sample has not given clear results, so the next step is to look at an ensemble of similarly downscaled CMIP6 model projections.

3.2.5 Key Findings and Immediate Next Steps

Key Findings

- Downscaled CMIP5 historical simulations reasonably describe the probability distribution of multiday precipitation events.
- Projections from the same models do not all seem reasonable, there is not a convincing monotonic relationship between forcing strength, and response magnitude is lacking.

Immediate Next Steps

- Look at a downscaled CMIP6 ensemble in the same manner.
- Construct a statistical model of the trivariate event distribution parameters to gain more information from the small ensemble (if theoretical development within the project period allows).

3.3 References

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Gershunov, A., Shulgina, T., Clemesha, R. E. S., Guirguis, K., Pierce, D. W., Dettinger, M. D., Lavers, D. A., Cayan, D. R., Polade, S. D., Kalansky, J. & Ralph, F. M. (2019). Precipitation regime change in Western North America: The role of atmospheric rivers. *Scientific Reports, 9*(9944). https://doi.org/10.1038/s41598-019-46169-w.

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Section 4. Preliminary Viability Assessment Scoping

The objective of the Preliminary Viability Assessment (PVA) is to conduct technical studies that describe meteorological, hydrological, water resource engineering, and environmental work, as well as develop enhanced monitoring, decision support tools, and communication materials for the U.S. Army Corps of Engineers (USACE) and water agency partners to consider using for Forecast Informed Reservoir Operations (FIRO) testing and operationalization. This section develops key questions and recommended tasks for the Preliminary Viability Assessment (PVA), with the expected outcome of producing sufficient analyses and supporting documentation to assist with a deviation request to the local sponsors and USACE to implement FIRO at Seven Oaks Dam.

4.1 Observations

4.1.1 Context

The watershed above Seven Oaks Dam encompasses an elevation range of 2150 - 11240 feet. The mountainous terrain creates high gradients in precipitation amount and precipitation phase that is difficult to monitor with the observations available in the watershed. Observations are a critical component to forecast verification, model evaluation, and in-situ decision support tools to support FIRO objectives. Reliable and accurate observations available in near real-time are required to support these efforts. The main observation types targeted in the Technical Studies include: precipitation amount and phase, snow depth and snow water equivalent, soil moisture, and discharge. Preliminary results of the Technical Studies highlight existing gaps in the observations network including snow, soil, and discharge measurements (**Figure 4-1**). Historically, the watershed included six snow survey locations with periods of record of three to 31 years, all ending operation by the mid-1990s. There are currently no publicly available snow surveys or near real time stations measuring snow depth or snow water equivalent. Additionally, there are no publicly available soil moisture or discharge stations in the watershed. **Figure 4-1** shows the stations available online and in near real time, including a Center for Western Weather and Water Extremes (CW3E) station that measures snow level, precipitation amount, and precipitation phase that was installed as part of FIRO for at Prado Dam.

The results from the observations network analysis are required to understand watershed characteristics currently represented by observations, quality of existing observations, and identify specific gaps to be filled.

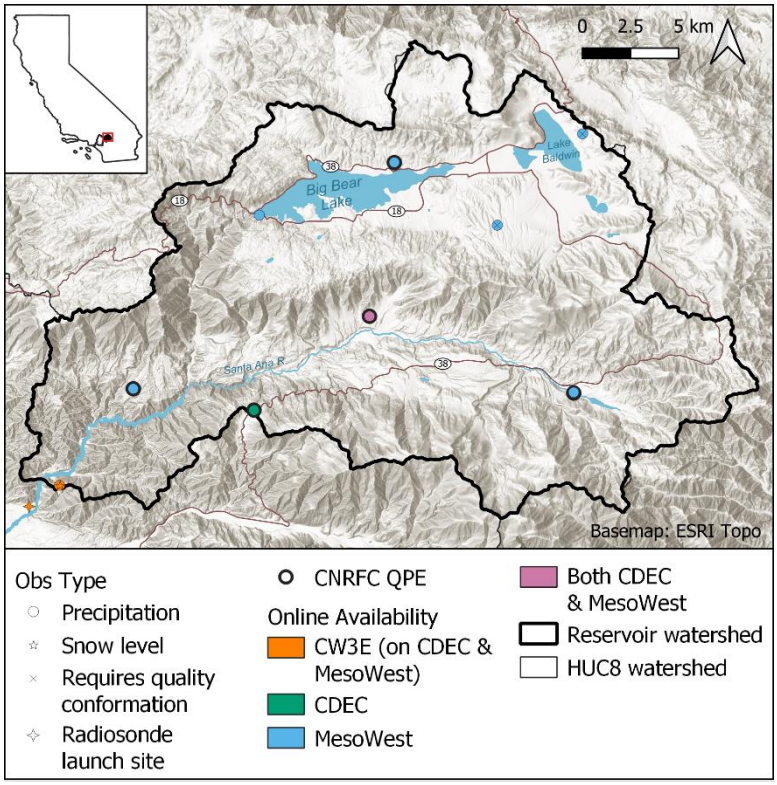

Figure 4-1. *Map of existing stations in the Santa Ana River watershed above Seven Oaks Dam. Symbols represent observations type and status, while colors show where the data are available online. Not shown are the reservoir storage observations at Big Bear Lake and Seven Oaks Dam and monthly precipitation measurements from Big Bear Lake.*

Watershed characteristics considered in the observations network analysis include elevation, slope, aspect, climatological precipitation (from PRISM), and land use. As discussed in Section 0, the FIRO team will use these inputs in a spatial cluster analysis to classify different areas of the watershed and summarize what characteristics the current observations represent. The team will assess data quality and reliability for a select number of precipitation events and will cross-reference the data with forecast verification analyses for areas with the largest precipitation and freezing level forecast errors. These analyses are underway as a part of the Technical Studies (see Section 0) and will inform where, what kind, and how many additional observations are needed to address identified gaps.

4.1.2 List of Key Questions and Tasks

The following key questions and tasks will be addressed by the observations section within the PVA:

Key Questions

Based on the gaps identified in the Technical Studies:

- Where will new hydrometeorological observations have the most impact?
- What type of observations (e.g., discharge, soil moisture) are needed to support FIRO goals?
- Are there additional gaps, either in observation type or location, that still need to be addressed?

Recommended Tasks:

1. Scout locations and install two new hydrometeorological stations.
    a. Determine station locations based on gaps identified in the network analysis conducted in partnership with the meteorology and forecast verification teams and operational forecasters. Acquire permits for installation as needed. These stations will include a standard suite of hydrometeorological sensors to measure precipitation, temperature and relative humidity, wind speed and direction, incoming solar radiation, air pressure, and soil moisture and temperature.
    b. Install stations.
    c. Disseminate data in near real-time to partner platforms, including the California Data Exchange Center, MesoWest, and the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Laboratory.
2. Scout location and install one new enhanced hydrometeorological station.
    a. Determine station locations based on gaps identified in the network analysis and freezing level verification findings, and acquire permits for installation as needed. This station will include a standard suite of hydrometeorological sensors to measure precipitation, temperature and relative humidity, wind speed and direction, incoming solar radiation, air pressure, and soil moisture and temperature, as well as a disdrometer to measure hydrometeor drop size and velocity to derive precipitation phase.
    b. Install station.
    c. Disseminate data in near real-time to partner platforms, including the California Data Exchange Center, MesoWest, and the NOAA Physical Sciences Laboratory.
3. Scout location and install one new discharge station.
    a. Determine station location based on gaps identified in network the analysis and acquire permits for installation as needed. This station will include pressure transducers to measure river stage and will require manual discharge measurements to establish a rating curve to derive discharge.
    b. Install station.
    c. Survey stream channel for developing rating curve.
    d. Create a sampling plan for manual discharge measurements to develop the rating curve.
4. Report on gaps filled and summarize remaining gaps in the observations network.
5. Engage with forecast verification and meteorology work teams to align available observations with model evaluations and storm characteristics.

4.1.3 Expected Outcomes

The observations section of the PVA aims to fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real-time monitoring stations. Filling key gaps in observations will support efforts undertaken by the meteorology and forecast verification work teams by providing additional hydrometeorological data along with data not previously available within the watershed such as soil moisture and soil temperature. Data from these stations will be leveraged for multiple sections of the Final Viability Assessment (FVA) to report on preliminary data collected and provide additional data for forecast verification and meteorology. Longer term, the period of record for these stations will help better represent the climatology of the watershed and provide valuable information for decision support and situational awareness.

The Technical Studies and PVA will inform additional observations or areas of interest that might be initially out of scope but will inform future observational needs. These needs can be addressed in the FVA or as post-FIRO activities to continue expanding and improving the observation network.

4.2 Meteorology

4.2.1 Introduction

Southern California precipitation depends on a relatively small number of extreme events each year. For example, 42 percent of the annual precipitation falls on days with extreme precipitation (defined as the top 5 percent of wet days), and 50 percent of the annual precipitation falls on average in just seven days in the Santa Ana River watershed (Ricciotti and Cordeira 2020). Landfalling ARs in Southern California are responsible for approximately two-thirds of these extreme precipitation events, with the remaining precipitation related to other processes such as cutoff cyclones and convection storms (i.e., severe thunderstorms) (Cannon et al. 2018).

The overarching goal of the meteorology effort is to identify the physical processes associated with precipitation extremes across the upper portion of the Santa Ana River watershed, and to evaluate their predictability to help understand the potential viability of FIRO in the Seven Oaks Reservoir. This section is related to Section 4.4 on Forecast Verification.

4.2.2 Precipitation Extremes and ARs

4.2.2.1 Background

Landfalling ARs are important to both annual and extreme precipitation in the Santa Ana River watershed (Cannon et al. 2018, Ricciotti and Cordeira 2020, Ralph et al. 2024). The purpose of these tasks is to further summarize the relationships among landfalling ARs and extreme precipitation, specifically over the upper portion of the Santa Ana River watershed in the Seven Oaks basin, as well as to evaluate the AR-related and non-AR-related forecast skill for precipitation events over the basin.

In addition to climatological analyses of the influence of ARs and non-ARs on extreme precipitation events and their skill over a long period of record, additional tasks will investigate case studies of high-impact events that contained large amounts of precipitation (i.e., inflow), including events with forecast errors. These analyses will leverage in situ observations collected by the CW3E field team and other local data.

4.2.2.2 Key Questions and Tasks

The following key questions related to precipitation extremes and ARs will be addressed by the meteorology team in coordination with the forecast verification team, as part of the PVA:

- What fraction of extreme precipitation events over the Seven Oaks basin is associated with landfalling ARs?
- What meteorological processes influence spatial and temporal variability in precipitation during landfalling ARs or other non-AR events?
- How does the precipitation forecast skill differ between AR-related and non-AR-related events over the Seven Oaks basin?
- What meteorological processes produce challenges to precipitation forecast skill during extreme events?
- How do in situ observations help scientific understanding and model validation of extreme precipitation events?

The following tasks will be conducted by the meteorology team during the PVA:

1. Create and summarize an hourly, event-based catalog of precipitation events for the Seven Oaks basin.
2. Create and summarize both a coastal and inland catalog of landfalling ARs based on the Ralph et al. (2019) AR scale for the Seven Oaks basin.
3. Evaluate and summarize relationships between precipitation extremes and landfalling ARs using the precipitation and AR catalogs.
4. Quantify and summarize precipitation forecast skill as a function of lead time for AR-related and non-AR-related precipitation events over the Seven Oaks basin using a re-forecast dataset.
5. Investigate meteorology processes responsible for non-AR-related precipitation events such as cutoff cyclones or convection.
6. Conduct case studies of high-impact events to the Seven Oaks basin—including at least one AR-related and one non-AR-related event that contained low precipitation forecast skill—by leveraging in situ observations.

4.2.2.3 Expected Outcomes

The tasks investigating the physical processes responsible for extreme precipitation and their influence on precipitation forecast skill over the Seven Oaks basin, specifically related to both landfalling ARs and other drivers, will provide context for evaluating the predictability of large inflow and streamflow events into the Seven Oaks Reservoir.

4.3 Hydrology

4.3.1 Context

The hydrology task primarily focuses on meeting the data and informational requirements of the Water Resources Engineering (WRE) task. For this project, the hydrology team will review and

assess the current streamflow modeling implemented by the California Nevada River Forecast Center (CNRFC) and make recommendations for improvements where appropriate.

They hydrology task primarily focuses on meeting the data and information requirements of the WRE analysis of alternative Water Control Plans that leverage streamflow forecasts.

4.3.2 Tasks

1. **Team charter and collaboration with other work teams.** The hydrology team will develop a team charter with specific tasks as described below. They will collaborate significantly with the WRE team to ensure the work products effectively meet the WRE team's requirements for the PVA.
2. **Historical observations of inflow.** Diversions and water use upstream of Seven Oaks Dam impact inflows and can compromise the quality of the calibrated streamflow model if not properly accounted for. The hydrology team will ensure the historical inflow records used in PVA analyses are well understood and provide the best possible representation of "unimpeded" or "full natural flow" conditions.
3. **Review of the CNRFC's Seven Oaks Dam inflow model.** WRE work relies upon the quality of the CNRFC's inflow model for Seven Oaks Dam. As an initial step, the hydrology team will review the ability of the inflow model to simulate historical observations. The team will address and correct identified gaps and deficiencies if feasible within the project timeline.
4. **Critical duration analysis.** The hydrology team will evaluate historical precipitation and streamflow records to estimate the most appropriate critical duration for inflow to Seven Oaks Dam. The critical duration will be used for the frequency analysis and is needed for the scaling of individual large events within the hindcast period of record.
5. **Frequency analysis.** The hydrology team will conduct a frequency analysis for the critical duration to ensure the range of scaling factors used in the hindcast preparation adequately covers the extremes needed for robustness testing (e.g. 500-year, three-day inflow event).
6. **Hydrologic Ensemble Forecast System (HEFS) hindcasts.** The hydrology team will work with the CNRFC to develop the HEFS hindcasts needed for the WRE evaluation of Water Control Plan (WCP) alternatives. To the greatest extent possible, hindcasts will be consistent with the CNRFC's real-time operations so the WRE evaluation results are representative of expected operations. HEFS hindcasts will be generated for:
    a. Period of record (1980–2022).
    b. Scaled events (two to three selected events incrementally scaled to cover 100- to 500-year recurrence intervals.
    c. Synthetic events outside of the HEFS period of record (if available).
7. **Collaboration with other teams.** As stated above, the hydrology team will work closely with the WRE team to ensure delivered products and information meet the defined needs. In collaboration with the verification team (Section 4.4), the hydrology team will assess and document the quality and uncertainty of the CNRFC's Seven Oaks Dam inflow model and collaborate with the observations team (Section 4.1) to ensure that sufficient monitoring supports decision support.

4.3.3 Expected Outcomes

Through the process of performing the tasks identified above, the hydrology team expects to develop substantial insight on the predictability of Seven Oaks Dam inflows and refine the process for delivering analysis and hindcasts to support WRE team tasks.

4.4 Forecast Verification

4.4.1 Introduction

Weather and water forecast verification is paramount to FIRO, where forecast information could be leveraged for water management decisions. Water managers need confidence in the forecast information and context for predicted weather and hydrologic conditions to utilize forecasts to the maximum extent.

The goal of the forecast verification effort is to provide forecast skill analyses for multiple components of the hydrometeorological system impacting operations at Seven Oaks Dam. The evaluation will focus particularly on the scales that dictate the development of meteorological mechanisms responsible for precipitation generation, localized orographic patterns, rain-snow partitioning, and resulting streamflow or inflow into the reservoir. It will also serve as a pathway to identify opportunities for advancing AR prediction, such as physical process identification, model analysis and improvement, and observation quality and spatial distribution.

4.4.2 Baseline Assessment Using Historical Forecast Information for Precipitation and Inflow

4.4.2.1 Context

Long-term forecast skill assessments ultimately provide users with knowledge on how well and at what lead times models can predict different magnitudes and characteristics of extreme events using long periods of data records (typically between 10–30 years). This effort provides a baseline for forecast skill of precipitation and inflow predictions on relevant time scales and spatial bounds associated with operations at Seven Oaks Dam. Ultimately, it serves as the starting point for further partitioning the meteorological and hydrologic characteristics that could affect predictability of precipitation and runoff generation.

4.4.2.2 List of Key Questions and Tasks

The verification team will address the following key questions for long-term forecast skill evaluations as part of the PVA:

- What is the skill of precipitation and inflow forecasts within the Seven Oaks basin?
- What are the relationships between precipitation and inflow forecast skills?

The verification team will conduct the following tasks during the PVA:

- Identify relevant basin information (e.g., regulations, diversions, important tributary locations) to better approximate the operational basin extent.
- Obtain observations of precipitation and inflow for Seven Oaks Reservoir and relevant location information relative to the dam and important tributaries.

- Compute mean areal precipitation forecast skill from archived or re-forecasted global and high-resolution models and determine lead times where there is evidence of skill. Precipitation totals can be examined on sub-daily, daily, and multiday timescales.
- Compute skill of multi-volume totals of inflows into Seven Oaks Reservoir using re-forecasted and archived inflow forecasts generated from (or simulated from a matching configuration of) the CNRFC Hydrologic Modeling System.
- Identify pathways to intercompare links between atmospheric and hydrologic forecast skill.

4.4.2.3 Expected Outcomes

The expected outcome of this effort will be a series of statistical skill measures of precipitation and inflow for Seven Oaks Reservoir using several metrics, models, and aggregation times relevant for operations.

4.4.3 Post-Event Precipitation Verification to Provide Context of Forecast Evolution for Impactful Events

4.4.3.1 Context

Each winter season, ARs can bring considerable rainfall and runoff to the Seven Oaks basin that vary alongside the duration, intensity, position, and life cycle evolution of ARs. Understanding the variability in forecast evolution will allow the verification team to study and rectify how different scales of variability and uncertainty impact the decision-making process and actionable timelines. This understanding is especially important when AR forecasts are highly uncertain (e.g., forecasts of an AR look significantly different from that of the previous day's forecast). When forecasts were particularly challenging, it is important to analyze what components of the forecast were correct and which were highly variable. To provide added value of forecast utility, the verification team will provide post-event and post-season verification statistics of precipitation. These statistics will also guide future science investigations and case study analysis that will ultimately improve understanding of AR predictability and variability.

4.4.3.2 List of Key Questions and Tasks

The following key questions for long-term forecast skill evaluations will be addressed by the verification team as part of the PVA:

1. What were the forecast errors of precipitation of several high-impact events in the Seven Oaks basin?
2. What were the overall seasonal errors of precipitation forecasts in the Seven Oaks basin for the last several years?
3. How do individual AR storms and their forecast errors contribute to the overall seasonal error?

The verification team will conduct the following tasks during the PVA:

- Analyze several water years of seasonal and event-total precipitation errors in the Seven Oaks basin and compute the percentage of seasonal error for each AR occurring during the season.

- Provide list of poorly forecasted (i.e., bust) case studies and their precipitation error tendencies.

4.4.3.3 Expected Outcomes

The expected outcome of this effort will be a report on a series of water year evaluations of precipitation on daily, event, and seasonal time scales. The report will include a quantitative evaluation of the fraction of ARs to the seasonal total error of precipitation, as well as findings on any relevant trends in forecast tendencies.

4.4.4 Identification and Alignment of Storm Characteristics Associated with Forecast Errors

4.4.4.1 Context

Precipitation errors can be influenced by meteorological and hydrological mechanisms that span scales from localized to synoptic in nature. After identifying precipitation error in Section 4.4.3, the verification team will look at key influencing factors potentially affecting the predictability of precipitation and inflow, and their associated skill. Factors include large-scale ones such as landfall, intensity, and duration of ARs, as well as localized influences like freezing level. This section will provide forecast assessments of the key factors provided to the meteorological team for further processing, review, and study.

4.4.4.2 List of Key Questions and Tasks

The following key questions for long-term forecast skill evaluations will be addressed by the verification team as part of the PVA:

1. What is the landfall, intensity, and position forecast skill for ARs making landfall near the Seven Oaks basin?
2. What is the forecast skill of the volume of precipitation falling as rain or snow during key events?
3. What are other scales of factors influencing precipitation and runoff predictability?

The following tasks will be conducted during the PVA:

- Provide assessments of landfall, intensity, and position skill of forecasts for ARs making landfall near the Seven Oaks basin.
- Calculate the forecast skill of volumetric precipitation in areas with sub-freezing temperatures.
- Iterate with the meteorology team to subset the above characteristics to identify related patterns of forecast errors.

4.4.4.3 Expected Outcomes

The expected outcome of this task will include a report that summarizes the characteristics of ARs (and other features) that influence forecast skill over a relevant time period.

4.4.5 Coordination of Verification with Regional Model Development and Forecasting

4.4.5.1 Context

Identifying systematic model forecast errors is a goal of the verification group. Understanding the source of these errors takes coordination with the modeling team to identify unresolved physical processes and/or dynamical features to target for improvement. This task is aimed at building pathways between model development and verification to iterate on findings associated with integrating AR and precipitation predictions and models.

4.4.5.2 List of Key Questions and Tasks

1. What are some key differences between regional and global forecast errors associated with ARs impacting the Seven Oaks basin?
2. What are some pathways for exploring improvements to precipitation and AR forecasting using regional models?

4.4.5.3 Expected Outcomes

The expected outcome from this effort will be identifying priorities for model development based on verification outcomes.

4.5 Water Resources Engineering

4.5.1 Context

The Water Resources Engineering (WRE) task seeks to gain insight toward the rigorous assessment of FIRO for Seven Oaks Dam. The PVA serves as a testing ground where the team learns the complexities of the system and how to effectively and accurately simulate candidate reservoir operations that integrate forecasts into their decision logic. Experience with previous FIRO projects has shown that the lessons learned through the PVA contribute to a significantly better and more robust FVA.

The WRE tasks associated with the PVA are also intentionally "exploratory." While practical considerations are both primary and necessary, there is room to try less conventional and even novel approaches that may not be immediately targeted for a Water Control Manual. This research approach pushes the limits of conventional approaches and provides opportunities to advance the state of the science and practice of reservoir management.

4.5.2 Tasks

4.5.2.1 Organizational Approach: Hydrologic Engineering Management Plan (HEMP).

The WRE team will develop a HEMP to demonstrate FIRO viability at Seven Oaks Dam, in accordance with the process developed by previous FIRO projects. The HEMP will describe both the process and components of the assessment.

The goal of the HEMP is to create an evaluation framework whereby alternative WCPs that use streamflow forecasts can be compared with existing (i.e., baseline) operations as well as each other.

The HEMP will be developed by the WRE team and vetted with the Seven Oaks Dam Steering Committee. The HEMP contains the following sections:

- Objective and overview of technical analysis process.
- WCP alternative requirements, constraints, and considerations.
- WCP alternatives to be evaluated (baseline and FIRO).
- Metrics for evaluating viability and efficiency of alternatives.
- Tasks and subtasks.
- Project delivery team members and their roles.
- Schedule for completion of technical analyses.
- Risks to success.

4.5.2.2 Modeling and Simulations.

A modeling framework will be established to account for how the movement of water affects the operations of Seven Oaks Dam.

4.5.2.3 Water Accounting

As shown in Figure **2-4**, the movement of water associated with Seven Oaks Dam is quite complex. It includes activities within the Seven Oaks Dam watershed and activities below the dam, including imports from the State Water Project. The simulation framework will strive to account for the structure of water movement to the greatest extent feasible. Where detailed data are not available, the WRE team will make reasonable estimations based on well-informed guidance.

4.5.2.4 Reservoir Operations

The WRE team will model reservoir operations for each of the selected FIRO alternatives (and the non-FIRO baseline) through a combination of the USACE Water Management System and research applications (e.g., Ensemble Forecast Operations model). Reservoir operations models will be configured to simulate storage and releases while providing the information needed to quantitatively assess the performance metrics identified in the HEMP. The time step of reservoir operations simulations will be determined during the study. It may be possible to simulate the system at a daily time step, although an hourly time step may be required during flood operations.

4.5.2.5 Groundwater Recharge

Groundwater recharge will be modeled to adequately represent the process's complexities while running efficiently enough to permit extensive simulation (across the record period and scaled events). The WRE team will leverage existing recharge models, such as the Integrated Santa Ana River Model developed by the San Bernardino Valley Municipal Water District. Simulations will represent the envisioned recharge facilities currently under development and construction.

4.5.2.6 Simulation Plan

The WCP alternatives identified in the HEMP will be simulated using water accounting, reservoir operations, and groundwater recharge over a lengthy period of record (~30 years) and for a collection of extreme events representing return intervals up to 500 years (0.002 percent

annual probability of exceedance). The WRE team will collect and process the information from the simulations to compute the performance metrics identified in the HEMP.

4.5.2.7 Coupling to Prado Dam Operations

The potential impacts of FIRO at Seven Oaks Dam on the performance of Prado Dam operations are of interest to the Steering Committee. As the WRE team develops the simulation and modeling framework for the PVA, efforts will be made to ensure that Prado Dam operations can be effectively coupled at the appropriate time.

4.5.2.8 Collaboration with Other Teams.

The WRE team will rely upon the hydrology team (see Section 4.3) for the following information:

a. Curated inflow observations that consider water management activities by upstream entities.
    i. Daily time step for the period of record.
    ii. Hourly time step for significant or scaled events.
b. Consensus on the critical duration for reservoir operations.
c. Frequency analysis of reservoir inflows.
d. Potential recalibration of the Seven Oaks Dam inflow model used and provided by the CNRFC.
e. Generation of period of record hindcasts using HEFS.
f. Generation of scaled HEFS hindcasts for alternative testing outside the period of record.
g. Potential generation of synthetic HEFS hindcasts.

The WRE team will rely upon the verification team (see Section 4.4) for the following information:

a. Assessment of CNRFC reservoir inflow simulation modeling. The WRE team will use this modeling to assess the need to recalibrate the inflow model.

The WRE team will collaborate with the decision support team (see Section 4.6) to ensure candidate alternatives are appropriately supported with established tools and near real-time data.

4.5.3 Expected Outcomes

Through the process of performing the tasks identified above, the WRE team expects to develop substantial insight on the potential for Seven Oaks Dam to benefit from FIRO. In addition, the experience gained through the PVA process is expected to sharpen and improve the WRE assessment associated with the FVA and eventual Water Control Manual update.

4.6 Decision Support

4.6.1 Context

The decision support team is focused on activities that identify, collect, refine, and develop data and technology transfer applications that benefit reservoir operations decision making. The decision support team will leverage experience gained with other FIRO viability studies (PVA and FVA) but will be tailored to the specific needs and decision-makers associated with Seven Oaks Dam and its beneficiaries.

Decision support is a key pillar of FIRO, and the process of identifying and improving the informational system cuts across all disciplines and partner agencies.

4.6.2 Tasks

4.6.2.1 Develop a team charter.

The decision support team will develop a team charter with the specific tasks described below. Additional tasks may be added while developing the PVA.

4.6.2.2 Identify and document key decision-makers.

4.6.2.3 Catalog existing decision support tools (DSTs) used by Seven Oaks Dam operations and partner agencies.

4.6.2.4 Conduct DST workshop(s).

4.6.2.5 Identify additional DSTs that may support FIRO operations.

4.6.2.6 Develop a FIRO-specific needs assessment.

4.6.2.7 Work with developers to prototype new information sources identified in the needs assessment.

4.6.2.8 Collaborate with other work teams.

The decision support team will work closely with nearly every PVA work team. The closest collaboration will take place with the observations, meteorology, WRE, and environmental teams.

4.6.3 Expected Outcomes

By performing the tasks identified above, the decision support team expects to develop substantial insight on the informational needs of reservoir operations, as well as downstream recharge facility operations. The team will work toward prototyping new informational environments that provide cross-cutting data and forecasts in an intuitive fashion. Experience and progress gained during the PVA will be carried forward and refined during the FVA effort.

4.7 Communications

4.7.1 Context

The communications team supports the project's communications and outreach needs as identified by the Steering Committee. Tasks focus on translating technical information into accessible terminology and messaging that capture the key milestones, accomplishments, and challenges of this project in a way that audiences will quickly and easily understand. This translation is essential to ensure that elected officials, agency representatives, advocacy groups, taxpayers, and other stakeholders are aware of, and can support, all steps of the FIRO process, leading to improved reservoir operations for multiple benefits.

Communication is an essential function of FIRO to ensure project objectives are clear and stakeholders are engaged throughout the FIRO process.

4.7.2 Tasks

4.7.2.1 Review and revise team charter as needed.

The Communications team has developed a team charter for the workplan, which it will review for any revisions as the FIRO project transitions from the workplan to the PVA.

4.7.2.2 Prepare fact sheets as the FIRO team reaches key milestones; then, introduce the next step of the process.

4.7.2.3 Identify opportunities to communicate progress, benefits, and other unique aspects of the Seven Oaks Dam FIRO project, including public events, major milestones, inquiries, and conferences or workshops.

4.7.2.4 Create communication products as needed (e.g., fact sheets, YouTube videos, infographics, other visuals) and distribute them via social media, websites, press releases, and other outlets as directed by the Steering Committee co-chairs.

4.7.2.5 Oversee production of the PVA, FVA, and all other FIRO documents—including formatting, editing, and presentation of materials and visuals—to ensure the documents succinctly convey important information with a single voice and unified look and feel.

4.7.2.6 Collaborate with other teams.

The communications team will work closely with other PVA work teams, particularly the WRE and environmental teams, to ensure the information they produce is accurately and concisely translated.

4.7.3 Expected Outcomes

The communications team expects the Seven Oaks Dam FIRO objectives, major milestones, operational alternatives, and possible outcomes will be easily understood by audiences and stakeholders.

4.8 Environment

A key goal for FIRO at Seven Oaks Dam is to explore the potential to enhance and protect habitat through flexible reservoir operations. Modifying reservoir management under FIRO may allow for changes to reservoir water surface elevations, pool duration and timing, and release regimes. These changes may help enhance habitat for special-status (federally or state-listed) species in riparian, alluvial fan sage scrub and perennial stream habitats.

4.8.1 Special Status Species Consideration

The biological resources of the area surrounding Seven Oaks Dam can be characterized by three biogeographical focal areas of importance (**Figure 4-2**). This section will describe the habitats within these focal areas, occurrence of special-status species that may be impacted by

changes to hydrologic regimes under FIRO (Table **4-1**, **Figure 4-3**), and implications of habitat health for these species in relation to reservoir operations.

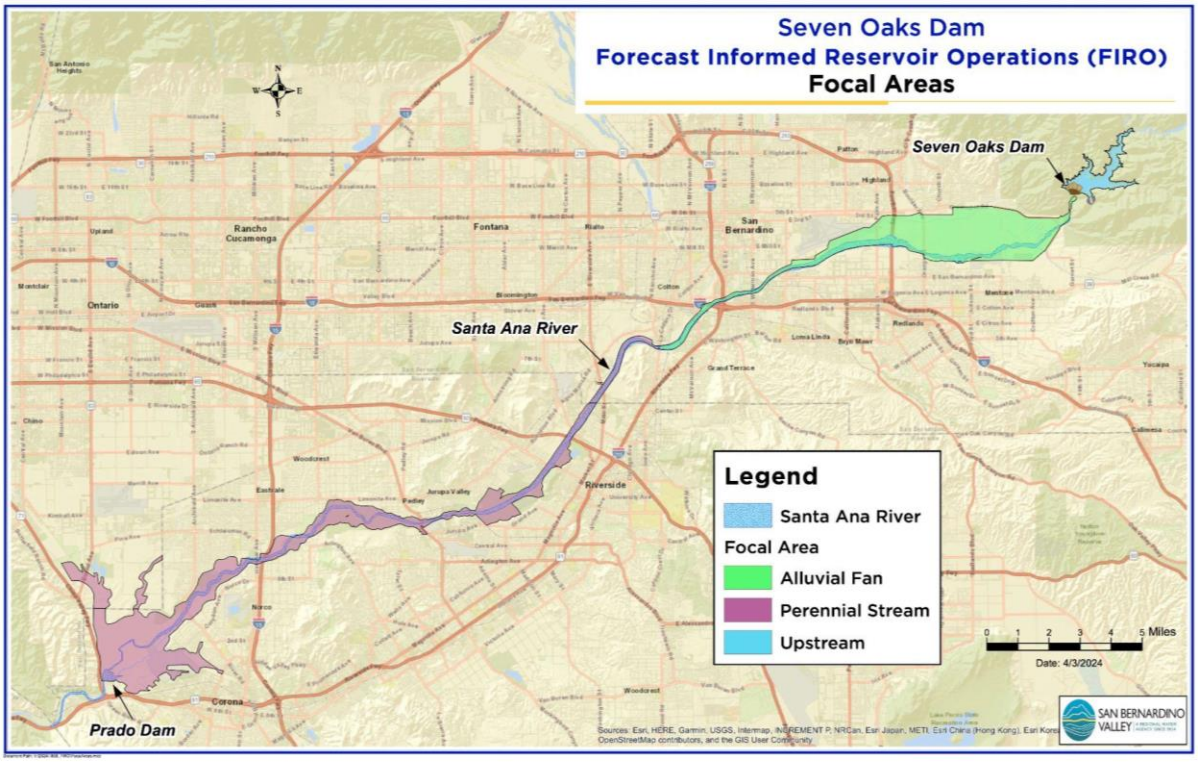

***Figure 4-2**. FIRO at Seven Oaks Dam biogeographical focal areas. (Credit: San Bernardino Valley Municipal Water District.)*

***Table 4-1.** Special-Status Species Relevant to FIRO at Seven Oaks Dam*

Common Name	Scientific Name	Focal Area	Federal Status	State Status
Southwestern willow flycatcher	*Empidonax traillii extimus*	Upstream, perennial stream (riparian)	Endangered	Endangered
Least Bell's vireo	*Vireo bellii pusillus*	Upstream, perennial stream (riparian)	Endangered	Endangered
Cactus wren	*Campylorhynchus brunneicapillus*	Alluvial fan	None	Species of Special Concern (SSC)
San Bernardino kangaroo rat	*Dipodomys merriami parvus*	Alluvial fan	Endangered	Endangered

Common Name	Scientific Name	Focal Area	Federal Status	State Status
Slender-horned spineflower	*Dodecahema leptoceras*	Alluvial fan	Endangered	Endangered
Santa Ana River woolly-star	*Eriastrum densifolium* ssp. *sanctorum*	Alluvial fan	Endangered	Endangered
Los Angeles pocket mouse	*Perognathus longimembris brevinasus*	Alluvial fan	None	SSC
Coastal California gnatcatcher	*Polioptila californica californica*	Alluvial fan	Threatened	SSC
Western spadefoot toad	*Spea hammondii*	Alluvial fan	Proposed Threatened	SSC
Santa Ana sucker	*Catostomus santaanae*	Perennial stream	Threatened	None
Arroyo chub	*Gila orcuttii*	Perennial stream	None	SSC
Yellow-breasted chat	*Icteria virens*	Perennial stream (riparian)	None	SSC

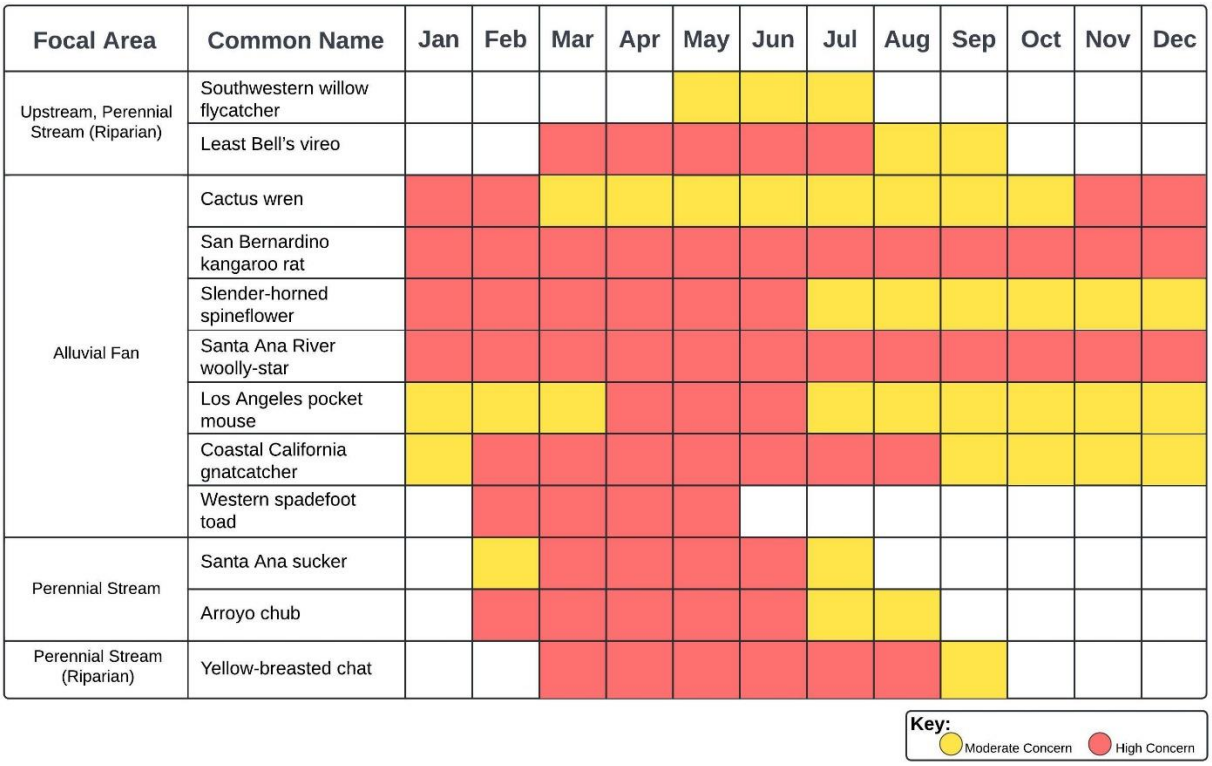

Figure 4-3. *Special-status species occurrence throughout the calendar year and associated level of concern. High concern indicates species' breeding season and potential presence. Moderate concern indicates non-breeding season and potential presence.*

4.8.2 Upstream

Biological resources upstream of Seven Oaks Dam are primarily associated with chaparral intergrading to riparian habitats. Riparian scrub habitat is found above the flood inundation elevation upstream of the Warm Springs tributary and just below the Alder Creek confluence. Patches of moderately dense riparian scrub vegetation are present and can support a variety of riparian species including least Bell's vireo and southwestern willow flycatcher; however, no breeding has been detected for these species above Seven Oaks Dam. The U.S. Fish and Wildlife Service (USFWS) has designated Critical Habitat for southwestern willow flycatcher at and above Seven Oaks reservoir.

Fluctuations in the reservoir size and depth, as well as changes to pool duration and timing with FIRO, may alter the distribution and quality of riparian habitat suitable for these species. The 1988 Supplemental Environmental Impact Statement provided mitigation for the loss of all vegetation within the 50-year flood pool elevation of 2,425 feet. No new mitigation would be required if potential FIRO operations do not exceed this pool elevation. In the PVA, the FIRO team will further analyze potentially introducing non-native aquatic species due to changes in pool elevation and/or duration.

4.8.3 Alluvial Fan

Riversidean alluvial fan sage scrub (RAFSS) is the dominant vegetation community found downstream of Seven Oaks Dam in the Santa Ana River Wash. RAFSS is a mediterranean shrubland type that occurs in washes and on gently sloping alluvial fans. Special-status species

known to occur in RAFSS habitat downstream of Seven Oaks Dam include the Santa Ana River woolly-star, slender-horned spineflower, and San Bernardino kangaroo rat.

Seven Oaks Dam affects flood magnitude and depositional characteristics in overbank floodplain areas downstream. Current dam operations interfere with flood cycles needed for healthy habitat in large portions of the Santa Ana River wash. Natural fluvial processes (or other mechanisms that mimic these processes), whereby cycles of overbank flooding and dry periods result in dynamic fluctuations and rejuvenation of RAFSS habitat, are crucial for these species. Extensive studies have been completed and a successful pilot project constructed to better understand the ability of land managers to replicate these natural processes using small-scale flows.

4.8.4 Perennial Stream

For this project's purposes, the perennial stream focal area of the Santa Ana River begins at the La Cadena drop structure, about 15 miles downstream of Seven Oaks Dam. The perennial stream and associated willow-cottonwood riparian forest and scrub habitats support special-status species including the Santa Ana sucker, Southwestern willow flycatcher, and least Bell's vireo. Santa Ana sucker inhabit small streams with coarse substrates, consistent flow, and water temperature typically below 72 ºF. USFWS-designated Critical Habitat for Santa Ana sucker includes the Santa Ana River within the perennial stream focal area. Southwestern willow flycatchers have historically bred in Prado Basin, where suitable habitat for this species is well distributed and maintained through conservation programs by the Orange County Water District. However, no breeding pairs of this species have been detected in Prado Basin since 2013. Least Bell's vireo are a migratory, riparian obligate species commonly observed within the perennial stream focal area, with the highest concentration located in Prado Basin.

Seven Oaks Dam modifies the historical flow regime of the upper Santa Ana River. Reductions in peak flows have reduced both the amount and size of sediment that is transported downstream, affecting the prevalence of coarse sediment (USACE 2000). Furthermore, the dam creates a discontinuity in sediment transport because it traps the bedload transported into Seven Oaks Reservoir, reducing sediment supply downstream. Occasional moderate- and high-velocity flows from Seven Oaks Dam and/or other tributaries or sources are critical for maintaining and enhancing habitat conditions in the perennial stream focal area for species such as the Santa Ana sucker. Potential benefits of these flows may include flushing fine sediments downstream and exposing or relocating coarse sediment substrates for spawning and foraging.

4.8.5 Potential Species Translocations

The Upper Santa Ana River Habitat Conservation Plan includes programs for translocating species including the Santa Ana sucker, Santa Ana speckled dace, and mountain yellow-legged frog as a component of its conservation strategy. Translocations of these three species are being contemplated in areas upstream of Seven Oaks Dam within the San Bernardino Mountains. Translocations of Santa Ana sucker could also occur in the perennial reaches of the Santa Ana River or its tributaries downstream. The environmental team will consider the potential translocation of additional species during the analysis of FIRO at Seven Oaks Dam.

4.8.6 Key Questions and Tasks

The following section describes key questions to be explored by the environmental team in the PVA, and the associated tasks.

Key Questions

- What are the habitat goals for special-status species that may be achieved with FIRO operations?
- What changes to the dam operations could enhance the habitat of special-status species within all focal areas?
- What metrics will help the FIRO team track progress toward these habitat goals, and what metrics should the team propose to compare FIRO operational alternatives?

4.8.6.1 Recommended Tasks:

1. Define specific environmental goals to achieve with FIRO at Seven Oaks Dam.
    a. Hold a workshop to discuss and define these goals.
    b. Present the proposed goals to the FIRO Seven Oaks Dam Steering Committee for concurrence.
2. Define quantifiable metrics that will help track progress toward environmental goals and FIRO operational alternatives.
3. Perform an analysis of current environmental monitoring projects in the area, including identifying gaps in environmental monitoring needs for potential FIRO implementation.
4. Explore opportunities to aggregate environmental monitoring data into a dashboard or other reporting format.

4.8.7 Expected Outcomes

The work in the PVA will define the environmental opportunities and constraints in relation to potential FIRO operations at Seven Oaks Dam. The environmental team will identify quantifiable metrics it can use to assess progress toward environmental goals and FIRO operational alternatives. The team will analyze current environmental monitoring projects and identify potential gaps, as well as exploring opportunities for a dashboard or other system used to track and report on environmental metrics relating to FIRO. In close collaboration with the WRE team, the environmental team will begin working toward a method of analysis to assist with evaluating environmental metrics in the PVA.

4.9 References

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Section 5. FIRO Implementation Strategy

5.1 From FIRO Viability Assessment to Water Control Manual Update

This workplan serves to provide context and the scoping document for the rest of the Forecast Informed Reservoir Operations (FIRO) viability assessment process, shown in **Figure 5-1**. After finalizing the workplan, the Steering Committee will pivot to the Preliminary Viability Assessment (PVA). The FIRO team will develop a detailed PVA outline, including a list of tasks and assignments, at a technical workshop, after which all work teams will transition into the next step of the process. The PVA will outline meteorological, hydrologic, engineering, and environmental parameters related to FIRO operationalization for Local Sponsors and the U.S. Army Corps of Engineers (USACE) to consider including in the Water Control Manual (WCM). The PVA will determine FIRO viability at Seven Oaks Dam and specify additional analyses needed to develop the Final Viability Assessment (FVA) and WCM update.

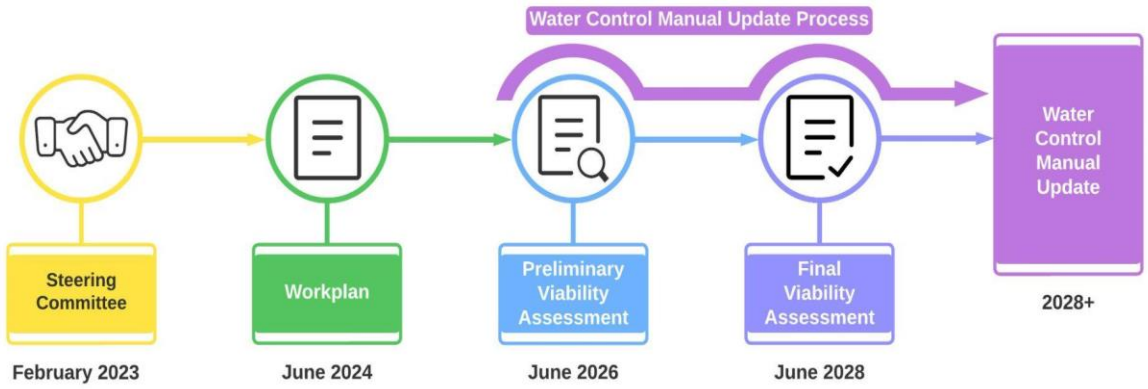

Figure 5-1. *FIRO and WCM update timeline at Seven Oaks Dam.*

5.1.1 Potential Planned Deviation

The FIRO process typically tests FIRO operations via approved minor (or major) deviations to the Water Control Plan (WCP). As the PVA is developed, information will become available to determine if a deviation to the WCP may be feasible to test FIRO. If the information indicates a deviation may be feasible from a technical standpoint, the Steering Committee will likely consider making a recommendation to the Local Sponsors and USACE regarding initiating an assessment of a deviation. This process would involve scoping out the technical analyses involved in assessing the deviation, preparing environmental documentation, and conducting related work.

5.2 Implementation Timeline

Ideally, the WCM update process will either overlap with, or begin toward the end of, the FIRO viability assessment process, as shown in Figure 5-1 above, to ensure efficient FIRO implementation. FIRO implementation includes an array of efforts that are introduced during

the PVA and subsequently developed in the FVA to support FIRO outcomes into the future. Specific findings and recommendations within the research areas of forecast skill assessment and enhancement, water resources engineering, observations, weather forecasting, hydrologic modeling, and an understanding of environmental objectives are all fundamental components of the viability assessment process. Following this foundational work, FIRO implementation is pursued through deviation requests to the USACE Los Angeles District before being permanently implemented through updating the WCM. One of the central needs for FIRO implementation is a WCP that utilizes forecasts to inform reservoir release decisions. This process will require the support of Local Sponsors and USACE.

5.3 FIRO 2.0

USACE has not been regularly funded to update WCMs. It is fundamental to make the WCPs in WCMs as adaptive as possible, with the ability to integrate better forecast products as forecast skill improves. FIRO 2.0 is a concept that defines water management methodologies that consider improvements in weather and water forecast technology that can be applied to WCMs. It is a framework for WCPs that supports the future incorporation of improvements to forecast skill and reservoir operations modeling by developing sufficiently flexible WCP language and a forecast skill assessment process.

Section 6. Appendices

6.1 Background and Context—Appendix

Date	Release Flow Rate (cfs) based on pool Elevation							
	Debris Pool	Intermediate Pool	Main Trash Rack Pool		Main Flood Control Pool			
	2149.72 to 2200'	2200' to 2265'	2265' to 2299'			2299' to 2400'	2400' to 2500'	2500' to 2580'
Oct 1 - Mar 14	3 cfs	3 to 500 cfs	Seven Oaks Rising	50 cfs	Prado Rising	500	500	500
			Seven Oaks Falling	500 - 2000 cfs	Prado Falling	2000 - 4340	4340 - 6560	6560 - 7000
Mar 15 - Apr 15	3 cfs	3 to 250 cfs	Seven Oaks Rising	50 cfs	Prado Rising	500	500	500
			Seven Oaks Falling	1000 cfs	Prado Falling	2000	4340	6560
Apr 16 - May 31	Min = 3 cfs	Min = 3 cfs	Seven Oaks Rising	50 cfs	Prado Rising	500	500	500
	Max = Inflow	Max = 250 cfs	Seven Oaks Falling	1000 cfs	Prado Falling	2000	4340	6560
Jun 1 - Jun 30	Min = 3 cfs	Min = Inflow + 10	Min = Inflow + 10		Min = Inflow + 10			
	Max = Inflow + 10 cfs	Max = 250 cfs	Max = 250 cfs		Max = 250 cfs			
Jul 1 - Jul 15	Min = 3 cfs	Min = Inflow + 20	Min = Inflow + 20		Min = Inflow + 20			
	Max = Inflow + 20 cfs	Max = 250 cfs	Max = 250 cfs		Max = 250 cfs			
Jul 16 - Aug 31	Min = 3 cfs	3 to 500 cfs	Seven Oaks Rising	50 cfs	Prado Rising	500	500	500
	Max = Inflow + 20 cfs		Seven Oaks Falling	500 - 2000 cfs	Prado Falling	2000 - 4340	4340 - 6560	6560 - 7000
Sep 1 - Sep 30	Min = 3 cfs	3 to 500 cfs	Seven Oaks Rising	50 cfs	Prado Rising	500	500	500
	Max = Inflow + 20 cfs		Seven Oaks Falling	500 - 2000 cfs	Prado Falling	2000 - 4340	4340 - 6560	6560 - 7000

Figure 6-1. *Seven Oaks Dam release flow rate schedule based on pool elevation. (Credit: Orange County Public Works.)*

Note: Discharges can be modified based on unforeseen and unique hydrologic conditions to meet public safety concerns, environmental mitigation, and/or maintenance deadlines.

* Typically, the operational goal is to allow the water surface elevation to build up during the storm season (November to April). Then, from April to September, the operational goal is to be fully out of the intermediate pool by September 1.

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

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SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA 92093-0210
OFFICE OF CONTRACT AND GRANT ADMINISTRATION
9500 GILMAN DRIVE

URL: WWW.UCSD.EDU
TEL: 858-534-0841
FAX: 858-534-5306

San Bernardino Valley Municipal Water District
Attn: Greg Woodside
380 East Vanderbilt Way
San Bernardino, CA 92408

June 28, 2024

Dear Greg Woodside:

After reviewing the proposal, it is my pleasure to forward UCSD reference number 58195-2024-30348330 on behalf of The Regents of the University of California.

Title:	Forecast Informed Reservoir Operations in Seven Oaks Dam: Development of Preliminary Viability Assessment
Principal Investigator:	Fred (Marty) Ralph – CASPO, Researcher
Contract/Grant:	New
For:	Research
Period:	October 01, 2024 through September 30, 2026
Amount:	$1,071,000.00

Additional project information may be obtained from Dr. Ralph. Please note this transmission is only for the submission of the above referenced proposal and it only becomes binding when both parties can agree to the terms and conditions of a written executed Agreement. According to the researcher, the work has been scoped and intentionally proposed as fundamental research. Our researcher intended and has anticipated the scope of the work to be primarily fundamental research and its results to be published and shared broadly in the scientific community. UCSD submits this proposal with the understanding as fundamental research as defined by National

Security Decision Directive (NSDD) 189 and the Export Control regulations. As such there should be no limitation on the freedom to publish research results or data, nor restrictions on the citizenship or national origin of those performing the research. If the question on whether or not the work is fundamental research, then the determination will be made by the Government's Contracting Officer prior to execution by the University of any resulting award.

Inquiries concerning contractual or budgetary aspects should be directed to Judy Cheng at judycheng@ucsd.edu. If an award is made, please issue it in the name of **The Regents of the University of California** and forward it directly to this office. Thank you for your consideration.

Sincerely,

Judy Cheng
Principal Contract Officer
Scripps Institution of Oceanography
UCSanDiego

SCRIPPS INSTITUTION OF OCEANOGRAPHY
PROPOSAL SIGNATURE PAGE

The Regents of the University of California
University of California, San Diego

UCSD# 58195-2024

	Principal Investigator:	Co-Principal Investigator:
Last Name	Ralph	
First Name	Fred (Marty)	
Title	Researcher	
Department/ORU	SIO CASPO	
Mail Code	0230	
Phone #	858-822-1809	
Fax #	858-822-4307	
Email	mralph@ucsd.edu	
Agency Information:		
Agency Name	San Bernardino Valley Municipal Water District	If applicable, include the following information:
Contact Name	Greg Woodside	Award #
Contact Phone	909-387-9241	PA/RFA/RFP, etc #
Street Address	380 East Vanderbilt Way	Other required agency information, such as DUNS Number, etc.
City, State, Zip	San Bernardino, CA 92408	
Contact Email	GregW@sbvmwd.com	
Proposal Title	Forecast Informed Reservoir Operations at Seven Oaks Dam: Development of Preliminary Viability Assessment	

Project Begin Date: 10/01/2024 Project End Date: 09/30/2026 Total Costs Requested: $1,071,000

Principal Investigator

F. Martin Ralph

Principal Investigator Signature — Date: 06/21/24

Co-Principal Investigator

Co-Principal Investigator Signature — Date

Judy Cheng Digitally signed by Judy Cheng Date: 2024.06.28 14:34:32 -07'00'

SIO-OCGA Official Authorized to Sign on Behalf of The Regents

Authorized Representative Signature — Date: 2024 June 28

Judy Cheng, Principal Contract and Grant Officer - UCSD/SIO

Print or Type Name and Title

Please issue awards to: The Regents of the University of California
Please send award documents as indicated below:

[X] **Email Address:**
judycheng@ucsd.edu

[ ] **Mailing Address:**
University of California, San Diego
SIO Contract and Grant Office
9500 Gilman Drive, Dept 0210
La Jolla, California 92093-0210
Phone # 858-534-4570
Fax # 858-534-5306

[ ] **Courier Address:**
University of California, San Diego
SIO Contract and Grant Office
8622 Charles F Kennel Way, Room 116
(formerly 8622 Discovery Way)
La Jolla, California 92037
Phone # 858-534-4570

Forecast Informed Reservoir Operations (FIRO) at Seven Oaks Dam:
Development of Preliminary Viability Assessment
Center for Western Weather and Water Extremes (CW3E)
Scripps Institution of Oceanography - U.C. San Diego
PI: Dr. Marty Ralph
Period of performance: 1 October 2024 - 30 September 2026
Statement of Work - June 11, 2024

Overview and Purpose:

This proposal requests funding from the San Bernardino Valley Municipal Water District (SBVMWD) for technical, scientific and project management support to carry out the Preliminary Viability Assessment phase of forecast-informed reservoir operations (FIRO) at Seven Oaks Dam. There are four major objectives for the funding requested over the next two years: :

1. Ensure CW3E staff support for management, coordination, communication, outreach, and facilitation during the Preliminary Viability Assessment (PVA) process.
2. Draft and produce the Preliminary Viability Assessment (PVA) report for FIRO at Seven Oaks Dam.
3. Provide additional capacity needed in water resources modeling/hydrologic engineering and decision support for operationalization of FIRO.
4. Targeted technical studies focused on enhanced monitoring and snow-level forecasting for FIRO at Seven Oaks Dam.

In addition, this proposal supports coordination of CW3E's hydrometeorological research to ensure applicability to the Santa Ana Watershed. For example, ongoing work at CW3E in advancing water prediction is being leveraged to further development of operational forecasts of streamflow prediction in the upper Santa Ana River watershed.

Background:

FIRO at Seven Oaks Dam, initiated in 2022, has resulted in formation of steering committee; finalizing a steering committee Terms of Reference with specific FIRO goals; creation of work teams and a workplan outline. In addition, two technical workshops and a field trip were conducted to establish common understanding of the environmental objectives and system operations. The preliminary technical studies report and draft workplan are well underway and will be completed on time. This work, which will be completed in October 2024, has established a strong foundation for the FIRO viability assessment.

This new contract will ensure CW3E has the capacities needed to fully pursue the Preliminary Viability Assessment (PVA) for Seven Oaks Dam in the context of the broader USACE-led FIRO Program.

Context:

The 2800 mi^2 Santa Ana River watershed flows from the San Gabriel, San Bernardino, and San Jacinto Mountains to its terminus at the Pacific Ocean. These mountains form a barrier to atmospheric river (AR) storms that originate in the Pacific and make landfall in Southern California, forcing moist flow upward and generating clouds and precipitation. Rainfall accumulation during several AR storms per winter season accounts for 40-50% of annual precipitation, with large interannual variability in total precipitation arising due to differences in AR activity. Thus, these infrequent events contribute significantly to flood hazards and water supply within the Santa Ana River Watershed.

In tandem with Prado Dam, Seven Oaks prevents flood-related damages from extreme precipitation events in Orange, Riverside, and San Bernardino Counties. These events have typically been driven by strong and long-lasting ARs that arrived after earlier events had already moistened the watershed's soils and filled its streams. Operations at Prado Dam and Seven Oaks Dam have historically accounted for such storms, but recent advances in understanding how ARs work, and how to better predict them, yield the potential to enhance water supply reliability and flood control capacity. This project builds on a decade of science to understand ARs dynamics and impacts along the U.S. West coast, and on experience in developing the concept of FIRO at Lake Mendocino, Prado Dam, and New Bullards Bar and Oroville Dams in California.

Research to quantify and improve forecasts of ARs and other precipitation mechanisms is an essential component of FIRO. Research and operational aspects of FIRO include the understanding of and ability to forecast extreme precipitation events and their impact on runoff within the Seven Oaks Dam watershed (Fig. 1a) and to diagnose opportunities for minimizing forecast errors.

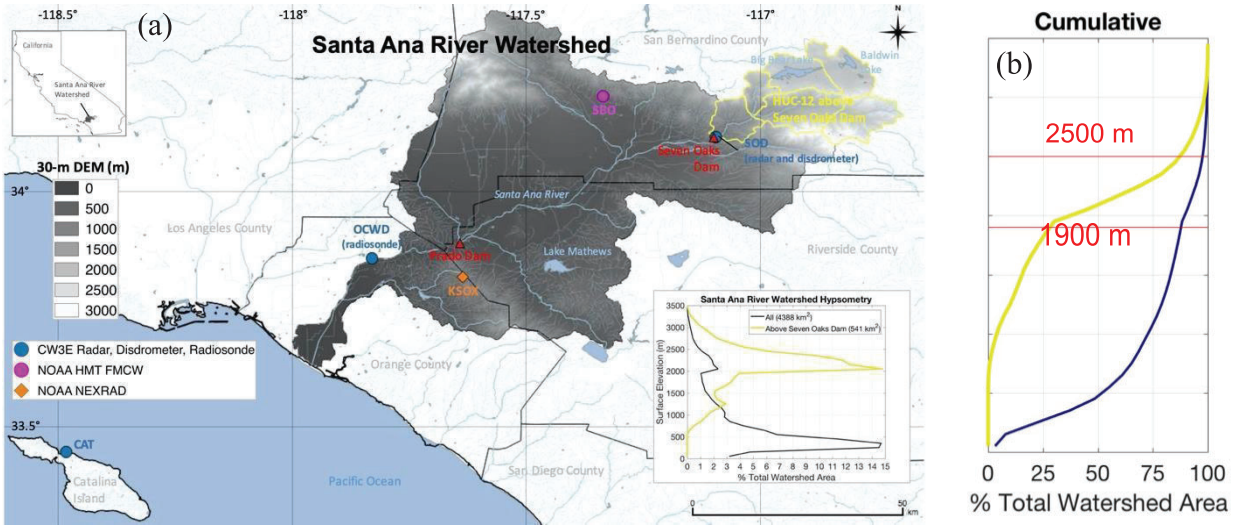

Figure 1 – (a) Geography of the Santa Ana River Watershed. The watershed area above Seven Oaks Dam is 541 km^2 (209 mi^2) and 74% of this area is at an elevation higher than 1,900 m above mean sea level (b).

Technical approach:

The Workplan (Ralph et al., 2024) establishes the background and wider context for FIRO, identifies technical and research gaps and will serve as a scope for the work to be completed in the PVA. The PVA will consist of an initial assessment of the viability of FIRO at Seven Oaks Dam and will:

- determine whether FIRO is viable
- explore FIRO alternatives
- specify what additional analyses may be needed to develop the Final Viability Assessment (FVA).

The PVA and FVA will outline meteorological, hydrologic, engineering, and environmental parameters for FIRO implementation for consideration by USACE for operationalization of FIRO into the Water Control Manual (WCM). The various phases and estimated timeline for completion are listed in Table 1.

Table 1: Phases of FIRO Study and Schedule at Seven Oaks Dam

Phase	Activity	Schedule
Workplan	Develop FIRO Viability Assessment Workplan	June 2024
Preliminary Technical Studies	Complete preliminary technical studies	Sep 2024
PVA	Prepare FIRO Preliminary Viability Assessment Report	2026
FVA	Prepare FIRO Final Viability Assessment Report	2028
post-FVA	FIRO incorporated into Seven Oaks Dam Water Control Manual	TBD

The PVA phase involves co-leadership of the Seven Oaks FIRO Steering Committee, developing the FIRO Preliminary Viability Assessment report, planning and executing technical meetings and workshop, and conducting the technical studies to complete the PVA for Seven Oaks Dam. The work proposed during the PVA phase is summarized in Table 2.

Table 2: PVA Phase Tasks and Activities

Task	Activities
Task 1: Seven Oaks FIRO Steering Committee (SC) Co-Leadership	Convene quarterly meetings of the FIRO Steering Committee, with working sessions and prep calls in between meetings. Organize, lead, monitor, and support activities of up to nine Work Teams with quarterly progress updates. Maintain one-on-one communications with SC members as needed to ensure follow-up actions. Develop communications materials as needed. Present briefings at various events as requested.
Task 2: Preliminary Viability Assessment Report for FIRO at Seven Oaks Dam	Prepare a draft and final FIRO Preliminary Viability Assessment Report. The report will contain sufficient analyses and supporting documentation for consideration by USACE for operationalization of FIRO into the Water Control Manual (WCM). Develop recommendations and a scope (road map) for the Final Viability Assessment.
Task 3: Plan and Execute FIRO Meetings and Workshop	Plan and execute technical meetings and workshop(s) for in-depth, topic-specific exploration and to bring together key stakeholders and experts.
Task 4: Technical Studies	Building on prior technical work and addressing technical aspects that are unique to the upper Santa Ana watershed, these studies will focus on enhanced monitoring and freezing level forecast skill and uncertainty. The outcome of these studies will provide improved understanding and decision support on how much precipitation will be affected by freezing level uncertainty during FIRO operations.

Task 1: Seven Oaks FIRO Steering Committee (SC) Co-Leadership

This task supports the efforts of Marty Ralph, who co-chairs the Steering Committee with Jessica Knickerbocker from SBVMWD and Cary Talbot from USACE, and support staff. Key areas of responsibility include planning and executing quarterly meetings of the FIRO Steering Committee (SC); conducting working sessions for Work Teams and staff between Steering Committee meetings to prepare for upcoming Steering Committee meetings and ensure deliverables are on schedule; support from a technical and strategic communications team, including agenda development, note taking, meeting facilitation, report writing (fact sheets, draft technical documents), maintenance of a Seven Oaks Dam project website at CW3E; CW3E administrative staff support and associated travel, and governmental relations activities including participation in Association of California Water Agencies meetings, presenting at national meetings and briefings in Washington, D.C. and Sacramento as appropriate.

Task 2: PVA Report for FIRO at Seven Oaks Dam

Building on the final Workplan, the CW3E team will help guide and coordinate the Seven Oaks Steering Committee to develop the PVA as well as develop the strategy and team to accomplish this, including staff support and Work Teams. Sub-tasks include developing a PVA outline, vetting it with the Steering Committee, assigning PVA sections, and tracking progress on a shared drive ensuring timelines are met. Those will also include forming technical work groups to focus on analyses and supporting documentation to support operationalization of FIRO into the WCM at Seven Oaks, conducting conference calls, communicating the plans and results at suitable venues (agencies, conferences, etc.), coordinating with agency staff supporting the planning and project, and attending relevant meetings including technical work sessions with the USACE LA District Office. Following completion of the PVA, we will pivot to begin scoping the FVA, with the goal of developing an outline, assigning tasks, and developing a schedule for the FVA. A technical workshop will be held to transition from the PVA to the FVA.

Task 3: Plan and Execute FIRO Meetings and Workshop

The CW3E team will participate as appropriate at events or briefings with key stakeholders, such as the Santa Ana River Science and Conservation Symposium. CW3E staff will also support an annual FIRO workshop to share results across all FIRO projects and invite input from a group of FIRO experts from throughout California and beyond. This task supports the planning, facilitation, and logistics for the meetings, including refreshments, meeting space and other relevant costs for meetings at Scripps..

Task 4: Technical studies

Progress toward development of a FIRO Viability Assessment Workplan has identified the need for technical studies focused on enhanced monitoring and snow-level forecasting for FIRO at Seven Oaks Dam. The watershed above Seven Oaks Dam encompasses an elevation range of 2150 - 11240 feet. The mountainous terrain creates high gradients in precipitation amount and precipitation phase that is difficult to monitor with the observations available in the watershed. A majority (75%) of the watershed over the San Bernardino mountains is exposed to freezing temperatures during precipitation events and understanding variability in the freezing level is an important component to improving precipitation forecast skill.

Task 4.1 Enhanced monitoring

Observations are a critical component to forecast verification, model evaluation, and in-situ decision support tools to support FIRO objectives. Reliable and accurate observations available in near-real time

are required to support these efforts. Preliminary results of the Technical Studies in the Workplan highlight existing gaps in the observations network including snow, soil, and discharge measurements (Figure 2). Historically, the watershed included 6 snow survey locations with periods of record of 3 to 31 years, all ending operation by the mid 1990s. There are currently no publicly available snow surveys or near real time stations measuring snow depth or snow water equivalent. Additionally, there are no publicly available soil moisture or discharge stations in the watershed. Figure 2 shows the stations available online and in near real time. Analyses are underway as a part of the Technical Studies in the Workplan to inform where, what kind, and how many additional observations are needed to address identified gaps.

The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real time monitoring stations. Specific tasks include:

1. Scout locations to fill observational gaps identified through the Preliminary Technical Studies Report.
2. Install 2 new hydrometeorological stations, 1 new enhanced hydrometeorological station and 1 new discharge station.
3. Report on gaps filled and summarize remaining gaps in the observations network. Engage with forecast verification and meteorology teams to align available observations with model evaluations and storm characteristics.

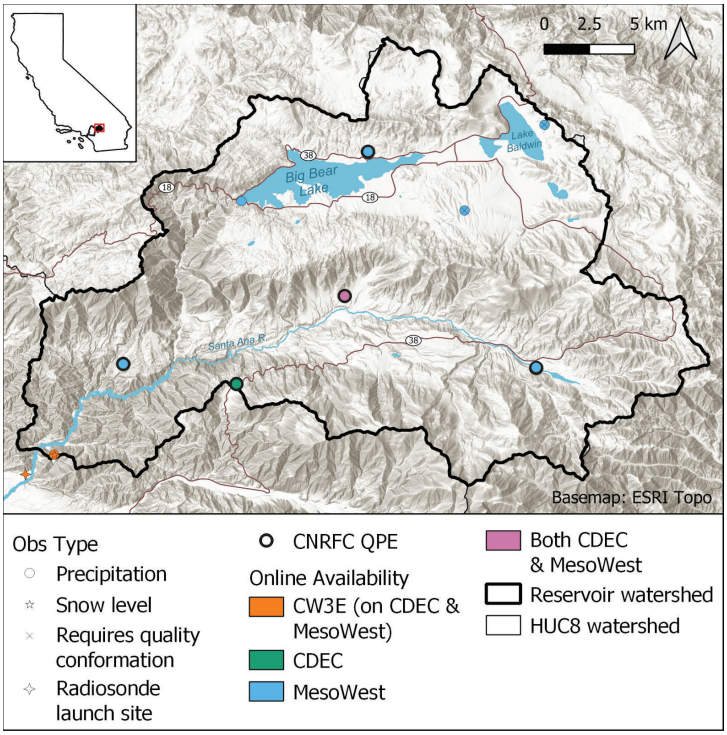

Figure 2 - Map of existing stations in the watershed above Seven Oaks Dam. Symbols represent observations type and status, colors show where the data are available online. Not shown are the reservoir storage observations at Big Bear Lake and Seven Oaks Dam and monthly precipitation measurements from Big Bear Lake.

Task 4.2 Freezing level uncertainty

Freezing level forecast uncertainty influences water management strategies because it can affect the phasing of the volumetric water distribution occurring within a reservoir-watershed system. Phasing is important because there is often a time-lag of infiltration and runoff generation from snow versus rainwater due to differing melt/accumulation rates. When freezing level uncertainty is large, it can translate into large uncertainty in available reservoir pool capacity when runoff efficiency is high (i.e. saturated soils).

Technical studies focusing on freezing level forecast skill will be targeted to address and investigate:

1. The variability in observed volume partitioning across several case studies of ARs impacting Seven Oaks.
2. The identification of freezing level variability and skill across case studies using ensembles.
3. Resolving differences between measures to quantify the rain-snow elevation (i.e. differences between 0°C isotherm and observations made by vertical profiling radars)

References:

Ralph, F.M., Talbot, C., Dyer, H., Fairbank, T., Laber, J., Anderson, M., White, R., Haney, L., Forbis, J., Tyler, J. and Fam, M., 2024. Workplan for Seven Oaks Dam Forecast Informed Reservoir Operations.

Budget:

Estimated costs for people, travel, supplies relevant to Tasks 1, 2, 3 and 4 described above; executed over 2 years with a period of performance from 1 October 2024 to 30 September 2026.

Table 3: Cost estimate for the proposed effort

Task	Description	Y1 ($)	Y2 ($)	**Total ($)**
1	Seven Oaks FIRO Steering Committee (SC) Co Leadership	85,000	91,000	**176,000**
2	PVA Report for FIRO at Seven Oaks Dam	160,000	172,000	**332,000**
3	Plan and Execute FIRO Meetings and Workshop	40,000	43,000	**83,000**
4	Technical studies	285,000	195,000	**480,000**
Totals		**570,000**	**501,000**	**1,071,000**

Forecast Informed Reservoir Operations (FIRO) at Seven Oaks Dam:
Development of Preliminary Viability Assessment
Center for Western Weather and Water Extremes (CW3E)
Scripps Institution of Oceanography - U.C. San Diego
PI: Dr. Marty Ralph
Period of performance: 1 October 2024 - 30 September 2026
June 11, 2024

Budget Justification

Salaries and Wages:

Salaries for all personnel are based upon current university salary scales. Escalations for all personnel costs reflect range and merit increases in accordance with University of California policies.

Dr. F. Martin Ralph (PI) will lead the overall project to obtain the objectives sought in this proposed research project. He will serve on the steering committee and his role also includes the general direction and management of the project and team. He will provide progress reports to the San Bernardino Valley Municipal Water District management as needed.

Dr. L. Delle Monache (Director of Research) will provide general direction and oversight of the project research tasks.

Dr. Duncan Axisa (Academic Program Manager) will manage the specific tasks and analysis efforts that are discussed in the statement of work. He will communicate with the PI (Ralph) on progress, project execution and issues related to this project, and will provide progress reports to the SIO team and San Bernardino Valley Municipal Water District. Additional tasks also include coordination of efforts between project contractors. Axisa will support work on Task 1 Steering Committee Co-Leadership, Task 2 PVA Report for FIRO, and Task 3 Plan and Execute FIRO Meetings and Workshop.

Taylor Dixon (Academic Program Manager) will perform work to support hydrology and water resource engineering studies to develop the Preliminary Viability Assessment (PVA) as described in Task 2 of the Statement of Work.

Rachel Weihs (Research Data Analyst) will co-lead and perform work to support meteorology and forecast verification studies to develop technical studies as described in Task 4.1 and Task 4.2 of the Statement of Work.

TBN (Research and Development Engineer) will perform work to support hydrometeorological monitoring systems and products to develop technical studies as described in Task 4.1 of the Statement of Work.

Erfan Goharian (Research and Development Engineer) will co-lead and perform work to support reservoir operations and water resource engineering studies to develop the Preliminary Viability Assessment (PVA) as described in Task 2 of the Statement of Work.

TBN (Research and Development Engineer) will perform work to support reservoir operations and water resource engineering studies to develop the Preliminary Viability Assessment (PVA) as described in Task 2 of the Statement of Work.

TBN (Academic Program Manager) will co-lead and perform work to support meteorology and forecast verification studies to develop technical studies as described in Task 4.1 and Task 4.2 of the Statement of Work.

Ava Cooper (Research Data Analyst) will perform work to support meteorology and forecast verification studies to develop technical studies as described in Task 4.1 and Task 4.2 of the Statement of Work.

Paul Iniguez (Research Data Analyst) will perform work to support meteorology and forecast verification studies to develop technical studies as described in Task 4.1 and Task 4.2 of the Statement of Work.

Shawn Roj (Research Data Analyst) will perform work to support meteorology and forecast verification studies to develop technical studies as described in Task 4.1 and Task 4.2 of the Statement of Work.

Janel Mayo (Project Policy Analyst) will provide management support for the project research tasks. She will assist with project coordination, tracking, and communication. She will coordinate closely with Dr. Axisa and assist with progress reports. Mayo will support work on Task 1 Steering Committee Co-Leadership, Task 2 PVA Report for FIRO, and Task 3 Plan and Execute FIRO Meetings and Workshop.

Ethan Morris (R&D Engineer) will perform work to support hydrometeorological monitoring systems and products to develop technical studies as described in Task 4.1 of the Statement of Work.

Lili Gilmore (Administrator) will assist the PI with the financial and administrative aspects of the project.

Fringe Benefits: Fringe benefits are calculated using the current planning Composite Benefit Rates (CBR) in effect for the UC San Diego. CBRs are reviewed and approved by UC San Diego's cognizant Federal agency, the Department of Health and Human Services.

Domestic Travel:

Funds are requested for project participants to travel from San Diego or Denver to Orange County/San Bernardino County to support the goals of this project to attend Steering Committee meetings and governmental relations activities as described in Task 1 Steering Committee Co-Leadership. Travel is also included for field work as described in Task 4.1 Enhanced monitoring, for scouting trips, installation of equipment and maintenance of this equipment.

Cost estimates for these trips are based on reasonable estimates of airfare, car rental, registration, and Federal per diem. Airfares were obtained by www.expedia.com quote, per diem and lodging rates were estimated by using university and federally approved rates and recent lodging costs, per prescribed maximum per diem rates for CONUS web site.

Equipment:

Equipment purchases are needed for Task 4.1 Enhanced Monitoring in Year 1. The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real time monitoring stations.

Equipment purchases consist of the following:
3 qt ... Surface meteorological station: Pre-wired weather resistant enclosure including data logger, battery, solar panel, barometer, TRH sensor, anemometer, pyranometer, rain gauge , tripod

12 qt … Soil moisture/temperature sensor (2 stacks down to 1m, 6 probes each)
1 qt ... Disdrometer: Parsivel present weather sensor
1 qt … Stream gage station including GOES radio

Consultants:

Eastern Research Group, Inc. (ERG) will provide support for Seven Oaks Dam FIRO Steering Committee (SC) meeting facilitation, support development of PVA, and plan and execute workshops as discussed in the statement of work provided.

Robert K. Hartman Consulting Services will provide professional support for FIRO development of PVA at Seven Oaks Dam in a variety of ways, as discussed in the statement of work provided.

Project Specific Communications, Mailing/FedEx, and Network Costs: The estimate for this category includes mail services, printing and photocopying, misc. project supplies, etc. and is based on actual usage and historical costs on similar projects. UC San Diego Information and Technology Services (ITS) charges a flat per month fee for services to provide state-of-the-art technology infrastructure and services to the campus community. These charges are directly attributable and proportionally applied for the individual(s) included in the proposed budget on the project. These costs are not included in the campus' Facilities & Administration (F&A) rate as an indirect cost. UC San Diego auditors have determined that it is both equitable and consistent with the OMB Circular 2 CFR 200 provisions on cost allocability that the costs be assigned to FTE on grant and contract funds. Accordingly, an allocable portion of these NGN costs are included in this budget as direct project costs.

MLM: Managed Lab Machine (MLM) enhances security for computers used by researchers that are part of this project through Scripps Information Technology.

SDSC: Supercomputing (SDSC computing costs) costs are included to support the computation that will be needed for the analyses.

Catering – Meeting: Catering is budgeted for lunch and coffee for Steering Committee meetings and other meetings related to San Bernardino Valley Municipal Water District.

Telemetry: 3 quantity telemetry units (Cellular modem, Omni antenna for communication of sensor data) are needed as part of Task 4.1 Enhanced Monitoring in Year 1. The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real time monitoring stations.

Computer: 1 quantity rugged computer for disdrometer data acquisition is needed as part of Task 4.1 Enhanced Monitoring in Year 1. The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real time monitoring stations.

Staff plate: 1 quantity staff plate for stream gage equipment is needed as part of Task 4.1 Enhanced Monitoring in Year 1. The enhanced monitoring task will fill identified gaps in the observation network to better represent watershed characteristics and hydrometeorological conditions with reliable, near real time monitoring stations.

Publications: In order to communicate findings to the scientific community, funds to cover page charges in the peer-reviewed literature have been included in the proposed budget - two publications expected for year 2 for $6,200.

Indirect Costs:
UC San Diego's indirect costs are calculated based on Modified Total Direct Costs (MTDC) as defined in 2 CFR Part 200.68 using Facilities and Administration (F&A) rates approved by the U.S. Department of Health and Human Services (DHHS). Rates established by UC San Diego's F&A rate agreement dated May 23, 2018.

Forecast Informed Reservoir Operations at Seven Oaks Dam: Development of Preliminary Viability Assessment

Year 1: 10/01/24 through 09/30/25

A. SALARIES	FY Rates Beginning	Monthly Direct Salary Rate	No. Months	% Salary or Effort	Person Mos.	Salary Subtotal	Fringe Benefits %	Fringe Benefits Amount	TOTAL
Fred (Marty) Ralph	7/24	27,220	9.00	2.00%		4,900	36.50%	1,789	6,689
Director, CW3E	7/25	28,581	3.00	2.00%	0.24	1,715	37.23%	638	2,353
Luca Delle Monache	7/24	22,750	9.00	2.00%		4,095	36.50%	1,495	5,590
Deputy Director	7/25	23,888	3.00	2.00%	0.24	1,433	37.23%	534	1,967
Duncan Axisa	7/24	13,203	9.00	4.20%		4,991	47.10%	2,351	7,342
Acad Prg Mgt Ofc	7/25	13,863	3.00	4.20%	0.50	1,747	48.04%	839	2,586
Taylor Dixon	7/24	12,687	9.00	4.20%		4,796	47.10%	2,259	7,055
Acad Prg Mgt Ofc	7/25	13,322	3.00	4.20%	0.50	1,679	48.04%	807	2,486
Rachel Weihs	7/24	9,986	9.00	4.20%		3,775	47.10%	1,778	5,553
Rsch Data Analyst	7/25	10,485	3.00	4.20%	0.50	1,321	48.04%	635	1,956
TBD	7/24	8,609	9.00	4.20%		3,254	47.10%	1,533	4,787
Rsch and Dev Engr	7/25	9,039	3.00	4.20%	0.50	1,139	48.04%	547	1,686
Erlan Goharian	7/24	14,167	9.00	4.20%		5,355	47.10%	2,522	7,877
Rsch and Dev Engr	7/25	14,875	3.00	4.20%	0.50	1,874	48.04%	900	2,774
TBD	7/24	7,875	9.00	4.20%		2,977	47.10%	1,402	4,379
Rsch and Dev Engr	7/25	8,269	3.00	4.20%	0.50	1,042	48.04%	501	1,543
TBD	7/24	13,203	9.00	4.20%		4,991	47.10%	2,351	7,342
Acad Prg Mgt Ofc	7/25	13,863	3.00	4.20%	0.50	1,747	48.04%	839	2,586
Ava Cooper	7/24	8,091	9.00	18.21%		13,259	47.10%	6,245	19,504
Rsch Data Anayst	7/25	8,496	3.00	18.21%	2.19	4,641	48.04%	2,230	6,871
Paul Iniguez	7/24	7,227	9.00	5.00%		3,252	47.10%	1,532	4,784
Rsch Data Analyst	7/25	7,589	3.00	5.00%	0.60	1,138	48.04%	547	1,685
Shawn Roj	7/24	6,866	9.00	9.50%		5,870	47.10%	2,765	8,635
Rsch Data Analyst	7/25	7,209	3.00	9.50%	1.14	2,055	48.04%	987	3,042
Janel Mayo	7/24	6,865	9.00	16.65%		10,287	47.10%	4,845	15,132
Project Policy Analyst	7/25	7,208	3.00	16.65%	2.00	3,600	48.04%	1,729	5,329
Ethan Morris	7/24	8,251	9.00	10.00%		7,427	47.10%	3,498	10,925
R&D Engineer	7/25	8,663	3.00	10.00%	1.20	2,600	48.04%	1,249	3,849
Lillian Gilmore	7/24	6,855	9.00	5.00%		3,085	47.10%	1,453	4,538
Res. Admin	7/25	7,198	3.00	5.00%	0.60	1,080	48.04%	519	1,599
				Total person months	11.71				
				DIRECT SALARIES TOTAL		111,125			

B. FRINGE BENEFITS — **BENEFITS TOTAL** 51,319

SALARIES AND BENEFITS TOTAL **162,444**

C. TRAVEL	Airfare/Baggage	Car/RF Per Diem	No. of Days/Bags	No. of Trips	Total
Domestic					
Water District Stakeholder Meeting					
RT SD/San Bernardino, CA	$ 277			4	$ 1,108
RT Checked Baggage	$ 70		2	4	$ 560
Rental Car/Ground Transportation		$ 125	2	4	$ 1,000
Per Diem		$ 248	2	4	$ 1,984
Meeting					
RT Denver,CO/Orange Cty, CA	$ 484			4	$ 1,936
RT Checked Baggage	$ 70		1	4	$ 280
Rental Car/Ground Transportation		$ 176	1	4	$ 704
Per Diem		$ 256	2	4	$ 2,048
Field Work					
RT SD/TBD					
Rental Car/Ground Transportation		$ 125	3	1	$ 375
Per Diem		$ 248	3	1	$ 744
			Total Domestic Travel		**10,739**

TRAVEL TOTAL **10,739**

D. EQUIPMENT (or equivalent and includes sales tax)			
Disdrometer: Parsivel present weather sensor	1 qt. @	$ 7,761	7,761
Steam gage station	1 qt. @	$ 7,349	7,349
Soil moisture/temperature sensor	12 qt. @	$ 7,085	85,020
Surface meteorological station	3 qt. @	$ 17,482	52,446
		Total Equipment	152,576

EQUIPMENT TOTAL **152,576**

F. CONTRACTUAL

ERG - Arleen O'Donnell	35,640
RKHCS - Robert Hartman	37,400

SERVICE CONTRACT TOTAL **73,040**

H. OTHER

Project Specific Communications, Mailing/FedEx, and Network Costs			2,700	
Managed Lab Machines (MLM)			750	
SDSC - Supercomputer			8,956	
Catering - Steering Committee Lunches			1,000	
Telemetry	3 qt. @	$ 1,000	3,000	
Computer	1 qt. @	$ 3,125	3,125	
Staff plate	1 qt. @	$ 100	100	
			OTHER EXPENSES TOTAL	**19,631**

I. TOTAL DIRECT COSTS **418,430**

J. INDIRECT COSTS (less equipment, tuition remission, subcontract costs in excess of $25K)

		Base	OH Rate	
Tuition:	*0*			
Equipment:	*152,576*	256,898	59.0%	151,570
SDSC - Supercomputer	*8,956*			
Excluded from Indirect:	*161,532*			

TOTAL INDIRECT COST **151,570**

K. TOTAL AMOUNT REQUESTED **570,000**

Forecast Informed Reservoir Operations at Seven Oaks Dam: Development of Preliminary Viability Assessment

Year 2: 10/01/24 through 09/30/26

A. SALARIES	FY Rates Beginning	Monthly Direct Salary Rate	No. Months	% Salary or Effort	Person Mos.	Salary Subtotal	Fringe Benefits %	Fringe Benefits Amount	TOTAL
Fred (Marty) Ralph	7/25	28,581	9.00	2.00%		5,145	37.23%	1,915	7,060
Director, CW3E	7/26	30,010	3.00	2.00%	0.24	1,801	37.97%	684	2,485
Luca Delle Monache	7/25	23,888	9.00	2.00%		4,300	37.23%	1,601	5,901
Deputy Director	7/26	25,082	3.00	2.00%	0.24	1,505	37.97%	571	2,076
Duncan Axisa	7/25	13,863	9.00	4.20%		5,240	48.04%	2,517	7,757
Acad Prg Mgt Ofc	7/26	14,556	3.00	4.20%	0.50	1,834	49.00%	899	2,733
Taylor Dixon	7/25	13,322	9.00	4.20%		5,036	48.04%	2,419	7,455
Acad Prg Mgt Ofc	7/26	13,988	3.00	4.20%	0.50	1,762	49.00%	863	2,625
Rachel Weihs	7/25	10,485	9.00	4.20%		3,963	48.04%	1,904	5,867
Rsch Data Analyst	7/26	11,009	3.00	4.20%	0.50	1,387	49.00%	680	2,067
TBD	7/25	9,039	9.00	4.20%		3,417	48.04%	1,642	5,059
Rsch and Dev Engr	7/26	9,491	3.00	4.20%	0.50	1,196	49.00%	586	1,782
Erlan Goharian	7/25	14,875	9.00	4.20%		5,623	48.04%	2,701	8,324
Rsch and Dev Engr	7/26	15,619	3.00	4.20%	0.50	1,968	49.00%	964	2,932
TBD	7/25	8,269	9.00	18.40%		13,693	48.04%	6,578	20,271
Rsch and Dev Engr	7/26	8,682	3.00	18.40%	2.21	4,792	49.00%	2,348	7,140
TBD	7/25	13,863	9.00	4.20%		5,240	48.04%	2,517	7,757
Acad Prg Mgt Ofc	7/26	14,556	3.00	4.20%	0.50	1,834	49.00%	899	2,733
Ava Cooper	7/25	8,496	9.00	25.00%		19,116	48.04%	9,183	28,299
Rsch Data Anayst	7/26	8,921	3.00	25.00%	3.00	6,691	49.00%	3,279	9,970
Paul Iniguez	7/25	7,589	9.00	4.20%		2,869	48.04%	1,378	4,247
Rsch Data Analyst	7/26	7,968	3.00	4.20%	0.50	1,004	49.00%	492	1,496
Shawn Roj	7/25	7,209	9.00	8.33%		5,405	48.04%	2,597	8,002
Rsch Data Analyst	7/26	7,570	3.00	8.33%	1.00	1,892	49.00%	927	2,819
Janel Mayo	7/25	7,208	9.00	16.66%		10,808	48.04%	5,192	16,000
Project Policy Analyst	7/26	7,569	3.00	16.66%	2.00	3,783	49.00%	1,854	5,637
Ethan Morris	7/25	8,663	9.00	10.00%		7,797	48.04%	3,746	11,543
R&D Engineer	7/26	9,097	3.00	10.00%	1.20	2,729	49.00%	1,337	4,066
Lillian Gilmore	7/25	7,198	9.00	5.00%		3,237	48.04%	1,555	4,792
Res. Admin	7/26	7,558	3.00	5.00%	0.60	1,134	49.00%	556	1,690
			Total person months		13.99				
				DIRECT SALARIES TOTAL		136,201			

B. FRINGE BENEFITS — **BENEFITS TOTAL** 64,384

SALARIES AND BENEFITS TOTAL **200,585**

C. TRAVEL	Airfare/Baggage	Car/RF Per Diem	No. of Days/Bags	No. of Trips	Total
Domestic					
Water District Stakeholder Meeting					
RT SD/San Bernardino, CA	$ 290			4	$ 1,160
RT Checked Baggage	$ 70		2	4	$ 560
Rental Car/Ground Transportation		$ 140	2	4	$ 1,120
Per Diem		$ 260	2	4	$ 2,080
Meeting					
RT Denver,CO/Orange Cty, CA	$ 508			4	$ 2,032
RT Checked Baggage	$ 70		1	4	$ 280
Rental Car/Ground Transportation		$ 185	1	4	$ 740
Per Diem		$ 269	2	4	$ 2,152
Field Work					
RT SD/TBD					
Rental Car/Ground Transportation		$ 131	3	3	$ 1,179
Per Diem		$ 260	3	3	$ 2,340
			Total Domestic Travel		**13,643**
				TRAVEL TOTAL	**13,643**

F. CONTRACTUAL

ERG - Arleen O'Donnell	35,640
RKHCS - Robert Hartman	47,950
SERVICE CONTRACT TOTAL	**83,590**

H. OTHER

Project Specific Communications, Mailing/FedEx, and Network Costs	3,150
Managed Lab Machines (MLM)	750
SDSC - Supercomputer	9,047
Catering - Steering Committee Lunches	1,000

Publications

AMS/JAMC/JAS/JCLI/JHM/JPO/JTECH/MWR/WAF					
Page Charges (includes color pages)	30	pages @ $	120	/page	3,600
Optional Open Choice Access Fee	2	@ $	1,300	flat fee	2,600

					Total Publications	6,200
					OTHER EXPENSES TOTAL	**20,147**
I. TOTAL DIRECT COSTS						**317,965**
J. INDIRECT COSTS (less equipment, tuition remission, subcontract costs in excess of $25K)						
Tuition:	*0*	Base	OH Rate			
Equipment:	*0*	231,689	59.0%	136,697		
SDSC - Supercomputer	*9,047*	77,230	60.0%	46,338		
Excluded from Indirect:	*9,047*					
					TOTAL INDIRECT COST	**183,035**
K. TOTAL AMOUNT REQUESTED						**501,000**

d Reservoir Operations at Seven Oaks Dam: Development of Preliminary Viability

	Year 1	Year 2	TOTAL PROJECT
A. Salaries	111,125	136,201	**247,326**
B. Fringe Benefits	51,319	64,384	**115,703**
C. Travel	10,739	13,643	**24,382**
D. Equipment	152,576	0	**152,576**
E. Supplies	0	0	**0**
F. Contractual Service Contracts	73,040	83,590	**156,630**
H. Other Expenses	19,631	20,147	**39,778**
I. Total Direct Costs	**418,430**	**317,965**	**736,395**
J. Indirect Cost	151,570	183,035	**334,605**
K. Total Amount Requested	**570,000**	**501,000**	**1,071,000**