AGENDA

18700 Ward St.
Fountain Valley, CA 92708
(714) 378-3200

WATER ISSUES COMMITTEE MEETING
WITH BOARD OF DIRECTORS *
ORANGE COUNTY WATER DISTRICT
Wednesday, May 14, 2025 12:00 p.m., Boardroom

*The OCWD Water Issues Committee meeting is noticed as a joint meeting with the Board of Directors for the purpose of strict compliance with the Brown Act and it provides an opportunity for all Directors to hear presentations and participate in discussions. Directors receive no additional compensation or stipend as a result of simultaneously convening this meeting. Items recommended for approval at this meeting will be placed on the **May 21** Board meeting Agenda for approval.

This meeting will be held in person. As a convenience for the public, the meeting may also be accessed by Zoom Webinar and will be available by either computer or telephone audio as indicated below. Because this is an in-person meeting and the Zoom component is not required, but rather is being offered as a convenience, if there are any technical issues during the meeting, this meeting will continue and will not be suspended.

Computer Audio: Join the Zoom Webinar by clicking on the following link:
https://ocwd.zoom.us/j/98592928069

Webinar ID: 985 9292 8069

Telephone Audio: (213) 338 8477

Teleconference Sites:
10382 Bonnie Drive, Garden Grove
20 Civic Center, Santa Ana
19 Cannery, Buena Park
1454 Madison Street, Tustin
1502 North Broadway, Santa Ana
6148 E Baja Dr, Anaheim
* Members of the public may attend and participate at all locations.

PLEDGE OF ALLEGIANCE

ROLL CALL

ITEMS RECEIVED TOO LATE TO BE AGENDIZED

RECOMMENDATION: Adopt resolution determining need to take immediate action on item(s) and that the need for action came to the attention of the District subsequent to the posting of the Agenda (requires two-thirds vote of the Board members present, or, if less than two-thirds of the members are present, a unanimous vote of those members present.)

VISITOR PARTICIPATION

Time has been reserved at this point in the agenda for persons wishing to comment for up to three minutes to the Board of Directors on any item that is not listed on the agenda, but within the subject matter jurisdiction of the District. By law, the Board of Directors is prohibited from taking action on such public comments. As appropriate, matters raised in these public comments will be referred to District staff or placed on the agenda of an upcoming Board meeting.

At this time, members of the public may also offer public comment for up to three minutes on any item on the Consent Calendar. While members of the public may not remove an item from the Consent Calendar for separate discussion, a Director may do so at the request of a member of the public.

CONSENT CALENDAR (ITEMS NO. 1 – 12)

All matters on the Consent Calendar are to be approved by one motion, without separate discussion on these items, unless a Board member or District staff request that specific items be removed from the Consent Calendar for separate consideration.

1. MINUTES OF WATER ISSUES COMMITTEE MEETING HELD APRIL 9, 2025

   RECOMMENDATION: Approve minutes as presented

2. INVITATION FOR QUOTES (IFQ-24-002) FOR SOIL BORINGS AT ANAHEIM LAKE (RESILIENCE PLAN PRIORITY PROJECT NO. 12)

   RECOMMENDATION: Agendize for May 21 Board meeting: Authorize issuance of Invitation for Quotes for services to drill soil borings at Anaheim Lake

3. AUTHORIZE AGREEMENT TO BUTIER ENGINEERING INC FOR CONSTRUCTION MANAGEMENT AND INSPECTION SERVICES FOR SB-2025-1 BOND BASIN SLOPE REPAIR AND BUDGET INCREASE

   RECOMMENDATION: Agendize for May 21 Board meeting:

   1. Authorize agreement with Butier Engineering, Inc. for a not-to-exceed amount of $321,123.50 for construction management and inspection services for SB-2025-1 Bond Basin Slope Repair; and

   2. Increase project budget by $71,124 for a total project budget amount of $3,849,414

4. CONTRACT NO. TUS-2022-1: AMENDMENT NO. 2 TO BUTIER ENGINEERING

   RECOMMENDATION: Agendize for May 21 Board meeting: Authorize issuance of Amendment No. 2 to Agreement No. 1558 with Butier Engineering Inc. for construction management and inspection services in the amount of $197,010

5. AGREEMENT EXTENSION FOR ON CALL SURVEYING SERVICES

   RECOMMENDATION: Agendize for May 21 Board meeting: Authorize time extension of agreements to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. for on-call surveying services through June 30, 2027

6. TALBERT BARRIER INJECTION WELLS I-24 & I-25 CONTROL VALVE PROJECT – PUBLICATION OF NOTICE INVITING BIDS

   RECOMMENDATION: Agendize for May 21 Board meeting: Authorize publication of Notice Inviting Bids for Contract No. TAL-2024-2, Talbert Barrier Injection Wells I-24 and I-25 Control Valve Replacement Project

7. CONTRACT NO. A-2025-1 ANAHEIM LAKE VALVE VAULT CATEGORICAL EXEMPTION AND NOTICE INVITING BIDS

   RECOMMENDATION: Agendize for May 21 Board meeting:

1. Authorize filing of a Categorical Exemption for the Anaheim Lake Valve Vault project in compliance with the California Environmental Quality Act (CEQA) guidelines; and

2. Authorize publication of Notice Inviting Bids for Contract No. A-2025-1, Anaheim Lake Valve Vault

8. GOLDEN STATE WATER COMPANY CLAIR PLANT, BEACH PLANT, AND DALE PLANT PFAS TREATMENT SYSTEMS PROJECT: ENGINEER'S REPORT AND CATEGORICAL EXEMPTION

RECOMMENDATION: Agendize for May 21 Board Meeting:

1. Approve the Engineer's Report for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project and determine the project feasible, necessary and beneficial to the lands of the District; and

2. Authorize filing of a Categorical Exemption for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project in compliance with the California Environmental Quality Act (CEQA) guidelines

9. AUTHORIZE AGREEMENT TO TAIT AND ASSOCIATES, INC. FOR 2025 ASPHALT PAVEMENT REHABILITATION DESIGN

RECOMMENDATION: Agendize for May 21 Board Meeting: Authorize issuance of Agreement to Tait and Associates, Inc. for an amount not to exceed $100,000 for the 2025 Asphalt Pavement Rehabilitation Design

10. ISSUANCE OF SERVICES AGREEMENT WITH TETRA TECH, INC. FOR 2025 PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LIGHT DETECTION RANGING (LIDAR)

RECOMMENDATION: Agendize for May 21 Board Meeting:

1. Authorize issuance of an Agreement to Tetra Tech, Inc., in the amount of $41,198 for multispectral aerial imaging and high-pulse count LiDAR data collection of Prado Basin; and,

2. Approve and authorize execution of cost share agreement with Inland Empire Utilities Agency and Chino Basin Watermaster for multispectral aerial imagery and LiDAR data collection, subject to approval as to form by the District's General Counsel.

11. AUTHORIZATION TO ENTER INTO A MEMORANDUM OF UNDERSTANDING (MOU) WITH THE COUNTY OF ORANGE FOR THE CONTINUED USE OF THE COUNTY'S ALERTOC

RECOMMENDATION: Agendize for May 21 Board Meeting: Authorize the General Manager to sign the Memorandum of Understanding (MOU) between the Orange County Water District and the County of Orange for the continued use of the County's Mass Notification System, AlertOC, administered through Everbridge, Inc.

12. AWARD CONTRACT NO. GWRS-2025-1 REVERSE OSMOSIS CIP VALVE RELOCATION TO MURRAY COMPANY

RECOMMENDATION: Agendize for May 21 Board Meeting:

1. Receive and file Affidavit of Publication of Notice Inviting Bids for Contract GWRS-2025-1 Reverse Osmosis CIP Valve Relocation Project;

2. Ratify issuance of Addendum No. 1 to provide responses to potential bidder's questions; and

3. Accept bid and award contract GWRS-2025-1 to the lowest responsive bid and responsible bidder, Murray Company, in the amount of $340,885; and

4. Establish the Reverse Osmosis CIP Valve Relocation Project budget in the amount of $500,000

END OF CONSENT CALENDAR

MATTERS FOR CONSIDERATION

13. AWARD DIRECT ACCESS ELECTRICITY CONTRACT FOR GROUNDWATER REPLENISHMENT SYSTEM, BURRIS PUMP STATION, AND GREEN ACRES PROJECT SANTA ANA RESERVOIR

RECOMMENDATION: Agendize for May 21 Board Meeting: Authorize the general manager in consultation with the board president to enter into a five year contract ending June 30, 2030 for Direct Access electricity procurement with Constellation New Energy, NRG/Direct Energy or Shell Energy for the OCWD Kiwi Substation, Burris Pump Station, and Green Acres Project Santa Ana Reservoir on May 22, 2025

14. RESULTS OF RIVERBED FILTRATION SYSTEM DEMONSTRATION PROJECT AND AUTHORIZATION TO ISSUE REQUEST FOR PROPOSALS FOR FEASIBILITY STUDY (Resilience Plan Priority Project No. 11)

RECOMMENDATION: Agendize for May 21 Board meeting: Authorize issuance of Request for Proposals for the Riverbed Filtration System Feasibility Study

CHAIR DIRECTION AS TO ITEMS IF ANY TO BE AGENDIZED AS MATTERS FOR CONSIDERATION AT THE MAY 21 BOARD MEETING

DIRECTORS' ANNOUNCEMENTS/REPORTS

GENERAL MANAGER'S ANNOUNCEMENTS/REPORTS

ADJOURNMENT

WATER ISSUES COMMITTEE MEMBERS

Committee Members
Cathy Green – Chair
Erik Weigand – Vice Chair
Roger Yoh
Van Tran
Dina Nguyen

Alternates
Valerie Amezcua
Fred Jung
Natalie Meeks
Steve Sheldon
Denis Bilodeau

In accordance with the requirements of California Government Code Section 54954.2, this agenda has been posted at the guard shack entrance and in the main lobby of the Orange County Water District, 18700 Ward Street, Fountain Valley, CA and on the OCWD website not less than 72 hours prior to the meeting date and time above. All written materials relating to each agenda item are available for public inspection in the office of the District Secretary. Backup material for the Agenda is available at the District offices for public review and can be viewed online at the District's website: www.ocwd.com

Pursuant to the Americans with Disabilities Act, persons with a disability who require a disability-related modification or accommodation in order to participate in a meeting, including auxiliary aids or services, may request such modification or accommodation from the District Secretary at (714) 378-3234, by email at cfuller@ocwd.com by fax at (714) 378-3373. Notification 24 hours prior to the meeting will enable District staff to make reasonable arrangements to assure accessibility to the meeting.

As a general rule, agenda reports or other written documentation has been prepared or organized with respect to each item of business listed on the agenda and can be reviewed at www.ocwd.com. Copies of these materials and other disclosable public records distributed to all or a majority of the members of the Board of Directors in connection with an open session agenda item are also on file with and available for inspection at the Office of the District Secretary, 18700 Ward Street, Fountain Valley, California, during regular business hours, 8:00 am to 5:00 pm, Monday through Friday. If such writings are distributed to members of the Board of Directors on the day of a Board meeting, the writings will be available at the entrance to the Board of Directors meeting room at the Orange County Water District office.

MINUTES OF BOARD OF DIRECTORS MEETING
WATER ISSUES COMMITTEE
ORANGE COUNTY WATER DISTRICT
April 9, 2025 @ 12:00 p.m.

Director Green called the Water Issues Committee meeting to order at 12:00 p.m. in the District Boardroom. Public access was also provided via Zoom webinar. The Secretary called the roll and reported a quorum as follows:

Committee Members		OCWD
Cathy Green		John Kennedy – General Manager
Erik Weigand		Chris Olsen – Executive Director of Engineering
Roger Yoh	(arrived 12:16 p.m.)	Mehul Patel – Executive Director of Operations
Van Tran	(arrived 12:07 p.m.)	Jason Dadakis – Executive Director of Water Quality
Dina Nguyen	(absent)	Lisa Haney – Executive Director of Planning and Natural Resources
Alternates		Bruce Dosier – Director of IS/Property Management
Valerie Amezcua		Roy Herndon – Chief Hydrogeologist
Fred Jung	(arrived 12:05 p.m.)	Dave Mark – Principal Hydrogeologist
Natalie Meeks	(arrived 12:07 p.m.)	Bill Leever – Principal Hydrogeologist
Steve Sheldon		Brendan Neel – Hydrogeologist
Denis Bilodeau		Adam Hutchinson – Recharge Planning Manager
		Megan Plumlee – Director of Research
		Randy Fick – Treasurer/CFO
		Ryan Bouley – Director of Engineering
		Larry Esguerra – Senior Engineer
		Shawn Neville – Principal Planner
		Alicia Harasty – Legislative Affairs Liaison
		Jeremy Jungreis – General Counsel
		Leticia Villarreal – Assistant District Secretary
		Janice Kovacevic – Executive Assistant

CONSENT CALENDAR

The Consent Calendar was approved upon motion by Director Amezcua, seconded by Director Weigand and carried [5-0], as follows:
Ayes: *Green, Weigand, Amezcua, Sheldon, Bilodeau*

1. Minutes of Water Issues Committee Meeting

The Minutes of the Water Issues Committee meeting held March 12, 2025, were approved as presented.

2. Reject Bid Protest and Award Contract SB-2025-1 Bond Basin Slope Repair to Innovative Construction Solutions Authorize Amendment No. 2 to ENGEO and Establish Project Budget

This item was removed from the Consent Calendar and considered separately.

3. Terminate the Inactive Conjunctive Use Program Storage Agreement with Metropolitan Water District

Recommended for approval at April 16 Board meeting: Terminate the Conjunctive Use Program Storage Agreement with the Metropolitan Water District.

4. Execution of Access Agreements for Existing Monitoring Well Sites SCS-3, -4, -8 and OM-8 on County of Orange Property

Recommended for approval at April 16 Board meeting: Authorize the General Manager to finalize and execute a no-cost 10-year term license agreement with the Orange County Flood Control District for continued access to existing monitoring wells SCS-3, SCS-4, and SCS-8 and a no-cost 10-year term entry permit agreement with the County of Orange for continued access to existing monitoring well site OM-8.

5. Field Headquarters Aboveground Gasoline Storage Tank Project Budget Increase

Recommended for approval at April 16 Board meeting: Increase project budget by $35,000 for a total project budget of $155,000.

6. Request for Qualification On-Call Environmental Services

Recommended for approval at April 16 Board meeting: Authorize issuance of a Request for Qualifications for On-Call Environmental Consultants.

MATTERS FOR CONSIDERATION

2. Reject Bid Protest and Award Contract SB-2025-1 Bond Basin Slope Repair to Innovative Construction Solutions Authorize Amendment No. 2 to ENGEO and Establish Project Budget

Executive Director of Engineering Chris Olsen stated that Innovative Construction Solutions (ICS) was the lowest bidder, but a protest was filed by the second-lowest bidder, citing a lapse in DIR certification for one of ICS's subcontractors. He explained that upon review with legal counsel and verification through the DIR website, it was confirmed the subcontractor had a valid certification at the time of bid submission.

General Counsel Jeremy Jungreis advised that sufficient evidence has been determined, and that two letters from both sides were submitted for the Boards consideration. He recommended that the Board proceed with the staff recommendation.

Upon motion by Director Weigand, seconded by Director Sheldon and carried [5-0], the Committee recommended for approval at the April 16 Board meeting:

1. **Receive and file Affidavit of Publication of Notice Inviting Bids for Contract SB-2025-1 Bond Basin Slope Repair Project;**

2. **Ratify issuance of Addenda 1-2;**

3. **Reject the bid protest of Empire Equipment Service, Inc, (Empire) and accept bid and authorize award of contract SB-2025-1 to the lowest responsive bid and responsible bidder, Innovative Construction Solutions, in the amount of $3,199,190.00;**

4. **Authorize Amendment No. 2 to Agreement No. 1555 with ENGEO a not-to-exceed amount of $59,800.00 for engineering construction support services; and**

5. **Establish project budget in the amount of $3,778,290.**

Ayes: Green, Weigand, Amezcua, Sheldon, Bilodeau

7. Amendment to Agreement with City of Santa Ana and Moulton Niguel Water District

Mr. Olsen presented an overview of the agreements history stating that the agreement was originally established to deliver up to 50 cfs of water during emergencies and is nearing expiration. He discussed the coordination efforts with the South Orange County agencies. Mr. Olsen said the amendment allows time to continue feasibility assessment, stakeholder coordination, and to move forward with design and CEQA.

Recommended for approval at the April 16 Board meeting: Authorize execution of an amendment to the agreement with the City of Santa Ana and Moulton Niguel Water District, with quarterly updates to be brought to the Board.

8. Request for Proposals for Stormwater Credit Banking Feasibility Study

Executive Director of Planning and Natural Resources Lisa Haney stated that the feasibility study would help to understand if municipal storm water could be an alternate source of water supply for OCWD. She provided an overview of the diverse water supply portfolio and summarized each supply source. She advised that the study would help to show cost benefit, benefit analysis, and potential water supply at each level. The Committee requested more information and this item was deferred to a future Water Issues meeting.

INFORMATIONAL ITEM

9. Proposed Fiscal Year 2025-26 Capital Improvement Program Budget

Director of Engineering Ryan Bouley provided an overview of the proposed fiscal year 2025-26 Capital Improvement Program (CIP) budget totaling $87.2 million for 27 projects to be funded with operating revenues (Pay-as-you-go Program), grants and WIFIA loan. He presented the larger items that are included in the proposed CIP Budget.

CHAIR DIRECTION AS TO ITEMS IF ANY TO BE AGENDIZED AS MATTERS FOR CONSIDERATION AT THE APRIL 16 BOARD MEETING

ADJOURNMENT

There being no further business, the meeting was adjourned at 1:27 p.m.

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Cathy Green, Chair

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: A. Hutchinson/D. Field/
L. Haney

Budgeted: Yes
Budgeted Amount: $75,000 (FY25-26)
Cost Estimate: $55,000
Funding Source: General Fund
Program/Line Item No.: 1044.53001
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: INVITATION FOR QUOTES (IFQ-24-002) FOR SOIL BORINGS AT ANAHEIM LAKE (RESILIENCE PLAN PRIORITY PROJECT NO. 12)

SUMMARY

Anaheim Lake is OCWD's oldest recharge basin which was put on-line in 1961. Although a high-performing facility, data suggests that a fine-grained sedimentary layer below the basin bottom is causing groundwater mounding. Staff recommends drilling soil borings to confirm the depth, thickness and characteristics of this layer, which will assist in evaluating the potential to increase the recharge capacity of the basin if a portion of this layer were removed. This work is part of OCWD's Resilience Plan Priority Project No. 12, Anaheim Lake Recharge Basin Rehabilitation Project.

Attachments:

- tTEM Geophysical Survey in Anaheim Lake and Kraemer Basin, Anaheim, California. Report prepared for OCWD by Geophysical Imaging Partners, October 2024.
- Draft Invitation for Quotes

RECOMMENDATION

Agendize for May 21 Board meeting: Authorize issuance of Invitation for Quotes for services to drill soil borings at Anaheim Lake.

BACKGROUND/ANALYSIS

Anaheim Lake is OCWD's first recharge basin. A total of 64 acres were purchased in 1958. Additional land was added in 1968 (24 acres) and from 1970-4 (23 acres). The current wetted area of the basin is 72 acres. The basin was placed into service in 1961, recharging only imported water from 1961 to 1975. In 1975, the Warner Transmission Pipeline was completed, which allowed for the recharge of Santa Ana River water.

The suspended sediment in Santa Ana River water causes clogging of all basins that receive this water, including Anaheim Lake. To maintain recharge rates, basins are periodically drained, allowed to dry, and then mechanically cleaned using heavy

equipment. The cleaning process on the flat basin bottom is effective at removing clogged sediment; however, it is difficult to clean basin sidewalls. The process of cleaning the basin sidewalls doesn't remove the clogging layer but breaks it up. As a result, over time, this mixture of clean and clogged material accumulates and degrades the recharge capacity of the basin sidewalls.

Because Anaheim Lake was expanded to the west by purchasing additional parcels, there are several peninsulas and an island that occupy space in the basin as shown in Figure 1. Removing these peninsulas and the island would increase basin storage by 300-600 acre-feet and create a large, uniform basin bottom that could be cleaned more efficiently. The native sand in the peninsulas could be re-purposed within the basin to regrade portions of the bottom and sidewalls.

Figure 1: Anaheim Lake

Based on lithologic logs of wells around the basin, there is a fine-grained sedimentary layer located approximately 40 feet below the basin bottom. Monitoring well water level data shows that this fine-grained layer impedes the downward flow of water, causing mounding and forcing water in the basin to migrate laterally through the basin sidewalls. Nearby Kraemer Basin does not have a fine-grained layer underlying the basin. This could be one reason why it is able to recharge as much water as Anaheim Lake despite being half the size. Staff has been exploring the possibility of over excavating a portion of the basin to remove the fine-grained layer and create a "window" of high permeability and thus increase the overall recharge capacity of the basin.

To further define the extent of this fine-grained layer, a geophysical survey was conducted using the time-domain electromagnetic method (TEM). The transmitter/receiver equipment is towed behind an ATV or other vehicle and thus is often called TowTem. The TowTem survey was conducted by Geophysical Imaging Partners in Anaheim Lake on August 26, 2024. The survey also included Kraemer

Basin. The results of the survey are presented in the attached report entitled “tTEM Geophysical Survey in Anaheim Lake and Kraemer Basin, Anaheim, California, October 2024.” A key figure from the report is presented as Figure 2, which shows the calculated resistivity of the sediment in Anaheim Lake with high resistivity (purple to red color) indicating sands and gravels and lower resistivity (green to blue) indicating finer grained sediments such as silty sand and silts. This figure clearly shows the presence of a fine-grained layer that shows up as a green layer within the more permeable sands and gravels shown in red and purple.

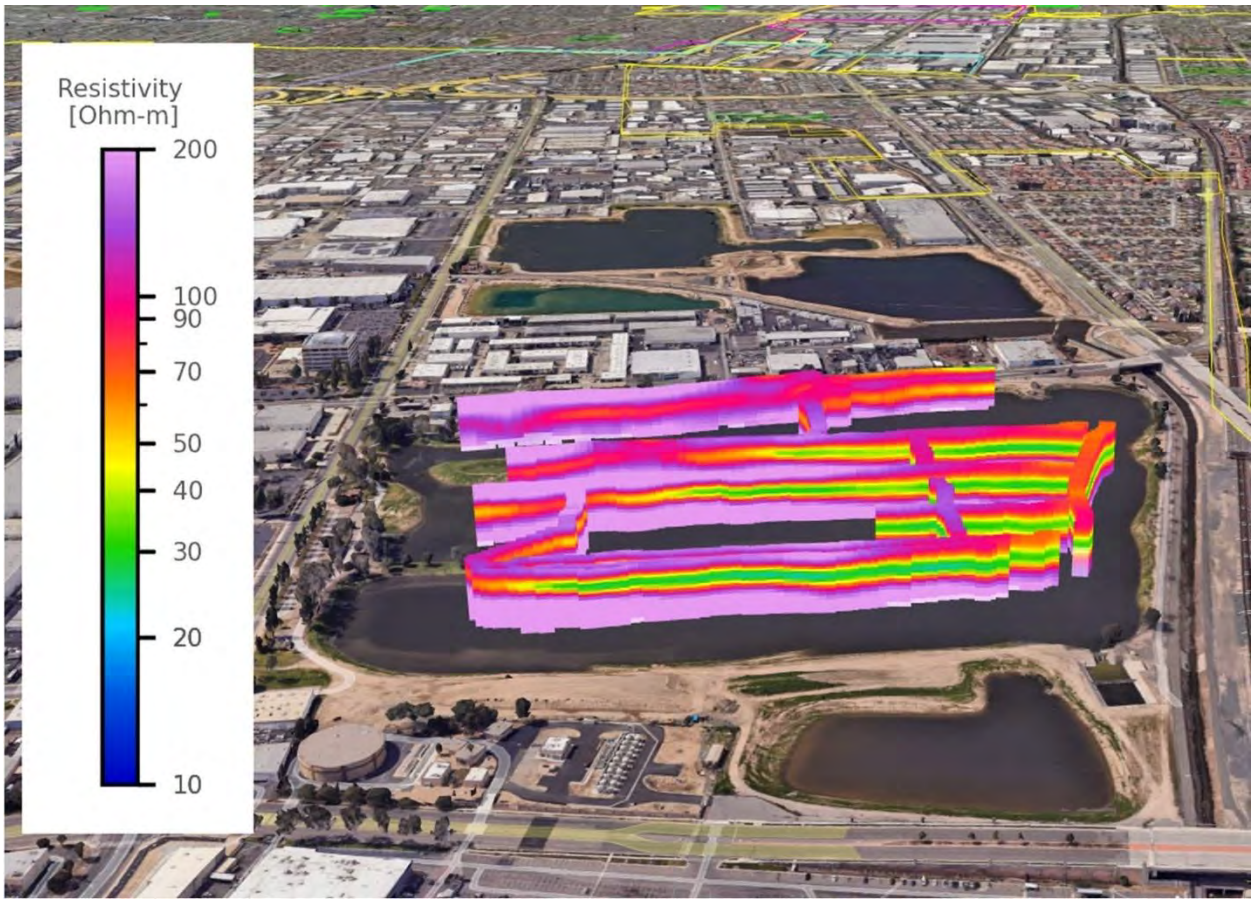

Figure 2: TowTem Survey Results of Anaheim Lake

To confirm the depths, thickness and sediment characteristics of this layer, staff is proposing to drill seven exploratory borings to 100 feet below the basin bottom as shown on Figure 3. The borings will be drilled using the sonic drilling method which will provide a continuous core of sediment from the surface to the bottom of the boring. The cores will be logged by a geologist and selected samples will be sent to OCWD’s Field Recharge Lab (FRL) for sieve analyses to characterize the sediment profile.

OCWD staff will also be digging trenches and collecting samples for sieve analyses to characterize the sediments within the internal island and peninsulas. This work will allow staff to assess whether or not the island/peninsula sediments can be repurposed to replace clogged sediments from the basin sidewalls and to replace a portion of the fine-grained layer below the basin bottom if it were removed.

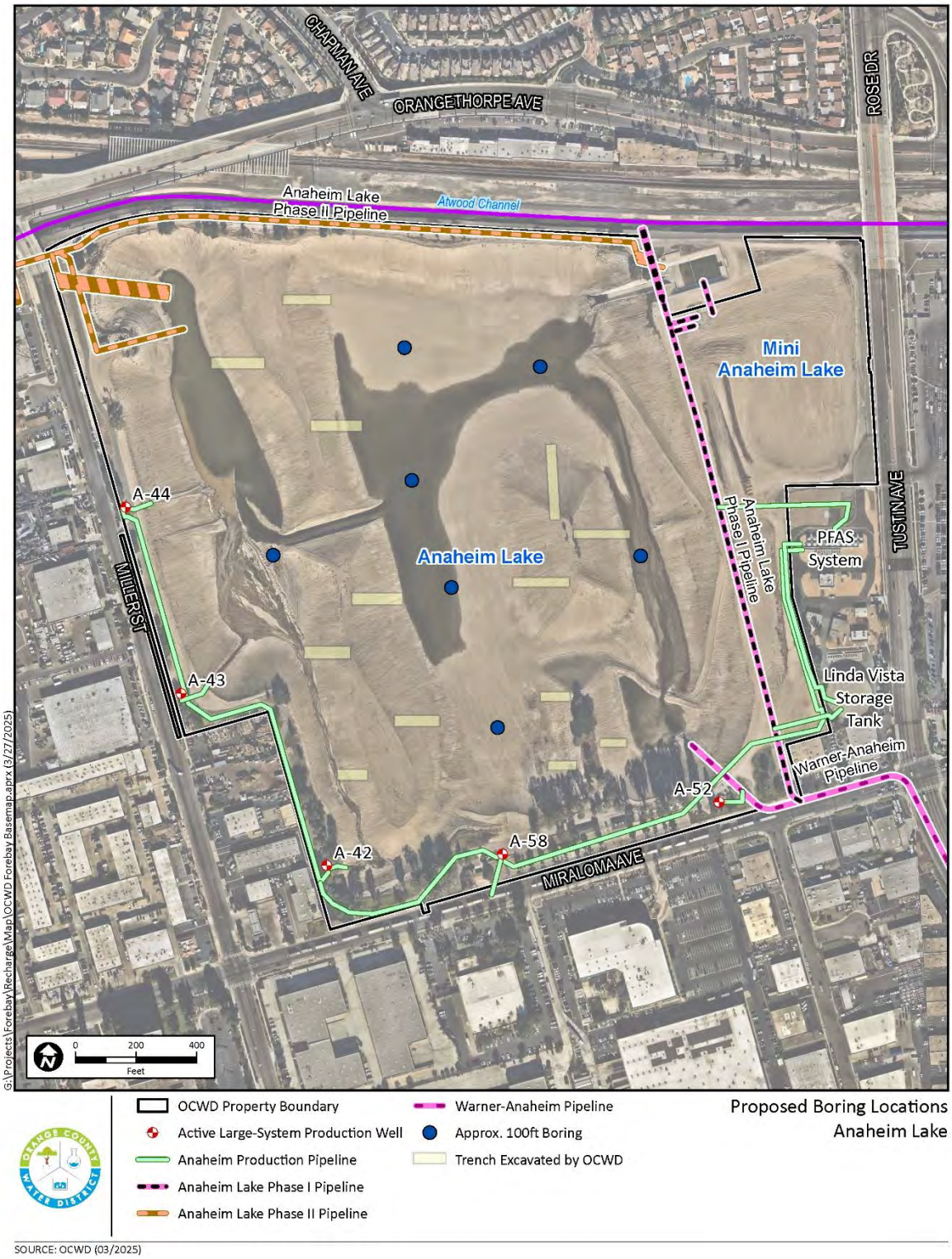

Figure 3: Locations of Proposed Soil Borings in Anaheim Lake.

This effort is part of OCWD's Resilience Plan Priority Project No. 12, Anaheim Lake Recharge Basin Rehabilitation Project. The Anaheim Lake Recharge Basin Rehabilitation Project has three components:

1. Remove clogged sidewall material and regrade sidewalls;
2. Remove peninsulas and island to increase basin storage and create large, uniform bottom area; and,
3. Remove portion of fine-grained layer underlying the basin.

As discussed in the Resilience Plan, the pros of this project include increased recharge capacity, increased basin storage, and reduced cleaning times. The challenges include the cost of removing the fine-grained layer and disposing of poor-quality sediment removed from the basin.

Staff recommend issuing a request for proposals to drill soil borings in Anaheim Lake using the sonic drilling method. The estimated cost to drill the soil borings is $55,000.

PRIOR RELEVANT BOARD ACTION(S)

2/19/25, R25-2-19 – Receive and File OCWD Resilience Plan and Authorize Filing of a Notice of Exemption

Project Report

tTEM Geophysical Survey in Anaheim Lake and Kraemer Basin, Anaheim, California

October 2024

Client:
Orange County Water District
18700 Ward Street, Fountain Valley, CA 92708
Att. Mr. Adam Hutchinson

GEOPHYSICAL IMAGING PARTNERS

Project #	24011
Project Name	tTEM Geophysical Survey in Anaheim Lake and Kraemer Basin, Anaheim, California
Date	25 October 2024
Client	Orange County Water District Fountain Valley, CA
Prepared by	Ahmad-Ali Behroozmand and Max Halkjaer
Project description	tTEM geophysical surveys to enhance the understanding of the variations in the sediments beneath Anaheim Lake and Kraemer Basin.
Cover Photo	The tTEM system in operation in Anaheim Lake on August 26, 2024.

Geophysical Imaging Partners, Inc.

Pleasant Hill, CA 94523, USA

Email: ahmad@geophysicalimaging.com, max@geophysicalimaging.com

Phone: +1 415-430-7173

October 25, 2024

Mr. Adam Hutchinson
18700 Ward Street
Fountain Valley
CA 92708
USA

Geophysical Imaging Partners, Inc.
Pleasant Hill
California 94523

tTEM geophysical surveys at Anaheim Lake and Kraemer Basin

Dear Adam,

We are pleased to submit this project report detailing the results of the tTEM geophysical investigations conducted at Anaheim Lake and Kraemer Basin in the City of Anaheim, California.

This project was conducted in the study area with the main objective of improving the understanding of the variations in the geological sediment beneath the two active recharge basins.

We highly acknowledge Orange County Water District's staff for their support during the fieldwork and providing elevation map of the basin floors.

It has been a pleasure to work with you on this project. We remain available to discuss this report or to answer any questions you may have.

Yours Sincerely,

Ahmad-Ali Behroozmand, PGp, PhD
Senior Geophysicist
ahmad@geophysicalimaging.com

Max Halkjaer, M.Sc.
Principal Geophysicist/Hydrogeologist
max@geophysicalimaging.com

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List of Appendices

Abbreviations

1D	One Dimensional
AMSL	Above Mean Sea Level
ATV	All-Terrain Vehicle
BGS	Below Ground Surface
DC	Direct Current
DEM	Digital Elevation Model
DOI	Depth of Investigation
EM	Electromagnetics
EPSG	European Petroleum Survey Group
Ft	Foot
GERDA	Geophysical Relationship Database
GPS	Global Positioning System
HM	High Moment
LCI	Laterally Constrained Inversion
LM	Low Moment
M	Meter
MAR	Managed Aquifer Recharge
OHM-M	Ohm Meter
QC	Quality Control
SCI	Spatially Constraint Inversion
TEM	Transient Electromagnetics
tTEM	Towed TEM

Introduction

Geophysical Imaging Partners, Inc. (GIP) has conducted a towed Transient Electromagnetic (tTEM) survey at the Anaheim Lake and Kraemer Basin in the City of Anaheim, California. The purpose of this geophysical investigation was to further understand and characterize subsurface sediments and geology beneath the Orange County Water District's (OCWD) two active recharge basins.

At Anaheim Lake, the purpose of the geophysical survey was to map variations in the depth to and the thickness of a fine-grained layer, expected to be at approximately 40 ft depth and has a thickness in the range of 20 ft, followed by an underlying layer of coarse sediments.

During OCWD staff's site visit in the field, it was decided to also survey the Kreamer Basin, which is located near Anaheim Lake. Kreamer Basin has a higher percolation rate than Anaheim lake.

One (1) day of tTEM geophysical investigations were conducted across the two recharge basins. A location map of the surveyed areas is shown in Figure 1.

Following data processing, the tTEM data were interpreted as smooth (multi-layer) electrical resistivity models through geophysical inversions. The tTEM results provide a detailed representation of electrical resistivity variations along the survey lines. The results are presented in the form of mean resistivity plan-view maps and vertical resistivity cross sections. The tTEM depth of investigation (DOI) extended to depths greater than 70 m (230ft) below ground surface (bgs).

This report provides a summary of the field operations and a description of the tTEM results. In addition, the following appendices provide supplementary information:

- Appendix 1: General introduction to the TEM method,
- Appendix 2: tTEM system specifications, including system configuration and details about processing and inversion settings,
- Appendix 3: Mean resistivity plan-view maps at different depth intervals across the study area,
- Appendix 4: Cross sectional illustrations of the results.
- Appendix 5: A description of the digital data formats.

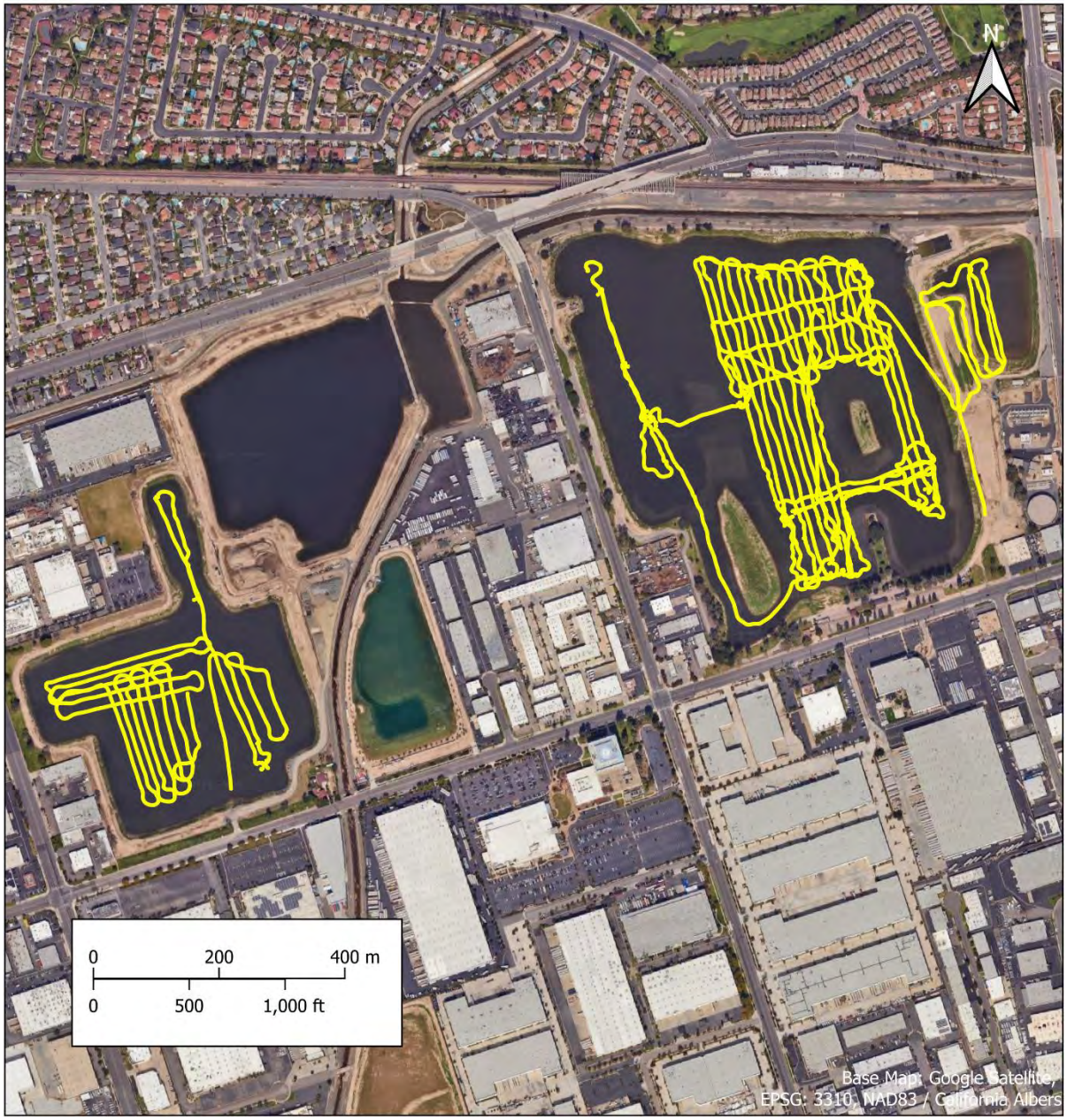

Figure 1 Location map of the tTEM surveyed area. Yellow lines show the tTEM survey lines.

Figure 2 The tTEM system in operation in Anaheim Lake on August 26, 2024.

Field Operations

The fieldwork took place on August 26, 2024, conducted by Max Halkjaer and Ahmad-Ali Behroozmand of Geophysical Imaging Partners. The field crew visited the site in the afternoon of August 25, 2024. The equipment was transported to and from the site using a cargo van. The system was assembled at the site and test measurements were performed before conducting the survey.

The transmitter and receiver units were mounted on sleds and towed behind an all-terrain vehicle (ATV). The sleds and frames are made from nonmetallic materials to prevent noise interference with the data (Figure 4). All electronic instruments and the power supply were mounted in the back of the ATV.

The tTEM system was checked and tested prior to the fieldwork to ensure its proper functionality. The TEM measurements, referred to as “soundings”, provide subsurface information to depths greater than 60 m (200 ft). The depth of investigation varies depending on subsurface conditions and the signal-to-noise ratio at the site.

The tTEM data characterizes the electrical resistivity of subsurface materials by injecting a direct current (DC) into the transmitter loop, emitting magnetic fields into the ground. After the current stabilizes, it is abruptly turned off. This abrupt turnoff of the transmitter current induces short-duration eddy currents in the ground, which propagates downwards and outwards. A receiver coil located on a sled behind the transmitter loop then measures the decaying magnetic field resulting from the eddy currents.

For further details about the TEM method and the tTEM system specifications, please see Appendix 1 and Appendix 2.

Figure 3 A photo of Anaheim Lake taken during site visit on August 25, 2024.

Figure 4 GIP staff assembling the tTEM system at Anaheim Lake in the morning of August 26, 2024. The transmitter loop (red wire) attached to a frame with red arms that is mounted on a sled (black). Similarly, the receiver coil (white box) is mounted on a sled and pulled behind the transmitter loop.

Data Collection

During the survey startup, pre-planned tTEM survey lines with line spacing of 15 m (50 ft) were prepared. The planned lines were loaded into the tTEM navigation system. This allowed real-time tracking of the lines and maintaining the distance between neighboring lines. The system's functionality was frequently monitored by the operator through the navigation system to ensure all measuring parameters fell within expected ranges.

Overall, the site conditions were well-suited for acquiring tTEM data. As anticipated, data near electromagnetic noise sources, such as powerlines, fences, and other metal objects, were influenced by the interference. These data were removed during the processing step.

Instrument Issues

No instrument issues were encountered in the field.

Data Processing and Inversion

The processing and inversion of the tTEM data were carried out with the software packages Aarhus Workbench (https://www.aarhusgeosoftware.dk/aarhus-workbench). We utilized applications that are specifically designed for processing and inversion of tTEM data.

During data processing, noisy data are removed, and the remaining data are averaged. Then the voltage data are fitted by identifying the geophysical resistivity model that best matches the measured data. The results are resistivity models presented as depth slices across the area and as vertical cross sections.

tTEM Data Processing Steps

After the collected raw data from the instrument underwent quality control, the dataset was processed to remove unusable, noisy data. The tTEM data was processed with the following steps:

1. Data were imported into a Firebird database.
2. Line numbers were assigned to the data during the field operation. The assigned line numbers were reviewed and updated.
3. Verification that all EM data and secondary data (GPS, speed, transmitter currents, etc.) were continuously measured throughout the survey.
4. Data were checked to ensure proper masking at turning points to avoid data where the system was not properly aligned.
5. Secondary data were reviewed to ensure they met specifications and do not vary significantly along the survey lines.
6. Processing of GPS data.
7. A standard uniform 3% noise was assigned to all data.
8. A standard processing scheme was defined to automatically reject data and assign noise.
9. Manual inspection of each survey line. Data determined noisy, which had not been rejected in the previous step, were removed. Noise sources include overhead powerlines, buried power cables, metal fences, and other man-made sources. This was done for the individual measurements (soundings) and for sequences of soundings along the survey line.
10. Elevation values were assigned to each data point from a digital elevation model grid to improve elevation accuracy of the resulting models. Basin floor elevation data were collected by OCWD following the survey. The elevation grid was applied to the tTEM data.
11. Data were averaged along the lines using a trapezoidal filter. This step involved averaging more data from late time gates compared to fewer data from early time gates. The aim was to improve the signal-to-noise ratio for data representing the deeper parts while maintaining high resolution information for near-surface features along the lines.
12. A final processed dataset with a sounding distance of approximately 5-10 m (~ 16-33 ft) was developed.

More information about the tTEM data processing can be found in Appendix 2.

tTEM Data Inversion Steps

After processing the data, an inversion algorithm was applied to the entire dataset to estimate subsurface electrical resistivity models. The following inversion scheme was used:

1. Define the number of model layers and layer thicknesses and set horizontal and vertical constrains on resistivities.
2. Perform inversion using the laterally-constrained inversion (LCI) approach (Auken et al., 2005) and the spatially-constraint inversion (SCI) approach (Viezzoli et al., 2009). The LCI inversion results was used for an initial assessment of the estimated resistivity models and to identify if any parts of the dataset required additional processing before running the SCI inversion.
3. Present the data as depth slices. If the depth slices revealed distinct anomalies, the processing of the corresponding data was revisited, and the data were re-inverted.
4. Calculate the depth of investigation (DOI) for each resistivity model through sensitivity analysis.

More information about the inversion process can be found in Appendix 2.

Quality Control

Quality control (QC) was performed during data acquisition in the field, at the office on the following day, and as part of the data processing and inversion.

QC in the field

Throughout data acquisition, the system components were frequently assessed to ensure that all parts were intact and secure. In addition, the TEM signal, battery voltage, current, temperature and GPS reception were constantly monitored. Overall, good signal-to-noise ratios (SNR) were observed for most of the surveyed areas.

Daily QC at the office

The data were exported from the instrument and imported into the processing and inversion software. The TEM data files were checked for completeness and the GPS data were checked for accuracy.

Repeated Line

A portion of survey lines 470 and 480 was surveyed repeatedly to quality check the repeatability of the recorded data as well as the processed and inverted data. The two data sets were treated independently and both inverted using the LCI approach, with the same settings applied as for the entire data set.

The repeated section is approximately 140 m (460 ft) long, and the two data sets were recorded nearly at the same locations. Figure 5 shows the comparison. It was found that the two data sets produce very similar models, with the layer boundaries aligning perfectly.

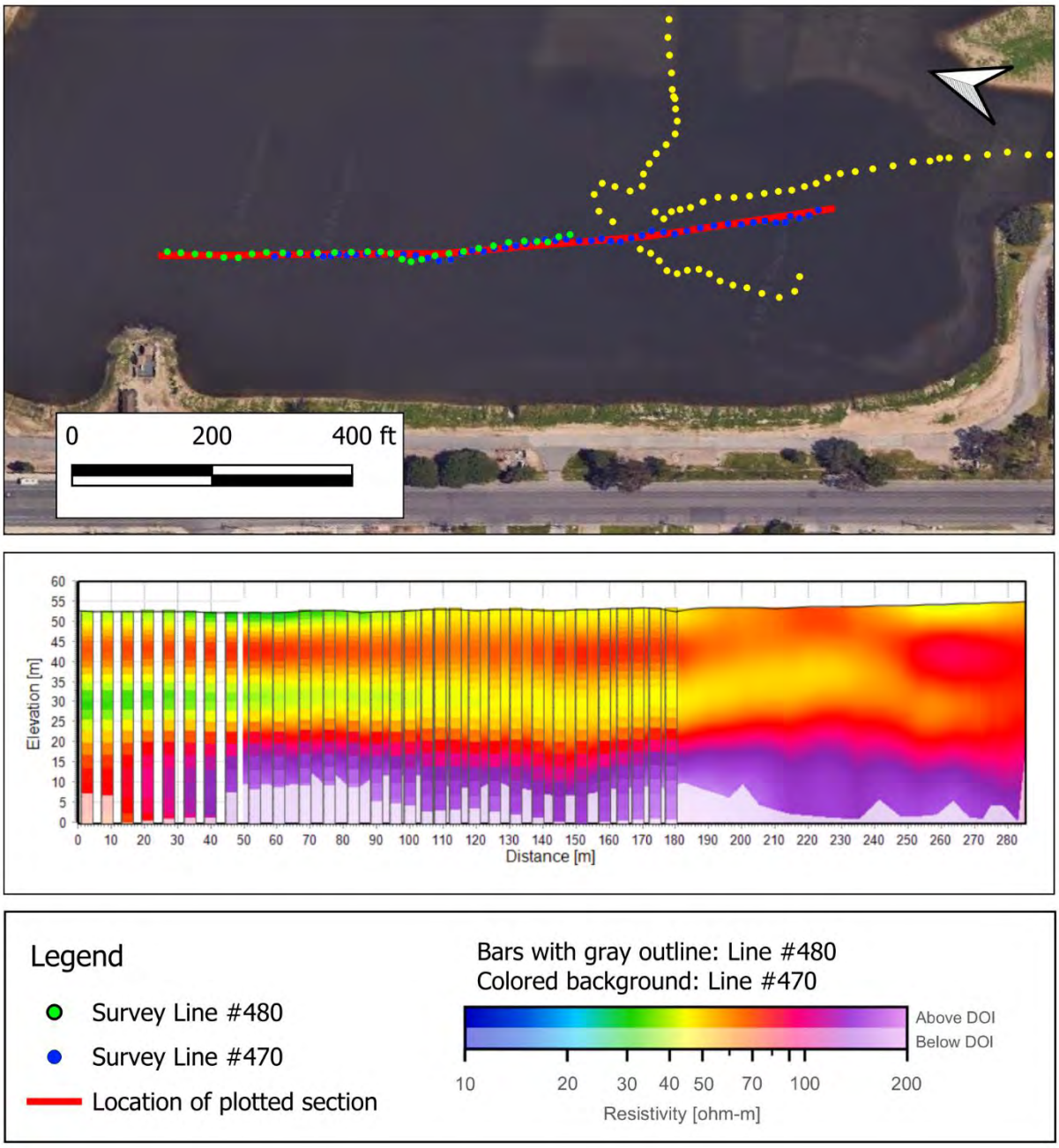

Figure 5 Repeated survey line(top) and corresponding inversion results (bottom). The background section shows results from Line #470 and the bars with gray borders show results from Line #480.

QC of the processed and inverted data

The processed and inverted data were quality controlled by inspecting various parameters like the number of data points per location, the last data point at each location, noise levels, data fits etc. Three QC thematic maps are presented in Appendix 3: Accepted versus rejected data, Data residual, and Depth of investigation.

Results

As previously described, the measured data are modeled to represent electrical resistivities at various depths, which can then be interpreted as lithology to gain insight into the site's geology. The tTEM results are presented as vertical resistivity sections and mean resistivity plan-view depth maps.

Color scale

The tTEM method measures the electrical resistivity of the subsurface. To obtain the subsurface lithologic information, the measured electrical resistivities must be transformed into lithologies. Transforming resistivity to lithology is based on a general correlation between resistivity and sediment type. Figure 6 shows a general correlation, where low permeability clay has a low resistivity value, sandy clay typically has a medium-range resistivity value, and sand to coarse sand has a relatively large resistivity value. This correlation is a general assumption and the range of resistivity for each lithologic unit can vary between locations. The water quality and saturation degree can also impact the resistivity, i.e., the more saline the water, the lower the formation resistivity and the lower the saturation degree, the higher the formation resistivity. Therefore, correlation with additional data sources if available (such as information from boreholes and water quality) and general geologic knowledge of the study area are crucial to obtain the most accurate description of the subsurface hydrogeology.

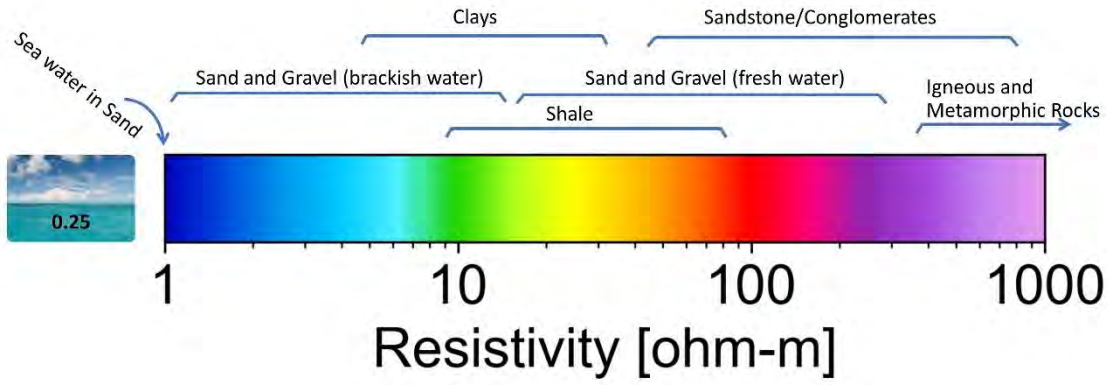

Figure 6 General correlation between resistivity, type of geologic materials, and water quality.

In this project, the resistivity colormap was adjusted to enhance the visualization of the resistivity variations across the study area. The color scale used for all presentations in this report is shown in Figure 7.

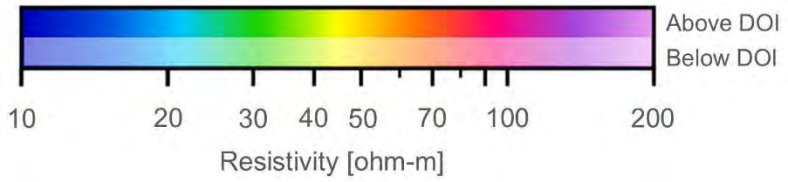

Figure 7 Resistivity color scale used for all presentations in this report.

Mean resistivity plan-view maps

Appendix 3 presents mean resistivity plan-view maps at various depth intervals. The maps show resistivity averages over 2-m (7-ft), 5-m (16-ft) and 10-m (33-ft) depth intervals, ranging from the ground surface to a depth of 70 m (230 ft). The mean resistivity maps provide insights into variations across the survey area at each depth interval.

Figure 8 provides an example of the mean resistivity maps for the depth interval of 15-20 m (bgs); all depth interval figures are available in Appendix 3.

Vertical sections

Figure 9 provides an example of a vertical resistivity model section from the study area, showing detailed structural variations, including the clay layer, along the section. All section figures are available in Appendix 4.

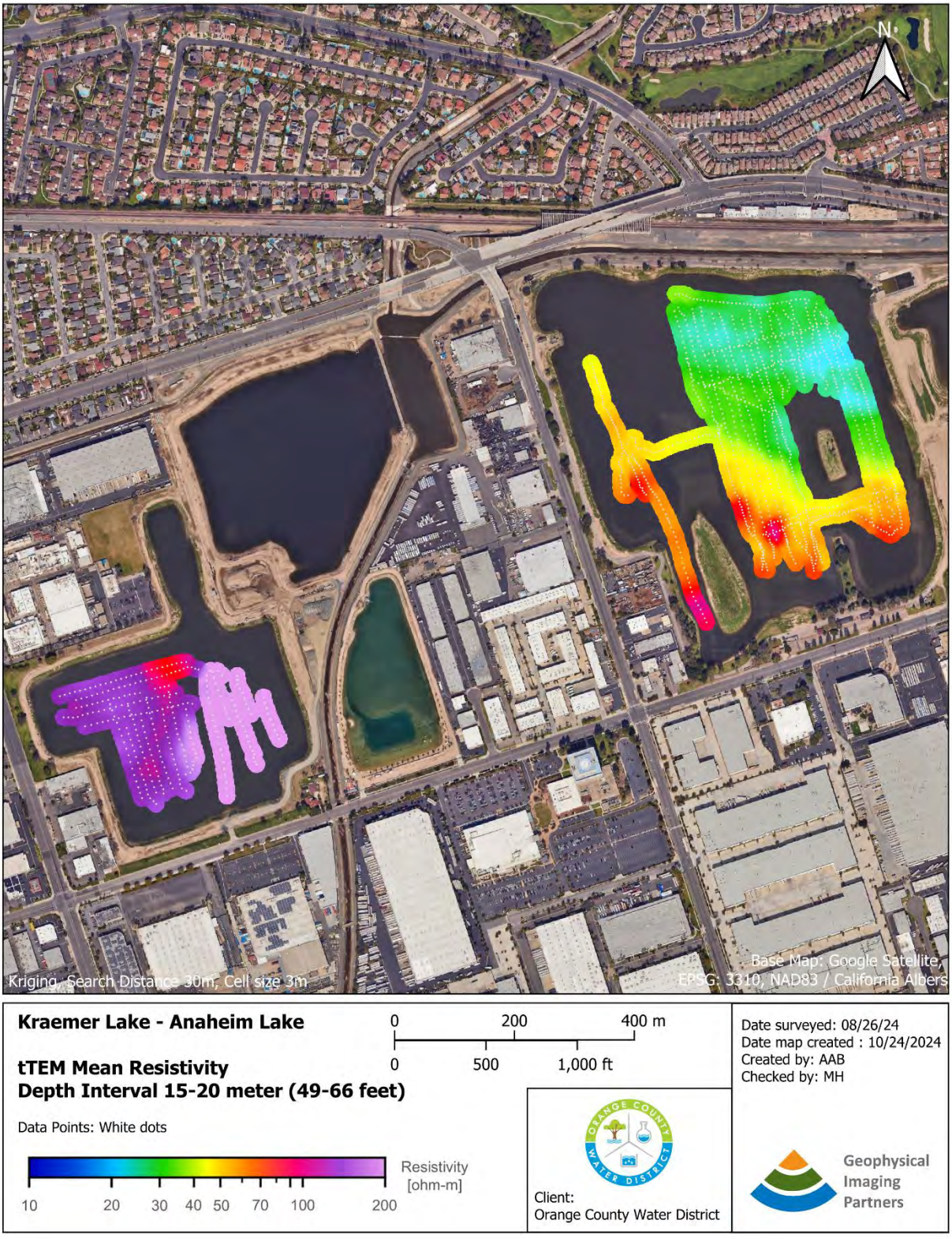

Figure 8 An example of a mean resistivity map for depth interval 15-20 m (49-66 ft) bgs.

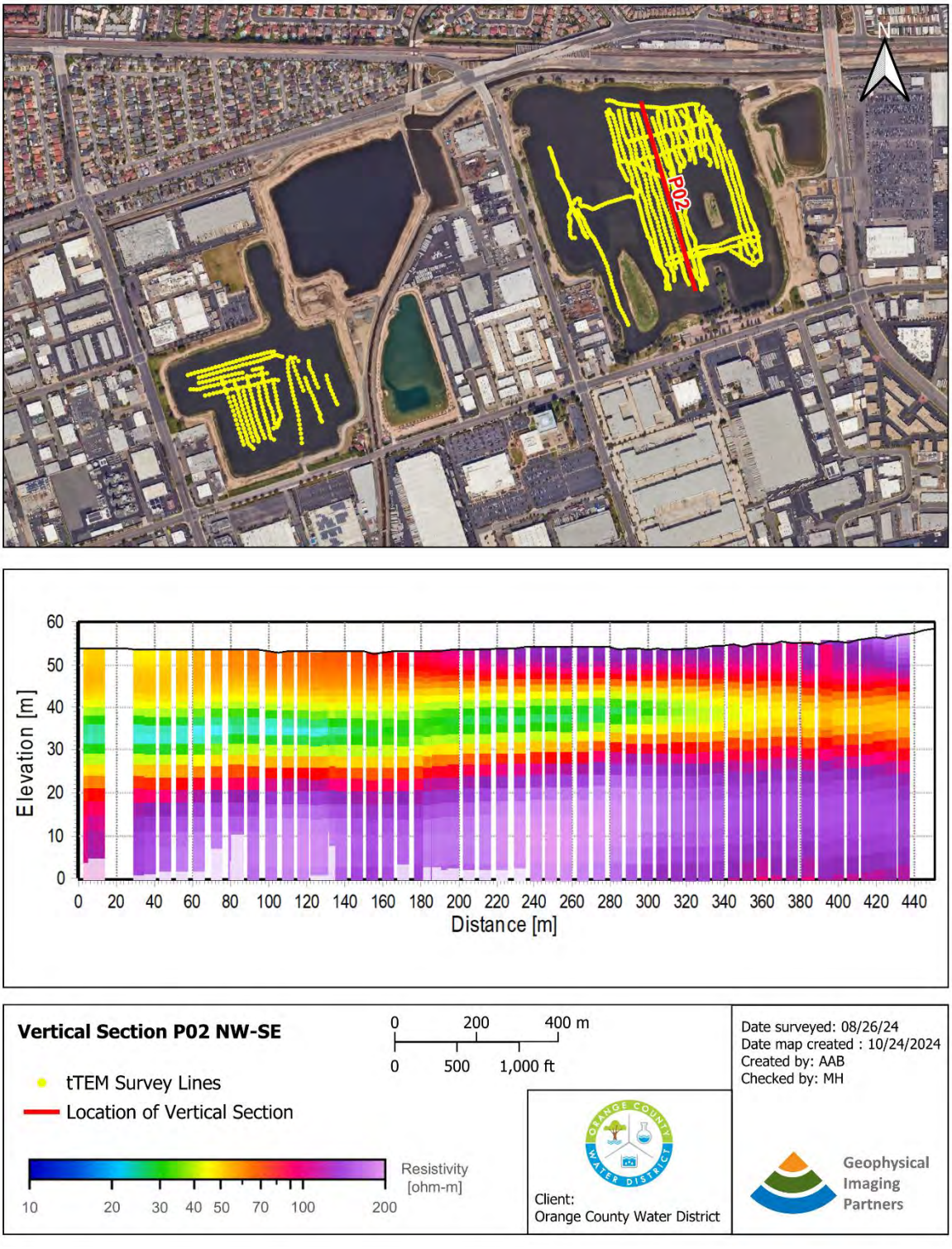

Figure 9 An example of a vertical model section (P02 orientated NW-SE) from Anaheim Lake showing resistivity-elevation variations along a 450-m section.

Data Deliverables

The following files have been provided as project deliverables. Each set of files is accompanied by a readme.txt file describing the file formats and contents.

1. Raw data as extracted from the instrument, including:
   A. Ascii files with information about the geographical coordinates, transmitted current and many other supporting data. All files are named YYYYMMDD_HHMMSS_MMM followed by three letters as an extension. The more crucial files have a filename extension SPS. One file with a filename extension LIN describes the start and end of each survey line.
   B. Binary data files with the electromagnetic decay measurements. These files have a filename extension SKB. The top section of the binary file is an ascii section with all information about measurement cycles and settings in the instrument.
2. A Firebird database (in the GERDA format) containing all collected data, processed data, as well as the inverted model results.
3. ArcGIS layers including:
   A. *Layout*. ArcGIS shape files ("*.shp") containing general information about the surveyed area (project area outline etc.), location of tTEM survey lines day and locations of the remaining data after processing.
   B. *Mean Resistivity Maps*. Geo-referenced TIF files ("*.tif*) illustrating plan-view maps of average resistivities within different elevation and depth intervals that are presented in this report. Each file name includes information about the top and bottom of the interval.
   C. *Model Sections*. ArcGIS shape files ("*.shp") containing locational information for the vertical sections presented in this report.
4. Model outputs. Ascii files (with a filename extension XYZ) containing exported models from the Firebird database in different file formats.
5. Google Earth KMZ files, which include the mean resistivity maps and model sections, among others.
6. A project report, delivered as a PDF file.

Conclusions

The tTEM survey provided high-quality data, enabling continuous mapping of geologic units and detailed information about their characteristics, including heterogeneity, continuity, and extent of each unit.

At Anaheim Lake, the fine-grained layer is mapped across the basin. At Kraemer basin, the resistivities are high across the basin, which indicates coarse-grained materials down to the tTEM depth of investigation.

The tTEM results at both basins support the Client's understanding of the subsurface conditions at each site.

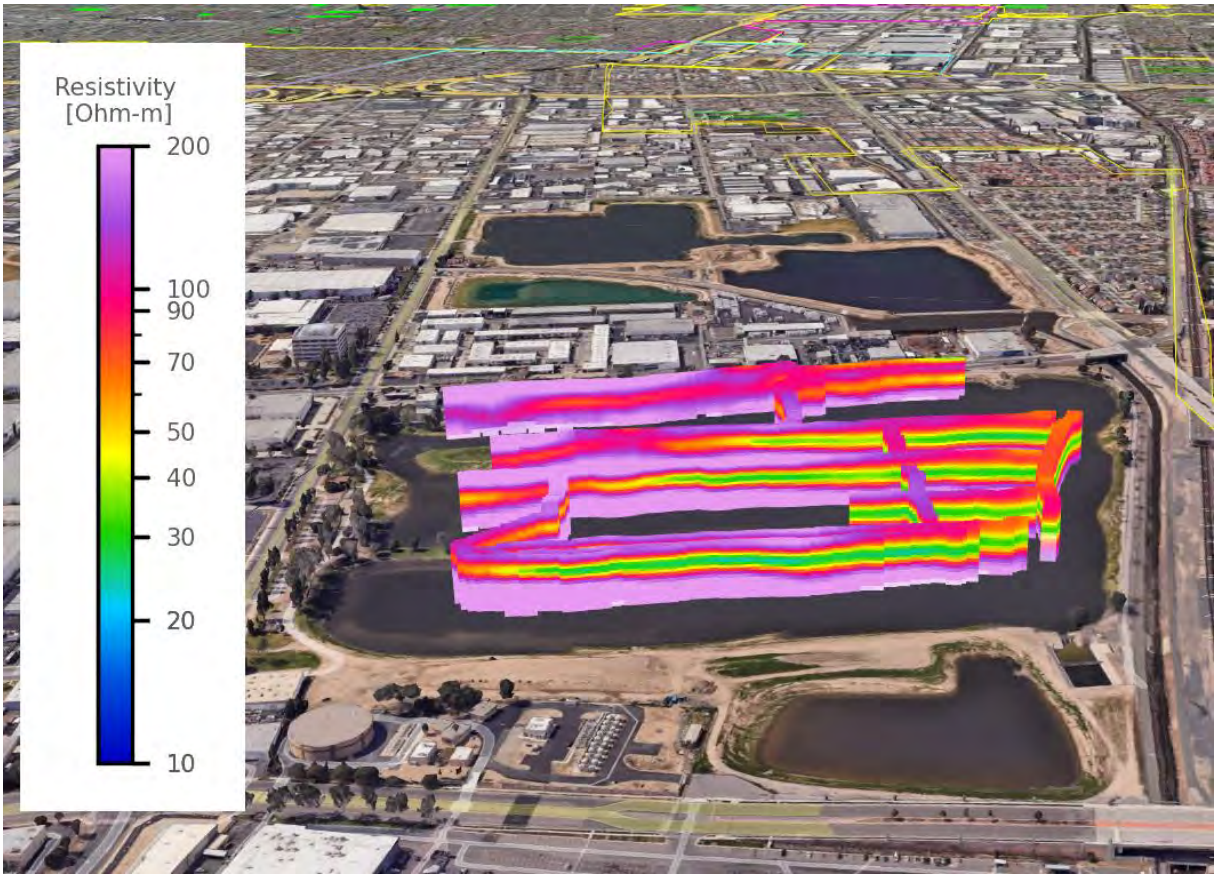

Figure 10 The tTEM results at Anaheim Lake shown in Google Earth (selected survey lines are shown).

Appendix 1 – TEM Theory

For decades electromagnetic (EM) methods have been used worldwide for cost effective mapping of the subsurface materials for different applications. More recently, the accuracy of the instruments and their ability to obtain information about aquifers and hydrogeological properties has improved significantly. As a result, the TEM method is now one of the most efficient geophysical technologies for groundwater investigations.

Principles of TEM

The physical principle of the TEM is based on the electromagnetic induction phenomenon. The ground is first energized by a primary magnetic field generated by a direct current injected in a transmitter (Tx) loop. When the current stabilizes, the transmitter is turned off abruptly. During this rapid decay of the current an electromotive force results in short-duration eddy currents whose strength is largest in conductive parts of the ground. The EM induction phenomenon generates what is called the secondary magnetic field, the decay of which is measured just after the end of the turn-off using an induction receiver coil located in the center of the Tx loop (central loop configuration like ground-based stationary TEM) or outside the Tx loop (off-set configuration like tTEM). The actual measurement, referred to as TEM "sounding" or dB/dt curve, is the time derivative of the magnetic flux passing through the receiver coil. An example of a measured sounding curve is shown in Figure A1- 1.

The TEM response is measured and interpreted as a function of time. Just after the current in the Tx loop is turned off, the eddy currents in the ground will be close to the surface, and the measured signal primarily reflects the resistivity of the top layers. At later times the current will run deeper in the ground, and the measured signal contains information about the resistivity of the deeper layers. This is why the method is referred to as time-domain EM or TEM. Measuring a TEM sounding will therefore provide information about the resistivity as a function of depth.

The transmitter magnetic moment (Tx loop area x current x number of wire turns) and the signal-to-noise ratio (SNR) determine the depth of investigation (DOI). A stronger magnetic moment enables deeper penetration of the magnetic fields and thus greater DOI. The SNR depends on the ground electrical resistivity and ambient noise. The higher the SNR, the greater the DOI.

More information about the principles of the TEM method can be found in Ward and Hohmann (1988).

Noise in TEM data

TEM data are comprised of different types of noise components. Noise can cause bias signals and affect the depth of investigation and if not properly identified and removed, can result in incorrect geological and hydrological interpretations. The different sources of noise include: (1) Galvanic coupling caused by the electromagnetic signal induced in a metal object, such as grounded overhead powerlines, metal pipes, metal fences etc., (2) Capacitive coupling caused by the induced EM signal in an insulated installation such as a power cable, (3) Coherent noise from electrical powerlines, (4) Atmospheric noise, and (5) Instrument internal noise.

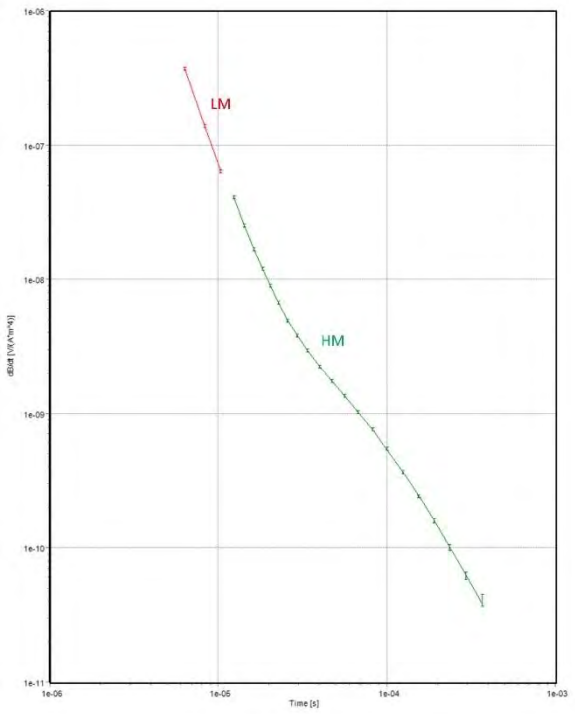

Figure A1- 1 An example of a dB/dt curve (sounding data) measured with the tTEM system.

References

Ward SH, Hohmann GW (1988) Electromagnetic theory for geophysical applications. In: Nabighian MN (ed) Electromagnetic methods in applied geophysics, vol 1. SEG, Tulsa, pp 131–311.

Appendix 2 – tTEM Instrumentation, Processing & Inversion Settings

This appendix describes the tTEM instrument setup, processing and inversion settings.

Instrument Setup

The tTEM instrument measures data continuously while being towed on the ground. The system is designed to provide very high near-surface resolutions using very early time gates. The tTEM data collection was performed using an offset loop configuration (Figure A2- 1), employing a 2.9 m x 2.9 m (9.5 ft x 9.5 ft) single-turn square-shaped transmitter loop and a 0.5 m x 0.5 m (1.6 ft x 1.6 ft) multi-turn receiver coil placed 7.5 m (25 ft) behind the transmitter loop. The transmitter loop was positioned 4 m (13 ft) away from the ATV. The entire system layout extended to 14.4 m (47 ft).

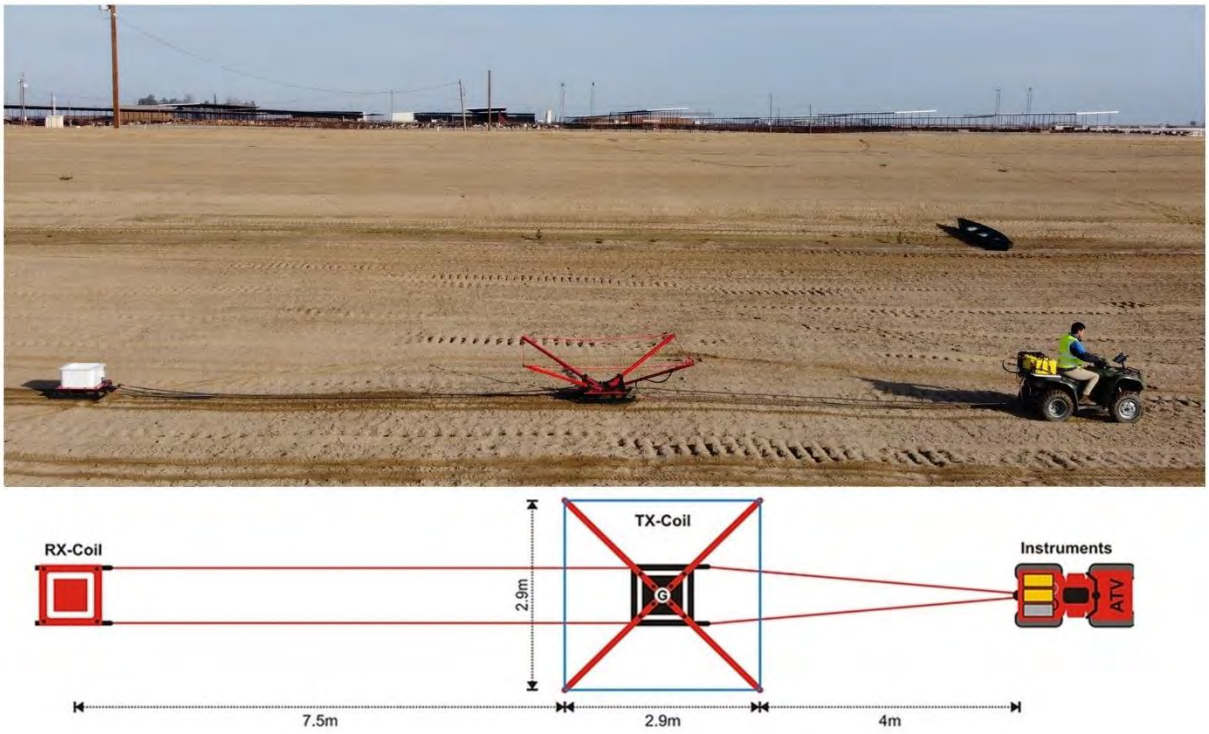

Figure A2- 1 The tTEM system configuration.

Instrument ID

The ID information of the instruments used in this survey can be found in Table A2- 1.

Unit	ID1	ID2
TIB Receiver instrument	Tib47	20220407
RC20 Receiver coil	RC20-51	20230601
tTEM Receiver Platform		20220850
tTEM Transmitter	TX50	20221002

Table A2- 1a ID information for the instruments used in this survey.

Device positions and geometry

The positions and geometry of the main tTEM system components with respect to the transmitter frame are listed in Table A2- 2 in (x,y,z) coordinates. X and y define the horizontal plane. Z is perpendicular to (x, y). X is positive in the survey direction, y is positive to the right of the survey direction, and z is positive downwards.

Unit	X (m)	Y (m)	Z(m)
GP_Tx (GPS)	5.85	0.00	-0.90
RxZ (Z-receiver coil)	-9.00	0.00	-0.43
Tx-Coil, center	0.00	0.00	-0.97
Tx-Coil corner 1	-1.45	-1.45	-0.97
Tx-Coil corner 2	1.45	-1.45	-0.97
Tx-Coil corner 3	1.45	1.45	-0.97
Tx-Coil corner 4	-1.45	1.45	-0.97

Table A2- 2 Positions and geometry of the tTEM transmitter, receiver, and GPS units

Measurement cycle

The key parameters defining the transmitter setup are listed in Table A2- 3.

Parameter	LM	HM
Moment ID	2	1
No. of turns	3	3
Transmitter effective area (m2)	25.23 m2	25.23 m2
Tx Current	~ 1 A	~ 25 A
Tx Peak moment	~ 25 Am2	~ 250 Am2
Repetition frequency	1055 Hz	496 Hz
Raw Data Stack size	336	248
Period Time	496E-6	1773E-6 s
Raw Moment cycle time	0.17 s	0.50 s
Tx on-time	200 µs	450 µs
Duty cycle	40%	25%
Turn-off time	2.6 µs at 3 Amp	4.2 µs at 30 Amp
Number of gates	15	30
Gate time interval (gate center time)	4 µs – 30 µs	12 µs – 910 µs
Front-gate	2 µs	4 µs

Table A2- 3 Basic settings of the instrumentation.

Receiver coil

The receiver coil can be described by the following parameters. The parameters are used in the inversion scheme.

Parameter	Value
Low pass filter frequency	679 kHz
Low pass filter order	1
Effective area	20m^2

Table A2- 4 Receiver coil parameters.

Processing and inversion settings

The processing and inversion are based on the Aarhus Workbench software, version 6.9.0.0.

A 30-layer model has been applied. Table A2- 5 lists the fixed layer thicknesses, depth to bottom of layer and the initial resistivity assigned to the model layers. For this survey, an initial resistivity value of 40 ohm-m was assigned to all layers during the inversion.

Layer	Thickness [Meter]	Depth [Meter]	Start value [Ohm-m]
1	1	1	40
2	1.1	2.1	40
3	1.2	3.3	40
4	1.3	4.6	40
5	1.4	6.0	40
6	1.5	7.5	40
7	1.7	9.1	40
8	1.8	11.0	40
9	2	12.9	40
10	2.1	15.1	40
11	2.3	17.4	40
12	2.5	19.9	40
13	2.8	22.7	40
14	3.0	25.7	40
15	3.3	28.9	40
16	3.5	32.5	40
17	3.9	36.3	40
18	4.2	40.5	40
19	4.6	45.1	40
20	5.0	50.1	40
21	5.4	55.5	40
22	5.9	61.4	40
23	6.4	67.8	40
24	7.0	74.8	40
25	7.6	82.4	40
26	8.3	90.6	40
27	9.0	99.6	40
28	9.8	109.4	40
29	10.6	120.0	40
30	--		40

Table A2- 5 Depth discretization and starting resistivity values for the inversion.

Appendix 3 – QC and Mean Resistivity Maps

Appendix 4 – Vertical Section

Appendix 5 – A description of the digital data formats

For each model type (multi-layer model/smooth model or few-layer model/sharp model), data can be exported in different formats to facilitate import and management of data in third-party software solutions. Below are descriptions of four ASCII formats (*_byLayer.xyz, *_syn.xyz, *_inv.xyz, *_dat.xyz). The file named *Project_byLayer.xyz* might be the most generic format, suitable for visualization in software packages like Leapfrog, Rockworks, EVS, and similar. In addition to the four ASCII files, georeferenced raster files (Geotiffs) and ArcGIS shape files are provided as part of the data deliverables.

The *_byLayer.xyz file uses the following format:

Header section:

```
/INFO
/Aarhus SPIA export file. File created: 30-03-2023 13:00:34. Exported from SPIA64
/SPIA VERSION          3.7.0.0
/PROJECT NAME          Projectname.gdb
/DUMMY
/9999
/DATATYPE              Type of data
/COORDINATE SYSTEM     Coordinate System: WGS 84 UTM zone 19S (epsg:32719)
/NUMBER OF LAYERS      6 Max Number of layers
/MODEL UNIT            Base unit used for resistivities: /Resistivity (Ohm-m) / conductivity
(mS/m)
/LENGTH UNIT           Base unit used for distances: Meter
```

Main section:

```
ID                     Incrementing number
LINE_NO                Line number
LAYER_NO               Layer number
UTMX                   UTMX
UTMY                   UTMY
ELEVATION_CELL         Elevation top of Layer
RESISTIVITY            Resistivity
RESISTIVITY_STD        STD on Resistivity
CONDUCTIVITY           Conductivity
DEPTH_TOP              Depth to top of layer
DEPTH_BOTTOM           Depth to bottom of layer
THICKNESS              Thickness of layer
THICKNESS_STD          STD on Layer Thickness
```

The *_SYN.xyz file use the following format:

Header section:

```
/INFO
/Aarhus SPIA export file. File created: 30-03-2023 13:00:34. Exported from SPIA64
/SPIA VERSION          3.7.0.0
/PROJECT NAME          ProjectName.gdb
/DUMMY
/9999
/DATATYPE              Type of data
/COORDINATE SYSTEM     Coordinate System: WGS 84 UTM zone 19S (epsg:32719)
/NUMBER OF LAYERS      30 Number of layers
/MODEL UNIT            Base unit used for resistivities: /Resistivity (Ohm-m) / conductivity
(mS/m)
/LENGTH UNIT           Base unit used for distances: Meter
```

Main section:

```
LINE_NO                Line number
MODEL_NAME             Model Name
UTMX                   UTMX
UTMY                   UTMY
DATE                   Dummy value
TIME                   Dummy value
RECORD                 Record
ELEVATION              Topography
NUMDATA                Number of gates inverted
SEGMENT                Moment ID (low moment=1, high moment=2)
RESDATA                Data misfit (normalized with STD)
RESTOTAL               Total misfit
DATA_1                 Voltage (V/Am^4), for gate_1
DATA_2                 Voltage (V/Am^4), for gate_2
…
DATA_N                 Voltage (V/Am^4), for gate_N
```

The *_inv.xyz file use the following format:

Header section:

```
/INFO
/Aarhus SPIA export file. File created: 30-03-2023 13:00:34. Exported from SPIA64
/SPIA VERSION          3.7.0.0
/PROJECT NAME          ProjectName.gdb
/DUMMY
/9999
/DATATYPE              Type of data
/COORDINATE SYSTEM     Coordinate System: WGS 84 UTM zone 19S (epsg:32719)
/NUMBER OF LAYERS      30 Number of layers
/MODEL UNIT            Base unit used for resistivities: /Resistivity (Ohm-m) / conductivity
(mS/m)
/LENGTH UNIT           Base unit used for distances: Meter
```

Main section:

```
LINE_NO                Line number (always 0)
UTMX                   UTMX
UTMY                   UTMY
DATE                   Dummy value
TIME                   Dummy value
RECORD                 Record
ELEVATION              Topography
NUMDATA                Number of gates inverted
SEGMENT                Moment ID (low moment=1, high moment=2)
RESDATA                Data misfit (normalized with STD)
RESTOTAL               Total misfit
RHO_I_1                Resistivity (Ohm m) for layer_1
RHO_I_2                Resistivity (Ohm m) for layer_2
…                      …
RHO_I_N                Resistivity (Ohm m) for layer_N
RHO_I_STD_1            STD on resistivity for layer_1
RHO_I_STD_2            STD on resistivity for layer_2
…                      …
RHO_I_STD_N            STD on resistivity for layer_N
```

SIGMA_I_1	Conductivity (mS/m) for layer_1
SIGMA_I_2	Conductivity (mS/m) for layer_2
…	…
SIGMA_I_N	Conductivity (mS/m) for layer_N
IP_P1_I_1	IP parameter 1 for layer_1
IP_P1_I_2	IP parameter 1 for layer_2
…	…
IP_P1_I_N	IP parameter 1 for layer_N
IP_P1_I_STD_1	STD on IP parameter 1 for layer_1
IP_P1_I_STD_2	STD on IP parameter 1 for layer_2
…	…
IP_P1_I_STD_N	STD on IP parameter 1 for layer_N
IP_P2_I_1	IP parameter 2 for layer_1
IP_P2_I_2	IP parameter 2 for layer_2
…	…
IP_P2_I_N	IP parameter 2 for layer_N
IP_P2_I_STD_1	STD on IP parameter 2 for layer_1
IP_P2_I_STD_2	STD on IP parameter 2 for layer_2
…	…
IP_P2_I_STD_N	STD on IP parameter 2 for layer_N
...	...
IP_PM_I_1	IP parameter M for layer_1
IP_PM_I_2	IP parameter M for layer_2
…	…
IP_PM_I_N	IP parameter M for layer_N
IP_PM_I_STD_1	STD on IP parameter M for layer_1
IP_PM_I_STD_2	STD on IP parameter M for layer_2
…	…
IP_PM_I_STD_N	STD on IP parameter M for layer_N
DEP_TOP_1	Depth (m) to top of layer_1
DEP_TOP_2	Depth (m) to top of layer_2
…	…
DEP_TOP_N	Depth (m) to top of layer_N
DEP_BOT_1	Depth (m) to botttom of layer_1
DEP_BOT_2	Depth (m) to botttom of layer_2

…	…
DEP_BOT_N-1	Depth (m) to botttom of layer_N-1
DEP_BOT_N	Depth (m) to bottom of layer_N calculated as 1.5 times DEP_BOT_N-1
THK_1	Thickness (m) of layer_1
THK_2	Thickness (m) of layer_2
…	…
THK_N-1	Thickness (m) of layer_N-1
THK_STD_1	STD on thickness of layer_1
THK_STD_2	STD on thickness of layer_2
…	…
THK_STD_N-1	STD on thickness of layer_N-1
DEP_BOT_STD_1	STD on depth bottom of layer_1
DEP_BOT_STD_2	STD on depth bottom of layer_2
…	…
DEP_BOT_STD_N-1	STD on depth bottom of layer_N-1
DOI_CONSERVATIVE	DOI Conservative for resistivity/conductivity
DOI_STANDARD	DOI Standard for resistivity/conductivity

The *_dat.xyz file use the following format:

Header section:

```
/INFO
/Aarhus SPIA export file. File created: 30-03-2023 13:00:34. Exported from SPIA64
/SPIA VERSION          3.7.0.0
/PROJECT NAME          ProjectName.gdb
/DUMMY
/9999
/DATATYPE              Type of data
/COORDINATE SYSTEM     Coordinate System: WGS 84 UTM zone 19S (epsg:32719)
/NUMBER OF LAYERS      30 Number of layers
/MODEL UNIT            Base unit used for resistivities: /Resistivity (Ohm-m) / conductivity
(mS/m)
/LENGTH UNIT           Base unit used for distances: Meter
```

Main section:

```
LINE_NO                Line number (always 0)
MODEL_NAME             Model Name
UTMX                   UTMX
UTMY                   UTMY
DATE                   Dummy value
TIME                   Dummy value
RECORD                 Record
ELEVATION              Topography
NUMDATA                Number of gates inverted
SEGMENT                Moment ID (3 or 5)
RESDATA                Data misfit (normalized with STD)
RESTOTAL               Total misfit
DATA_1                 Voltage (V/Am^4), for gate_1
DATA_2                 Voltage (V/Am^4), for gate_2
…
DATA_N                 Voltage (V/Am^4), for gate_N
DATASTD_1              STD on voltage, for gate_1
DATASTD_2              STD on voltage, for gate_2
…
DATASTD_N              STD on voltage, for gate_N
```

ORANGE COUNTY WATER DISTRICT

INVITATION FOR QUOTES
IFQ-24-002

FOR
ANAHEIM LAKE SOIL BORINGS

ISSUED: May 22, 2025

QUOTES DUE:

June 25, 2025

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Section **Page**

The Orange County Water District ("OCWD" or "District") is seeking cost quotations from qualified and experienced firms to complete the Anaheim Lake Soil Borings. The work is expected to commence after all required documents have been received upon Agreement execution and a Notice to Proceed is issued. This Invitation for Quote (IFQ) describes the required scope of services, the information that must be included in the quote, and the quote selection process. Bidders are encouraged to carefully review this IFQ in its entirety prior to submitting their quotes. Failure to submit information in accordance with these requirements and procedures may be cause for disqualification. For the purpose of this IFQ, the term "Bidder" shall refer to any entity submitting a quote in response to this IFQ, and the term "Contractor" shall refer to the successful Bidder selected for the contract subject to this IFQ.

1. Introduction

OCWD is an internationally recognized leader in the water industry that was formed in 1933 by the California State Legislature which entrusted OCWD to guard and protect the region's groundwater basin and limited water supply. OCWD's mission is to provide a reliable supply of high-quality water that is sourced in an environmentally responsible manner to the more than 2.5 million residents and businesses within the 270 square mile service area of Orange County, California that OCWD serves. OCWD manages three of Southern California's greatest water supplies, this includes protecting rights to the Santa Ana River, managing and replenishing the Orange County Groundwater Basin, and operating and maintaining the Groundwater Replenishment System (GWRS), the world's largest advanced water purification system for potable water reuse. More information regarding the OCWD can be found at www.ocwd.com.

2. Solicitation Schedule

The solicitation schedule is summarized in the table below. OCWD reserves the right to modify the schedule below at its discretion. Proper notification changes will be made to interested bidders.

IFQ Issued	May 22, 2025
Pre-Quote Meeting (optional)	June 3, 2025 @10:00 AM PT
Questions Due Date	June 10, 2025 @ 2:00 PM PT
Quotes Due	June 25, 2025 @ 2:00 PM PT
Agreement Award Date:	July 2025

2.1. Optional Pre-Quote Meeting

The pre-quote meeting will be held on June 3, 2025. Firms interested in submitting quotes are encouraged to attend the pre-quote meeting. The meeting will be held at the District office, 18700 Ward Street, Fountain Valley, Ca. In addition, participants can join the meeting via Zoom service.

Link to the meeting: https://ocwd.zoom.us/j/86222485917
Meeting ID: 862 2248 5917
Passcode: 632868

2.2. Questions Concerning Invitation for Quotes

All questions regarding the IFQ must be submitted in writing before the deadline due date of June 10, 2025 by 2:00PM PT. All questions must be titled "**Question – IFQ-24-001 Anaheim Lake Soil Borings**". Responses to questions received from prospective bidders will be formally documented in a Question and Answer (Q&A) table that will be posted on the OCWD website: https://www.ocwd.com/working-with-us/IFQ-contracts/. The Q&A table will be updated regularly as questions are received from prospective bidders. Questions received after the questions due date will not be considered.

Attention: Ashlie Valencia, Contracts Administrator
Email: procurement@ocwd.com

2.3. Deadline for Quotes

One (1) hard copy of the quote must be received in a sealed envelope by OCWD no later than **June 25, 2025 at 2:00 PM** or such later time that OCWD may announce by an addendum at any time prior to the quote deadline. The envelope shall be plainly marked on the exterior "Quote for **IFQ-24-002 Anaheim Lake Soil Borings**" and with the name, company name, and address of the bidder.

Quotes must be mailed or delivered in person or via courier services at the District office listed below. To deliver submittal packages in person or via courier, please notify the guard at the main gate for quote drop off. Sealed envelopes will be timestamped upon receipt at the receptionist desk.

Orange County Water District
Administration Office Building
Attention: Ashlie Valencia, Contracts Administrator
Address: 18700 Ward Street
Fountain Valley, CA 92708

It is the Bidder's responsibility to ensure that quotes are received prior to the submittal deadline. Quote packages should also include all signed Acknowledgment of Addendum forms that may be issued by OCWD as part of this IFQ process, as further described below. Quotes received after the deadline will not be considered under any circumstances. FAXED OR E-MAILED SUBMISSIONS WILL NOT BE ACCEPTED. The OCWD will not be responsible for the proper identification and handling of any quotes submitted incorrectly. Only responses properly submitted to OCWD will be considered. OCWD reserves the right to reject any and/or all responses received. There will be no formal opening of the quotes.

2.4. Pre-Submittal Activities

The District reserves the right to revise the IFQ prior to the date of the Quote submittal

deadline and reserves the right to issue a written Addendum or Addenda to provide further clarification or make revisions or corrections to the IFQ. All Addenda will be issued via https://www.ocwd.com/working-with-us/RFP-contracts/ for all interested Bidders. If an Addendum is necessary within 72 hours of the Quote submittal deadline, or for any other reason deemed appropriate by the District, the District, at its discretion, reserves the right to extend the Quote submittal deadline.

Any Addendum issued must be acknowledged by the Bidder by signing and submitting the "Acknowledgment of Addendum" form that will be provided with each Addendum. All Acknowledgment of Addendum forms must be submitted to OCWD as part of Quote package that is submitted by the Quote submittal deadline. Failure to acknowledge any Addenda may result in the Quote being considered nonresponsive and subject to rejection.

The Bidder shall be responsible for ensuring that its Quote reflects any and all Addenda issued by the District prior to the submittal due date. Therefore, the District recommends that prospective bidders check the OCWD website periodically for this IFQ prior to making their submission.

3. Project Background and Description

Anaheim Lake is OCWD's oldest recharge basin which was brought online in 1961. Although a high-performing facility, data that suggests a fine-grained sedimentary layer below the basin bottom is causing groundwater mounding. Because of this, District Staff intends to drill soil borings to confirm the depth, thickness, and characteristics of this layer, which will aid in evaluating the potential to increase the recharge basin capacity if a portion of this layer is removed. This work is a part of OCWD's Resilience Plan Priority Project No. 12, Anaheim Lake Recharge Basin Rehabilitation Project.

4. Scope of Work

The selected Contractor shall furnish all labor, materials, equipment, and incidentals required to complete the Anaheim Lake Soil Borings. See **Exhibit A-1,** attached at the end of this IFQ for details of the Scope of Services. A boring location map and a site picture are provided in **Exhibit A-3.**

5. General Information

As more particularly set forth in the Services Agreement attached as **Exhibit B**, the selected Contractor shall be required to provide quality service in accordance with industry standards and contractor safety. The firm must demonstrate experience with the type of anticipated work and must be dependable and have the ability to perform all services in a timely manner upon the request(s) from the District or the District's authorized representative. All work shall comply with the requirements of federal, state, and local laws, and District policies.

5.1. Minimum Qualifications

The selected Contractor is required to have at minimum the following qualifications:

- Experience drilling similar soil borings

5.2. Contractor Safety

OCWD is committed to the safety of all its employees, contractors, and visitors. All contractors and subcontractors must adhere to applicable Federal, State, and Regional Environmental, Health and Safety (EHS) requirements, as well as OCWD EHS policies and procedures. As part of OCWD's Contractor Safety Program, the bidder shall review and sign the required documents provided in **Exhibit C**, which describes OCWD's Contractor Safety Program Requirements (**Exhibit C-1**) and Appendix forms (**Exhibit C-2**) that are required to be filled out by the Contractor at time of the quote deadline and throughout the duration of the Agreement. OCWD's Risk and Safety Department will coordinate with the awarded contractor on safety training regarding OCWD's Contractor Safety Program.

5.3. Prevailing Wage

California law, including but not limited to Labor Code Sections 1720 et seq. and 1770 et seq. thereof, and interpreting case law and regulations (the "Prevailing Wage Laws") require the payment of prevailing wages for "public works" projects, including "[w]ork done for irrigation, utility, reclamation, and improvement districts, and other districts of this type" where the total compensation exceeds $1000. The District has determined that some or all of the scope of work requires the payment of prevailing wages under the Prevailing Wage Laws.

Responding Bidders must expressly agree to be responsible for compliance with all Prevailing Wage Laws applicable to the work performed.

Successful Contractors to whom an Services Agreement is awarded hereunder shall comply with all Prevailing Wage Laws, including the payment of prevailing wages to persons performing public works for OCWD. A copy of these prevailing wage rates is on file with the Department of Industrial Relations (DIR) and can be found online with the State of California at http://www.dir.ca.gov/dlsr/pwd. A copy of such prevailing wage rates shall be posted on the jobsite by selected firms.

In accordance with Sections 1773 and 1773.2 of the California Labor Code, the District has found and determined the general prevailing rates of wages in the locality in which the public work is to be performed are those determined by the Director of Industrial Relations and available at https://www.dir.ca.gov/OPRL/DPreWageDetermination.htm. Copies of the prevailing rates of wages are maintained with the District's principal office and are available to any interested party on request. The selected firm shall post a copy of the prevailing rate of per diem wages at each job site.

The description provided herein only summarizes the Prevailing Wage Laws applicable to the work, and Bidders are independently responsible for reviewing and assuring compliance with the same.

5.4. DIR Contractor Registration

Bidders submitting quotes to this IFQ must be registered with the DIR prior to submitting a quote pursuant to the requirements of Sections 1725.5 and 1771.1 of the California Labor Code. Contractor registration information can be found at http://www.dir.ca.gov/Public-Works/PublicWorks.html. Contracts entered into with any firm in violation of Section 1771.1(a), shall be subject to cancellation by the District at the sole discretion of the District consistent with Section 1771.1(f). Pursuant to California Labor Code Section 1771.4, bidders are alerted that the project is subject to compliance monitoring and enforcement by the DIR.

5.5. Certified Payroll Reporting

Without limiting any other provision of the Prevaling Wage Laws, the Contractor to whom a Services Agreement is awarded hereunder, and any subcontractors, must submit certified payroll records to the Labor Commissioner using the DIR's electronic certified payroll reporting (eCPR) system, and supply a copy to the District. It shall be the Contractor and any subcontractor to comply with its obligation under this Section. Payment for the work will be withheld until the DIR reporting is up to date.

Certified payroll records must be submitted at least monthly (within a month after the end of the payroll period) or more frequently if more frequent submission is required by the District. The best practice is to submit the records weekly or at the conclusion of each payroll period. Essential components of a proper "Weekly Certified Payroll" include all the information that is called for on the standard WH-347 report:

- The Fringe Benefits Statement (signed)
- The Payroll Earnings/Timesheet pages
- The Certification Statement (signed)
- Non-Performance reports covering periods where no certified payroll was incurred.

6. Elements of Quote

To provide a degree of consistency in the review of the written Quotes, Bidders are required to include the following content in their Quotes. The information required below will be used to evaluate each Quote for responsiveness. Quotes may be deemed nonresponsive if they do not respond to all areas specified below.

Quotes shall be prepared simply and economically, providing a straightforward and concise description of how the Quote has satisfied all the requirements of this IFQ. Emphasis shall be on completeness and clarity of content with sufficient detail to allow for accurate evaluation and comparative analysis. Excessive or irrelevant materials will not be favorably received.

The following subsections describe the contents required in the Quote. The Quote shall be of such scope and depth to sufficiently describe and demonstrate the Bidder's

understanding of and approach to the project.

6.1 Title Page

The Bidder should identify the IFQ title, name and title of the firm's contact person, address, telephone number, fax number, email address, and date of Quote submission.

6.2 Cover Letter

A principal of the Bidder authorized to commit the Bidder to the requirements of the IFQ must sign the cover letter. The letter should identify a contact person (name, e-mail address, and phone number) for future communication during the selection process. And shall also discuss the Bidder's commitment to providing high quality services, describe the firm's understanding and approach to the services, and its ability to perform the requirements of this IFQ. Include a brief background of the firm including history, types of services provided, number of employees, number of offices and locations with staff size and disciplines, and any other relevant information that may be useful in determining the firm's qualifications to provide the services described in this IFQ.

6.3 Contractor License and DIR Contractor Registration, Prevailing Wage Laws Compliance

Bidders must be registered with the DIR pursuant to the requirements of Sections 1725.5 and 1771.1 of the California Labor Code prior to submitting a Quote. The Bidder must provide their DIR reference number and expiration date and a copy of its contractor license issued by the State of California that is (C-57**)**.

Bidders shall include an express statement asserting that the Quote was prepared taking into account all applicable Prevailing Wage Laws and that the Bidder agrees to comply with all such laws applicable to the work.

6.4 Experience and record of past performance.

Bidders must provide a minimum of three (3) references from other municipal, city, or county governmental agencies for which the Bidder has recently or is currently providing Sonic Borehole drilling that is equivalent or greater in scope as being required in this IFQ. Bidders shall indicate the scope of work, date, contract amount, and the name, email address, and telephone number of the client contact. Bidders shall further provide a complete list of other public agencies in California utilizing your services over the past five (5) years. Ongoing projects currently being performed by the bidder may also be submitted for consideration. The District at its discretion may contact the references for additional information.

6.5 Price Quote

Please complete the Cost Quote Sheet that is attached in **Exhibit A-2** for the Scope of Work. It is expected that the indicated rates will remain in effect for the duration of the Services Agreement term unless otherwise specified and approved by OCWD.

6.6 Statement of Insurance Compliance

Bidder shall provide a statement that it will meet the insurance requirements that are listed the Services Agreement. OCWD will request the insurance forms and associated documentation when OCWD provides notice that the Services Agreement is awarded.

6.7 OCWD Contractor Safety Program

The Bidder is required to review, complete, sign and submit the following documents:

- Contractor Environmental Health and Safety Agreement form, attached at the end of **Exhibit C-1**
- Appendix B: Contractor Required Information Form, attached in **Exhibit C-2**, must be completed in its entirety, and signed and submitted with the Quote.

6.8 Safety Manual

Contractor must include in their Quote a copy of its safety manual that meets requirements for their injury and illness prevention program. The selected Contractor shall submit to OCWD Bidder's Quality Control Plan, in hard-copy or electronic copy upon award of a Services Agreement.

6.9 OCWD Standard Agreement

Bidders shall provide a statement that the Bidder accepts OCWD's form of Services Agreement attached hereto as **Exhibit B**. Bidders responding to this IFQ must be prepared to proceed with the Services Agreement in substantially the form provided, with minor non-substantive changes in OCWD's sole discretion. OCWD retains full discretion to rescind the proposed Services Agreement award to a Bidder who fails to comply with this requirement, and to exclude the Bidder from future procurement where applicable. The Services Agreement shall be executed by the Contractor within ten (10) calendar days of receipt of OCWD's Notice of Intent to Award letter to the Contractor.

6.10 Billing

Bidders shall provide a statement that it will meet the minimum requirements specified in this Section.

OCWD will provide reporting requirements to the selected Contractor, and the selected Contractor shall prepare invoices that comply with the requirements. Failure to satisfy the reporting requirements may result in rejection, payment delay, or short pay of the invoices submitted to OCWD for payment. At a minimum, invoices shall include the Services Agreement Number and Purchase Order Number (PO). It shall be the responsibility of the Contractor and any subcontractor performing work on the project to comply with its obligation under the certified payroll reporting requirement by the DIR. Payment for the work will be withheld until the DIR reporting is up to date.

6.11 Conflict of Interest

Bidders shall provide a statement that the Bidder, individuals employed by the Bidder, or

firms employed by or associated with the Bidder, do not have a conflict of interest under applicable law with OCWD or the project. The Bidder shall exercise reasonable efforts to prevent any actions or conditions that could result in a conflict of interest and shall include, but is not limited to, establishing precautions to prevent its employees or agents from making, receiving, providing in, or offering gifts, entertainment, payments, loans, or other considerations which could be deemed to appear to influence individuals to act contrary to the best interest of the District. If a potential conflict of interest is identified in any form, the Bidder shall inform the District immediately. Bidders are subject to disqualification on the basis of a conflict of interest as determined by OCWD. Submission of a Quote serves as an affirmation by the Bidder that it does not have a conflict of interest with OCWD or the Project.

7. Quote Submission Requirements

7.1. Quote Submittal Procedures

It is the Bidder's responsibility to ensure that Quotes are received prior to the submittal deadline. Quote packages should also include all signed Acknowledgment of Addendum forms that may be issued by OCWD as part of this IFQ process, and all other items required by the IFQ.

The District will not be responsible for the proper identification and handling of any Quotes submitted incorrectly. Late Quotes, late modifications, or late withdrawals will not be considered under any circumstances. Faxed or emailed Quotes will not be accepted. There will be no formal opening of the received Quotes

7.2. Quote Preparation Costs

This solicitation does not commit the District to award any work nor to pay any costs incurred from the preparation of Quotes. Bidders will be solely responsible for all costs and expenses incurred during the selection process, even in cases where the Bidder is selected for award.

8. Selection Process

The lowest responsive and responsible Bidder will be awarded the Services Agreement in accordance with applicable laws and OCWD's Policies and Procedures. OCWD reserves the discretion to (i) decline to award any Services Agreement, (ii) reject any or all Quotes deemed by OCWD to be non-responsive or to be submitted by a non-responsible Bidder, and/or (iii) reject all Quotes and readvertise the project pursuant to any procurement method permitted by applicable law and OCWD's Policies and Procedures.

9. Special Conditions

9.1. Reservations

This IFQ does not commit the District to award a contract, to defray any costs incurred in the preparation of a Quote pursuant to this IFQ, or to procure or contract for any work. OCWD reserves the discretion to (i) decline to award any Services Agreement, (ii) reject any or all Quotes deemed by OCWD to be non-responsive or to be submitted by a non-responsible Bidder, and/or (iii) reject all Quotes and readvertise the project pursuant to any procurement method permitted by applicable law and OCWD's Policies and Procedures.

9.2. Public Records

All Quotes submitted in response to this IFQ become the property of the District and are public records and as such may be subject to public review regardless of whether any material in such Quotes is labelled as confidential, privileged, or proprietary, or otherwise protected.

9.3. Right to Cancel or Revise

The District reserves the right to cancel or revise, for any or no reason, in part or in its entirety, this IFQ including but not limited to: solicitation schedule, submittal date, and submittal requirements. If the District cancels or revises the IFQ, the District will issue an Addendum on its website. Posting the Addendum on the District's website will be the only notification to Bidders. It is the Bidder's responsibility to check the OCWD website periodically prior to making their quote submission.

9.4. Additional Information

The District reserves the right to request additional information and/or clarifications from any or all Bidders.

9.5. Public Information

Bidders shall not disclose to any third party any of the information provided by OCWD in connection with the project or this IFQ absent express prior written approval of OCWD. Requests for public records should be directed to OCWD for processing in compliance with applicable law.

9.6. . Equal Employment Opportunity and Affirmative Action Requirements

Bidders shall provide a Statement of Equal Employment Opportunity/Affirmative Action. The selected Contractor and each subconsultant/subcontractor shall not discriminate in the employment of persons on the work because of race, religious creed, color, national origin, ancestry, physical handicap, medical condition, marital status, sexual preference or sex of such persons except to the extent permitted by Section 12940 of the California Government Code. The selected Contractor is expected to maintain policies similar to those of the District regarding equal employment opportunities and affirmative action as set forth in the District's Administrative Policies.

EXHIBIT A

Scope of Services and Cost Quote Sheet

EXHIBIT A-2

Cost Quotation

EXHIBIT A-3

Picture of Anaheim Lake

EXHIBIT B

Service Agreement and Insurance Requirements

FIGURE 1

Anaheim Lake Soil Borings

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: R. Bouley/L. Esguerra

Budgeted: Partially
Budgeted Amount: $3,778,290
Cost Estimate: $3,849,414
Funding Source: R&R Fund
Program/Line Item No.: R22028
General Counsel Approval: N/A
Engineers/Feasibility Report: NA
CEQA Compliance: Cat. Ex.

Subject: AUTHORIZE AGREEMENT TO BUTIER ENGINEERING INC FOR CONSTRUCTION MANAGEMENT AND INSPECTION SERVICES FOR SB-2025-1 BOND BASIN SLOPE REPAIR AND BUDGET INCREASE

SUMMARY

A total of three proposals were received on April 17, 2025, for Construction Management and Inspection Services for Bond Basin Slope Repair Project, Contract SB-2025-1 (the "Project"). Based on staff's evaluation of the proposals, staff recommends authorizing an Agreement with Butier Engineering, Inc. for a not-to-exceed amount of $321,123.50 for construction management and inspection services and increasing the project budget by $71,124.

Attachment: Butier Engineering Inc. proposal

RECOMMENDATION

Agendize for May 21 Board meeting:

1. Authorize agreement with Butier Engineering, Inc. for a not-to-exceed amount of $321,123.50 for construction management and inspection services for SB-2025-1 Bond Basin Slope Repair; and

2. Increase project budget by $71,124 for a total project budget amount of $3,849,414.

DISCUSSION

Bond Basin is part of the Santiago Basins recharge system as shown in Figure 1. A City of Orange storm drain outlets into the southeasterly corner of the basin. Over the past few years, the supporting slope and storm drain failed causing significant erosion to the area. Due to the complicated history of ownership and maintenance of the storm drain, the City and District have agreed to share in the cost to repair the slope and storm drain. Emergency repair work to construct a soil nail wall with rip rap placement was completed in January 2023 (See Figure 2). Final design of the permanent slope repair and storm drain pipeline relocation was completed in January 2025 and construction was bid and awarded to ICS on April 16, 2025.

Figure 1 – Project Location

Figure 2 – Soil Nail Wall at corner of Bond Basin

Due to the level of complexity and risk involve with the project, along with the high-profile location and material testing required, the Board authorized issuance of Request

for Proposals (RFP) for a construction management firm to oversee construction and perform inspections. The scope of services includes overseeing overall construction activities for the District, including conducting construction progress meetings; facilitating responses to submittals, RFIs, and change order requests; daily inspections; geotechnical services; project documentation; and project closeout. The RFP was issued March 24, 2025 to seven qualified firms and posted on the District website. Staff received three proposals on April 17, 2025 from Butier Engineering, Inc.(Butier), MKN, and CDM Smith. The proposals were independently reviewed and scored by engineering staff, and the scoring of the proposals included evaluating each firm's experience and qualifications of the project team, approach and schedule, experience on similar projects, commitment of key staff and organization support services, and fee. See Table 1 for the proposed score and proposed fee.

Table 1:
Proposal Score and Proposed Fee

Firm	Score (out of 100)	Proposed Fee
Butier	**89**	**$321,123.50**
MKN	**83**	**$355,216.00**
CDM Smith	**75**	**$199,275.00**

Staff's evaluation of the proposals and consideration of cost proposals resulted in a recommendation of Butier for Construction Management and Inspection Services for Bond Basin Slope Repair Project for the following reasons:

- Butier's Project Team has experience with mass grading projects including installation of geotextile reinforcement, soil nail walls, rip-rap, and pipelines;

- Butier's Project Team comprises specialized inspectors needed for structural inspection and soils and material testing for the project;

- Butier has a strong record of success performing construction management and inspection services for OCWD and other agencies; and

- Butier provided a detailed proposal which demonstrated a clear understanding of the scope for this project. Their proposal identified construction challenges specific to construction within the Bond Basin and highlighted the importance of maintaining communication with the City of Orange and the City of Villa park to minimize impacts to the surrounding community.

Staff met with Butier to discuss scope of services and their assumed level effort included in their original fee of $346,523.50. Butier agreed to revise their scope of services to align with the other proposers, and this reduced their fee by $25,400. Staff recommends authorizing an agreement with Butier for a not-to-exceed amount of $321,123.50 for Construction Management and Inspection Services for Bond Basin

Slope Repair Project. The project budget for the Bond Basin Slope Repair Project, Contract SB-2025-1, is summarized in Table 2.

Table 2: SB-2025-1 Bond Basin Slope Repair Project
Budget Summary

Description	Budget	Proposed Budget
Design and Construction Management		
Design Agreement 1555 – (ENGEO)	$46,800	$46,800
Amendment 1	$42,500	$42,500
Amendment 2	$59,800	$59,800
Construction Management and Inspection – (Butier)	*$250,000*	*$321,124*
Design and CM&I Subtotal	***$399,100***	***$470,224***
Construction		
Contract SB-2025-1 (ICS)	$3,199,190	$3,199,190
Permits and Advertisement Costs	$20,000	$20,000
Construction Subtotal	**$3,219,190**	**$3,219,190**
Project Contingency (5% of Contract Amount)	$160,000	$160,000
Total Project Budget	***$3,778,290***	***$3,849,414***
City of Orange Contribution	$1,889,145	$1,924,707
Total Cost to OCWD	**$1,889,145**	**$1,924,707**

The anticipated project schedule is shown below in Table 3.

Table 3: SB-2025-1 Bond Basin Slope Repair Project
Schedule Summary

Description	Date
Design	Oct 2023 – Jan 2025
Construction Contract SB-2025-1	June 2025 – Jan 2026

PREVIOUS BOARD ACTIONS

4/16/25, R25-4-XX: Reject bid protest and award contract to Innovative Construction Solutions, authorize Amendment No. 2 to Engeo and establish project budget.

3/19/25, R25-3-36: Authorize issuance of RFP for Construction Management and Inspection Services for Contract SB-2025-1, Bond Basin Slope Repair Project.

2/19/25, R25-2-15: Authorize filing of a Categorical Exemption in compliance of CEQA and authorize publication of Notice Inviting Bids for Contract SB-2025-1, Bond Basin Slope Repair Project.

3/20/24, R24-3-17: Authorize issuance of an Amendment to Agreement No. 1555 with ENGEO for final design services of Bond Basin slope repair and storm drain realignment for an amount not to exceed $42,500.

10/18/23, R23-10-140: Authorize issuance of a Professional Services Agreement to ENGEO for design services for the permanent Bond Basin slope repair and storm drain extension for an amount not to exceed $46,800.

11/16/22, R22-11-153: Ratify the emergency slope repair contract for Bond Basin in an amount of $992,000 to Access Limited Construction and ratify an amendment issued to ENGEO Incorporated for testing, construction inspection and reporting for $76,400.

10/5/22, R22-10-141: Authorized the General Manager to negotiate and execute a 50/50 cost share agreement with the city of Orange.

BUTIER
Construction Managers, Consulting Engineers

Mark Butier, Jr.
BUTIER ENGINEERING, INC.
17822 E. 17th Street, Suite 404
Tustin, California 92780

SEALED PROPOSAL FOR

RFP NO. 24-019
CONSTRUCTION MANAGEMENT AND INSPECTION SERVICES FOR BOND BASIN SLOPE REPAIR CONTRACT NO. SB-2025-1

DO NOT OPEN WITH REGULAR MAIL

ORANGE COUNTY WATER DISTRICT
Administration Office Building
Attn: Marcus Villalobos, Buyer
18700 Ward Street
Fountain Valley, CA 92708

Due Date: April 17, 2025

APR 17'25 AM08:26

I.V.

TITLE PAGE

ORANGE COUNTY WATER DISTRICT RFP-24-019

CONSTRUCTION MANAGEMENT AND INSPECTION SERVICES FOR BOND BASIN SLOPE REPAIR CONTRACT NO. SB-2025-1

SUBMISSION DATE: APRIL 17, 2025

SUBMITTED BY

Butier Engineering, Inc.
17822 E. 17th Street
Suite 404
Tustin, CA 92780

POINT OF CONTACT

Mark M. Butier, President/CFO
Tel: 714.832.7222
Fax: 714-832-7211
Email: jrbutier@butier.com

Cover Letter

April 17, 2025

Orange County Water District
Administration Office Building
Attention: Marcus Villalobos, Buyer
18700 Ward Street
Fountain Valley, CA 92708

Subject: **Request for Proposals RFP-24-019 for Construction Management and Inspection Services for Bond Basin Slope Repair Contract No. SB-2025-1**

Dear Mr. Villalobos and members of the Selection Panel,

Butier Engineering, Inc. (Butier) is pleased to present three (3) hard copies and one (1) electronic flash drive copy of our proposal (Part One) and fee proposal (Part Two) in response to the RFP issued on March 24, 2025. Our submittal includes sections and attachments in accordance with the RFP submittal requirements and procedures. **Butier—a long-time partner of Orange County Water District ("OCWD" or District)—is committed to providing high quality construction management and inspection services in support of your mission to provide a reliable, high quality water supply in a cost-effective and environmentally responsible manner**.

Our Project Management Team has thoroughly reviewed the project documentation to ensure we have a clear understanding of the goals, objectives, and potential challenges. We understand that the Bond Basin Slope Repair Project is a significant undertaking, involving careful planning and execution. The project will include slope repair and slope stabilization, storm drain relocation, and the construction of a concrete swale and plunge pool. To address the demands of the Project, we have assembled a team that has a proven record working successfully with OCWD.

Butier Brings Unique Team Features to OCWD

Independent, Third-Party CM is Our Focus

Butier has provided **independent third-party construction management and inspection services** for some of the largest water treatment, storage, and conveyance projects throughout Southern California since its inception in 1976. We have a successful history of managing aggressive schedules, identifying logistical site constraints, meeting diverse technical challenges, and mitigating community impacts. We understand the importance of timely delivery and the consequences of project delays.

We have an excellent history of **change order and claims defense**. The Bond Basin project risk profile will require the DCM to employ disciplined QA/QC and field documentation procedures. Our personnel are trained to document the work to defend against contractor claims.

Professional Relationship with OCWD Spans 25 Years

Butier began its partnership with OCWD over two decades ago. Members of our proposed team, including **Mark Butier, Joseph Blum, Casey Harris, Stephen White, and Bryan Wilson have worked closely with District staff on the following projects:** Santiago Recharge Bond Basin Floating Pump Station, Burris Basin Pump Station, GWRS Final Expansion, Tustin PFAS Treatment System and Conveyance, Mid-Basin Injection: Centennial Park, OC Groundwater Storage Program, Kraemer/Miller Recharge Basins, and Prado Wetlands Restoration. Our team is fluent with District contract administration and operational protocols. Our specific knowledge will help relieve District personnel of the burden dedicated to training consultant staff.

Delivering Community Sensitive Projects

Butier has successfully delivered complicated capital projects under very similar conditions. **Challenges have included residential neighborhoods, active community groups, adjacent schools, recreational facilities, and restrictive traffic control plans.** Our proposed team has worked closely with the District to perform public outreach services for various community sensitive projects.

Staffing Efficiencies

Butier has the capacity to provide the District with the required level of resources and staffing. Our personnel consists of 40 resident, field, and office engineers; project/construction managers; field QA/QC personnel; schedulers; estimators; and office support staff. Proposed Butier team members are **local to the Orange County area and are based out of Butier's Tustin office, located less than 4 miles from the Bond Basin project site**. This will provide the District with **highly qualified, responsive personnel** to meet the project's schedule demands. We have the ability to immediately address staffing changes commensurate with field activity.

Continuing Partnership with Sub-Consulting Firm

Butier has developed a successful professional relationship with Ninyo & Moore over the past 25 years. They have provided geotechnical observation and testing, materials testing, special inspection, and laboratory testing as a sub-consultant to Butier for numerous projects including, but not limited to, OCWD's Mid-Basin Injection: Centennial Park, Tustin PFAS Treatment System and Influent Conveyance, EW-1 Well Equipping, City of Whittier Murphy Reservoir Replacement, WRD Sativa Well 5 Treatment, City of Manhattan Beach 8 MG Peck Reservoir Replacement, CDA Chino I Desalter VOC Treatment Facilities, and City of Chino Hills 1,2,3-TCP Removal Treatment Plant.

Sophisticated Management Technology

Butier proposes using Procore for document controls. Our staff used the cloud-based system for the recent GWRS Final Expansion and Tustin PFAS Treatment System and Influent Conveyance Projects. The program allows District management and key stakeholders to quickly access the project record for key metrics and provide near real time updates of project progress.

Required Proposal Statements

- **Insurance Requirements**—Butier meets the insurance requirements that are listed in Exhibit C, Services Agreement.
- **OCWD Standard Agreement**—We have reviewed the OCWD's Services Agreement, which was provided as Exhibit C in the RFP, and we accept all the terms and conditions specified.
- **Billing**—Butier will prepare invoices that comply with the requirements specified in the RFP, which include the Purchase Order Number, Agreement Number, and the itemized summary of each authorized project task along with the names of persons, their job titles, the hours worked, and the hourly billing rates.
- **Conflict of Interest**—Butier Engineering, Inc. (Butier), individuals employed by Butier, and firms employed by or associated with Butier, including subconsultants, do not have a conflict of interest with the Project. Butier will exercise reasonable efforts to prevent any actions or conditions that could result in a conflict of interest and has established precautions to prevent our employees or agents from making, receiving, providing in, or offering gifts, entertainment, payments, loans, or other considerations that could be deemed to appear to influence individuals to act contrary to the best interest of the District. If a potential conflict of interest is identified in any form, Butier will inform the District immediately.

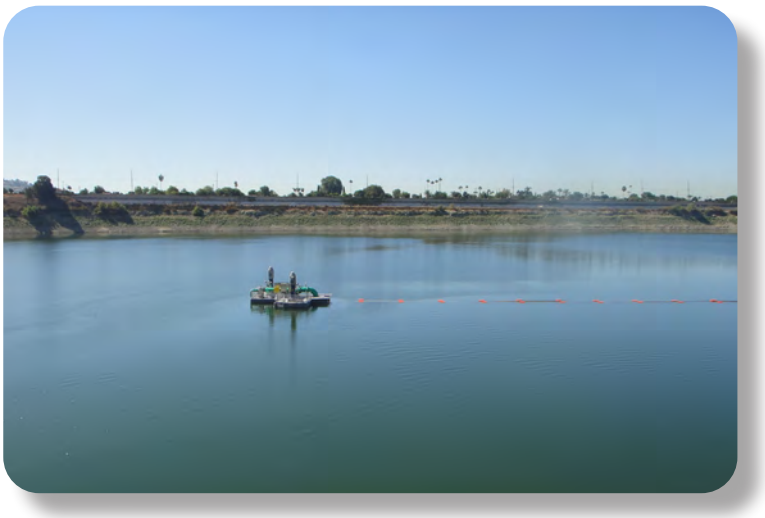
We appreciate the opportunity to provide a proposal for the Bond Basin Slope Repair project and are confident that we have assembled a team that will serve the best interests of all project participants. **I am Butier's main point of contact for future communication during the selection process. Therefore, any questions regarding our proposal can be directed to me for clarification at 714.832.7222 and jrbutier@butier.com**.

Respectfully Yours,
BUTIER Engineering, Inc.

Mark M. Butier, Jr.
President/CFO

Request for Proposals
RFP-24-019

Construction Management and Inspection Services for Bond Basin Slope Repair Contract No. SB-2025-1



Submitted On
April 17, 2025

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1. Experience & Record of Past Performance

BUTIER
Construction Managers, Consulting Engineers

1 Trampas Canyon Dam and Reservoir
San Juan Capistrano, California

Butier provided construction management and inspection services for the dam and reservoir, which has a capacity of 1.6 billion gallons. The project included 4.3 million CY of grading and excavation, as well as construction of new inlet/outlet structures, a spillway, microtunneling, instrumentation, and new dam control building. A buttress was built on the upstream face adjacent to the main dam to address the nearby access road and vertical bedrock face. Standard buttress methods were used by using keys and back cuts to start the buttress and work vertical. **Final stabilization involved large ½ ton riprap to minimize erosion from wave action.** Additionally, **a geotextile stabilization method was used** due to the non-bearing nature of the material within the reservoir. It is important to note that **¼ ton riprap was applied on all upstream faces of the embankments for slope stabilization and erosion control**.

Contract Value: $92.5 million
Completion: March 2021
Owner: Santa Margarita Water District
Contact: **Don Bunts, PE** Tel: 760.533.4086 Email: dbunts@watersynergy.org
Proposed Key Personnel: **Mark Butier** (Project Director), **Casey Harris** (Senior Scheduler), and **Bryan Wilson** (Project Controls)
Project Similarities: Slope Stabilization and Erosion Control

2 Murphy Reservoir Replacement
Whittier, California

Butier provided construction management, inspection, structural observation, and materials testing services. The scope of work included the demolition and replacement of two existing .5 MG concrete reservoirs and construction of one larger 2.31 MG reservoir, as well as construction of an exterior stairway, interior ladder, access hatches, vent, overflow pipe, drain line, inlet/outlet line, sample taps, level controls, and appurtenances. Additionally, the project included grading, shotcrete retaining wall, concrete masonry block retaining wall, concrete curb and gutter, and concrete swale for proper site drainage. **The project incorporated the construction of a retaining wall into a hillside slope, utilizing 248 soil nails, the wall height varying from 6 feet to 35 feet**.

Contract Value: $6.5 million
Completion: January 2025
Owner: City of Whittier/Whittier Utility Authority
Contact: **Phil Wang, PE** Tel: 562.567.9504 Email: pwang@cityofwhittier.org
Proposed Key Personnel: **Mark Butier** (Project Director), **Stephen White** (Resident Engineer), and **Bryan Wilson** (Project Controls)
Project Similarities: Slope Stabilization
Sub-consultant: Ninyo & Moore (Special Inspection & Materials Testing)

3 Peters Canyon Channel Improvements
Tustin, California

Butier provided project management, construction management, and inspection services. The work included demolition, widening the channel by 30 feet along the eastern edge, and relining 5,000 feet of the existing rock riprap lined channel. The scope of work also included demolition of the existing storm drain, construction of new storm drain lines, extension of existing storm drain lines, construction of junction structures, maintenance roads, and improvements to the pedestrian and bicycle trail on the east side. The project required dewatering, control of surface water, **sediment and erosion**, dust, and noise.

Contract Value: $13 million
Completion: December 2019
Owner: City of Tustin, Public Works
Contact: **Ken Nishikawa** Tel: 714.573-3389 Email: knishikawa@tustinca.org
Proposed Key Personnel: **Mark Butier** (Project Director) and **Joe Blum** (Construction Manager)
Project Similarities: Erosion Control and Storm Drain Pipe Installation

4 Otay River Estuary
Chula Vista, California

Butier provided construction management, inspection QA/QC, cost estimating/review, and schedule review services. The project involved the restoration of 125 acres of intertidal wetland habitat within the San Diego Bay National Wildlife Refuge. It supports emergent salt marsh vegetation by replenishing the salt ponds with an estimated 750,000 to 1 million CY of soil. The project protects and preserves endangered native fish, migratory birds, and other coastal-dependent species by widening and enhancing the habitat area.

Contract Value: $35 million
Completion: March 2025
Owner: Poseidon Resources (Channelside)
Contact: **Paul Rajmaira** Tel: 832.488-8298 Email: paul@931cs.com
Proposed Key Personnel: **Mark Butier** (Project Director), **Eddie Fonbon** (Lead Inspector) **Casey Harris** (Senior Scheduler), **Bryan Wilson** (Project Controls)
Project Similarities: Soil Removals and Fills, Use of Heavy Equipment (320/326/330 CAT Excavators and CAT D4/D6 Dozers)

5 Kraemer Basin Pipeline and Miller Basin
Anaheim, California

The Kraemer Recharge Basin project consisted of the following: construction of 966 LF of 48-inch CMC and epoxy lined steel pipe, removal and/or abandonment of portions of the existing 48-inch RCP pipeline, concrete encasement, **concrete slope anchors**, flow meter, corrosion test stations, electrical/instrumentation equipment, and **grading activities**.

The Miller Recharge Basin project consisted of the following; construction of 200 LF of 42-inch CMC and epoxy lined steel pipe, concrete junction structure, concrete impact structure with motor operated sluice gate, concrete encasement, flow meter, corrosion test stations, **removal and reconstruction of a section of the existing Carbon Creek Channel**, electrical/instrumentation equipment, and **grading activities**.

Contract Value: $806,610
Completion: 2007
Owner: Orange County Water District
Contact: **Chris Olsen, PE** Tel: 714.378.3232 Email: colsen@ocwd.com
Proposed Key Personnel: **Mark Butier** (Project Director) and **Joe Blum** (Construction Manager)
Project Similarities: Slope Stabilization

Public Agencies Utilizing Butier's Services Over the Past 5 Years

Chino Basin Desalter Authority

Cities of Chino, Chino Hills, Manhattan Beach, Oceanside, Poway, San Diego, Santa Ana, Tustin, and Whittier

County of Orange

East Orange County Water District

Eastern Municipal Water District

Encina Wastewater Authority

Inland Empire Utilities Agency

Irvine Ranch Water District

Mesa Water District

Metropolitan Water District of Southern California

Moulton Niguel Water District

Orange County Sanitation District

Orange County Water District

San Diego County Water Authority

Santa Margarita Water District

South Coast Water District

South Orange County Wastewater Authority

Water Replenishment District of Southern California

West Basin Municipal Water District

Whittier Utility Authority

2. Project Team & Qualifications

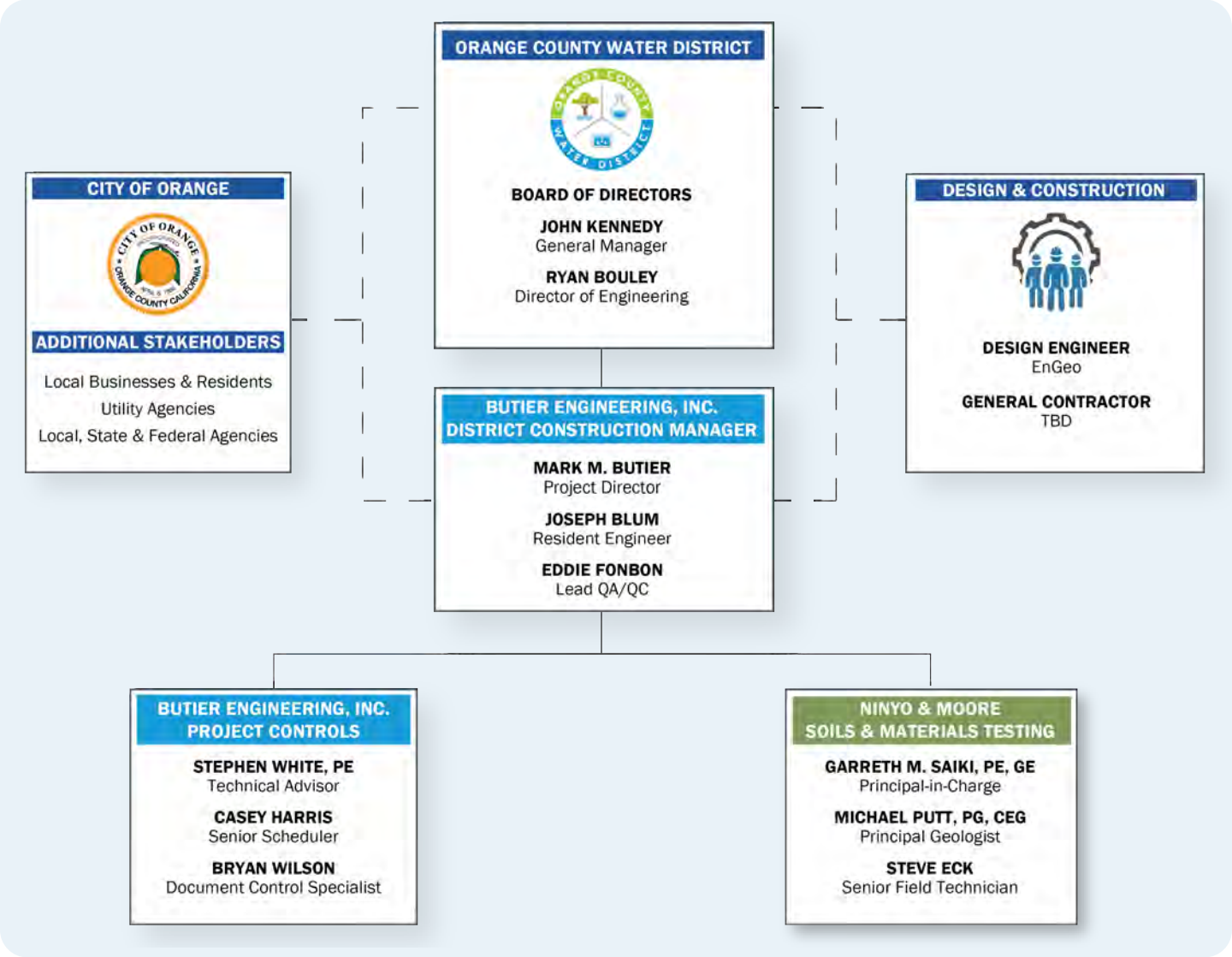
BUTIER
Construction Managers, Consulting Engineers

A. Project Team Organization

By having the Butier Team serve the District as a single source of responsibility, the CM and inspection activities will be well coordinated and delivered efficiently. Our project teams provide disciplined layers of quality assurance, from preconstruction through project close-out. **Butier's Project Director and Resident Engineer have full access to teams of civil, mechanical, electrical, and structural engineers, specialty consultants, and inspectors through existing teaming arrangements with local firms**.

Butier's project leadership team has managed extensive community outreach efforts from the entitlement phase through post-construction for projects located in the counties of Orange, Los Angeles, San Diego, San Bernardino, and Riverside. They have coordinated with community leaders, organized neighborhood meetings to gather concerns to convey to the owner for possible implementation, and been responsible for generating and distributing public notices and presenting to numerous public boards and community associations dealing with the impact of construction activity on the local community.

Our key personnel are based out of Butier's corporate office at 17822 E. 17th Street, Tustin, CA 92780, located less than 4 miles from Bond Basin. Please find Butier's key personnel bios and sub-consulting team's company profile on the following pages. Detailed resumes are provided in the Appendix. **Our proposed key personnel will not be substituted with other personnel or reassigned without the District's prior approval**.



Team Member	Areas of Expertise / Recent Experience

MARK M. BUTIER
Project Director
Tel: 714.240.0870
jrbutier@butier.com
Availability: As-Needed

Mark has 38 years of leadership and project/contract management experience in the A/E/C industry. He has extensive experience with staff resource management, **high-level negotiations, claims mitigation, dispute resolution, key partnership development, community outreach,** and administration of large budgets for major water treatment, storage, and transmission projects. Mark will meet with the District's representatives at key project milestones and provide as-needed support throughout all project phases. He will work closely with RE Joseph Blum to ensure scope requirements are being fully implemented.

Mark has worked in this capacity for numerous OCWD projects, including the GWRS Final Expansion, Tustin PFAS Treatment System and Influent Conveyance, **Santiago Recharge Bond Basin Floating Pump Station**, Mid-Basin Injection: Centennial Park, Kraemer Basin Pipeline, Upper and Lower Five Coves Rehabilitation, Burris Basin Pump Station, Fletcher Recharge Basin, and La Jolla Recharge Basin.

JOSEPH BLUM
Resident Engineer
Tel: 714.448.0216
jblum@butier.com
Availability: 35%

Joe has over **40 years of experience managing the construction of heavy civil engineering projects, including recharge basins, wetlands, earth moving, mass grading (125 million yards of soil)**, reservoirs, pipelines, wells, pump stations, treatment facilities, and wet and dry utilities. **He will serve as the District's primary point of contact** throughout all phases of the Project, support Butier's Lead QA/QC Inspector, and maintain on-going interaction with the District, Contractor, Engineer, and stakeholders. Joe will manage the project field office; perform contract administration; lead progress meetings; respond to contractor correspondence, RFIs, and submittals; review shop drawings and cost estimates; manage change orders and claims; recommend monthly progress payments; prepare progress reports; maintain a diary of events; coordinate with District personnel; and oversee project close-out.

His experience includes, but is not limited to, the **OCWD Tustin PFAS Treatment System and Influent Conveyance, Trampas Canyon Dam & Reservoir (technical advisor-grading), Peters Canyon Channel Improvements, Prado Wetlands Reconstruction, La Jolla Recharge Basin, Kraemer/Miller Recharge Basins**, San Timoteo Creek Basin, and Agua Chinon Channel Improvements.

EDDIE FONBON
Lead QA/QC
Tel: 619.883.3328
efonbon@butier.com
Availability: 100%

Eddie has 25 years of experience as a Lead QA/QC on complex, multi-million-dollar construction projects, including heavy-civil infrastructure, **mass grading (20 million+ CY of soil)**, water and wastewater treatment facilities, pipelines, flood control channels, estuaries, city and county roads and highways, significant concrete structures, paving, drainage.

As Lead QA/QC, Eddie will observe and document the work and its conformance with the plans and specifications, and schedule general and specialty inspections. Additional responsibilities include preparing notices of deficiencies and non-compliance, recording major material deliveries, coordinating with District staff, and updating project red lines. Recent project experience includes the **Trampas Canyon Dam & Reservoir (4.3 million cubic yards of grading and excavation), Otay River Estuary Restoration (125 acres of coastal wetland and upland habitat restoration)**, City of Santa Ana's South Main Street Corridor Improvements, and San Lorenzo Sewer Lift Station.

STEPHEN WHITE, PE
Technical Advisor
Tel: 714.240.1005
swhite@butier.com
Availability: As-Needed

Stephen has **28 years of experience as a resident engineer and general contractor for water and wastewater treatment plants, reservoirs, wells, and pump stations**. He has excellent project management skills and the ability to look at all elements in the big picture to see where there are gaps and where there are areas of overlap. Stephen brings experience in constructability/ design reviews, value engineering, contract administration, managing the CM field office, project scheduling, change order and claims analysis, and client interface.

He is intimately familiar with the District's operations and procedures, having performed as a Resident Engineer for the GWRS Final Expansion, Burris Basin Pump Station Phases I and II, OC Groundwater Storage Program (8 wells), and the Advanced Water Quality Assurance Laboratory. Additional experience includes, but is not limited to, the **City of Whittier's Murphy Reservoir Replacement Project, which incorporated the construction of a retaining wall into a hillside slope, utilizing 248 soil nails**. The wall height varied from 6 feet to 35 feet.

Team Member	Areas of Expertise / Recent Experience

CASEY HARRIS
Senior Scheduler
Tel: 310.508.2813
charris@butier.com
Availability: 5%

Casey has 45 years of varied experience as a senior project manager, expert CPM scheduler, and estimator. He will be engaged on an as-needed basis from preconstruction through closeout and acceptance. **Casey will utilize Oracle Primavera P6 to provide a comprehensive baseline schedule review and updates**. He will review the Contractor's schedule cost loading if required, evaluate and monitor the baseline schedule, prepare weekly look-ahead schedules, and provide monthly schedule updates, time impact analyses, schedule revisions, and as-built schedule submittals. He is intimately familiar with the District's operations, having managed the **GWRS Final Expansion and Advanced Water Quality Assurance Laboratory Projects and provided schedule review services for the Mid-Basin Injection: Centennial Park, Burris Basin Pump Station, and EW-1 Well Equipping Projects.**

BRYAN WILSON
Document Controls
Tel: 714.335.6367
bwilson@butier.com
Availability: 5%

Bryan has 25 years of experience providing project controls for water and wastewater treatment, storage, and conveyance projects. **He will be engaged prior to Contractor NTP and assist Butier's Resident Engineer with establishing document control procedures and managing lines of authority. Bryan will be responsible for the initial set up of Procore** and will provide training to project team members during pre-construction. Following project completion, Bryan will assist Butier's RE with furnishing all documents and final project reports to OCWD's Project Manager in a format that will meet the District's archive standards.

Project experience includes the **GWRS Final Expansion**, Mid-Basin Injection: Centennial Park, Tustin PFAS Treatment System and Influent Conveyance Project, EW-1 Well Equipping, Upper and Lower Five Coves Rehabilitation, **Otay River Estuary Restoration Project**, SARER Phase 1A Sedimentation Basin and Pipeline, and the **Trampas Canyon Dam & Reservoir.**

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

475 Goddard, Suite 200
Irvine, CA 92618
949.753.7070

GARRETH SAIKI, PE, GE
Principal-In-Charge
Availability: As-Needed

Ninyo & Moore provides high-quality geotechnical engineering and materials testing and inspection services. Their staff of professionals consists of 500 registered geotechnical, civil, and environmental engineers; engineering geologists; hydrogeologists; environmental scientists; certified technicians and field inspectors; and hazardous waste and regulatory compliance specialists. **The firm has successfully completed work on hundreds of recharge basins,** water, recycled water, pipelines, wastewater treatment plants, water and potable water, trunk sewers, lift and pump stations, storm drains, sewers, and reservoir projects throughout the western United States. **Ninyo & Moore has three fully equipped, certified soils and materials testing laboratory facilities in Southern California**. Their laboratories are certified by AASHTO, CCRL, Caltrans, DSA, and the City of Los Angeles.

Ninyo & Moore has provided geotechnical observation and testing, materials testing, special inspection, and laboratory testing as a sub-consultant to Butier for numerous projects over the past 25 years, including OCWD's Mid-Basin Injection: Centennial Park and the Tustin PFAS Treatment System and Influent Conveyance. Additional experience includes the following:

- **OCWD Santiago Creek Smith Basin Sour Assessment, Villa Park, CA (Key Personnel: Garreth Saiki and Michael Putt)**—Preliminary geotechnical evaluation of erosion that has occurred on the embankment slopes. Conducted a design-level geotechnical evaluation to perform subsurface exploration and slope stability analyses of the basin embankment slopes to develop geotechnical design and construction recommendations for rehabilitation of the slopes.
- **OCWD Santiago Recharge Bond Basin Floating Pump Station (Key Personnel: Garreth Saiki and Michael Putt)**—With increased pumping capacity, the potential for rapid draw down conditions and impacts to slope stability was a concern. Performed stability analyses of the basin slopes to address the existing conditions and potential stability issues. Services included technical review of previous geotechnical data, review of geologic background data, field geologic mapping of slopes, preparation of geologic cross sections, and slope stability models.
- **OCWD Santiago Pits Pump Station (Key Personnel: Garreth Saiki and Michael Putt)**—Performed a geotechnical evaluation for the proposed pump station and improvements. The first phase included a subsurface evaluation of the portions of the project alignment above the reservoir waterline. The second phase included a subsurface evaluation in the area of the proposed pump station following the lowering of the reservoir water level by over 100 feet.

3. Project Overview & Approach

BUTIER
Construction Managers, Consulting Engineers

A. Project Understanding

The Butier Team has been tracking the progress of the Bond Basin Slope Repair Project. We have attended the pre-proposal meeting, are intimately familiar with the project site, and thoroughly reviewed the project documentation. We have gained a clear understanding of the Project's main goals, objectives, and challenges.

The Butier Team offers OCWD a proven team of professionals with the requisite knowledge and experience to manage a project of this size and complexity. **Butier and our team member firm Ninyo & Moore are familiar with the District's project goals, quality objectives, and operating standards.** We have worked as an extension of the District's staff for 25 years, performing construction management and inspection services for numerous projects, including the Santiago Recharge Bond Basin Floating Pump Station, Burris Basin Pump Station Phases I and II, and Kraemer/Miller Basins.

Project Background / Purpose

The District is seeking a firm to provide professional construction management and inspection services for the Bond Basin Slope Repair project. The Agreement will be for a minimum of one year and **work is expected to commence on June 16, 2025**. Construction activities will be conducted from 7:00 AM to 5:00 PM Pacific Time.

The Bond Basin is one of three basins that were former gravel pits that OCWD converted into groundwater conservation basins in the early 1990s. The southeasterly corner of Bond Basin contains a City of Orange storm drain outlet. Over the past few years, the supporting slope and storm drain failed causing significant erosion to the area. Emergency repair work was completed in January 2023 to stabilize the corner. The Bond Basin Slope Repair project will now permanently repair the slope. The major components of the project include the following:

- **Temporary Construction Access**: Build and maintain temporary roads and work areas within the basin to access the repair site.
- **Slope Repair**: Excavating unstable landslide debris to firm native subgrade. Approximately 10,000 cubic yards of approved filled material will be keyed and benched into the existing slope. Fill will be reinforced with geotextile fabric. The cavity below the existing soil nail wall will be backfilled with approximately 500 cubic yards of control density fill. Approximately 1,200 cubic yards of usable fill material is stockpiled on-site and approximately 8,800 cubic yards of approved material will be procured and transported to the site.
- **Storm Drain Relocation**: Relocating and abandoning a 60-inch storm drain outlet. Installing approximately 270 linear feet of 60-inch reinforced concrete pipe and three storm drain manholes connecting the existing 60-inch storm drain to the new swale and plunge pool.
- **Concrete Swale and Plunge Pool Construction**: Construction of a concrete headwall, grade beam, and piers connected to the 60-inch storm drain. Construction of a 10-foot wide concrete swale with a 10 foot by 4 foot section of 1/4 to 1/2 ton grouted riprap placed on each side. The swale discharges into the plunge pool consisting of 1/4 to 1/2 ton grouted riprap and 105 to 300 pound rock.

Bond Basin Slope Repair Contract No. SB-2025-1

Key Project Considerations

- Unforeseen utilities that have not been identified/verified
- Potential impacts to downslope and adjacent properties
- Percolating water impact at excavation
- Close coordination between City, County, school activities
- Traffic control flagmen at ingress/egress of site
- Work site maintenance and daily sweeper
- Preconstruction video of work site and adjacent streets
- Double handling import material for slope repair
- Compaction of 90% density
- Water quality protection
- Cast-in-place concrete susceptible to cracking
- Testing coordination for reinforced steel, tie-back anchors, and earthwork foundation
- Riprap placed on slope steeper than a 3:1 benched into slope
- 5 foot clearance on monitoring well at new 60-inch pipe

B. Potential Project Challenges

The following table identifies the potential challenges, strategies for resolution, and results for construction management and stakeholder coordination/interface.

CHALLENGES	CM Team Strategies
Multiple Stakeholder Coordination *Adjacent residential property, local residents, City/community meetings*	• Use Procore document control system. Provides 24/7 project progress and streamlines communications and accountability. It will be customized to provide efficient integration of the project team and transparency/security to project stakeholders. • Preliminary meetings will be held with key stakeholders to ensure all site compliance activities are identified in the proposed baseline schedule. • A communication matrix will be developed to eliminate potential conflicts. • Proactive communication & coordination with City of Orange and City of Villa Park. • RE must build a relationship with adjacent residents. • Provide OCWD Public Relations staff with weekly field activity updates and potential community impacts
Coordination with Designer of Record	• Coordinate with Design team on early critical submittals. Eliminate resubmittal. • Ensure answers to RFIs are fully vetted for cost and time impacts. • Tight coordination with geotechnical QA/QC team (Ninyo & Moore).
Construction Noise & Dust *Excavators, dump trucks, hoist/crane, compactor, etc.*	• Monitor construction noise and dust to ensure compliance with permit thresholds. • Follow ROW permit and allowed construction hours (7:00 AM to 5:00 PM PST). • Ensure permitted haul routes for import and export are being strictly enforced. • Inform stakeholders on a weekly basis of field activities likely to generate dust and noise.
Schedule	• OCWD Basin Operations to participate in initial baseline schedule workshop. • Develop contingency work plans to eliminate gaps in work activity. • Weekly statement of working days. • Monthly schedule updates to be submitted with contractor pay request. • TIAs submitted with any contractor request for time.
Site Access/Traffic Control	• Coordination with OCWD Basin Operations staff in the development of the baseline schedule. • Ensure permitting issues have been addressed and incorporated into the baseline schedule. • Coordinate with OCWD, Villa Park, and Orange on traffic safety requirements. Evaluate and identify potential contingency options.

C. Approach to Project Control

1. Cost & Schedule Controls

Butier utilizes **Oracle Primavera P6** to provide resource-loaded schedules, which are the basis for evaluating performance and identifying if potential problems will occur. The Contractor will be required to submit a detailed resource-loaded schedule for acceptance by the District. The Contractor is then required to provide timely, detailed status information as the work progresses.

Accurate two-week look ahead schedules are a key component to keeping focus on critical activities. Butier's Resident Engineer will conduct project meetings to discuss look-ahead schedules, projecting critical milestones and items needing resolution.

Recovery plans are required whenever the Contractor falls significantly behind schedule. These plans should address mitigation efforts such as additional crews, additional shifts, or developing work-around schedules that move the delayed activity off the critical path so that its completion will not affect critical milestones.

2. QA/QC Plan

The QA/QC Plan will reflect a set of objectives defined by District staff and assigned construction management and inspection personnel. The Plan will provide District staff with a format for measuring policy objectives.

- **Quality Assurance**—Procedures or actions to be confirmed include the following: CM Plan; specific QA/QC requirements; submittal process plan; document control

and file management plan; need for corrective action; and auditing to verify compliance.

- **Quality Control**—Activities to be verified for the work include review by the quality control team; identification and compliance with applicable codes, ordinances, permits, environmental requirements, review design for compliance with safety standards.

3. CM Manual

The RE will prepare a CM Communications Manual to be approved by the District. The Manual will establish an effective communication protocol and integrate the interdependent roles of the District, Construction Manager, Engineer, Contractor, and stakeholders through all phases of the work. It will include project correspondence in accordance with the District's document formatting standards. All correspondence will be issued in Procore. The Manual will include, at a minimum, the following items:

- **Project Organization**: assignments, responsibilities, lines of communication, and methods for interfacing with team members
- **Meeting and Notice Procedures**: Schedules, notices, agendas, reporting procedures, documentation requirements, and timely acceptance processes
- **Contract Administration**: Description of control systems and procedures utilizing **Procore** for performing and documenting submittal reviews, RFIs, change orders, claims, and closeout activities

D. Scope of Work

Butier has assigned **Joseph Blum as the Resident Engineer** (RE) who will be responsible for performing project coordination services and resident engineering duties. He will report directly to the District's Project Manager (PM) and maintain ongoing interaction and communication with the General Contractor and the Design Engineer. Mr. Blum will ensure appropriate staff are available to adequately provide the services within the Project Scope of Work.

1. Project Coordination Services

1.1 Monthly Construction Progress Reports

Prepare a written summary report with progress photos monthly for the District's internal review. The summary report will provide details of the entire project, including project costs to date citing the status of time and costs associated with the project; reconciliation of contract time, work progress, and manpower usage by the Contractor; and key issues addressed or arising from the project requiring resolution.

1.2 Monthly Invoices

Provide monthly invoices, broken down by project component, in a form acceptable to the District that identifies each individual's actual hours and provide supporting invoices for direct and subcontracted costs.

1.3 Scheduling of Utilities

The RE will coordinate with OCWD and the General Contractor for scheduling of utilities, as well as connection to the City storm drain.

2. Resident Engineering Duties

2.1 Pre-construction Services

The RE will attend the project kick-off meeting with the District, the Engineer, and all project stakeholders to become familiar with the scope of work and the District's CM Procedures. The Butier Team will present its construction management plan, including communication protocols and templates proposed for use while administering the construction contract. Additionally, the RE will receive, process, and review RFIs (assume 20), assist with and/or coordinate filing of the Notice of Intent (NOI).

2.2 Document Control & Tracking

The Butier Team has been utilizing **Procore** as its main document control system for over eight (8) years. Our Document Controls Specialist will create the Project in Procore within 1-2 days, and the RE will manage all aspects to ensure clear and organized project files are kept up to date. The system inherently tracks submittals and RFIs and sends alerts to reviewers within the workflow and provides 24/7 team access to all documents.

Procore can be configured to display the latest Primavera P6 construction project schedule and weather information, both current and forecast. At the conclusion of the project, project-related documentation will be converted to PDF format and distributed to the appropriate parties.

2.3 Project Correspondence

The RE will maintain field memoranda, transmittals, updated schedules, logs of shop drawings and other submittals, logs of RFIs, change orders, progress payment requests, progress meeting reports, daily inspection reports, and all other project correspondence.

2.4 Construction Progress Report

As stated previously, the RE will prepare a monthly progress report and submit to the District's PM. The report will provide details of the entire project, including project costs to date citing the status of time and costs associated with the project, etc.

2.5 Project Meetings

- **Preconstruction Meeting**—Schedule and facilitate a pre-construction meeting with the District, Engineer, Contractor, and other critical project stakeholders. The project team will outline the following to the Contractor: contract administration guidelines, contractual roles, reinforcement of specific requirements for safety, traffic access, and coordination issues for the work.
- **Weekly Progress Meetings**—Schedule, coordinate, and conduct weekly progress meetings with the Contractor, the District, and other necessary stakeholders. The meetings will cover site safety, progress, job problems, and any

actions requiring clarification of design intent, ambiguities in contract documents, and other key issues. Action monitoring will be implemented to ensure compliance and timely response by all parties.

- **Pre-Construction Scheduling Meeting**—Facilitate a meeting with the District's PM and the Contractor to discuss the scheduling specification requirements and format. The meeting will facilitate timely submittal, review, and approval of the Contractor's Baseline Schedule

2.6 Construction Phasing and Sequencing

Perform review of construction phasing, staging plans, and other pertinent information related to mobilization and first steps and propose revisions for construction, as necessary. Analyze sequencing of operations to be performed during construction prior to the submittal of the proposed baseline schedule.

2.7 Interpret Plans and Specifications

Prior to the pre-construction meeting and throughout the project, review the contract plans, specifications, and other project related documents, including requirements found in the Special Provisions for possible errors and deficiencies and report such findings to the District's PM.

2.8 Submittals and Requests for Information

Using **Procore**, a computerized systematic tracking procedure will be established for timely submittal review and processing of shop drawings, and the status of submittals will be known at all times. The system will be coordinated with the Contractor per contract document requirements. The RE will provide limited reviews as shop drawings are received during the construction phase and provide recommendations and review comments supplemented by District staff.

Distribute all submittals to the District's PM and appropriate District staff, as necessary, and track responses. Ensure that all deferred submittals are submitted in a timely manner for review by the Engineer and subsequently submitted to the District.

Coordinate the RFI review process and route all RFIs to the appropriate reviewer. The documentation will be logged, tracked, maintained, and organized in Procore in PDF format.

2.9 Resolving Day-to-Day Construction Issues

The RE will coordinate with inspectors, Design Engineer, Contractor and PM as required to reach resolution. The CM Communications Manual will help prevent conflicts and providing work directives.

2.10 Key Specification Referenced Standards

The RE will obtain and maintain key specification referenced standards (e.g., codes, standards, publications, permitting, etc.) as stated in the Scope of Work. The documents will be made available for review by the Contractors, District, and other interested parties.

2.11 Change Orders and Disputes

Prepare contract change orders on District-provided forms within 30 calendar days of completion of change order work. The RE will track, document, and negotiate changes for added costs or credits with the Contractor and evaluate schedule impacts of changes. The RE will report all verbal and written disputes immediately to the District's PM and coordinate all disputes. The RE will advise the District's PM of equitable cost and time adjustments for proposed or authorized changes.

Review and approve the Contractor's Schedule of Values at the beginning of the project, and ensure that it includes sufficient detail to track the progress of the work. Establish a pay request format to accelerate the checking, processing, and updating of project budgets and cost projections. Forward the format to the District's PMs for approval.

Prepare monthly progress payment recommendations by measuring and tabulating contract quantities, verifying material tickets, reviewing the Contractor's invoices, verifying completed work, approving all quantities, and assisting with Contractor meetings to resolve any differences in percent complete.

Prepare a Project Application for Payment based on the Contractor's Certificate for Payment once it has been verified that the work has progressed to the point indicated and the quality of the work is in accordance with the Contract Documents. Submit monthly Certificate for Payment packages to the District's PM for payment processing with supporting documents. Confirm the submittal of a Conditional Waiver and Release form with the applicable monthly progress payment request and upon final payment request.

2.12 Special Testing

The Butier Team, including Ninyo & Moore, will provide appropriately qualified/certified personnel and required specialty equipment for all testing and inspection. This will include, but not be limited to, materials (including concrete), reinforcing, soils, subgrade, compaction, and tie-back testing.

2.13 Record Drawings

Review the Contractor's record drawings monthly to ensure that timely recording is being accomplished. The RE will ensure that the District's record drawings identify RFIs, shop drawing revisions, change order modifications, etc. and that they are updated weekly. The RE will hold monthly record drawing meetings with the District's PM and the General Contractor prior to submittal of the monthly progress payment.

2.14 Schedules

Review the Contractor's baseline and monthly Critical Path Method (CPM) schedules.

3. Construction Inspection Duties

3.1 Construction Observation Services

The Butier Team will provide inspection by qualified/certified inspectors to verify the Contractor's work is performed in compliance with the contract documents and industry standards. Perform technical inspection at the jobsite or off-site of materials and workmanship in accordance with the Contract Documents. The inspectors will not authorize extra work or approve of work that deviates from the Contract Documents. Any changes will be authorized by the assigned RE, DCM, and the District's PM.

3.2 Safety Program

Maintain an awareness of safety and health requirements and enforce applicable regulations and contract provisions for the protection of the public and project personnel. Receive and file the Contractor's Injury and Illness Prevention Plan and Job Hazard Analyses and observe the Contractor's work. Attend the Contractor's safety meetings and monitor the Contractor's safety program.

3.3 Regulatory Compliance

Monitor compliance with the Specifications and other requirements, such as the Contract, Traffic Control, Cal-OSHA Standards, Contract Change Orders, Permits, Standard Plans, checking line, grade and location of improvements.

3.4 Daily Diaries/Inspection Reports

Maintain daily inspection reports, which will be submitted to the District's Project Manager on the next business day for review and filing.

3.5 Photographic Records

Provide weekly photographic/digital records during construction. Log construction digital photographs daily. A digital photographic library will be maintained of significant construction activities. The photographs will be labeled with the date, location, and narrative information.

4. Project Closeout

4.1 Punch List and Substantial Completion

Prepare detailed punch lists at substantial completion of the project. Coordinate the correction of deficiencies and schedule, coordinate and conduct a final walk-through prior to the acceptance of work with a team consisting of the Design Engineer, District's PM, District's Operations and Maintenance Department and others as directed by the District's PM.

4.2 Dispute Resolution and Final Payment

Negotiate and resolve outstanding COs, global settlements, and any other items necessitating dispute resolution, working closely with the District's PM. Prepare a project application for final payment based on the Contractor's certificate for final payment. The application will constitute that the work has progressed to the point of final completion and the quality of work is in accordance with the Contract Documents.

4.3 Project Closeout Deliverables

Review and certify that the Contractor's project record drawings are complete and accurate before final payment is approved and drawings are given to the Design Engineer for incorporation into AutoCAD. The RE will furnish all original project documents and final project reports to the District within 60 calendar days following filing of the Notice of Completion and will deliver the electronic files and documents created during the project electronically.

5. Supplemental Scope of Work

5.1 Specialty Inspection and Materials Testing

Butier has selected **Ninyo & Moore** to perform Specialty Inspection and Materials Testing services. The following is an abbreviated summary of N&M scope of services.

- Project coordination, management and technical support including review of the project geotechnical reports, material submittals, plans and specifications, work scheduling and distribution of test data.
- Attendance at pre-construction meetings and as-requested field meetings.
- Field Geologist for observation of slope repair bottom keyway and benching, as needed.
- Field Technician services to provide observation, sampling and testing during slope excavation, slope reconstruction with Mirafi, storm drain pipe bedding and trench backfill, headwall backfill, and riprap placement. Field density tests will be performed to evaluate the Contractor's compaction efforts.
- Field Specialty Inspector services during reinforced concrete caisson foundations, grade beam, headwall, and swale construction, including checking reinforcement steel installation, spacing, size, grade, location, clearances and anchorage.
- Field Specialty Inspector services during the tieback installation and stressing, including proof and creep testing.
- Field ACI Technician services to provide observation, sampling and testing during structural concrete and tieback grout placement, including checking mix design, elapsed time, temperature, slump and casting a set of cylinders for each batch.
- Laboratory testing including Proctor density, sieve analysis, sand equivalent, Atterberg limits, and corrosivity. Perform compressive strength testing of concrete, cement slurry, and tieback grout samples obtained in the field.
- Preparation of daily reports and test data sheets to document the items inspected.
- Preparation of a Final Compaction Report which presents our opinion of the grading operations and summarizes our field density tests results.

5.2 Site Safety and Clean-Up

The RE will monitor site safety and will immediately notify the General Contractor of any unsafe side conditions and follow up to be sure corrective action is taken. The RE or Inspector(s) will conduct daily site walks to ensure a clean and orderly site and direct the Contractor as necessary. The RE or Inspector(s) will be on site during final clean-up and demobilization to ensure that all impacted road surfaces and other existing facilities are completed per the contract documents and to the satisfaction of OCWD and City inspectors.

4. Additional Services

BUTIER
Construction Managers, Consulting Engineers

SECTION 4
Additional Services

We do not have additional comments or additions to the scope of work.

6. APPENDIX

-Addenda Acknowldegement Forms

BUTIER
Construction Managers, Consulting Engineers

END OF ADDENDUM

MANDATORY FORM

ACKNOWLEDGE RECEIPT OF ADDENDUM NO. 1

Request for Proposal (RFP-24-019)
CONSTRUCTION MANAGEMENT AND INSPECTION SERVICES FOR BOND BASIN SLOPE REPAIR, CONTRACT SB-2025-1

04/08/2025

Proposer shall acknowledge receipt of this addendum by detaching, signing and attaching to his/her proposal, one (1) copy of this sheet.

I, Mark M. Butier, Jr., Butier Engineering, Inc.

Name of Proposer, Company Name

17822 E. 17th Street, Suite 404, Tustin, CA 92780

Address, City, State, Zip

Hereby acknowledge receipt of Addendum No. 1 to the **Request for Proposal (RFP-24-019) Construction Management and Inspection Services for Bond Basin Slope Repair, Contract SB-2025-1** and have considered these revisions in the preparation of my proposal. This addendum, consisting of this acknowledgement, shall become a part of any contract made pursuant thereto.

Proposer's Signature

Mark M. Butier, Jr.

Printed Proposer's Name

April 17, 2025

Date

Butier Engineering, Inc.

Key Personnel Rèsumès

BUTIER
Construction Managers, Consulting Engineers

Mark M. Butier, Jr.

Project Director

EDUCATION

Master of Dispute Resolution, University of Southern California, Gould School of Law, 2025

MBA, Finance, University of California, Irvine, Graduate School of Management, 1998

Graduate Studies, Civil Engineering, California State University at Long Beach

B.A., Economics, University of Southern California, 1987

B.A., Social Sciences, University of Southern California, 1987

LICENSES / CERTIFICATIONS

General Engineering Contractor, State of California, Class A 716863, Exp. 12/31/2026

Registered Construction Inspector, ACIA: Division I Engineering 5572

HOME OFFICE

17822 E. 17th Street, Tustin, CA 92780

Professional Summary

Mr. Butier currently serves as President and CFO of Butier Engineering. He is the second-generation executive of the company, succeeding his father who founded the firm in 1976. His primary duties include functioning as the primary point of contact between Butier and its clients; contract management; sub-consultant contract management; maintenance of Butier's project information system; development of the firm's field procedural manuals; and staff resource management. Mr. Butier works closely with the field construction management staff to ensure all contract scope requirements are being fully implemented. Mr. Butier also serves as the firm's contact between the field construction management staff/client and the project public outreach effort, when necessary. He has been responsible for generating, distributing, and presenting to numerous public boards and community associations dealing with the impact of construction activity on the local community.

Mr. Butier has 25 years of varied experience as an Assistant Resident Engineer and Inspector for municipal and governmental agency projects. Primary emphasis has been in municipal water and wastewater transmission and treatment projects, as well as landfills. His responsibilities include project field engineer / inspector in quality control for civil inspection; shop drawing review and approval; full responsibilities for contract administration; CPM scheduling; cost controls; and contractor claims and changes.

Project Experience

Project Director, Groundwater Replenishment System Final Expansion Project; Fountain Valley, CA; Orange County Water District (Completion: 03/2023; Program Cost: $284 million)—Butier provided project management and inspection services. The GWRSFE is a water supply project designed to provide an additional 31,000 AFY of advanced treated wastewater (recycled water) to the groundwater basin in north and central Orange County. The GWRSFE scope of work included upgrading the existing 100 MGD Advanced Water Purification Facility (AWPF) by adding 30 MGD of additional capacity; constructing Plant No. 2 Secondary Effluent Conveyance Facilities; and rehabilitating an existing pipeline between Plant No. 2 and Plant No. 1 to bring secondary effluent to the GWRS.

Project Director, Trampas Canyon Reservoir and Dam; San Juan Capistrano, CA; Santa Margarita Water District (Completion: April 2021; Value: $88 million)—Butier provided construction management and inspection services for the construction of the Trampas Canyon Reservoir and Dam. SMWD reconstructed the dam and reservoir to create a 5,000 acre-foot recycled water reservoir, which will provide seasonal and operational storage for SMWD's existing and proposed recycled water system. The reservoir will supply irrigation demands for customers in Talega Valley and in Rancho Mission Viejo's (RMV) ongoing Ranch Plan development, as well as other existing irrigation demands in South Orange County. Recycled water will be supplied by the Chiquita Water Reclamation Plant (CWRP) and may be supplemented with other non-domestic water (NDW) supply sources. In addition, the reservoir may provide storage for other recycled water purveyors in South Orange County.

Project Director, Murphy Reservoir Replacement Project; Whitter, CA; Whittier Utility Authority (Completion 1/2025; Construction Value: $6.5 million)—Butier provided construction management, inspection, structural observation, and materials testing services for the Murphy Reservoir Replacement project. The scope of work included the replacement of two cylindrical concrete reservoirs with a larger 2.31 MG reservoir to meet operational, fire and emergency storage requirements. The replacement project included the demolition and removal of the existing .5 MG concrete reservoirs, an exterior

stairway, interior ladder, access hatches, vent, overflow pipe, drain line, inlet/outlet line, sample taps, level controls, and miscellaneous appurtenances. Also included is the grading of the site, shotcrete retaining wall, concrete masonry block retaining wall, concrete curb and gutter and concrete swale for proper site drainage.

Project Director, Peters Canyon Channel Improvements (CIP No. 50040), City of Tustin, Department of Public Works; Tustin and Irvine, CA (Completion: March 2020; Value: $13,031,662)– The channel work includes demolition, widening, and relining approximately 5,000 feet of the existing channel within the Cities of Tustin and Irvine from north of Edinger Avenue to Warner Avenue. The channel scope of work also includes the construction of new storm drain lines, extension of existing storm drain lines, and road under crossings. Butier staff is coordinating with the City of Irvine, Irvine Ranch Water District, Orange County Flood Control District, Southern California Gas Co., and Southern California Edison.

Project Director, Otay River Estuary Restoration; Chula Vista, CA; Poseidon Resources (Completion: 2025; Value: $35 million)—Butier provided construction management, inspection QA/QC, cost estimating/review, and schedule review services for the Otay River Estuary Restoration project. The project restored approximately 125 acres of coastal wetland and upland habitats within the San Diego Bay National Wildlife Refuge, benefiting native fish, migratory birds, and other coastal-dependent species.

Project Director, PFAS Water Treatment Plant, Orange County Water District, Tustin, California (Estimated Completion: 2025; Value: $21M)—The project includes the construction of conveyance pipelines to transport water extracted from four wells to a new PFAS water treatment facility. The treatment facility will consist of four ion exchange (IX) vessels to treat the water produced from the extraction wells. Additional project components include the construction of a new section of distribution piping from the Main Street Water Treatment Plant, upgraded booster pumps to handle the additional flows, and replacement of the existing nitrate treatment system.

Project Manager, Kraemer/Miller Recharge Basins 48-inch Pipeline Replacement and Secondary Fill Line; Orange County, CA (Orange County Water District)—Mr. Butier performed as the Project Manager for the construction of the Kraemer and Miller Recharge Basins. The Kraemer Basin consisted of the construction of 48-inch CMC and epoxy lined steel pipe, removal and/or abandonment of portions of the existing 48-inch RCP pipeline, concrete encasement, concrete slope anchors, flow meter, corrosion test stations, and electrical/instrumentation equipment.

The Miller Basin consisted of the construction of 42-inch CMC and epoxy lined steel pipe, concrete junction structure, concrete impact structure, concrete encasement, flow meter, corrosion test stations, removal and re-construction of a section of the existing Carbon Creek Channel, and electrical/instrumentation equipment.

BUTIER
Construction Managers, Consulting Engineers

Joseph C. Blum

Resident Engineer

EXPERIENCE
40+ Years Total
18 Years with Butier

EDUCATION
B. S., Civil Engineering, California Polytechnic University, San Luis Obispo, 1982

LICENSES / CERTIFICATIONS
Engineer-In-Training, California, #54215, 1982

AREAS OF EXPERTISE
Construction Management

Program Management

Contract Bidding

Value Engineering

Environmental Compliance

Water/Wastewater

Design Team Builder

Land Development

Transportation

Accounting Interface

HOME OFFICE
17822 E. 17th Street, Tustin, CA 92780

PROJECT REFERENCES
Peters Canyon Channel Improvements
Ken Nishikawa,
Deputy Director of
Public Works/Engineering
(714) 573-3389
knishikawa@tustinca.org

PFAS Treatment System and Influent Conveyance
Fernando Almario, PE
Project Manager
(714) 721-6380
falmario@ocwd.com

Professional Summary

Mr. Joseph Blum has over 40 years of experience managing and estimating the construction and reconstruction of heavy civil engineering projects. Projects include earth moving, mass grading (125 million yards of soil), wetlands, recharge basins, large and small diameter pipelines, reservoirs, concrete structures, city and county road construction, highways, bridges, paving, drainage, and wet and dry utilities. In addition, his construction experience includes flood control facility, blasting, and screening.

Mr. Blum has comprehensive experience in all aspects of due diligence analysis, management of design engineering, project development, and execution. These aspects include planning, environmental permitting, engineering, acting as governmental liaison, transportation programs, street improvements, dry and wet utility planning and construction, sewer/water entitlements, CFD formation and execution, and bond exoneration. He is a proven team leader, team organizer, and team player.

Responsibilities and capabilities range from overall field construction to day-to-day project management, estimating, constructability review, contract administration, business development, and operations.

Relevant Experience

Project Manager, Peters Canyon Channel Improvements (CIP No. 50040), City of Tustin, Department of Public Works; Tustin and Irvine, CA (Completion: March 2020; Value: $13,031,662)— The channel work includes demolition, widening, and relining approximately 5,000 feet of the existing channel within the Cities of Tustin and Irvine from north of Edinger Avenue to Warner Avenue. The channel scope of work also includes the construction of new storm drain lines, extension of existing storm drain lines, and road under crossings. Butier staff is coordinating with the City of Irvine, Irvine Ranch Water District, Orange County Flood Control District, Southern California Gas Co., and Southern California Edison.

Resident Engineer, Kraemer/Miller Recharge Basins 48-inch Pipeline Replacement and Secondary Fill Line; Orange County, CA (Orange County Water District)—The Kraemer Basin consisted of the construction of 48-inch CMC and epoxy lined steel pipe, removal and/or abandonment of portions of the existing 48-inch RCP pipeline, concrete encasement, concrete slope anchors, flow meter, corrosion test stations, and electrical/instrumentation equipment.

The Miller Basin consisted of the construction of 42-inch CMC and epoxy lined steel pipe, concrete junction structure, concrete impact structure, concrete encasement, flow meter, corrosion test stations, removal and re-construction of a section of the existing Carbon Creek Channel, and electrical/instrumentation equipment.

Project Manager, PFAS Water Treatment Plant, Orange County Water District, Tustin, California (Estimated Completion: 2025; Value: $21M)—The project includes the construction of conveyance pipelines to transport water extracted from four wells to a new PFAS water treatment facility. The treatment facility will consist of four ion exchange (IX) vessels to treat the water produced from the extraction wells. Additional project components include the construction of a new section of distribution piping from the Main Street Water Treatment Plant, upgraded booster pumps to handle the additional flows, and replacement of the existing nitrate treatment system.

Prado Wetlands Reconstruction Project; Corona, CA (Orange County Water District)—Mr. Blum performed as the Resident Engineer for the reconstruction of the Prado Wetlands, a natural water quality treatment system operated by the Orange County Water

District which was damaged by flood flows from the Santa Ana River in the 2004-05 storm season. The portion of the Prado Wetlands included in the reconstruction contract included 400,000 CY of earthwork; a diversion structure and approximately 6,812 feet of diversion channel to supply water from the Santa Ana River; approximately 23 wetland cells; conveyance channels which transport water to and from wetland cells; and water control or conveyance structures to manage water elevations or convey water between cells.

Also included were perimeter and internal levees and berms, berm roads, demolition and reconstruction of existing water control structures damaged during the flood, construction of new water control and conveyance structures, salvage and new construction of gabions, stockpiling of material for future construction of a diversion dam, reconstruction or installation of security gates, and other facilities or structures as specified or shown.

The scope of work also included protection of partially constructed work from storms, floods, and other natural events, including winter storm flooding. The project also required sediment and erosion control measures in compliance with all local, state, and federal regulations, and compliance with all specified and otherwise applicable local, state, and federal regulations.

La Jolla Recharge Basin; Anaheim, CA (Orange County Water District)—Mr. Blum performed as the Resident Engineer for the construction of the 6-acre wetted-area recharge basin. The project involves the following components: demolishing existing at-grade structures across the 8.6-acre property; excavating and hauling 83,000 cubic yards of soil; recharge inlet facilities consisting of an inflatable rubber dam, creek outlet structure, and 30-inch steel CMLC pipe with motor-operated isolation valve and flow meter; recharge basin outlet facilities, consisting of 36-inch steel CMLC pipe; control building and facilities; and all electrical and instrumentation, including video surveillance cameras and lighting.

BUTIER
Construction Managers, Consulting Engineers

J. Eduardo "Eddie" Fonbon

Lead QA/QC

EXPERIENCE
20+ Years Total
4 Years with Butier

TRAINING / CERTIFICATIONS
Construction Safety

Caltrans SWPPP Training

Safety Supervisor Training

Competent Person (Fall Protection)

Competent Person (Excavation)

CPR Certified

Flagger Training

Supervisor Training

Controlling Haz. Energy

Confined Space Training

Lead Awareness

HOME OFFICE
17822 E. 17th Street, Tustin, CA 92780

PROJECT REFERENCES
Otay River Estuary Restoration
Patrick Crain
Director, EPC Services (Retired)
(760) 889-2975
pcrain0317@outlook.com

Paul Rajmaira
Project Manager
(832) 488-8298
paul@932cs.com

Professional Summary

Mr. Fonbon has over 20 years of experience as a General Foreman in a wide range of activities on complex public and private multi-million-dollar construction projects, including heavy-civil infrastructure, mass grading (20 million+ cubic yards of soil), water and wastewater treatment facilities, pipelines, flood control channels, significant concrete structures, paving, drainage, wet and dry utilities, city and county road construction, highways, airport aprons/taxiways, and electrical substations. His responsibilities included planning, directing, and coordinating the efforts of skilled and unskilled labor forces; estimating manpower requirements and materials needed for projects and specific work assignments; ensuring quality and compliance; adhering to safety requirements during work; managing inventory of materials and equipment; and preparation of various daily reports to include SWPPP.

Project Experience

Lead Inspector, Otay River Estuary Restoration; Chula Vista, CA; Poseidon Resources (Completion: 2025; Value: $35 million)—Butier provided construction management, inspection QA/QC, cost estimating/review, and schedule review services for the Otay River Estuary Restoration project. The project restored approximately 125 acres of coastal wetland and upland habitats within the San Diego Bay National Wildlife Refuge, benefiting native fish, migratory birds, and other coastal-dependent species.

Lead Inspector, San Lorenzo Sewer Lift Station; Santa Ana, CA; City of Santa Ana, Public Works (Completion: 10/2023; Value: $8.5 million)—Butier provided construction management services for the San Lorenzo Sewage Lift Station Project. The Project consisted of construction of the following: lift station—below ground dry and wet wells; aboveground CMU block building; three (3) 15 hp dry pit sewage pumps; piping, fittings, valves, flow meter, in-line grinders, rail and hoist system; HVAC, ventilation and ducting; electrical and instrumentation; site grading and improvements; 560 (LF) of 15" gravity sewer pipe; 190 (LF) of 12" gravity sewer pipe; 545 (LF) of 10" force main; sewer manholes and appurtenances; and abandonment of existing Segerstrom Lift Station.

Lead Inspector, San Luis Rey Water Reclamation Facility Maintenance Building; Oceanside, CA; City of Oceanside (Completion: 2024, Construction Cost: $11,000,000)—Butier provided construction management and inspection services to oversee the site work and construction of the San Luis Rey Water Reclamation Facility Maintenance Building Project. The scope of work includes the following: a new 19,644 square foot pre-engineered steel framed maintenance building, new 5,120 square foot storage facility including the installation of underground utilities, as well as a remodel of an existing maintenance building, which includes a new steel framed mezzanine, restroom facilities, kitchen, and stairways.

Lead Inspector, La Salina Wastewater Treatment Plant Primary and Secondary Digesters Cleaning and Piping Improvements; Oceanside, CA; City of Oceanside (Completion: 2024; Value: $2.2 million)—Butier provided construction management and inspection services. The scope of work included dewatering and cleaning primary and secondary digester tanks, replacement of heated sludge supply and return piping and valves, including installation of new pipe supports, replacement of digester gas piping, valves and gas protection equipment, replacement of primary digester roof center ring cover and secondary digester seal rings and diaphragm on roof hatches and sample ports, and replacement of the digester overflow piping.

Lead Inspector, South Main Corridor Improvements; Santa Ana, CA; City of Santa Ana (Completion: 2022; Value: $12.8 million)— Butier provided construction management, inspection, and public outreach services for the South Main Corridor Improvements project. The scope of work includes the following: pavement rehabilitation, enhanced PCC crosswalks and intersections, decorative sidewalk extensions/bulb outs, lighting

improvements, landscape/irrigation and railroad coordination. In addition, the improvements will replace aging and deficient water mains, sewer mains, fire hydrants, sewer maintenance holes, water services, and sewer laterals within the project limits.

Field Inspector, ID1 Capacity, Reliability, and Augmentation Project—Construction Package #1; Tustin, CA; East Orange County Water District (Completion: 09/2022; Value: $5,035,686)—Butier performed construction management, inspection, document control, and multiple stakeholder coordination. The project was located east of the I-5 freeway and El Camino Real at the intersection of Sierra Vista Drive and Browning Avenue. The scope of work included replacing approximately 3,570 LF of the existing gravity interceptor sewer with new sewer pipes ranging in size from 15" diameter to 18" diameter. Work included, but was not limited to, piping installed by open-cut /jack & bore methods, a new manhole, traffic control, restriping, sheeting/shoring, groundwater control, backfill, and repairing sidewalks.

Field Inspector, ID1 Capacity, Reliability, and Augmentation Project—Construction Package #2; Tustin, CA; East Orange County Water District (Completion: 2023; Value: $7,398,452)—Butier performed construction management, inspection, document control, and multiple stakeholder coordination. The work is located at the intersection of Browning Avenue and Mitchell Avenue and extends to the intersection of Browning and Sierra Vista Drive. Additional locations include Edinger Avenue, Fallen Leaf Place, 6th Street, Crawford Canyon, and Clarissa Lane. The scope of work includes replacing the existing gravity interceptor sewer with approximately 3,480 LF of new sewer pipes ranging in size from 8" diameter to 20" diameter. Work includes, but is not limited to, piping installed by open-cut/jack & bore methods, new manholes, traffic control, restriping, sheeting/shoring, groundwater control, backfill, and repairing sidewalks.

Lead Inspector, Coastal Treatment Plant Sludge Force Main Replacement Project; Laguna Niguel, CA; South Orange County Wastewater Authority (Completion: 2021; Value: $3.2 million)—The project included the replacement of 3 miles of two 4-inch diameter ductile iron pipelines with one new 6-inch diameter high density polyethylene pipeline, which included HDPE export sludge force, connection to the existing dual 4-inch diameter DI export sludge force, dual 4-inch fiber optic conduits and associated pull, pressure testing of the existing Phase 1 6-inch ductile iron force main, connection to the existing 6-inch export sludge force main at Alicia Parkway, installation of 6-inch Force Main flushing station at the Alicia Parkway pump, connection to the existing dual 6-inch export sludge force main at the Regional Treatment Plant, and connection to the existing export sludge force main discharge piping at the Coastal Treatment Plant.

BUTIER
Construction Managers, Consulting Engineers

Stephen White, P.E.

Technical Advisor

EXPERIENCE

28+ Years Total
26 Years with Butier

EDUCATION

M.S., Civil Engineering
California State University
Long Beach, 2011

B.S., Civil Engineering,
California State University at
Long Beach, 1997

B.A., Physics, University of
California, Berkeley, 1986

LICENSE/CERTIFICATION

Registered Professional
Engineer (Civil), State of
California No. 61828,
Earned: 3/15/2001
Expires: 06/30/2025

Building General Contractor,
Murray White Construction,
No. 610678 (1991-2001)

HOME OFFICE

17822 E. 17th Street, Tustin,
CA 92780

PROJECT REFERENCES

GWRS Final Expansion — Orange County Water District
Michael Markus, PE
General Manager (Retired)
(714) 349-1677
michaelmarkus@gmail.com

Professional Summary

Mr. White has 28 years of experience in the construction industry as a resident engineer and general contractor for water and wastewater treatment plants, groundwater replenishment systems, reservoirs, wells, and desalination plants. He has been with Butier for 26 years, during which time he has focused his expertise on water treatment projects (RO, MF, UV). He has excellent project management skills and brings experience in performing constructability reviews, value engineering, and contract administration. He has the ability to look at all the elements in the big picture to see where there are gaps and where there are areas of overlap.

Mr. White works closely with the Engineer of Record to prepare for the bidding phase and construction activities. He has participated in various review committees to assess the design from all angles, providing constructability reviews that aim to minimize risks and identify cost-saving opportunities to be included in the final design. His objective is to propose value-added design modifications that achieve significant impacts on the project in terms of cost savings and reduced scheduling risk. He conducts constructability reviews through a comprehensive analysis of the existing facilities and proposed designs, along with meetings with the Owner and Engineer of Record to discuss potential opportunities.

Relevant Experience

Resident Engineer, Groundwater Replenishment System Final Expansion (GWRSFE); Fountain Valley, CA; Orange County Water District (Completion: 03/2023; Program Cost: $284 million)—Butier provided pre-bid constructability review, cost/schedule review, project management, resident engineering, QA/QC field inspection, field engineering, and document control services for the final expansion of the water treatment plant. The GWRSFE project provides an additional 30 MGD of advanced treated wastewater to the Orange County groundwater basin. The GWRSFE scope of work included expansion of the existing MF, RO, and UV light treatment processes, in addition to the installation of pumps, chemical storage tanks, chemical dosing pumps, blowers, decarbonators, and electrical components of the facility. The scope of work also included the construction of conveyance facilities at OC San's Plant No. 2, including a pump station building, two prestressed concrete tanks, piping and valving, weir boxes, and sluice gates; and rehabilitating an existing pipeline between Plant No. 2 and Plant No. 1 to bring secondary effluent to the GWRS.

Project Manager, Murphy Reservoir Replacement Project; Whittier, CA; Whittier Utility Authority (Completion: 2025; Construction Value: $6.5 million)—Butier provided construction management, inspection, structural observation, and materials testing services. The scope of work included the replacement of two cylindrical concrete reservoirs with a larger 2.31 MG reservoir to meet operational, fire and emergency storage requirements. The replacement project included the demolition and removal of the existing .5 MG concrete reservoirs, an exterior stairway, interior ladder, access hatches, vent, overflow pipe, drain line, inlet/outlet line, sample taps, level controls, and miscellaneous appurtenances.

Resident Engineer, Burris Pump Station Project—Phases 1 & 2; Anaheim, CA; Orange County Water District (Completion: 2016; Value: $24 million)—Butier provided constructability review (Phase I) and construction management services (Phase II). Phase I involved building a 45-foot-tall earthen cofferdam to encircle the new pump station site by moving 130,000 cubic yards of dirt over 3 months. This cofferdam enabled the construction of the pump station with minimal disruption to the aquatic habitat, allowed nesting birds to use the bird island, and enabled OCWD to continue to capture and pump 400 acre-feet of stormwater flows daily from the Santa Ana River to recharge Orange County's groundwater aquifer. Phase II involved building a 10,000 SF stormwater pump

station featuring four vertical turbine pumps in a circular wet well. It includes new mechanical, HVAC, electrical, instrumentation, and control systems, along with an intake pipe on the slope of the embankment, connecting the new pumps to the intake invert. Site improvements encompassed AC paving, a concrete boat ramp, a gravel road, concrete pads, curbs/gutters, fencing, and gates.

Assistant Resident Engineer, OCWD Advanced Water Quality Assurance Laboratory; Fountain Valley, CA; Orange County Water District (Completion: 2009; Value: $24 million)—Assistant Resident Engineer for construction management and inspection services for the 39,000 square-foot, two-story steel framed sustainable (green) laboratory. Construction management responsibilities include the following: preparing CM and procedures plan and communications manual; documents control; tracking and documenting submittal procedures, correspondence, RFIs, and change orders; reviewing construction documents and cost estimates; developing a QA/QC Plan; scheduling weekly meetings; community relations; coordinating field inspection and testing; contractor claims review; construction progress reports; reviewing/monitoring CPM schedule; Compiling and submitting operation and maintenance manuals; and start-up, close-out, and acceptance services.

Project Manager, Orange County Groundwater Storage Program; Orange County, CA; Orange County Water District (Completion: 2007; Value: $9.6 million)— Butier provided construction management and inspection services for eight (8) municipal water production wells located in the cities of Anaheim, Buena Park, Garden Grove, Santa Ana, Cypress, Westminster, and Placentia. The scope of work included the following: installation of deep well turbine pump and motors, electrical and instrumentation work, disinfection facilities, discharge piping and valving, and off-site piping and valving; construction of concrete block buildings and sitework; and startup, testing, and training. Stephen coordinated closely with seven water agency municipalities and their associated City Building and Public Works Departments.

BUTIER
Construction Managers, Consulting Engineers

Casey Harris

Senior Scheduler

EXPERIENCE
45 Years Total
44 Years with Butier

EDUCATION
B.S., Construction Engineering, Arizona State University, 1977

Graduate Studies, Arizona State University

HOME OFFICE
17822 E. 17th Street, Tustin, CA 92780

PROJECT REFERENCES
GWRS Final Expansion — Orange County Water District
Michael Markus, PE
General Manager (Retired)
(714) 349-1677
michaelmarkus@gmail.com

Professional Summary

Mr. Harris has 45 years of varied experience as a project manager, construction manager, resident engineer, and senior scheduler. As the on-site/owner representative for major municipal, public agency, and special district capital improvement projects, Mr. Harris has successfully managed the construction of multi-million-dollar water and wastewater treatment, pipeline, airport, solid waste landfill, and port facilities. Collectively, this project experience represents over $800 million in construction costs.

Mr. Harris' expertise is in contract administration for design/build, design/bid/build, and construction management programs. He is an expert CPM scheduler, has established and implemented effective change order control systems, negotiated change orders with design/build contractors, performed routine shop drawing reviews, and resolved contractor claims.

Relevant Experience

Senior Scheduler, Trampas Canyon Reservoir and Dam; San Juan Capistrano, CA; Santa Margarita Water District (Completion: April 2021; Value: $88 million)—Butier provided construction management and inspection services for the construction of the Trampas Canyon Reservoir and Dam. SMWD reconstructed the dam and reservoir to create a 5,000 acre-foot recycled water reservoir, which will provide seasonal and operational storage for SMWD's existing and proposed recycled water system. The reservoir will supply irrigation demands for customers in Talega Valley and in Rancho Mission Viejo's (RMV) ongoing Ranch Plan development, as well as other existing irrigation demands in South Orange County. Recycled water will be supplied by the Chiquita Water Reclamation Plant (CWRP) and may be supplemented with other non-domestic water (NDW) supply sources. In addition, the reservoir may provide storage for other recycled water purveyors in South Orange County.

Senior Scheduler, Otay River Estuary Restoration; Chula Vista, CA; Poseidon Water (Completion: 2025; Construction Cost: $35 million)—Butier Engineering Inc. is providing construction management, inspection QA/QC, cost estimating/review, and schedule review services for the Otay River Estuary Restoration project. The project will restore approximately 125 acres of coastal wetland and upland habitats within the San Diego Bay National Wildlife Refuge for the benefit of native fish, migratory birds, and other coastal dependent species. Construction is estimated to be completed in the Winter of 2024.

Project Manager / Senior Scheduler, Groundwater Replenishment System Final Expansion Project; Fountain Valley, CA; Orange County Water District—Mr. Harris was responsible for providing project management, CPM scheduling, and constructability review services for the Groundwater Replenishment System Final Expansion (GWRSFE) Project. The GWRSFE is a water supply project designed to provide an additional 31,000 AFY of advanced treated wastewater (recycled water) to the groundwater basin in north and central Orange County. The GWRSFE scope of work included upgrading the existing 100 MGD Advanced Water Purification Facility (AWPF) by adding 30 MGD of additional capacity; constructing Plant No. 2 Secondary Effluent Conveyance Facilities; and rehabilitating an existing pipeline between Plant No. 2 and Plant No. 1 to bring secondary effluent to the GWRS. The project included the construction of two prestressed concrete cylinder flow EQ tanks (6 MG) at Plant No. 2.

Senior Scheduler, Mid-Basin Injection: Centennial Park Project; Santa Ana, CA; Orange County Water District (Completion: 2020; Value: $29.5 million)— The Mid-Basin Injection project consisted of: the construction of four groundwater injection wells in below grade vaults; two (2) monitoring wells; a purified recycled water injection supply

pipeline approximately 5,700 feet long that connects to the District's existing Groundwater Replenishment System (GWRS) pipeline and crosses the Santa Ana River; a backflush discharge pipeline approximately 4,200 feet long that discharges to the Greenville-Banning Channel and Centennial Park Lake; installation of submersible pumps within the four injection wells; replacement of approximately 9.6 acres of paving within the Park; demolishing an existing City of Santa Ana restroom facility; and constructing two new buildings with shared City and District uses. Butier coordinated closely with the City of Santa Ana, Santa Ana Unified School District, Heritage Museum, and state and federal agencies.

Senior Scheduler, EW-1 Well Equipping Project; Fullerton, CA; Orange County Water District (Completion: September 2017; Value: $1,092,074)—Mr. Harris was responsible for performing schedule review services for the well equipping project. EW-1, which is located on private property in Fullerton Industrial Park, was one of six extraction wells constructed in 2008 as part of a project to contain groundwater with elevated concentrations of volatile organic compounds (VOCs). However, the project was put on hold and the wellhead was not constructed, a pump was not installed, and considerable biological growth formed inside EW-1 as it sat idle for over eight years. The project included rehabilitation and redevelopment of the well, completing construction of the wellhead, installing a submersible pump and shroud, and constructing piping and a connection to a nearby OCSD sewer trunk line in State College Blvd. for discharge of the pumped groundwater. The Butier Team coordinated with OCWD, the Contractor, and the property owner's association to select an acceptable temporary piping route to the nearest storm drain. In addition, a grade separation project was constructed concurrently in State College Blvd. adjacent to Fullerton Industrial Park. The Butier Team was the main point of contact between the Contractor and the City of Fullerton, OCTA and OCSD, to assist in coordinating project construction activities.

Constructability Review and Senior Scheduler, Burris Pump Station Project—Phase 2; Anaheim, CA (Orange County Water District)—Mr. Harris performed civil/structural design review for the Burris Pump Station Project—Phase 2 as a part of Butier's construction management agreement with OCWD. The scope of services included report and data review and Phase 2 Design Review at the 75% design stage. Mr. Harris is currently providing schedule review services under the construction phase of the Burris Pump Station Project. Phase 2 consists of the construction of a new 10,000 SF storm water pump station that will use four conventional vertical turbine pumps installed in a circular wet well. The pump station will also consist of new mechanical, electrical, and control systems. An intake pipe will be installed on the slope of the embankment, connecting the new pumps to the intake invert.

Resident Engineer, OCWD Advanced Water Quality Assurance Laboratory; Fountain Valley, CA; Orange County Water District (Completion: August 2009—Value $24 million)—Resident Engineer for construction management and inspection services for the 39,000 square-foot, two-story steel framed sustainable (green) laboratory. Construction management responsibilities include the following: preparing CM and procedures plan and communications manual; documents control; tracking and documenting submittal procedures, correspondence, RFIs, and change orders; reviewing construction documents and cost estimates; developing a QA/QC Plan; scheduling weekly meetings; community relations; coordinating field inspection and testing; contractor claims review; construction progress reports; reviewing/monitoring CPM schedule; Compiling and submitting operation and maintenance manuals; and start-up, close-out, and acceptance services.

BUTIER
Construction Managers, Consulting Engineers

Bryan Wilson

Document Controls Specialist

EXPERIENCE
20+ Years Total
11 Years with Butier

EDUCATION
B.S., Engineering Technology—Construction, California State Polytechnic University, Pomona, 2000

AREAS OF EXPERTISE
CPM Project Scheduling

Cost Control

Quality Control

Construction & Specialty Trade Estimating

Cost Valuation

Value Engineering

Construction Inspections

Surveying

Structural Design

Change Order Negotiation

Cost Segregation Studies

Project Organization

Engineering Management

Owner Presentations

Project Review

HOME OFFICE
17822 E. 17th Street, Tustin, CA 92780

Professional Summary

Mr. Wilson has over 20 years of construction estimating, cost review, inspection, contract administration, and field engineering management experience. He has analyzed and reviewed cost estimates for hundreds of projects ranging from underground pipelines to high-rise office buildings. He also has experience in organizing and tracking requests for information (RFI), project scheduling, negotiating construction change orders, and value engineering analyses.

Mr. Wilson's range of professional experience includes working for and with construction management firms, general contractors, architecture and engineering firms, and public accounting and consulting firms.

Project Experience

Project Controls, Trampas Canyon Reservoir and Dam; San Juan Capistrano, CA; Santa Margarita Water District (Completion: April 2021; Value: $88 million)—Butier provided construction management and inspection services for the construction of the Trampas Canyon Reservoir and Dam. SMWD reconstructed the dam and reservoir to create a 5,000 acre-foot recycled water reservoir, which will provide seasonal and operational storage for SMWD's existing and proposed recycled water system. The reservoir will supply irrigation demands for customers in Talega Valley and in Rancho Mission Viejo's (RMV) ongoing Ranch Plan development, as well as other existing irrigation demands in South Orange County. Recycled water will be supplied by the Chiquita Water Reclamation Plant (CWRP) and may be supplemented with other non-domestic water (NDW) supply sources. In addition, the reservoir may provide storage for other recycled water purveyors in South Orange County.

Project Controls, Murphy Reservoir Replacement Project; Whitter, CA; Whittier Utility Authority (Completion 1/2025; Construction Value: $6.5 million)—Butier provided construction management, inspection, structural observation, and materials testing services for the Murphy Reservoir Replacement project. The scope of work included the replacement of two cylindrical concrete reservoirs with a larger 2.31 MG reservoir to meet operational, fire and emergency storage requirements. The replacement project included the demolition and removal of the existing .5 MG concrete reservoirs, an exterior stairway, interior ladder, access hatches, vent, overflow pipe, drain line, inlet/outlet line, sample taps, level controls, and miscellaneous appurtenances. Also included is the grading of the site, shotcrete retaining wall, concrete masonry block retaining wall, concrete curb and gutter and concrete swale for proper site drainage.

Field Engineer, Groundwater Replenishment System Final Expansion (GWRSFE); Fountain Valley, CA; Orange County Water District (Completion: 03/2023; Construction Value: $198,138,145)—Butier provided project management and inspection services. The GWRSFE is a water supply project designed to provide an additional 31,000 AFY of advanced treated wastewater (recycled water) to the groundwater basin in north and central Orange County. The GWRSFE scope of work included upgrading the existing 100 MGD Advanced Water Purification Facility (AWPF) by adding 30 MGD of additional capacity; constructing Plant No. 2 Secondary Effluent Conveyance Facilities; and rehabilitating an existing pipeline between Plant No. 2 and Plant No. 1 to bring secondary effluent to the GWRS.

Document Control Specialist, Otay River Estuary Restoration; Chula Vista, CA; Poseidon Water (Completion: 2025; Construction Cost: $35 million)—Butier Engineering Inc. is providing construction management, inspection QA/QC, cost estimating/review, and schedule review services for the Otay River Estuary Restoration project. The project will restore approximately 125 acres of coastal wetland and upland habitats within the San Diego Bay National Wildlife Refuge for the benefit of native fish,

migratory birds, and other coastal dependent species. Construction is estimated to be completed in the Winter of 2024.

Document Control Specialist, PFAS Water Treatment Plant, Orange County Water District, Tustin, California (Estimated Completion: 2025; Value: $26M)—The project includes the construction of conveyance pipelines to transport water extracted from four wells to a new PFAS water treatment facility. The treatment facility will consist of four ion exchange (IX) vessels to treat the water produced from the extraction wells. Additional project components include the construction of a new section of distribution piping from the Main Street Water Treatment Plant, upgraded booster pumps to handle the additional flows, and replacement of the existing nitrate treatment system.

Office Engineer/Document Control Specialist, Mid-Basin Injection: Centennial Park Project; Santa Ana, CA; Orange County Water District (Completion: 2020; Value: $29.5 million)— The Mid-Basin Injection project consisted of the construction of the following: four groundwater injection wells in below grade vaults; two (2) monitoring wells; a purified recycled water injection supply pipeline approximately 5,700 feet long that connects to the District's existing Groundwater Replenishment System (GWRS) pipeline and crosses the Santa Ana River; a backflush discharge pipeline approximately 4,200 feet long that discharges to the Greenville-Banning Channel and Centennial Park Lake; installation of submersible pumps within the four injection wells; replacement of approximately 9.6 acres of paving within the Park; demolishing an existing City of Santa Ana restroom facility; and constructing two new buildings with shared City and District uses.

Field Engineer, ID1 Capacity, Reliability, and Augmentation Project #1; Tustin, CA; East Orange County Water District (Completion: 2022; Construction Cost: $5 million)— The project is located east of the I-5 freeway and El Camino Real at the intersection of Sierra Vista Drive and Browning Avenue. The scope of work included replacing the existing gravity interceptor sewer with new sewer pipes ranging in size from 15" diameter to 18" diameter. Work includes, but is not limited to, piping installed by open-cut methods, a new manhole, and all other work required in accordance with the Contract Documents.

Field Engineer/Document Controls, EW-1 Well Equipping Project; Fullerton, CA; Orange County Water District (Completion: September 2017; Value: $1,092,074)— Rehabilitation and redevelopment of the well, completing construction of the wellhead, installing a submersible pump and shroud, and constructing piping and a connection to a nearby OCSD sewer trunk line in State College Blvd. for discharge of the pumped groundwater.

Ninyo & Moore

Key Personnel Rèsumès

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Garreth Saiki, PE, GE

Principal Geotechnical Engineer

EXPERIENCE

28 Years Total
26 Years with Ninyo & Moore

EDUCATION

MBA, 1998, University of California Davis

M.S., Geotechnical Engineering, 1989, University of California Berkeley

B.S., Civil Engineering, 1987, University of California Berkeley

LICENSES / CERTIFICATIONS

PE 49665 (California)
Issue: 1/1992
Expires: 9/2026

GE 2509 (California)
Issue: 1/2000
Expires: 9/2026

Nuclear Gauge Operator Certification

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers

HOME OFFICE

475 Goddard, Ste 200, Irvine, CA 92618

Professional Summary

As a Principal Engineer for Ninyo & Moore, Mr. Saiki coordinates and conducts geotechnical evaluations for residential, commercial, and public facilities, including highways, railroads, airports, pipelines, public and private buildings, and bridges; performs slope stability analyses, flexible and rigid pavement design, and underground pipeline design; prepares and reviews geotechnical reports; and provides geotechnical design parameters and recommendations for shallow and deep foundations, retaining structures, in-situ ground remediation and earthwork; reviews laboratory results, project plans and specifications; provides supervision and technical support to staff-level engineers and geologists; performs project administration and management; and provides forensic evaluation of distressed pavement, residential and commercial structures.

Project Experience

Orange County Water District, Smith Basin Scour Assessment, Villa Park, California: Served as Principal Engineer performing a preliminary geotechnical evaluation of erosion that has occurred on the embankment slopes at Orange County Water District's Smith Basin located on Santiago Creek in Villa Park, California. Smith Basin was a former sand and gravel quarry located adjacent to Santiago Creek. Portions of the embankment slopes have experienced varied amounts of erosion from seasonal water runoff, major flood events, and water impoundment. Following our preliminary geotechnical evaluation, Ninyo & Moore performed a design-level geotechnical evaluation for the project. The purpose of this study was to perform subsurface exploration and slope stability analyses of the basin embankment slopes in order to develop geotechnical design and construction recommendations for the rehabilitation of the basin slopes.

Irvine Ranch Water District, On-Call Geotechnical Services, Orange County, California: Principal Engineer retained by the Irvine Ranch Water District to provide soils and materials testing services for various projects in Orange County. The various projects included Sewer Manhole Access Road Improvement, University of California, Irvine (UCI) Cooling Tower RW Conversion Pipeline, PA 51, Reach A, Phase II Sewer Improvements, and MWRP FPS2 Header Replacement. Our services included project coordination and management, and preparation of limited geotechnical evaluations and materials testing services.

Orange County Sanitation District, On-Call Geotechnical, Materials Testing, and Inspection Services for Collection Systems and Treatment Plant Projects, Orange County, California: Served as Project Manager for four consecutive contract periods (over 43 projects) to provide the Authority with as-requested geotechnical, materials testing, and inspection services for various projects located within the Authority's Collection System, Treatment Plant No. 1 in Fountain Valley and Treatment Plant No. 2 in Huntington Beach. Ninyo & Moore has provided field technicians and registered deputy inspectors on various Authority projects to perform field sampling and testing of materials and special inspection services.

South Coast Water District, As-Needed Geotechnical Engineering Services, Orange County, California: Principal Engineer retained to provide as-needed geotechnical engineering services that involved evaluations for design of new facilities or upgrades to existing facilities, including pipelines, pump stations, reservoirs, and various related structures. Services also included providing construction inspection and materials testing services, which included geotechnical observation and testing (compaction testing and laboratory soil testing) and materials testing (concrete and asphalt concrete testing) to check for compliance with project specifications and applicable codes and standards.

East Valley Water District, Materials Testing and Inspection Services for Various Water Projects: Served as Principal Engineer, providing oversight for materials testing

and inspection services for various projects for the district. These projects included the Pumalo Casa Water Improvements, Plant 40 Pump Station Improvements, the Sterling Avenue and Highland Avenue Waterline Repair Project, and the Seire Avenue and Baseline Avenue Repair Project.

Elsinore Valley Municipal Water District, On-Call Geotechnical and Materials Testing Services, Lake Elsinore, California: Served as Principal Engineer, providing oversight and technical input for the on-call materials testing services contract for various projects. Services consisted of as-requested, observation and field density testing during fill placement, sampling of the materials, and submittal of the test data. Laboratory testing generally consisted of Proctor density and expansion index testing on the materials sampled in the field.

West Basin Municipal Water District, On-Call Construction Management Services: Serving as Principal Engineer, providing oversight for on-call materials testing and inspection services for various water projects for the district. Projects have included the El Segundo Recycled Water Service Connection Project, the Northrop Grumman Recycled Water Service Connections, the Sodium Hypochlorite Storage Tank Replacements Project, and the T22 Alkalinity Improvements.

Inland Empire Utilities Agency On-Call Geotechnical Materials Testing and Inspection Services, Riverside County, California: Principal Engineer retained during on-call construction inspection, as well as geotechnical and materials testing services during the various Inland Empire Utilities Agency (IEUA) construction projects located throughout the Inland Empire. Services were provided for geotechnical design, consulting, testing, and inspection, as well as special inspection services for welding, fireproofing, and reinforced concrete and masonry inspection. Projects included new pipeline, pump station, and building construction, as well as new solar panel construction at the various Agency facilities.

Jurupa Community Services District Pyrite Creek/Regional Wastewater, Jurupa Valley, California: Principal-in-Charge during construction of the Pyrite Creek Trunk Sewer and Regional Wastewater Force Main projects. The project consisted of a sewer line and sewer force main, a sewer lift station, laterals, manholes, a sluice gate, couplers, fire hydrants, flanges, a storm drain, an electrical conduit, a curb and gutter, an aggregate base, an asphalt concrete paving overlay, traffic signal loops, and other miscellaneous appurtenances. Field services included observation, sampling, and testing during the trench backfill process, manhole construction, fine grading of subgrade and aggregate base, and asphalt concrete lay-down operations. Laboratory testing services included Proctor density, sieve analysis, sand equivalent, percent wear, durability, concrete compression, R-value, Hveem, gradation, and asphalt concrete core density.

Long Beach Water District, On-Call Geotechnical Engineering Support Services, Long Beach, California: Project Manager retained to provide geotechnical engineering support to the Long Beach Water District that involved services on an as-needed basis for the CIP located throughout the Long Beach vicinity. Under this contract, Ninyo & Moore provided geotechnical consulting services for the Atlantic Avenue Sewer Main Relocation project located at Atlantic Avenue from 56th Street to 59th Street in Long Beach, California.

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Michael Putt, PE, CEG

Principal Geologist

EXPERIENCE

28 Years Total
16 Years with Ninyo & Moore

EDUCATION

B.S., Geology, California State University, Fullerton, 1997

Applied Rock Slope Engineering Short Course, Association of Engineering Geologists, California, 2006

LICENSES / CERTIFICATIONS

PG 7581 (California)
Issued: 1/2003
Expires: 10/2025

CEG 2341 (California)
Issued: 1/2004
Expires: 10/2025

Radiological Safety and Gauge Use Certification, 1997

PROFESSIONAL AFFILIATIONS

South Coast Geological Society

HOME OFFICE

475 Goddard, Ste 200, Irvine, CA 92618

Professional Summary

Mr. Putt is a Principal Geologist with Ninyo & Moore and has extensive experience in providing engineering geology consultation in Southern California. Mr. Putt has extensive experience on a variety of project types, including highways, bridges, jack and bore tunneled undercrossings, hillside and flat-land mass grading projects for residential, commercial, and industrial developments, pipelines, and forensic investigations. Mr. Putt performs project administration and management, prepares and reviews geologic and geotechnical reports, and provides third-party review services for geotechnical reports. He conducts geologic and geotechnical field evaluations, including detailed logging of large- and small-diameter borings and trenches, as well as geologic evaluation/mapping. Projects have included fault hazard evaluations, landslide studies, slope stability analysis, seismic refraction studies, geologic reconnaissance studies, forensic evaluations, and construction and inspection services.

Project Experience

Orange County Water District, Smith Basin Scour Assessment, Villa Park, California: Served as Project Manager performing a preliminary geotechnical evaluation of erosion that has occurred on the embankment slopes at Orange County Water District's Smith Basin located on Santiago Creek in Villa Park, California. Smith Basin was a former sand and gravel quarry located adjacent to Santiago Creek. Portions of the embankment slopes have experienced varied amounts of erosion from seasonal water runoff, major flood events, and water impoundment. Following our preliminary geotechnical evaluation, Ninyo & Moore performed a design-level geotechnical evaluation for the project. The purpose of this study was to perform subsurface exploration and slope stability analyses of the basin embankment slopes in order to develop geotechnical design and construction recommendations for the rehabilitation of the basin slopes.

Orange County Water District, Burris and Lincoln Basin Reconfiguration Project, Anaheim, California: Served as Project Manager for the design and construction of the Orange County Water District groundwater recharge basin reconfiguration project in Anaheim, California. The project included excavation of the low-permeability materials and selective grading to replace the excavated areas with higher-permeability sand and gravel. Specific challenges related to this project included evaluation of the stability of the levee between the Santa Ana River and the basins for the proposed design conditions, temporary excavation during site grading, rapid drawdown (seepage) conditions, and pseudo-static conditions. Services included geotechnical observation and testing services during grading of the Burris and Lincoln Basins Reconfiguration Project and during construction of the Burris Basin Transfer Well, including observation of low permeability clay and silt removal and evaluation of excavation bottoms for appropriate high permeability sand; observation and assistance to the grading contractor during selective grading to generate high permeability sand for recharge areas; daily monitoring of temporary cut slopes; construction of planned buttresses; construction of structural fills, including basin berm, channel, and habitat island; and as-needed laboratory testing, including Proctor density/optimum moisture of fill materials, sieve analysis for select material evaluation and shear strength testing for buttress material.

Orange County Water District, Five Coves and Lincoln Basins Bypass Pipeline, Anaheim, California: Served as Project Manager for the design of a new water conveyance and distribution system that provides greater operational flexibility of the existing water distribution system. The pipeline project allows the individual groundwater recharge basins to be isolated for cyclical cleaning while maintaining flow to the rest of the system. The project included the design of approximately 4,300 linear feet of 66-inch-diameter pipeline and related flow control structures, a new earthen levee, and repairs to an existing levee. A portion of the pipeline included tunneling under an existing arterial roadway. Geotechnical concerns for the project included stability of temporary trenches

for pipeline construction, soft subgrade soils at pipeline subgrade, beneath the proposed levee, and other structures, and the presence of construction debris and running sands for the tunneling portion of the project.

Orange County Water District, Santiago Floating Pump Station, Orange, California: Served as Project Manager providing geotechnical consulting services for the Santiago Floating Pump Station project at the Santiago Recharge Basins in the City of Orange. The Santiago Basins are comprised of three basins, the Bond Pit, Blue Diamond Pit, and Smith Pit. The basins cover an area of approximately 250 acres and were a former aggregate quarry prior to being purchased by OCWD for water storage and groundwater recharge purposes. The purpose of the project was to re-establish the pumping capacity of the basin by constructing a new pump station to replace the existing submerged pump station. Mr. Putt performed stability analyses to address the existing slope conditions and potential stability issues at the site. Services included technical review of previous geotechnical data, review of geologic background data, field geologic mapping of slopes, preparation of geologic cross sections, and slope stability models. Our analyses included evaluation of slope stability for various basin operating levels. In addition, we simulated rapid drawdown conditions to evaluate potential failure mechanisms. The results of our evaluation were presented in an illustrated report.

Orange County Water District, Weir Pond Rehabilitation, Anaheim, California: Served as Project Manager providing geotechnical consulting services for the Orange County Water District's Weir Pond Rehabilitation Project in Anaheim, California. The project involved the reconstruction of two weirs and a Parshall flume that directs storm water from the Santa Ana River into the weir ponds system for desilting purposes prior to distribution into the District's recharge spreading facilities. The structures had deteriorated since they were constructed in the 1970's and seepage had been observed on the downstream faces of the weirs. Services included drilling seven small-diameter borings, geotechnical engineering analysis, and preparation of a geotechnical evaluation report presenting recommendations for earthwork and foundation design. Geotechnical engineering analysis included seepage analysis, uplift analysis, and slope stability analysis for static, pseudo-static, and rapid drawdown conditions.

OCTA/SCRRA/Railroad Track Slope Stabilization Project, Irvine to San Juan Capistrano, California: Served as Principal Geologist, providing a geotechnical evaluation of eight sites along the Orange County Transportation Authority-owned railroad corridor operated by the Southern California Regional Rail Authority (SCRRA). The eight sites have experienced varied amounts of erosion from seasonal water runoff that affects the existing rails and adjacent properties. The purpose of our evaluation was to perform surficial geologic mapping of each site in order to provide geotechnical information regarding the erosional conditions in the areas of concern and to provide recommendations for mitigation alternatives.

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Steve Eck

Senior Field Technician

EXPERIENCE

30 Years Total
14 Years with Ninyo & Moore

CERTIFICATIONS

ACI Field Testing Technician Grade I
Earned: 5/2015
Expires: 7/2025

City of Los Angeles Deputy Grading Inspector Radiation (Nuclear Gauge) User Safety
Earned: 1/2012
Expires: 7/2025

HOME OFFICE

475 Goddard, Ste 200, Irvine, CA 92618

Professional Summary

As a Senior Field Technician for Ninyo & Moore, Mr. Eck performs field testing of concrete and asphalt, inspection of asphalt and concrete batch plants, geotechnical laboratory testing, quality control for all laboratory procedures, including fulfilling requirements for ASTM, AASHTO, CALTRANS, ACI, and UBC Standards. Additionally, he provides geotechnical observation and testing services for earthwork projects. His field experience includes drill foundation, slope stability reconstruction, mass grading, and individual building pad overexcavation and recompaction; canyon clean-outs, retaining walls, structural, and trench backfills; caisson excavation and pile driving observation and documentation; roadway testing during subgrade, aggregate base, and asphalt concrete construction.

Project Experience

Irvine Ranch Water District (IRWD)/Syphon Reservoir Improvement, Irvine, CA: Served as Senior Field Technician providing geotechnical, materials testing, and special inspection services during construction of the Syphon Reservoir Improvements project. The project consisted of constructing a new access road into the reservoir site. The improvements included a new retaining wall, soil nail wall, storm drain system, asphalt concrete pavement, light poles, slurry seal and concrete sidewalks, curb and gutter, curb ramps, and driveways.

IRWD/Fleming Reservoir and Pump Station Project, Irvine, CA: Served as Senior Field Technician providing geotechnical and materials testing services during construction of the Fleming Reservoir and Pump Station project. The project consists of a new 1.3MG Reservoir, a new RMS Building, a Pump Station, a Storage Building, and various site improvements. The reservoir is an 80-foot diameter DYK-type design concrete tank with seismic cables, tensioning rods, shotcrete exterior over stressed strands, and steel stairs. Other site improvements included yard piping, overflow vault, drain inspection vault, sewer holding tank, generator, retaining walls, storm drain system with biofiltration, surge tank, pipe support structures, and asphalt concrete pavement. Geotechnical services included observation and testing during compacted fill, trench backfill, and subgrade preparation. Field density testing was performed during fill placement to evaluate the contractor's compaction efforts. Materials testing services include concrete sampling and testing. Laboratory testing included Proctor density, sieve analysis, sand equivalent, and concrete compressive strength testing.

IRWD/ILP North Conversion Santiago Hills Reservoir, Orange, CA: Served as Senior Field Technician providing geotechnical and materials testing services during construction of the ILP North Conversion Santiago Hills Zone C+ Reservoir project. The project generally consisted of a new concrete reservoir, modifications at the Rattlesnake Complex, and modifications at the Orchard Hills Strainer Facility. The new reservoir is a 2.4 MG buried prestressed concrete tank. Other project improvements included two geo-grid reinforced retaining walls, yard piping, buried concrete structures, concrete equipment and tank pads, and other various improvements. The earthwork for the tank pad preparation included over-excavation and recompaction to provide 3 feet of engineered fill and 12 inches of aggregate base below the tank.

IRWD/Orange Park Acres Well No. 1 Wellhead Facilities, Orange, California: Served as Senior Field Technician to provide geotechnical observation and testing services during construction of the proposed Orange Park Acres Well No. 1 Wellhead Facilities Project located in Orange, California. The project consisted of constructing a well/booster pump building, including a 15-foot deep clear well, chemical building, surge tank & pad, concrete masonry unit site walls, and associated site underground utilities and electrical service facilities, as well as site paving.

Steve Eck

Senior Field Technician

IRWD/Baker Water Treatment Plant, Lake Forest, CA: Served as Senior Field Technician providing geotechnical observation and testing during construction of the Baker Water Treatment Plant project located in Lake Forest, California. The project generally consisted of constructing several new structures, including a flow control facility, three pump stations, a chemical building, and a treatment building. The project also included yard piping, overflow pipe, and a product water line. The structures are supported by mat slabs and shallow spread footings. The site improvements also included retaining walls and new access roads. The earthwork for the building pad preparation included over-excavating up to 25 feet in depth. Site earthwork also included excavation for foundations, structural backfill, trench backfill, and subgrade preparation.

IRWD/Woodbridge Recycled Water Pipeline, Irvine, CA: Senior Field Technician for geotechnical testing services during construction of the Woodbridge Reclaimed Water Main project. The project included 47,200 linear feet of new underground piping. The project also included new hardscape and asphalt concrete pavement. Geotechnical services included observation and testing during trench backfill, subgrade preparation, and asphalt concrete placement. Field density testing was performed to evaluate the contractor's compaction efforts. Laboratory testing included Proctor density, sand equivalent, and Hveem stability & unit weight testing.

City of Los Angeles, Machado Lake Ecosystem Rehabilitation Project, Harbor City, California: Senior Field Technician retained for observation and testing services during the construction phase of the Machado Lake Ecosystem Rehabilitation project located in Harbor City, California. Services included evaluation of the soil conditions on site with regard to geotechnical design recommendations, and evaluation of the contractor's performance with regard to the project specifications. Services also included geotechnical observation and testing during remedial excavations for at-grade and below-grade structures, grading of lake edge and park improvements, installation of cast-in-drilled-hole (CIDH) pile foundations for the fishing piers, construction of dam improvements and the sediment basin, and backfill of structures and underground utilities

Wilson Reservoir Replacement Project, South Pasadena, California: Senior Field Technician performed materials testing and special inspection services during the construction of the Wilson Reservoir Replacement Project. The project consisted of replacing the existing reservoir and various improvements at the existing site. The new structures included a new Pump Station and Operations buildings, as well as new Clearwell and Reservoir structures. Services included field observation and testing, as well as providing as-needed reinforced masonry special inspection services for the areas of reinforced masonry construction. Services also included laboratory testing services that included sieve analysis, sand equivalent, proctor density, and asphalt concrete maximum density testing, as well as concrete, grout, and mortar compressive strength testing and concrete shrinkage testing.

Temescal Canyon Stormwater BMP, Pacific Palisades, California: Senior Field Technician retained during design and construction of the Temescal Canyon Stormwater Best Management Practices (BMP) project in Pacific Palisades. The project included the construction of a new approximately 35-feet-deep subsurface tank in Temescal Canyon Park, a new diversion structure to divert water to the tank from an existing storm drain, new hydrodynamic separators, and associated pipelines. Services included observation and testing services and specialty inspection services for the project, which included observation of soil nail shoring installation and foundation construction, field density testing of trench and retaining wall backfill, and deputy inspection of shotcrete and grout during shoring installation.

DRAFT

ORANGE COUNTY WATER DISTRICT

REQUEST FOR PROPOSALS
RFP-24-021

FOR
Engineering and Hydrogeologic Services Santa Ana River Riverbed Filtration System Feasibility Study

ISSUED: May 22, 2025

PROPOSALS DUE:

June 12, 2025 at 11:00AM PT

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List of Exhibits:

List of Attachments:

The Orange County Water District ("OCWD" or District) is seeking proposals from qualified and experienced firms to provide Engineering and Hydrogeologic Services for the Santa Ana River Riverbed Filtration System Feasibility Study. OCWD intends to evaluate the proposals received and enter into a Professional Services Agreement ("Agreement") with the qualified firm. The work is expected to commence on July 1, 2025. This Agreement will be for a minimum term of one (1) year from July 1, 2025 to June 30, 2026. The Agreement will be monitored closely for acceptable services rendered throughout the Agreement term. OCWD will have the option to terminate the contract in whole or in part during the Agreement term, for any reason or no reason, without penalty, upon notice. The proposer will not be entitled to lost profits or any other compensation not earned prior to the time of termination.

This Request for Proposal ("RFP") describes the required scope of services, the information that must be included in the proposal, and the proposal selection process. Proposers are encouraged to carefully review this RFP in its entirety prior to submitting their proposals. Failure to submit information in accordance with these requirements and procedures may be cause for disqualification.

1. INTRODUCTION

The OCWD is an internationally recognized leader in the water industry that was formed in 1933 by the California State Legislature which entrusted OCWD to guard and protect the region's groundwater basin and limited water supply. OCWD's mission is to provide a reliable supply of high-quality water that is sourced in an environmentally responsible manner to the more than 2.5 million residents and businesses within the 270 square mile service area of Orange County, California that OCWD serves. OCWD manages three of Southern California's greatest water supplies, this includes protecting rights to the Santa Ana River, managing and replenishing the Orange County Groundwater Basin, and operating and maintaining the Groundwater Replenishment System (GWRS), the world's largest advanced water purification system for potable water reuse. More information regarding the OCWD can be found at www.ocwd.com.

2. SOLICITATION SCHEDULE

The solicitation schedule is summarized in the table below. OCWD reserves the right to modify the schedule below at its discretion. Proper notification changes will be made to interested proposers.

RFP Issued	May 22, 2025
Pre-Proposal Meeting	N/A
Questions Due Date	May 29, 2025 at 12:00PM PT
Proposals Due	June 12, 2025 at 11:00AM PT
Agreement Award Date:	July 2025

2.1. PRE-PROPOSAL MEETING

There will be no pre-proposal meeting held for this project.

2.2. QUESTIONS CONCERNING REQUEST FOR PROPOSALS

All questions regarding the RFP must be submitted in writing before the deadline due date of **May 29, 2025 at 12:00PM PT**. All questions must be titled "Question – **RFP-24-021 Engineering and Hydrogeologic Services for the Santa Ana River Riverbed Filtration System Feasibility Study**". Responses to questions received from prospective proposers will be formally documented in a Question and Answer (Q&A) table that will be posted on the OCWD website: https://www.ocwd.com/working-with-us/rfp-contracts/. The Q&A table will be updated regularly as questions are received from prospective proposers. Questions received after the questions due date will not be considered.

Attention: Ashlie Valencia, Contracts Administrator
Email: procurement@ocwd.com

2.3. DEADLINE FOR PROPOSALS

Three (3) hard copies and one (1) electronic flash drive copy of the proposal must be received in a sealed envelope by OCWD no later than **June 12, 2025 at 11:00AM PT** or such later time that OCWD may announce by an addendum at any time prior to the proposal deadline. The envelope shall be plainly marked on the exterior "Proposal for **RFP-24-021 Engineering and Hydrogeologic Services Santa Ana River Riverbed Filtration System Feasibility Study"** and with the name, company name, and address of the proposer.

Proposals must be mailed or delivered in person or via courier services at the District office listed below. To deliver submittal packages in person or via courier, please notify the guard at the main gate for proposal drop off. Sealed envelopes will be timestamped upon receipt at the receptionist desk.

Orange County Water District
Administration Office Building
Attention: Ashlie Valencia, Contracts Administrator
Address: 18700 Ward Street
Fountain Valley, CA 92708

It is the Proposer's responsibility to ensure that proposals are received prior to the submittal deadline. Proposal packages should also include all signed Acknowledgment of Addendum forms that may be issued by OCWD as part of this RFP process, as further described below. Proposals received after the deadline will not be considered under any circumstances. FAXED OR E-MAILED SUBMISSIONS WILL NOT BE ACCEPTED. The OCWD will not be responsible for the proper identification and handling of any proposals submitted incorrectly. Only responses properly submitted to OCWD will be considered.

OCWD reserves the right to reject any and/or all responses received. There will be no formal opening of the proposals.

2.4. PRE-SUBMITTAL ACTIVITIES

The District reserves the right to revise the RFP prior to the date the Proposals are due. Addendums to the RFP shall be posted on the OCWD website: https://www.ocwd.com/working-with-us/rfp-contracts/ for all interested Proposers. The District reserves the right to extend the date by which the Proposals are due.

3. PROJECT BACKGROUND AND DESCRIPTION

Clogging due to the accumulation of suspended solids is a constraint that limits the capacity of OCWD's surface water recharge system. To decrease clogging and increase system capacity, OCWD has conducted extensive pilot testing and analysis of multiple methods designed to remove suspended solids from Santa Ana River (SAR) water and the resultant impact on recharge rates. Based on these tests, Riverbed Filtration, which is a variation of Riverbank Filtration, was shown to be highly effective in removing total suspended solids (TSS) and increasing recharge rates. These results are summarized in a report, Recharge Water Sediment Removal Feasibility Study, Final Report, February 2010, prepared by HDR, Inc., that is included in Exhibit A.

As a result, in 2013, OCWD constructed a large-scale demonstration Riverbed Filtration System (RFS) that covers approximately 10 acres and produces up to 20 cubic feet per second (cfs) of treated water using gravity flow. The RFS is located in the Off-River Channel directly downstream of Weir Pond 4 as shown in Figure 1. The treated water is conveyed to Olive Basin which had historically received untreated SAR water.

Extensive data collection and testing of the RFS was conducted from 2015 to 2023. The scope of testing included measuring the capacity of the RFS using different types of subsurface collection system materials, measuring the impact on recharge rates in Olive Basin, and measuring reductions in TSS concentrations and other water quality parameters. In summary, the RFS removed an average of 96 percent of the TSS in SAR water and more than doubled the recharge capacity of Olive Basin. The increased recharge capacity of Olive Basin is consistent with increases seen in other recharge basins receiving low TSS imported water and highly treated recycled water produced by the OCWD Groundwater Replenishment System. The results of the demonstration project are summarized in a report, Riverbed Filtration System, Demonstration Project Results and Recommendations, October 2024, that is included in Exhibit A.

Figure 1: Location of RFS Demonstration Project

The demonstration test results show that the RFS has the potential to increase recharge system capacity, particularly within the Terminal Recharge Basins, which are a series of eight shallow and deep recharge basins starting at Warner Basin and extending to Raymond Basin. These basins are particularly prone to clogging because suspended solids rapidly accumulate on the recharge surface in the placid waters of the basins.

Given the significant potential for increased recharge and capturing water that would otherwise be lost to the ocean, OCWD is interested in further examining the feasibility of scaling up the RFS to supply some or all the Terminal Recharge Basins that receive Santa Ana River water. This would include an analysis of using gravity, pumping, or a combination of both to supply water to the Terminal Recharge Basins. Figure 2 shows where the Terminal Recharge Basins are located. The area under consideration includes the Santa Ana River channel adjacent to OCWD's recharge system upstream to Weir Canyon Road. OCWD's Off-River System should also be considered (see Figure 2). OCWD owns the Santa Ana River channel from Imperial Highway to Ball Road. The area upstream of Imperial Highway to Weir Canyon Road is owned by Orange County Public Works (OCPW). Any work conducted in both areas will require the approval of the U.S. Army Corps of Engineers (USACE) and OCPW. The Off-River System owned by OCWD may require fewer regulatory approvals compared to work done in the Santa Ana River channel.

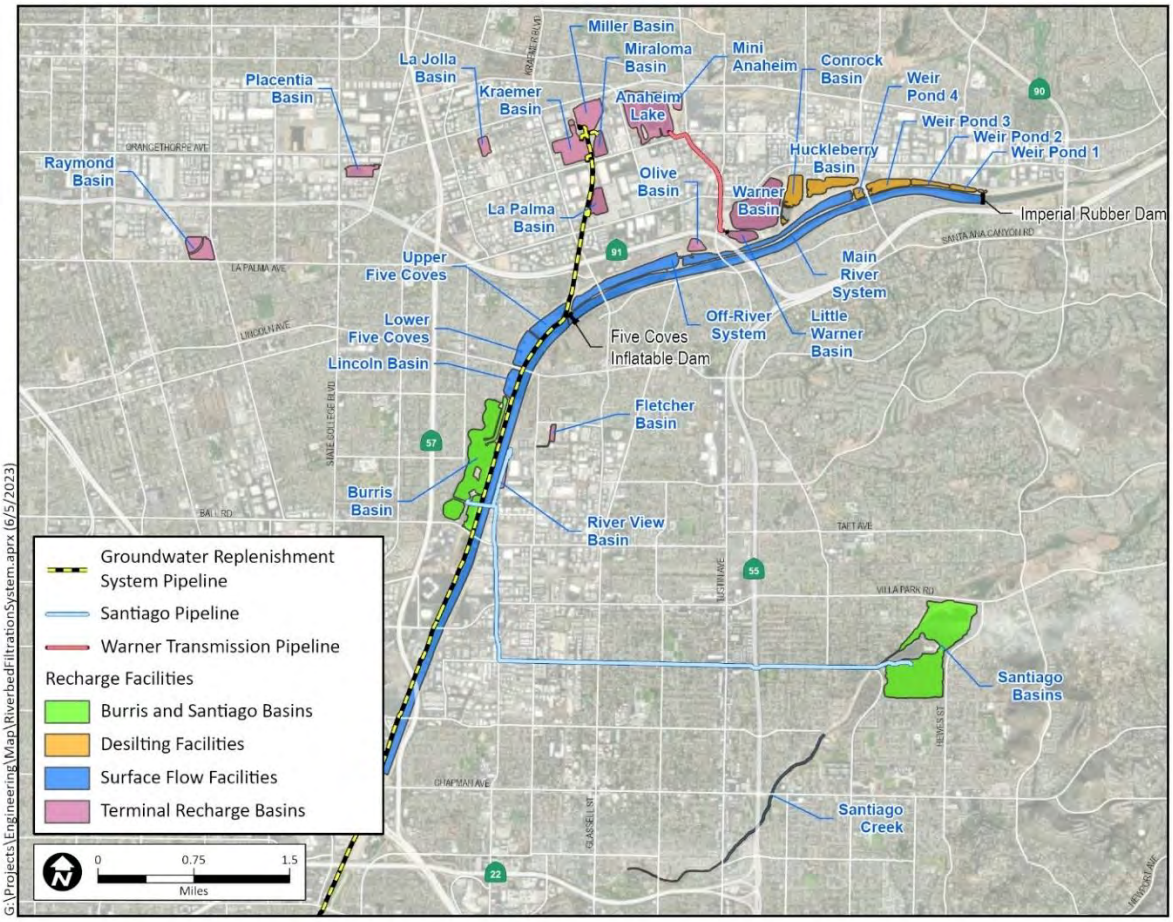


Figure 2: OCWD Surface Water Recharge Facilities

There are several entry points for water collected by a potential RFS into OCWD's recharge system. The ultimate design, if feasible, would be to supply the Warner Basin System and downstream basins. The Warner Basin System is designed to handle up to 450 cfs of flow. Flow out of the Warner System is via the Warner Transmission Pipeline: a 66-inch diameter reinforced concrete pipe (RCP) gravity flow pipeline that can handle up to 170 cfs. There is also a pipeline called the Warner Bypass Pipeline (60-inch diameter, cement mortar lined and coated steel pipe [CMLCSP]) that allows water by gravity from Weir Pond 4 to the Warner Transmission Pipeline. It is envisioned that the Imperial Rubber Dam would continue to divert surface water to the Weir Ponds and to the Off-River System but that this water would not comingle with RFS water. A potential constraint to keep in mind are Points of Diversion (PODs) defined in OCWD's water right to Santa Ana River water. Currently this water right includes PODs to divert water from the SAR at Imperial Highway, Lakeview Avenue and Tustin Avenue, which are shown in Figure 3. New PODs can be created but take time to gain approval from the State Water Resources Control Board (SWRCB).

The potential benefits of an expanded RFS were evaluated using OCWD's Recharge Facilities Model (RFM). Six RFS alternatives were developed (see Appendix D of RFS Demonstration Project Report in Exhibit A) and two are presented here as follows:

Alternative 3a:

- Maximum RFS flow to Terminal Basin System: 450 cfs
- Flow in SAR greater than 450 cfs is conveyed to the Off-River System
- Maximum flow through Warner Transmission Pipeline: 170 cfs
- No clogging caused by recharge water

Alternative 3b:

- Same conditions as above, except:
- No max flow limit in Warner Transmission Pipeline

The purpose of Alternative 3a is to examine the potential benefit of maximizing the diversion of RFS water directly to the Warner System, which has a conveyance capacity of 450 cfs. The details of how these flows would be conveyed or separated will be explored in this Feasibility Study. The maximum flow from the Warner System to the downstream facilities is limited to the current maximum of 170 cfs. To examine the maximum potential of using RFS water, no clogging is assumed.

Alternative 3b is the same as Alternative 3a except the capacity of the Warner Transmission Pipeline is undefined in that it will supply whatever flows are needed in the downstream basins. This was done to see what the peak demand of the downstream basins is and as a starting point to optimize the capacity of this pipeline in a future phase of work.

The results of Alternative 3a indicate that with the RFS, removing the flow constraint of the Warner Transmission Pipeline could produce an additional 1,100 afy of recharge. Additional work needs to be done to evaluate the benefits of the additional recharge versus the cost of expanding the pipeline's capacity. This could also include a phased approach to constructing the RFS to assess the production capacity of each phase before moving to the next phase until the appropriate capacity is developed.

A potential phased approach to implementing this project is to start with Phase I, which would only supply the Terminal Recharge Basins located downstream of the Warner Transmission Pipeline. Figure 3 shows the potential area where a gravity or pumped RFS could be constructed and potential discharge locations to the Warner Transmission Pipeline (A) and the Warner Bypass Pipeline (B).

Table 1 presents the current capacity of the Warner Transmission Pipeline and Warner Bypass Pipeline using gravity and potential future capacities if these lines were pressurized.

Table 1. Current and Potential Flow Rates in Warner Transmission Pipeline and Warner Bypass Pipeline

Pipeline	Pipeline Details	Gravity Flow Rate (cfs)	Potential Future Pipeline Details	Potential Pressure Flow Rate (cfs)*
Warner Transmission Pipeline	66-inch RCP	170	65-inch (0.5-in HDPE liner)	115-230
Warner Bypass Pipeline	60-inch CMLCSP	100	No change	100-200

*Assumes 5 to 10 ft/second velocity

Phase II could include expanding the RFS to supply the Warner Basin System, which contains a total of 4,100 acre-feet of storage. Phase II water could be discharged to Huckleberry Basin (C) as shown in Figure 3.

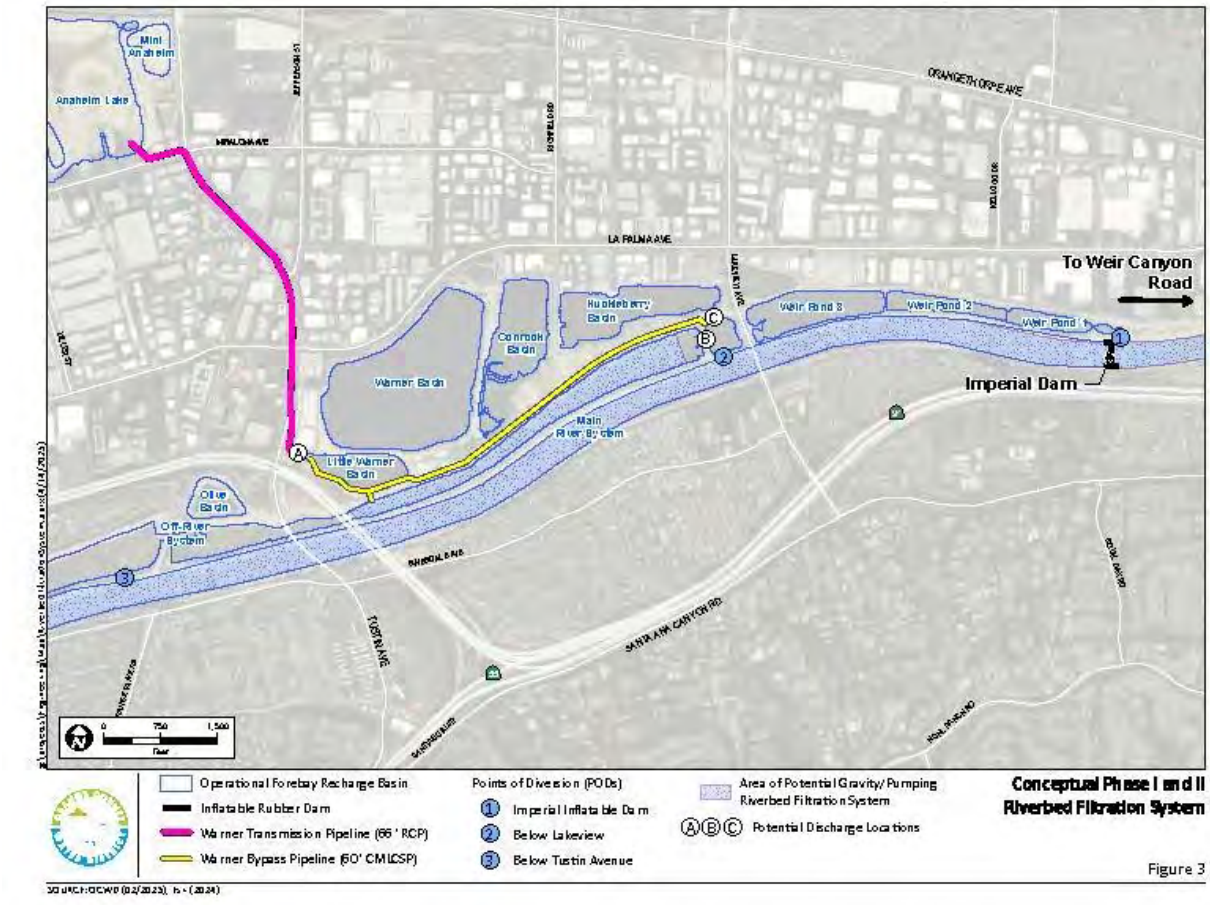


Figure 3: Conceptual Phase I and II of RFS

4. SCOPE OF SERVICES

The purpose of this request for proposal (RFP) is to secure a consultant with the requisite engineering and hydrogeologic expertise to prepare a Feasibility Study (FS), preliminary design, and cost estimate for a full-scale RFS that can supply filtered water to all or a portion of OCWD's Terminal Recharge Basins that receive Santa Ana River water. The consultant shall also investigate the capacity of expanding the RFS to supply the Warner Basin System as well as the Terminal Recharge Basins, either as one single project or a phased project approach.

Task 1 – Project Management and Quality Assurance/Quality Control (QA/QC)

The Consultant project manager will be responsible for the overall management of the project, including the budget, schedule, and quality of the work products delivered. The project manager will also serve as the primary point of contact to the District. All project management, meetings, administration, and QA/QC activities will occur under this task, including the following:

1. Conduct a Project Kick-Off Meeting.
2. Conduct monthly progress meetings and participate in conference calls, stakeholder meetings, etc. as required to keep the project on schedule and budget.
3. Prepare meeting agendas and minutes.
4. Prepare monthly invoices and progress reports.
5. Provide internal QA/QC on all work products and submittals (e.g., reports, calculations, cost estimates, etc.).

Task 2 – Background Information Collection

Key background information has been provided in the two reports in Exhibit A. It shall be the Consultant's responsibility to identify additional information and data needed to conduct the Feasibility Study. OCWD will provide any relevant information in its possession and may support the Consultant in data acquisition, as appropriate. At a minimum, the Consultant shall:

1. Prepare written information request for gathering relevant information (e.g., previous studies, reports, presentations, drawings, etc.) from the District and relevant agencies to aid in evaluation and project definition for the FS.
2. The Consultant shall identify any data gaps or other information needed to aid in alternatives development and analysis and submit it to the District in a timely manner.

Task 3 – Santa Ana River Supply and Recharge Analysis

OCWD has a Recharge Facilities Model (RFM) that utilizes daily inflow to Prado Dam and operates Prado Dam according to the U.S. Army Corps of Engineers Water Control Manual and the demand for water in OCWD's recharge system. The RFM has been used to conduct a preliminary assessment of the benefits that could be derived from a large RFS that provides water that causes no clogging to Warner Basin and downstream recharge basins (see Appendix D of Riverbed Filtration System, Demonstration Project Results and Recommendations, Oct. 2024).

For this analysis, the selected Consultant shall:

1. Review the RFM model, assumptions, and flow conditions with OCWD.
2. Collaborate and develop a final flow condition and set of assumptions with OCWD to use for the Feasibility Study.
3. Review model outputs provided by OCWD staff who will run the RFM as needed to support this Feasibility Study. The model outputs may include daily flow rates at various points in the recharge system and total recharge for the model period.

Task 4 – Streambed and Collection System Capacity Analysis

For this analysis, the selected Consultant shall:

Task 4A, Hydrogeologic Study Streambed Capacity Analysis

1. Review hydrogeologic data and RFS performance collected during the Pilot and Demonstration Project phases (see reports in Exhibit A).
2. Review vadose zone modeling developed for the Pilot Demonstration Project (Exhibit A - GeoSystems Analysis, Inc., Tucson, AZ).Review boring log and other sediment profile data for the Santa Ana River channel based on data generated by the US Army Corps of Engineers for the Santa Ana River Mainstem Project. OCWD can provide this data upon request.
3. Develop a MS Excel-based conceptual model of the SAR and Off-River channels and develop estimates of the potential yield from the streambed locations where the full-scale RFS could be located.

Task 4B, Collection System Analysis

1. Analyze how much flow can be generated from a gravity fed system based on Task 4A.
2. Analyze how much flow can be generated from a pumped system based on Task 4A and data from others that have constructed similar systems (e.g., Turlock Irrigation District).

3. Evaluate Phase I RFS System, with any combination of gravity and/or pumped systems, that supplies water to the Warner Transmission Pipeline and downstream basins.
    a. Phase I will include an analysis of increasing flow capacity of the Warner Transmission Pipeline by upsizing current pipeline, constructing a new parallel pipeline, or converting the existing pipeline to a pressure pipeline
    b. Phase I will also include analysis of using the Warner Bypass Pipeline.
4. Evaluate Phase II RFS System, with any combination of gravity and/or pumped systems, that can supply the Warner Basin System and downstream basins.

Task 5 – RFS Constructability Analysis

For this analysis, the selected Consultant shall complete a conceptual-level constructability analysis identifying constraints and data gaps to develop full-scale RFS considering several issues including, but not limited to, the following:

1. Design and construction of the RFS lateral drain system in the SAR and Off-River channels.
2. Design and construction of the gravity and pumped RFS pipeline approaches.
3. Increasing the capacity of Warner Transmission Pipeline, pump stations, river diversion structures, and other infrastructure needed.
4. Any known permitting and other issues associated with the USACE, OCPW and others.

Task 6 – RFS Preliminary Designs and Cost Analysis

For this analysis, the selected Consultant shall complete the following:

1. Develop preliminary facility designs (10% pre-design) sufficient to prepare rough order of magnitude (ROM) cost estimates. The Consultant shall work with OCWD staff to identify two Phase I (Supply Warner Transmission Pipeline Only) and two Phase II (Supply Warner System and downstream basins) designs.
2. Develop capital cost, O&M cost, and life cycle costs for each design. Cost estimates shall meet the requirements of an AACE Class 4 cost estimate. Future O&M costs are particularly important with respect to the cost of pumping options that are developed.
3. Prepare unit life-cycle cost estimates as a cost per acre-feet utilizing the life-cycle costs and the additional yield of each design as determined by the Recharge Facilities Model for each design concept. The unit life-cycle cost shall then be compared to imported water rate costs projected to a study year as determined by OCWD. The selected Consultant and OCWD shall collaborate on the assumptions to be used in this analysis.

Task 7 – Draft and Final Feasibility Study Preparation

The Consultant shall prepare an administrative draft Feasibility Study report for the District's review that summarizes the work completed in Tasks 1 through 6 and shall include:

1. An executive summary
2. A summary of the work conducted in Tasks 1 through 6.
3. A detailed discussion of the Phase I and II project concepts, including all aspects of the evaluation conducted in Tasks 1 through 6.

The Consultant shall address and incorporate one set of comments received from the District on the administrative draft Feasibility Study Report and prepare a Final Feasibility Study Report.

5. GENERAL INFORMATION

The District expects the selected firm to provide quality service in accordance with industry standards. The firm must demonstrate experience with the type of anticipated work and must have the ability to perform all services in a timely manner upon the request(s) from the District or the District's authorized representative. All work shall comply with the requirements of federal, state, and local laws, and District requirements.

Acceptable performance standards include, but are not limited to, dependability, contractor safety, demonstrated experience with anticipated work with the ability to perform all anticipated services in a timely manner upon receipt of request, expertise on engineering and hydrogeologic systems, with a preference towards riverbank or riverbed filtration systems.

5.1. MINIMUM QUALIFICATIONS

The selected firm is required to have at a minimum the following qualifications:

a. Selected firm, firm's project manager, or firm's staff shall possess at least five (5) years of experience providing multi-disciplinary professional engineering planning studies and/or design for open-hydraulic surface water systems, and large-capacity transmission systems.

6. ELEMENTS OF PROPOSAL

The hard copy proposal shall be submitted in one large, sealed envelope, which shall include a two (2) part sealed proposal where each part shall be submitted in a separate sealed envelope. The electronic file shall include two separate PDF files, plainly marked with Part One and Part Two as listed below:

1. Part One: the first envelope, and PDF file, shall be plainly marked as Part One – Statement of Qualifications. The name and address of the Proposer shall be marked on the physical envelope.

2. Part Two: the second envelope, and separate PDF file, shall be plainly marked as Part Two – Price Proposal. The name and address of the Proposer shall be marked on the physical envelope.

To provide a degree of consistency in the review of the written proposals, firms are required to include the following content in their proposals. The information required below will be used to evaluate each proposal based on the evaluation criteria outlined in this RFP. Proposals may be deemed non-responsive if they do not respond to all areas specified below.

Proposals shall be prepared simply and economically, providing a straightforward and concise description of how the proposal has satisfied all the requirements of this RFP. Emphasis shall be on completeness and clarity of content with sufficient detail to allow for accurate evaluation and comparative analysis. Excessive or irrelevant materials will not be favorably received.

Please include the following in your proposal:

6.1 Part 1 - Statement of Qualifications

The following subsections describe the contents required in Part One of the proposal. Part One of the proposal shall be of such scope and depth to sufficiently describe and demonstrate the Proposer's understanding of and approach to the project(s).

6.1.1 Title Page

The proposer should identify the RFP title, name and title of the firm's contact person, address, telephone number, fax number, email address, and date of proposal submission.

6.1.2 Cover letter

A principal of the firm authorized to commit the firm to the requirements of the RFP must sign the cover letter. The letter should identify a contact person (name, e-mail address, and phone number) for future communication during the selection process. And shall also discuss the Proposer's commitment to providing high quality services, describe the firm's understanding and approach to the services, and its ability to perform the requirements of this RFP. Include a brief background of the firm including history, types of services provided, number of employees, number of offices and locations with staff size and disciplines, and any other relevant information that may be useful in determining the firm's qualifications to provide the services described in this RFP.

6.1.3 Table of Contents

The table of contents should include a clear and complete identification by section and page number of the submitted materials.

6.1.4 Experience and record of past performance.

Provide a minimum of three (3) references from other municipal, city, or county governmental agencies for which the company has recently or is currently providing Engineering and or Hydrogeological Consulting Services that is equivalent or greater in scope as being required in this RFP. Indicate the scope of work, date, contract amount, and the name, email address, and telephone number of the client contact. Also provide a complete list of other public agencies in California utilizing your services over the past five (5) years. Ongoing projects currently being performed by the proposer also may be submitted for consideration. The District at its discretion may contact the references for additional information. Failure to provide accurate contact information may be cause for rejection of the proposal as being nonresponsive.

6.1.5 Project Team and Qualifications

Provide an organizational chart that describes the structure of the project team, including subconsultants. The project team description shall identify the following:

(i) The Project Manager,
(ii) The names of readily available key personnel that will be deployed for each task and their contact information, and the primary office locations of each project team member,
(iii) The role each team member will play in providing services under the Agreement, and
(iv) A written assurance that the key individuals listed and identified will be performing the work and will not be substituted with other personnel or reassigned to another project without the District's prior approval. The proposal shall clearly identify who will lead the execution of assigned tasks and the respective personnel that will be assigned to them.

Provide a description of the experience, qualifications including required licenses and certifications, area of expertise or specialization, and availability (including current workload) of the project team members, including subconsultants/subcontractors, if any. Describe other project commitments by project team members and the anticipated level of involvement of each team member based on the abilities and expertise required for the type of work desired.

Provide the resumes of all members of the project team, including subconsultants/ subcontractors, as an appendix. Each resume shall not exceed three (3) pages and shall include name and title, education, years with the company, licenses and certifications (issue and expiration dates), home office location, relevant

experience within at least the last five (5) years, and other required qualifications discussed in this RFP.

The identified Project Manager will be OWCD's main point of contact for all assigned projects for the duration of the Agreement. The proposal shall include the Project Manager's contact information, including phone and e-mail address.

Once an Agreement has been executed, the Consultant must request approval from the District in advance of any new personnel being assigned to the project. The District reserves the right to reject or remove personnel performing services at any time for the duration of the Agreement.

6.1.6 Project Overview and Approach

Present a narrative overview of the Proposer's understanding of the RFP requirements and the overall approach and technical plan for accomplishing the work assignments. Also discuss at a minimum the following:

- Ability to successfully complete work assignments within the District's required time frame and, as necessary, on short notice,
- Approach to assignment of work within the firm and how team members will conduct tasks and prepare anticipated deliverables,
- Describe the Proposer's project management approach and communications protocol,
- Describe the Proposer's approach to quality assurance and control, as well as any performance guarantees,
- Technical approach to assigned tasks, such as deployment strategies (how the project will be implemented from mobilization to demobilization), and
- Identify current and reasonably foreseeable actual and possible constraints, problems, and/or issues that could hinder the execution of services under the contract, and suggest approaches to resolving or managing these constraints, problems, and/or issues.

6.1.7 Additional Services

Include any comments, suggestions, or additions the Proposer may have regarding the scope of work or any other aspects of the work that the Proposer feels would be helpful to OCWD in selecting a firm for the services described in the RFP. Identify the potential impact(s) or benefit(s) that these recommendations would have if accepted by OCWD. Tasks above the minimum to complete the work described herein shall be clearly identified as "optional" in the proposal.

6.1.8 Statement of Insurance Compliance

Proposer shall provide a statement that it will meet the insurance requirements that are listed in the Services Agreement, attached hereto as **Exhibit C**. OCWD will request the insurance forms and associated documentation when OCWD provides notice that the Services Agreement is awarded.

6.1.9 OCWD Standard Agreement

Proposers shall provide a statement that the Proposer accepts OCWD's form of Services Agreement attached hereto as **Exhibit C**. Proposers responding to this RFP must be prepared to proceed with the Services Agreement in substantially the form provided, with minor non-substantive changes in OCWD's sole discretion. OCWD retains full discretion to rescind the proposed Services Agreement award to a Proposer who fails to comply with this requirement, and to exclude the Proposer from future procurement where applicable. The Services Agreement shall be executed by the Proposer within ten (10) calendar days of receipt of OCWD's Notice of Award to Proposer.

6.1.10 Billing

Proposers shall provide a statement that it will meet the minimum requirements specified here. At a minimum, the invoice for services shall include the Purchase Order Number, Agreement Number, and the itemized summary of each authorized project task along with the names of persons, their job titles, the hours worked, and hourly billing rates. OCWD will provide reporting requirements to the selected firm, and the selected firm shall prepare invoices that comply with the requirements. Failure to satisfy the reporting requirements may result in rejection, payment delay, or short pay of the invoices submitted to OCWD for payment.

6.1.11 Conflict of Interest

Provide a statement that the proposer, individuals employed by the proposer, or firms employed by or associated with the proposer, do not have a conflict of interest with the Project. The proposer shall exercise reasonable efforts to prevent any actions or conditions that could result in a conflict of interest and shall include, but is not limited to, establishing precautions to prevent its employees or agents from making, receiving, providing in, or offering gifts, entertainment, payments, loans, or other considerations which could be deemed to appear to influence individuals to act contrary to the best interest of the District. If a potential conflict of interest is identified in any form, the Proposer shall inform the District immediately. Proposers are subject to disqualification on the basis of a conflict of interest as determined by OCWD. By submitting a proposal you are stating you do not have a conflict of interest with the Project.

6.1.12 EQUAL EMPLOYMENT OPPORTUNITY AND AFFIRMATIVE ACTION REQUIREMENTS

The proposers shall provide a Statement of Equal Employment Opportunity/Affirmative Action. The selected consultant/contractor and each subconsultant/subcontractor shall not discriminate in the employment of persons on the work because of race, religious creed, color, national origin, ancestry, physical handicap, medical condition, marital status, sexual preference or sex of such persons except as permitted by Section 12940 of the California Government Code. The selected contractor is expected to maintain policies similar to those of the District regarding equal employment opportunities and affirmative action as set forth in the District's Administrative Policies.

6.2 Part 2 - Price Proposal (Separate Sealed Envelope)

Part two of the proposal shall include a table showing the following information:

- Labor hour breakdowns by the project tasks and subtasks identified in Section 4.0 (including other subtasks as the Proposer sees fit) and associated personnel, including any subconsultants, as well as total hours. Names and titles/categories of individuals proposed to work on the project tasks/subtasks, including names of subconsultants/ subcontractors shall be indicated.

- Fully loaded hourly billing rates – All direct, capital, and reimbursable expenses, including but not limited to travel and transportation costs, meals, lodging, office equipment and supplies, administrative and communications fees, etc., must be built into the hourly rates. Therefore, the District shall not pay Consultant nor its subconsultants/ subcontractors for any direct or reimbursable expenses incurred for implementation of the scope of services described herein.

- The labor hours and fees for proposed optional tasks, if any, shall be presented in a separate table to differentiate from the baseline Scope of Work.

It is expected that the indicated hourly rates will remain in effect for the duration of the Agreement unless otherwise specified and approved by OCWD. The rate sheet shall include any other rates or fees, such as markups for subconsultants/subcontractors not identified as part of the project team, equipment markups, or other direct costs that may be incurred.

The proposal shall also include a description of the anticipated method of billing for services performed, with provisions for monthly billing that will include itemized accounting of hours of personnel, hourly rates, and percent completion for each task

identified. A project schedule shall be included with the invoice to track project costs on a resource loaded schedule.

7. PROPOSAL SUBMISSION REQUIREMENTS

7.1. Proposal Format

The proposal shall be limited to no more than 25 single-pages in 8.5” width x 11” length size recycled or recyclable white bond paper, paginated, and bound. This does not include the title page, table of contents, cover letter, appendices, dividers, or résumés. Any oversized documents, such as charts or tables, must be folded to size and secured in the envelope.

All files shall be bookmarked and in a text searchable PDF format (i.e., not scanned images) compatible with Adobe Acrobat Version 8.0 (at a minimum). The main directory of the flash drive shall contain the entire proposal as two separate PDF files for Part One and Part Two. All sections of the PDF file shall be bookmarked.

7.2. Proposal Preparation Costs

This solicitation does not commit the District to award any work nor to pay any costs incurred from the preparation of proposals. Firms responding to this RFP will be solely responsible for all costs and expenses incurred during the selection process.

8. SELECTION PROCESS

Selection of the Consultant will be based on the proposal contents, prior experience of the firm, performance on similar or related projects, and overall costs that best serve the District. Other factors that may be considered during the evaluations include the firm’s reputation in the industry and any other aspects which could affect the proposer’s performance under the awarded Agreement.

All responsive proposals will be evaluated by a selection committee formed by the District. The proposal shall be of such scope and depth to sufficiently describe and demonstrate the proposer’s understanding, approach, and qualifications to successfully complete the scope of services described herein. Submittal of incomplete or vague responses to any section or subsection of this RFP may result in rejection of the proposal. Proposals will be evaluated, scored, and ranked based on the criteria specified in the table below. The evaluation criteria listed in the OCWD Proposal Evaluation form (**Exhibit B**) will be used to evaluate each proposer.

Item No.	Criteria for Proposal Evaluations	Maximum Points
1	Project Approach and Schedule	**20**
2	Experience and Qualifications of the Project Manager	**20**

3	Experience of Firm and Other Project Team Members	**20**
4	Time Commitment of Key Staff	**20**
5	Record of Success on Recent Similar Project	**10**
6	Man-Hour Estimate	**10**
TOTAL POINTS:		**100**

The District reserves the right to award the contract to the firm who presents the proposal, which in the judgment of the District, best accomplishes the desired results based upon this information, OCWD staff will recommend a firm to OCWD's Board of Directors for award of the contract. The selected firm must be able to begin work immediately upon award of contract and must be able to maintain the required level of effort to meet the proposed schedule.

9. SPECIAL CONDITIONS

9.1. RESERVATIONS

This RFP does not commit the District to award a contract, to defray any costs incurred in the preparation of a Proposal pursuant to this RFP or to procure or contract for work.

9.2. PUBLIC RECORDS

All Proposals submitted in response to this RFP become the property of the District and are public records and as such may be subject to public review.

9.3. RIGHT TO CANCEL

The District reserves the right to cancel, for any or no reason, in part or in its entirety, this RFP including but not limited to: selection schedule, submittal date, and submittal requirements. If the District cancels or revises the RFP, the District will notify all the proposers in writing via email.

9.4. ADDITIONAL INFORMATION

The District reserves the right to request additional information and/or clarifications from any or all Proposers.

9.5. PUBLIC INFORMATION

Release of Public Information selection announcements, contract awards, and all data provided by the District shall be protected from public disclosure. Proposers desiring to release information to the public must receive prior written approval from the District.

EXHIBITS

EXHIBIT A

Technical Reports

RIVERBED FILTRATION SYSTEM, DEMONSTRATION PROJECT RESULTS AND RECOMMENDATIONS, OCTOBER 2024

RECHARGE WATER SEDIMENT REMOVAL FEASIBILITY STUDY, FINAL REPORT, FEBRUARY 2010. PREPARED FOR OCWD BY HDR. INC.

EXHIBIT B

EVALUATION CRITERIA

EXHIBIT C

SERVICES AGREEMENT

ATTACHMENT NO.1

RFP SUBMITTAL CHECKLIST

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: R. Bouley/F. Almario

Budgeted: Yes
Budgeted Amount: $32,716,975
Cost Estimate: $197,010
Funding Source: WIFIA, Paygo
Program/Line Item No.: C19011
General Counsel Approval: Yes
Engineers Report: Completed
CEQA Compliance: Cat. Ex.

Subject: CONTRACT NO. TUS-2022-1: AMENDMENT NO. 2 TO BUTIER ENGINEERING

SUMMARY

Construction of the PFAS water treatment plant at the city of Tustin Main Street Plant is currently in progress. Due to the specific construction impacts and changes to the project schedule, staff recommends authorizing the issuance of Amendment No. 2 to Agreement No. 1558 with Butier Engineering Inc. for additional construction management and inspection services in the amount of $197,010.

RECOMMENDATIONS

Agendize for May 21 Board Meeting: Authorize issuance of Amendment No. 2 to Agreement No. 1558 with Butier Engineering Inc. for construction management and inspection services in the amount of $197,010.

BACKGROUND/ANALYSIS

Construction of the PFAS water treatment plant at the city of Tustin Main Street Plant is underway. The project generally includes four Ion Exchange (IX) vessel systems for four wells (Vandenberg, Columbus, Pasadena and Beneta) at a centralized treatment plant, construction of new pipelines to convey water from the well sites to the new PFAS treatment system located at the Main Plant, a new section of distribution piping from the Main Plant, replacement of an existing nitrate treatment system and upgraded booster pumps to handle the additional flows.

The approximately 13,000-feet of pipeline is generally located in or around the Old Town Tustin area. The public right-of -ways in this area contain congested underground utility corridors which include water, electricity, gas, sewer, storm drain, and telecommunications services. Additionally, Main Street is a two-lane street with retail and restaurant businesses on either side. Due to the alignment of the pipeline, complete closure of both traffic lanes would have been necessary to accommodate construction operations and to mitigate potential risks to the public. Because of these impacts, the City of Tustin directed OCWD to conduct the Main Street pipeline work at night – the remainder of the work was still performed during daytime hours.

The additional shifts required by the switch to night work in Main Street were not included in Butier's original scope of work. Their original scope of work included one full-time pipeline inspector to cover all work during one daytime shift. However, by adding night work, the pipeline contractor had a crew working a full nighttime shift on the Main Street pipeline and a separate crew working a full daytime shift to complete appurtenances, structures, and jack and bores beneath two separate open channels. Butier attempted to overlap Inspector shifts as much as possible, but this concurrent nighttime and daytime pipeline work necessitated Butier inspection and CM staff to add additional work shifts to ensure that the work was installed safely and in compliance with project requirements. Butier provided inspectors to cover both shifts, and their subconsultant soils technician was also onsite during both shifts to test for compaction in the pipe trench and structure backfill.

Additionally, Butier's original Agreement projected construction completion in October 2024. Due to the unforeseen construction issues in the pipeline, construction is now projected to be fully completed in June 2025. The PFAS treatment plant is scheduled to go online in May 2025, but an additional month will be needed for site restoration and punch list items. Due to the pipeline delays and additional staffing requirements discussed above, staff recommends issuance of Amendment No. 2 to Agreement No. 1558 with Butier Engineering Inc. for additional construction management and inspection services in the amount of $197,010. The level of effort in the recommended Amendment is sufficient to complete the project. Staff recommends maintaining the current project budget by deducting the amount of this amendment from the Project Contingency as shown in the budget for the City of Tustin PFAS Project that is summarized in Table 1.

Table 1: City of Tustin Treatment Budget Summary

Description	Budget 11/2024	Proposed Budget 5/2025
Design, Construction Management, Permitting		
Design and CM (Jacobs Engineering)	$2,272,041	$2,272,041
CM (Butier)	$652,488	$652,488
Amendment No. 1	$460,830	$460,830
Amendment No. 2		*$197,010*
Permitting, Reimbursements, Advertising	$15,000	$15,000
Construction		
Contract TUS-2022-1	$19,771,700	$19,771,700
Change orders 1-4 (3.3% of contract)	$658,822	$658,822
Change order 5 (0.4% of contract)	$172,580	$172,580
Revised pipeline construction – change order 6	$5,500,000	$5,500,000
Subtotal Contract TUS-2022-1	$26,103,102	$26,103,102
Treatment Vessels (Evoqua)	$1,608,000	$1,608,000
IX Resin (Evoqua)	$1,077,800	$1,077,800
Project Contingency	$527,749	*$330,739*
Total Project Cost:	**$32,716,975**	**$32,716,975**
Estimated Grant Funding	***($15,000,000)***	***($15,000,000)***

PRIOR RELEVANT BOARD ACTION(S)

11/20/24, R24-11-139: Contract No. TUS-2022-1 Amendment to Butier Engineering

5/15/24, M24-49: Contract No. TUS-2022-1 Change Order Ratification and Budget Increase.

11/1/23, R23-11-147: Authoring Issuance of Agreement to Butier Inc. For Construction Management and Inspection Services and Increasing Budget.

12/21/22, R21-12-174: Awarding Contract No. Tus-2022-1 City of Tustin Pfas Treatment System And Influent Conveyance Project To Caliagua Inc.

6/15/22, R22-6-79: Contract No. TUS-2022-1 City of Tustin Pfas Treatment System and Influent Conveyance Project: Engineers Report, Categorical Exemption, and Notice Inviting Bids.

5/19/21, R21-5-79: Issuance of Amendment No. 3 to Agreement No. 1423 with Aqueous Vets for PFAS Vessel System Design Modifications and Steel Price Increases, for an amount not to exceed $208,313; and Amendment No. 4 to Agreement No. 1434 with Evoqua for PFAS Vessel System Pressure Rating Increase and Steel Price Increases, for an additional amount not to exceed $131,854 are authorized.

10/21/20, R20-10-135: Issuance of Amendment No. 1 to Agreement No. 1422 with Aqueous Vets, for an amount not to exceed $306,338 and Issuance of Amendment No. 2 to Agreement No. 1423 with Evoqua, for an amount not to exceed $533,593 is authorized to modify 55 treatment vessel systems (110 vessels) to meet State Water Resources Control Board, Division of Drinking Water (DDW) requirements.

5/6/20, R20-5-56: The following agreements are authorized for the purchase of PFAS treatment pressure vessel systems: Agreement to Aqueous Vets for the purchase of 25 systems for a price not to exceed $8,159,052 and Agreement to Evoqua and for the purchase of 30 systems for a price not to exceed $11,020,220; and, upon approval as to form by District General Counsel, execution of such agreements by the District officers is authorized.

1/22/20, R20-1-13: Issuance of a Request for Quotes to pre-purchase up to 150 PFAS treatment vessels; Issuance of a Request for Proposals for on-call consultants to prepare PFAS Treatment System designs; Execution of PFAS treatment system professional services agreements for design services with the highest ranked consultants; and Establishment of a project design budget of $10,000,000.

Amendment No. 2 City of Tustin PFAS Treatment Facility

April 30, 2025

Mr. Fernando Almario, P.E.
Project Manager/Senior Engineer
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Subject: Amendment No. 2: Construction Management and Inspection Services for the City of Tustin PFAS Treatment System and Influent Conveyance Project

Dear Mr. Almario:

Attached you will find our Amendment No. 2 for the above-mentioned project. OCWD staff is familiar with specific construction impacts and changes to the project schedule modifying Butier's current budget. Additionally, the City of Tustin has directed the OCWD contractor to perform work in revised sequences causing additional delays to the schedule. The amendment was developed using the most recent project construction schedule update and weekly discussions with OCWD and City of Tustin staff. If a more comprehensive justification narrative is necessary, please let us know and one will be provided.

If you have any questions regarding our proposal, please contact Senior Construction Manager, Mr. Joe Blum, or the undersigned for clarification.

Respectfully Yours,
Butier Engineering, Inc.

Mark M. Butier Jr.
President/CFO

BUTIER
Construction Managers, Consulting Engineers

17822 E. 17th Street. Suite 404
Tustin. California 92780
Tel: (714) 832-7222 Fax: (714) 832-7211

BUTIER
Construction Managers, Consulting Engineers

Amendment Fee Proposal
City of Tustin PFAS Treatment System and Influent Conveyance - CM and Inspection Level of Effort

		2025											
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total Hrs	Rate/ Hour	Total $
		31	30	30	30	31	31	30	31	30			
1. Construction Phase													
Construction Manager	Blum	48	96	124	98	0	0	0	0	0	366	$ 220.00	$80,520
R.E./QA Manager (Plant)	Ling	64	112	96	64	0	0	0	0	0	336	$ 195.00	$65,520
Senior Field Inspector (Pipeline)		0	0	0	0	0	0	0	0	0	0	$ 175.00	$0
Field Engineer-Electrical	Phillips	64	102	64	16	0	0	0	0	0	246	$ 175.00	$43,050
											948		**$ 189,090.00**
Geotechnical Servics Budget													**$ 7,200.00**
Subcontractor: Includes 10% mark-up													**$ 720.00**
												Grand Total	**$ 197,010.00**

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: R. Bouley

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: CIP, R&R
Program/Line Item No. N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: AGREEMENT EXTENSION FOR ON-CALL SURVEYING SERVICES

SUMMARY

In June 2023, the on-call surveying agreements issued to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. were extended to June 30, 2025. Staff requests to extend the on-call agreements for an additional two years.

RECOMMENDATION

Agendize for May 21 Board Meeting: Authorize time extension of agreements to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. for on-call surveying services through June 30, 2027.

DISCUSSION

Survey work for OCWD projects is required to support the pre-design and design work of the Engineering, Hydrogeology, Planning and Property Management departments. Services are also needed during construction because the project documents require that the District provide an initial project benchmark on each construction project and during the course of construction the District has their surveyor periodically check the contractor's work. Additionally, if unknown conditions are discovered and slight redesigns are required, the District's surveyor will assist by documenting those existing conditions.

In June 2023, the on-call surveying agreements issued to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. were extended to June 30, 2025. Staff again requests to extend the agreement duration for on-call survey services by an additional two years for all three consultants. These firms provide engineering surveying services to the District (which includes Engineering, Hydrogeology, Planning and Property Management Departments) for projects managed in Orange County as well as in the Prado areas and have done great work over the past several years.

On-call services are charged to specific projects or department budgets and therefore do not require an initial budgeted value.

PRIOR RELEVANT BOARD ACTIONS

6/21/23, M23-70: Authorize time extension of agreements to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. for on-call surveying services through June 30, 2025.

4/21/21, R21-4-63: Authorize time extension of agreements to Stantec Consulting Services, Inc., CASC Engineering and Consulting, and Huitt-Zollars, Inc. for on-call surveying services through June 30, 2023.

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: M. Patel/F. Almario

Budgeted: Yes
Budgeted Amount: $200,000
Cost Estimate: $200,000
Funding Source: R&R
Program/Line Item No. R23010
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: TALBERT BARRIER INJECTION WELLS I-24 & I-25 CONTROL VALVE PROJECT – PUBLICATION OF NOTICE INVITING BIDS

SUMMARY

Plans and technical specifications for Talbert Barrier Injection Wells I-24 and I-25 Control Valve Replacement project have been prepared. The major construction elements include replacing inoperable down-hole flow control valves, upsizing column piping, replacement of submersible pumps, and upgraded electrical components. The upgrades to Wells I-24 and I-25 are necessary to bring the wells back online and inject up to 3.7 MGD into the Talbert Barrier.

RECOMMENDATION

Agendize for May 21 Board meeting: Authorize publication of Notice Inviting Bids for Contract No. TAL-2024-2, Talbert Barrier Injection Wells I-24 and I-25 Control Valve Replacement Project

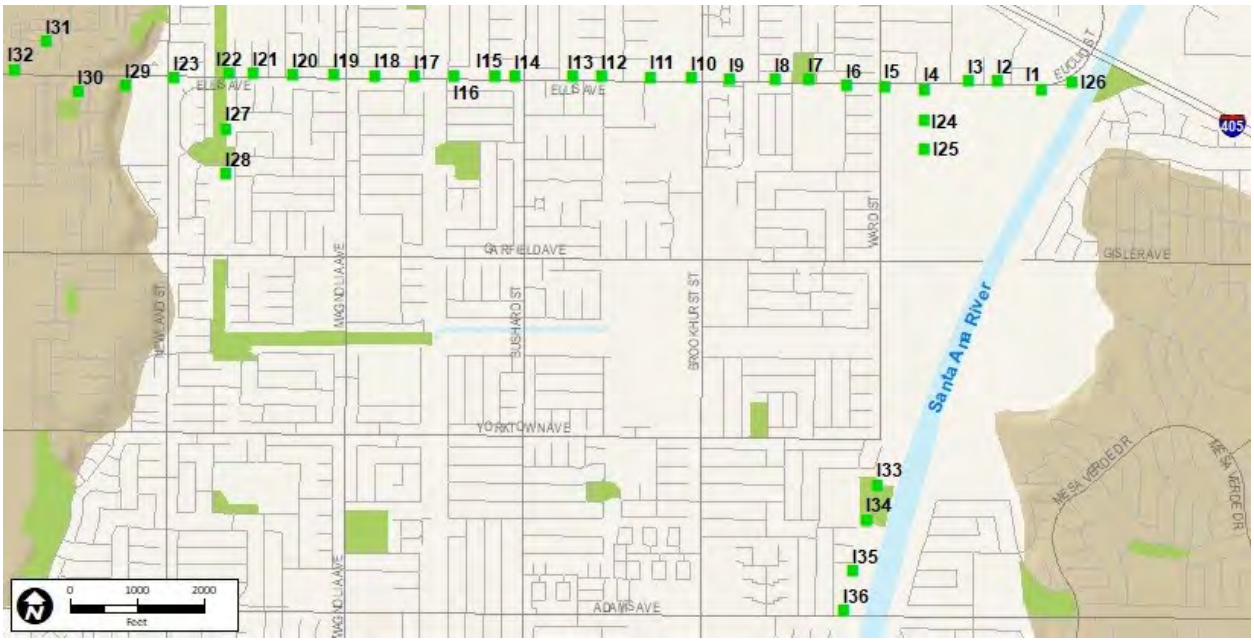
BACKGROUND/ANALYSIS

This Project involves modifications to injection wells I-24 and I-25 which are part of the Talbert Barrier system located on the OCWD Fountain Valley campus. The Talbert Barrier injection well field is comprised of 104 injection casings grouped into 36 well sites as shown in Figure 1 below. There are two primary types of injection wells: 1) Modern Wells (I-26 through I-36) and 2) Legacy Wells (I-1 through I-23). In addition, there is a third type of injection well, the Hybrid Well. The Hybrid Well combines design aspects of Legacy Wells and Modern Wells. There are only two of these Hybrid Injection wells in the Talbert Barrier system: I-24 and I-25. These two Hybrid Injection wells are located within the GWRS Advanced Water Purification facility plant site.

Like Modern Wells, Hybrid Wells are equipped with a flow control valve at the end of the eductor pipe. Hybrid Wells employs a down-well flow control valve called a variable orifice valve (VOV). The VOV operates on the principle of a solid sleeve hydraulically sliding over a ported cylinder and exposing or covering the ports to flow or secure water. The VOV valves at I-24 and I-25 have a history of failure and currently, all 3 VOVs are inoperable. Currently, both wells are unable to inject water into the Talbert Barrier due

to the loss of flow control. The combined maximum injection rate for these two wells are approximately 3.7 MGD when functioning properly.

Figure 1: Map of Injection Wells



This Project consists of replacing the VOV valves with Baski down-well flow control valve, manufactured by Baski Inc. These are the same valve as are used in the Modern Wells. This valve operates on the principle of an inflatable / deflatable rubber bladder inside a stainless steel body. Nitrogen gas is used to inflate the bladder to stop flow. Conversely, when nitrogen gas is bled from the Baski Valve, flow initiates. Pressure on the bladder determines the flowrate of water passing through the Baski Valve. The entire assembly is encased inside a stainless steel housing. Baski valves have been proven to be very reliable in controlling injection flows in the Modern Wells.

Design for this project is included in the fiscal year 2024-25 Refurbishment and Replacement budget in the amount of $200,000. Staff will return to the Board to establish the total project budget at the time of construction award.

Staff recommends authorizing publication of Notice Inviting Bids for Contract No. TAL-2024-2, Talbert Barrier Injection Wells I-24 and I-25 Control Valve Replacement Project

PRIOR RELEVANT BOARD ACTION(S)

10/18/23, R23-10-138: Professional Services Agreement to Tetra Tech for Design Services for the Talbert Barrier Injection Wells I-24 and I-25 Flow Control Valve Project

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: R. Bouley/L. Esguerra

Budgeted: Yes
Budgeted Amount: $2,500,000
Cost Estimate: $0
Funding Source: R&R
Program/Line Item No. R24032
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: Cat. Ex.

Subject: CONTRACT NO. A-2025-1 ANAHEIM LAKE VALVE VAULT CATEGORICAL EXEMPTION AND NOTICE INVITING BIDS

SUMMARY

Final plans and specifications for Anaheim Lake Valve Vault Project are nearing completion. Staff recommend filing a Categorical Exemption for the project and issuing a Notice Inviting Bids for the construction contract.

RECOMMENDATION

Agendize for May 21 Board Meeting:

1. Authorize filing of a Categorical Exemption for the Anaheim Lake Valve Vault project in compliance with the California Environmental Quality Act (CEQA) guidelines; and

2. Authorize publication of Notice Inviting Bids for Contract No. A-2025-1, Anaheim Lake Valve Vault.

BACKGROUND/ANALYSIS

The Anaheim Lake pipeline distributes water to various locations including Anaheim Lake, Miller Basin, Kraemer Basin, Atwood Channel, and the Carbon Creek Diversion Channel. Several connections to the Anaheim Pipeline are directly buried within a small area just north of the spillway between OC-28 and Anaheim Lake and are inaccessible without deep excavation. These connections were constructed from the late 1980s to the early 1990s. The existing valves within the project limits are at the end of their expected lifespan and need replacement. The project location can be seen in Figure 1.

Figure 1: Existing Anaheim Lake Buried Valve Location

Updating the design of the Anaheim Lake Valve Vault project was contracted to MKN. The new vault structure included with the project will house two existing 48-inch butterfly valves from the Warner Pipeline to the Anaheim Pipeline and one existing 72-inch valve from OC-28 to the Anaheim Pipeline. The project will also include replacing two 48-inch valves which release water from Anaheim Pipeline into the Atwood Channel and construct structural modifications to OC-28. The expected project schedule is shown in Table 1.

Staff has determined the Anaheim Lake Valve Vault project is consistent with the Categorical Exemption for New Construction or Conversion of Small Structures (Class 3) because it consists of the construction and operation of a limited number of new, small facilities of structures.

Staff recommends authorizing the filing of a Categorical Exemption and authorizing Publication of the Notice Inviting Bids for Contract No. A-2025-1, Anaheim Lake Valve Vault.

Table 1: Anaheim Lake Valve Vault Schedule Summary

Description	Dates
Design	August 2018 – May 2025
Construction Contract	July 2025 – October 2027

PRIOR RELEVANT BOARD ACTION(S)

2/19/2025, R25-2-21: Authorizing Amendment No.1 to Agreement No. 1681 with MKN for an amount not to exceed $33,200 for design services for the Anaheim Lake Valve Vault Project.

11/20/2024, R24-11-141: Authorizing issuance of agreement to MKN for design services for the Anaheim Lake Valve Vault Project.

3/20/2019, R19-3-38: Approving amendment to Gannett Fleming for Anaheim Lake Valve Vault Project.

10/17/2018, R18-10-145: Authorizing termination of agreement to KEH & Associates for design services for Anaheim Lake Valve Vault Project and awarding agreement to Gannett Fleming.

8/15/2018, R18-8-110: Authorize agreement to KEH & Associates for design services for Anaheim Lake Valve Vault Project.

12/20/2017, M17-170: Authorize Issuance of RFP for the Anaheim Lake Valve Vault Project.

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: R. Bouley / L. Esguerra

Budgeted: Yes
Proposed Budget: $0
Cost Estimate: $0
Funding Source: CIP/PFAS Grant
Program/Line Item No.: C24006
General Counsel Approval: Yes
Engineers Report: Completed
CEQA Compliance: Cat. Ex.

Subject: GOLDEN STATE WATER COMPANY CLAIR PLANT, BEACH PLANT, AND DALE PLANT PFAS TREATMENT SYSTEMS PROJECT: ENGINEER'S REPORT AND CATEGORICAL EXEMPTION

SUMMARY

The plans and specifications for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project (Project) are nearing 30% completion. Both the design and the construction costs will be funded, in part, by an Emerging Contaminant Principal Forgiveness Grant through the State Water Resources Control Board. Staff recommend approving the Engineer's Report for the project and filing a Categorical Exemption in compliance with the California Environmental Quality Act guidelines.

Attachment: Engineer's Report for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project

RECOMMENDATION

Agendize for May 21 Board Meeting:

1. Approve the Engineer's Report for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project and determine the project feasible, necessary and beneficial to the lands of the District; and

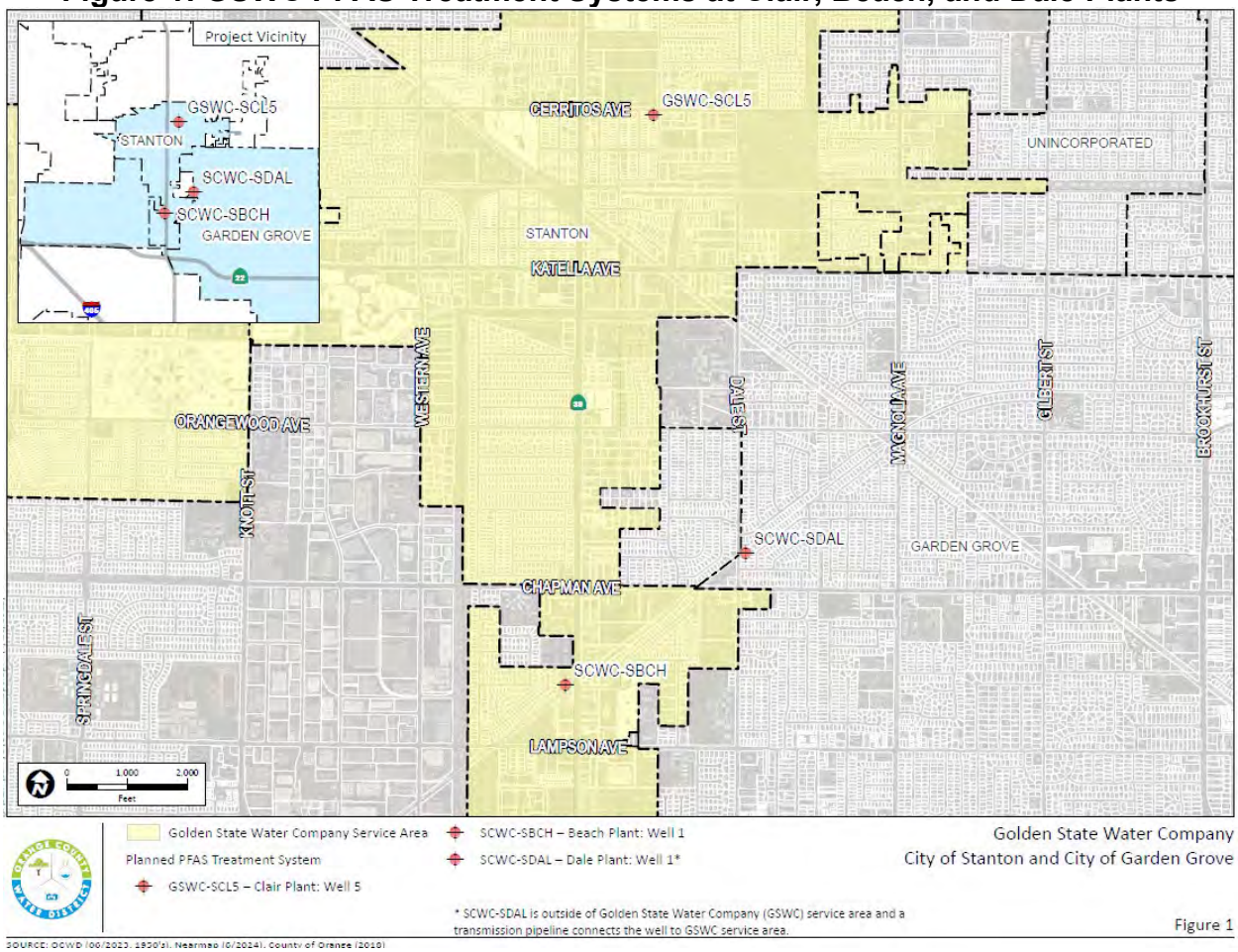
2. Authorize filing of a Categorical Exemption for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project in compliance with the California Environmental Quality Act (CEQA) guidelines.

BACKGROUND/ANALYSIS

To restore the use of groundwater supplies impacted by PFAS contaminants with minimal delay, the firm of PACE Advance Water Engineering began design of the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project in July of 2024. Due to site constraints at the three sites, Ion Exchange (IX) treatment has been selected as the treatment method. The number of vessels and required support systems needed for IX allows for less area to be occupied by the treatment plant than would be required for Granular Activated Carbon (GAC), Nanofiltration (NF), or Reverse Osmosis (RO). Without additional land

acquisition, IX quickly became the treatment choice for these sites. PACE is nearly 30% complete with design of the PFAS treatment systems for the Project. Figure 1 shows the location of the Golden State Water Company Wells:

Figure 1: GSWC PFAS Treatment Systems at Clair, Beach, and Dale Plants



The Project will include installing IX vessel systems and all pre-filtration, site piping, well modifications, electrical upgrades, and other appurtenances. Staff has determined that the Project is consistent with a California Environmental Quality Act (CEQA) Categorical Exemption for New Construction or Conversion of Small Structures (Class 3) because it consists of the construction and operation of a limited number of new, small facilities or structures. The expected project schedule is shown in Table 1.

Table 1: GSWC PFAS Treatment Systems at Clair, Beach, and Dale Plants Schedule Summary

Description	Date
Design	July 2024 – Dec 2025
DDW Permitting	July 2024 – Aug 2027
Construction Contract	Mar 2026 – Sep 2027

Staff submitted a financial assistance application for an Emerging Contaminant (EC) Principal Forgiveness (PF) Grant in the amount of $10 Million through the State Water

Resources Control Board (SWRCB) Division of Financial Assistance in May 2024. This application represents the first application for Golden State Water Company. This project was included in the Drinking Water State Revolving Fund EC Supplemental Intended Use Plan for the State fiscal year 2024-25 approved by the SWRCB. Therefore, the Project is eligible to receive an EC PF Grant for PFAS projects up to $10 Million. Staff is currently working with the SWRCB on the review and the approval of the District's Grant application for this project.

Prior to any construction costs being eligible for PFAS Grant reimbursement, the SWRCB is requiring the District process a Categorical Exemption as part of CEQA compliance. Upon completion of CEQA, the SWRCB will act as the lead agency for compliance with the National Environmental Policy Act (NEPA). This NEPA process is in addition to OCWD filing the CEQA Categorical Exemption and cannot proceed until after OCWD's filing is complete. Both the CEQA and NEPA environmental compliances require the Engineer's Report to provide the basis for the project. The recommended action in this submittal only includes approving the Engineer's Report and authorizing CEQA filing.

Staff recommends approving the Engineer's Report and authorizing the filing of a Categorical Exemption in compliance with CEQA guidelines for the Golden State Water Company Clair Plant, Beach Plant, and Dale Plant PFAS Treatment Systems Project.

PRIOR RELEVANT BOARD ACTION(S)

11/20/19, R19-146 - Approved PFAS Policy

1/22/20, R20-1-12 - Approved modifications to the PFAS Policy

ENGINEER'S REPORT

FOR

GOLDEN STATE WATER COMPANY
CLAIR WELL 5, BEACH WELL 1, AND DALE WELL 1, PFAS TREATMENT SYSTEMS PROJECT

Prepared By:

Laurence Esguerra, P.E.

April 2025

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1.0 EXECUTIVE SUMMARY

The purpose of this Engineer's Report is for Orange County Water District (OCWD; the District) and Golden State Water Company (GSWC) to evaluate the need, benefits, and cost of constructing a Per- and Polyfluoroalkyl Substances (PFAS) treatment systems for GSWC Wells: Clair Well 5, Beach Well 1, and Dale Well 1.

In April of 2024, the United States Environmental Protection Agency (EPA) issued final National Primary Drinking Water Regulation for six PFAS. EPA established enforceable maximum contaminant level (MCL) and non-enforceable maximum contaminant level goal (MCLG) for the following PFAS.

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA - perfluorooctanoic acid	Zero	4.0 parts per trillion (ppt)
PFOS - perfluorooctane sulfonate	Zero	4.0 ppt
PFHxS - perfluorohexanesulfonic acid	10 ppt	10 ppt
PFNA - perfluorononanoic acid	10 ppt	10 ppt
HFPO-DA - hexafluoropropylene oxide dimer acid (Commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more PFHxS, PFNA, HFPO-DA, and PFBS) [1]	1 Hazard Index[2]	1 Hazard Index[2]

[1] - perfluorobutane sulfonic acid (PFBS)

[2] $Harad\ Index\ (unitless) = \frac{PFBS\ ppt}{2{,}000\ ppt} + \frac{PFHxs\ ppt}{10\ ppt} + \frac{PFNA\ ppt}{10\ ppt} + \frac{HFPO{-}DA\ ppt}{10\ ppt}$

In February 2020, the State Water Resources Control Board's Division of Drinking Water (DDW) issued revised drinking water response levels of 10 parts per trillion (ppt) for PFOA and 40 ppt for PFOS. In March 2021, DDW issued a drinking water response level of 5 parts per billion (5,000 ppt) for PFBS and in October 2022 DDW issued a response level of 20 ppt for PFHxS. DDW recommends that sources exceeding these limits be taken out of service, treated, or blended. Water produced from the GSWC Wells has tested non-detect – 6.6 ppt for PFOA, 3.4 – 14.1 ppt for PFOS, and non-detect – 2.6 ppt for PFBS. When groundwater sources are taken out of service, their production is commonly replaced with more expensive imported water from the Metropolitan Water District of Southern California (MWD).

In 2019, the District hired Carollo to conduct a PFAS Planning Study to evaluate options for the treatment of groundwater wells that are potentially impacted by PFAS and to develop preferred alternatives. The five alternatives evaluated in the Planning Study were shutting down the potentially impacted well and replacing the source with imported water, blending well water with imported water, blending well water with other groundwater, packing part of the well to avoid zones with PFAS, and engineered treatment. Although GSWC was not part of the original Planning Study efforts, it was determined that engineered treatment, specifically ion exchange, would be the preferred treatment for the GSWC Wells: Clair Well 5, Beach Well 1, and Dale Well 1 given the similar nature of all the wells that were part of the study. The District also hired Jacobs in 2019 to perform pilot testing and life-cycle cost analysis of various treatment technologies. Preliminary results from the Jacobs study indicate that ion-exchange is an efficient technology to remove PFAS.

This project will consist of installing ion exchange vessel systems in lead-lag configuration (two vessels) at each well site, including the necessary piping, prefilters and related appurtenances.

Benefits of constructing a PFAS Treatment System at the wells sites include:

- Allowing GSWC to continue to utilize its well and infrastructure investment.
- Allowing GSWC to maintain a diversified water supply portfolio with a substantial local supply component.
- Saving the OCWD service territory approximately $5,115,345 per year in water supply costs.
- Saving OCWD over $2,057,305 per year by paying for the treatment plant instead of losing RA revenue.
- Avoiding approximately $3,058,040 of imported water costs incurred by GSWC by utilizing groundwater instead of imported water.

In November 2019, the District adopted a PFAS policy to design and construct the lowest reasonable cost but efficient treatment system to remove PFOA and PFOS compounds for Groundwater Producers, such as GSWC. Additionally, the policy states that OCWD will provide a 50 percent subsidy for future operation and maintenance expenses up to $89.60 per acre-foot.

The current estimated capital cost of this project is $11,000,000. The current estimated Operation and Maintenance cost is $121 per acre-foot per year, to be split between OCWD and GSWC. These costs will be adjusted as the engineering details are finalized and construction is completed.

2.0 BACKGROUND

In 2009, the United States Environmental Protection Agency (EPA) established a provisional health advisory of 400 parts per trillion (ppt) for PFOA and 200 ppt for PFOS to assess the potential risk for short-term exposure through drinking water. The EPA later released a non-regulatory health advisory level of 70 ppt for PFOA and PFOS (combined) in 2016.

In March 2019, the DDW issued mandatory PFAS testing orders to 12 public water systems (Groundwater Producers) in the District's service area, including Golden State Water Company. Dozens of wells in the District's service area had water quality testing results exceeding the DDW Notification Levels. Affected Producers were required to provide governing body notifications for exceedances of the Notification Level. Later in 2019, DDW lowered the Notification Limits to 5.1 ppt for PFOA and to 6.5 ppt for PFOS. In February 2020 DDW lowered the Response Levels to 10 ppt for PFOA and 40 ppt for PFOS. In March 2021, DDW issued a drinking water response level of 5 parts per billion (5,000 ppt) for PFBS and in October 2022 DDW issued a response level of 20 ppt for PFHxS.

In April of 2024, the EPA issued final National Primary Drinking Water Regulation for six PFAS. EPA established enforceable MCLs and non-enforceable MCLGs for the following PFAS.

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA - perfluorooctanoic acid	Zero	4.0 ppt
PFOS - perfluorooctane sulfonate	Zero	4.0 ppt
PFHxS - perfluorohexanesulfonic acid	10 ppt	10 ppt
PFNA - perfluorononanoic acid	10 ppt	10 ppt
HFPO-DA - hexafluoropropylene oxide dimer acid (Commonly known as GenX Chemicals)	10 ppt	10 ppt
Mixtures containing two or more PFHxS, PFNA, HFPO-DA, and PFBS) [1]	1 Hazard Index[2]	1 Hazard Index[2]

[1] - perfluorobutane sulfonic acid (PFBS)

[2]- $Harad\ Index\ (unitless) = \frac{PFBS\ ppt}{2{,}000\ ppt} + \frac{PFHxs\ ppt}{10\ ppt} + \frac{PFNA\ ppt}{10\ ppt} + \frac{HFPO{-}DA\ ppt}{10\ ppt}$

In preparation for the impacts of PFAS to groundwater supplies, the District adopted a PFAS policy in November 2019. Among other items, the policy states that OCWD will fund the lowest reasonable and efficient treatment system design and construction costs to remove PFAS compounds for Groundwater Producers. Additionally, the policy

states that OCWD will provide a 50 percent subsidy for operation and maintenance expenses up to $75 per acre-foot. The rate is adjusted annually each July 1 (beginning July 1, 2021) and the maximum subsidy for operation and maintenance has been updated to $89.60 per acre-foot for fiscal year 2023/2024.

Water produced from Clair Well 5, Beach Well 1, and Dale Well 1 (GSWC Wells) has tested non-detect – 6.6 ppt for PFOA, 3.4 – 14.1 ppt for PFOS, and non-detect – 2.6 ppt for PFBS. When groundwater sources are taken out of service, their production is commonly replaced with more expensive imported water from the Metropolitan Water District of Southern California (MWD).

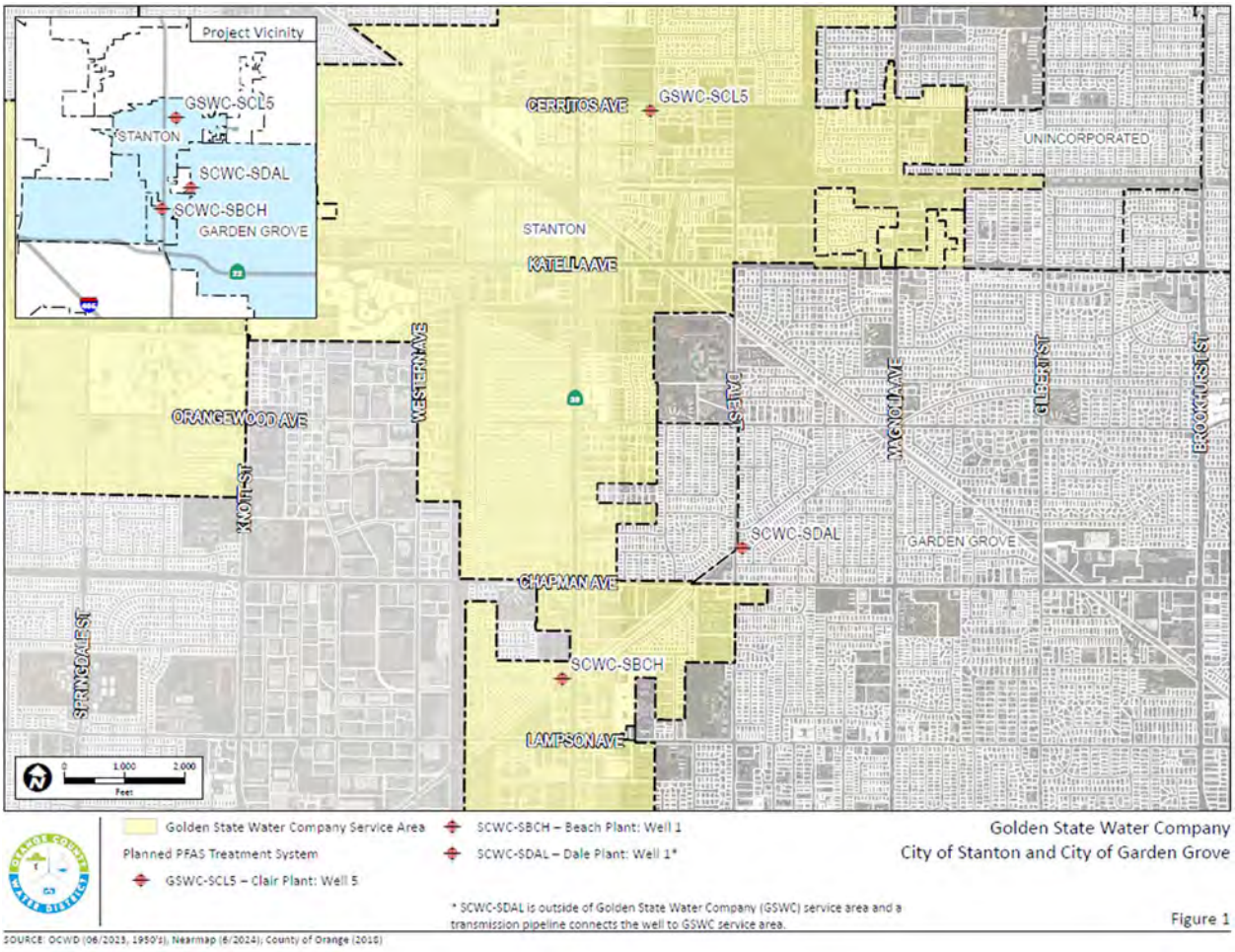
The GSWC Wells are currently under consideration for PFAS treatment systems are shown in Figure 1. Claire Well 5, and Beach Well 1 are in the City of Stanton and Dale Well 1 is in the City of Garden Grove. All sites are owned by GSWC and currently house the well head and discharge piping, communication equipment, electrical equipment, and disinfection facilities.

The Clair Well site is surrounded by residential use on three sides and commercial use on the fourth side. The Beach Well site is triangular surrounded by residential use on one side, commercial use on one side, and a flood control channel on the third side. The Dale Well site is surrounded by residential use on all sides.

IX is the preferred and most efficient treatment for the well sites due to site area limitations. The number of vessels and support systems required for IX allows for less area to be occupied by the treatment plant than would be required for Granular Activated Carbon (GAC), and IX would be more cost-effective than Nanofiltration (NF) or Reverse Osmosis (RO). RO is a treatment technology that ensures high reliability for PFAS removal but would generate a liquid waste stream containing PFAS and would be more expensive than the other technologies. Additionally, a RO plant would likely require additional GSWC staff with the appropriate water treatment certifications to operate. Although RO would be the most effective option for long-term removal of PFAS, the costs associated with RO make IX the most feasible treatment choice for the wells at this time.

The Jacobs-OCWD joint pilot study of various treatment medias began testing of IX in December 2019. The study has shown that IX successfully removes PFAS.

Figure 1: Claire Well 5, Beach Well 1, and Dale Well 1



3.0 PROJECT PURPOSE AND DESCRIPTION

3.1 Project Purpose

The purpose of this project is to design, permit, construct, and operate PFAS removal systems for the well sites in accordance with the District PFAS policy. The proposed IX treatment system is to remove PFOA and PFOS to less than 2 ppt (the current non-detect limit). Use of this PFAS removal treatment system will ensure the groundwater supplied by the well sites can be served in compliance with PFAS regulations.

3.2 Project Components

The PFAS treatment plant will be sized to treat the maximum well discharge flow rates for the sites. Trains (or systems) of two IX vessels will be used in lead-lag configuration. Each well site will have one or two IX systems and the treatment capacity will be design for the well pumping capacity. See Table 1 for the treatment capacity and vessel dimensions and quantity for each well site.

Table 1: Well Treatment Capacity Summary

Well Site	IX Vessels	Pumping Capacity (gpm)	Treatment Capacity (gpm)
Clair Plant Well 5	Two (2) Trains; Four (4) Vessels; 12 feet diameter x 13 feet height	2,700	3,000
Beach Plant Well 1	One (1) Train; Two (2) Vessels; 10 feet diameter x 13 feet height	750	1,400
Dale Plant Well 1	One (1) Train; Two (2) Vessels; 8 feet diameter x 13 feet height	450	600

The IX vessels are expected to be provided by Evoqua Water Technologies or Aqueous Vets. The influent and effluent supply pipelines can be operated in a way to switch which vessel is the lead and lag position by controlling valves. The lead-lag arrangement is beneficial because once the PFAS constituents reach a predetermined threshold in the lead vessel's effluent, then the lead vessel can be switched to the lag position once the spent resin in it is replaced with fresh resin. The new lead vessel houses pre-loaded IX resin from when the vessel was formerly in the lag position. Replacement of the IX media is performed before the lead vessel returns to service in the lag position. Sample ports are located at several positions in the vessel so that resin performance can be monitored.

Prior to the water entering the IX vessels, it first passes through a pre-filtration system. Since IX media should not be backwashed, its lifespan would be greatly reduced if

solids loading were to occur. It is proposed to use 5-micron bag-filters prior to the IX vessels to catch solids that may be discharged by the well.

The existing disinfection systems used at the wells must be reconfigured to facilitate the operation and replacement activities.

Electrical and telemetry systems will be integrated into the treatment plant to convey information into the existing SCADA system. Flow rates, pressure differential, and flood alarms are included in the list of proposed instrumentation.

3.3 Permits and Regulatory Issues

GSWC's drinking water system operates under a DDW permit that would need to be amended for the proposed PFAS treatment systems. Submittals for the amendment shall be submitted to DDW for review, including the 90% completed design. The permit amendment is not officially granted until after the system is constructed and satisfactorily inspected by DDW.

Several permits will be required from GSWC:

- A right of entry permit will be required to grant the District and its consultants and contractors control of the site during construction.
- A fire hydrant (construction meter) from the City of Garden Grove, and potentially a backflow preventer and temporary piping (fire hose or other depending on quantity needed) will be required for construction water to the Dale Well site.

In accordance with the California Environmental Quality Act (CEQA) guidelines, it is proposed to file a Categorical Exemption for the project. The project is consistent with the Categorical Exemption for New Construction or Conversion of Small Structures (Class 3) because it consists of the construction and operation of a limited number of new, small facilities or structures.

4.0 FINANCIAL ANALYSIS

4.1 Construction Cost Estimates

The estimated construction cost for the IX project is $7,825,000, as detailed in Table 2.

Table 2: IX Construction Cost Estimate

Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Mobilization	1	LS	$1,000,000	$1,000,000
General Conditions	1	LS	$800,000	$800,000
Dale Plant Well 1				
Pre-Filtration System	1	LS	$50,000	$50,000
Vessel Systems with IX Resin (170 cubic feet)	1	EA	$500,000	$500,000
IX Systems (appurtenances, install)	1	LS	$225,000	$225,000
Yard Piping	1	LS	$150,000	$150,000
Site Work	1	LS	$225,000	$225,000
Electrical and Communication	1	LS	$400,000	$400,000
Beach Plant Well 1				
Pre-Filtration System	1	LS	$75,000	$75,000
Vessel Systems with IX Resin (210 cubic feet)	1	EA	$575,000	$575,000
IX Systems (appurtenances, install)	1	LS	$250,000	$250,000
Yard Piping	1	LS	$200,000	$200,000
Site Work	1	LS	$325,000	$325,000
Electrical and Communication	1	LS	$450,000	$450,000
Claire Plant Well 1				
Pre-Filtration System	1	LS	$100,000	$100,000
Vessel Systems with IX Resin (460 cubic feet)	1	EA	$650,000	$650,000
IX Systems (appurtenances, install)	1	LS	$300,000	$300,000
Yard Piping	1	LS	$400,000	$400,000
Site Work	1	LS	$400,000	$400,000
Electrical and Communication	1	LS	$750,000	$750,000
			Total =	**$7,825,000**

A construction cost estimate for a Reverse Osmosis system is detailed in Table 3.

Table 3: RO Construction Cost Estimate

Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Mobilization	1	LS	$1,100,000	$1,100,000
General Conditions	1	LS	$900,000	$900,000
Dale Plant Well 1				
Pre-Filtration System	1	LS	$50,000	$50,000
RO Treatment Systems & Pumps	1	LS	$500,000	$500,000
RO Membranes	1	LS	$100,000	$100,000
Chemical Storage	1	LS	$150,000	$150,000
Sewer Connection & Fees	1	LS	$150,000	$150,000
Yard Piping & Mechanical	1	LS	$300,000	$300,000
Building	1	LS	$250,000	$250,000
Site Work	1	LS	$250,000	$250,000
Electrical and Communication	1	LS	$500,000	$500,000
Beach Plant Well 1				
Pre-Filtration System	1	LS	$125,000	$125,000
RO Treatment Systems & Pumps	1	LS	$1,000,000	$1,000,000
RO Membranes	1	LS	$200,000	$200,000
Chemical Storage	1	LS	$250,000	$250,000
Sewer Connection & Fees	1	LS	$200,000	$200,000
Yard Piping & Mechanical	1	LS	$450,000	$450,000
Building	1	LS	$340,000	$340,000
Site Work	1	LS	$300,000	$300,000
Electrical and Communication	1	LS	$700,000	$700,000
Claire Plant Well 1				
Pre-Filtration System	1	LS	$150,000	$150,000
RO Treatment Systems & Pumps	1	LS	$3,000,000	$3,000,000
RO Membranes	1	LS	$600,000	$600,000
Chemical Storage	1	LS	$300,000	$300,000
Sewer Connection & Fees	1	LS	$300,000	$300,000
Yard Piping & Mechanical	1	LS	$750,000	$750,000

Building	1	LS	$450,000	$450,000
Site Work	1	LS	$500,000	$500,000
Electrical and Communication	1	LS	$1,500,000	$1,500,000
			Total =	**$15,365,000**

4.2 Capital Cost Estimate

The estimated total capital cost for the IX project is $11,000,000, as shown in Table 4. The estimated total capital cost for a RO treatment plant is $22,000,000 as shown in the same table. The table includes the cost of constructing the site improvements for the PFAS treatment system, engineering services for design and construction phases, construction management and the cost associated with meeting regulatory requirements.

Table 4: Capital Cost Estimate

Item	IX Cost	RO Cost
Engineering, Permitting, Construction Management and Inspection & CEQA	$ 1,600,000	$ 3,300,000
Construction	$ 7,825,000	$15,365,000
Contingency	$ 1,575,000	$ 3,335,000
Total =	**$11,000,000**	**$22,000,000**

4.3 Annual Operation and Maintenance Cost Estimate

The estimated annual Operation and Maintenance (O&M) cost for the IX project is $518,800 per year, as detailed in Table 5. It conservatively assumes that visual inspection will be performed daily, and analytical testing will be performed by an outside entity instead of OCWD.

The five-year average of annual production from the GSWC Wells is approximately 4,295 acre-feet. Using this value results in a unit O&M cost of $121 per acre-foot. Per the District's PFAS policy, the O&M costs will be split between OCWD and GSWC with OCWD's portion being no larger than $89.60 per acre-foot. The estimated $121 per acre-foot O&M unit cost would cause OCWD to incur $61 per acre-foot and GSWC to incur $60 per acre-foot.

Table 5: IX Annual O&M Cost Estimate

Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Dale Plant Well 1				
Power	12	Month	$3,500	$42,000
Labor	1	Year	$10,000	$10,000
Maintenance	1	Year	$2,500	$2,500
Analytical Testing	12	Month	$300	$3,600
Media Replacement	1	Year	$37,500	$37,500
Beach Plant Well 1				
Power	12	Month	$6,500	$78,000
Labor	1	Year	$10,000	$10,000
Maintenance	1	Year	$2,500	$2,500
Analytical Testing	12	Month	$300	$3,600
Media Replacement	1	Year	$45,000	$45,000
Claire Plant Well 1				
Power	12	Month	$14,000	$168,000
Labor	1	Year	$10,000	$10,000
Maintenance	1	Year	$2,500	$2,500
Analytical Testing	12	Month	$300	$3,600
Media Replacement	1	Year	$100,000	$100,000
			Total =	**$ 518,800**

Table 6 shows an itemized breakdown of O&M cost for a RO treatment plant. Using an annual volume of 4,295 acre-feet, the RO O&M unit cost is estimated to be $418 per acre-foot.

Table 6: RO Annual O&M Cost Estimate

Description	Quantity	Units	Unit Cost ($/unit)	Cost ($)
Dale Plant Well 1				
Power	12	Month	$16,000	$192,000
Chemicals	12	Month	$600	$7,200
Labor	1	Year	$37,000	$37,000
Maintenance	1	Year	$50,000	$50,000
Analytical Testing	12	Month	$1,000	$12,000
Membrane Replacement	1	Year	$20,000	$20,000
Beach Plant Well 1				
Power	12	Month	$27,000	$324,000
Chemicals	12	Month	$1,250	$15,000
Labor	1	Year	$37,000	$37,000
Maintenance	1	Year	$50,000	$50,000
Analytical Testing	12	Month	$1,000	$12,000
Membrane Replacement	1	Year	$33,500	$33,500
Claire Plant Well 1				
Power	12	Month	$61,000	$732,000
Chemicals	12	Month	$2,500	$30,000
Labor	1	Year	$64,000	$64,000
Maintenance	1	Year	$80,000	$80,000
Analytical Testing	12	Month	$1,250	$15,000
Membrane Replacement	1	Year	$85,000	$85,000
			Total =	**$ $1,795,700**

4.4 Ion-Exchange Cost Comparisons

Three methods to evaluate the economic effectiveness of the IX project are presented below. All three methods indicate that there is a financial benefit to move forward with this project.

1) OCWD Service Territory Perspective - The total project cost of providing water to the OCWD service territory via treated groundwater versus purchasing MWD imported water.
2) OCWD Perspective - The OCWD lost revenue due to no GSWC groundwater production versus the OCWD cost to construct and operate the treatment plant.
3) GSWC Perspective – The cost of providing treated groundwater versus purchasing MWD imported water.

Method 1: OCWD Service Territory Perspective

The unit cost for GSWC to acquire treated imported water through MWD will be $1,460 per acre-foot ($1,395 Full Service Treated + $65 readiness to serve) on January 1, 2025. An annual volume of 4,295 acre-feet would cost $6,270,700.

If the capital cost is amortized over 30 years at a 4% interest rate, the annual payment for the PFAS treatment plant would be $635,660, or $148 per acre-foot for 4,295 acre-feet. The well power cost to pump groundwater averages $80 per acre-foot. The PFAS treatment system's O&M expense is estimated to be $41 per acre-foot. As shown in Table 7, the total unit cost of the treated groundwater would be $269 per acre-foot, or $1,155,355 per year for 4,295 acre-feet. Note that the Replenishment Assessment (RA) is not considered in this calculation because it would be both paid and received by agencies within the OCWD Service Territory.

Implementation of the PFAS treatment system at the GSWC Wells is estimated to save the OCWD service territory $5,115,345 per year in water supply costs.

Table 7: OCWD Service Territory Perspective

Groundwater			MWD Import		
Description	**Annual Cost**	**Unit Cost**	**Description**	**Annual Cost**	**Unit Cost**
Project Capital	$ 635,660	$148	Full Service Treated	$ 5,991,525	$ 1,395
Project O&M	$ 176,095	$41	Readiness to Serve	$ 279,175	$ 65
Well Power	$ 343,600	$80			
Total	$1,155,355	$269	Total	$ 6,270,700	$ 1,460

Method 2: OCWD Perspective

Taking GSWC Wells out of service would reduce the RA payments made by GSWC to OCWD. This assumes that other wells are not available to pump the volume. At an annual volume of 4,295 acre-feet and the current RA of $688 per acre-foot, OCWD would lose revenue of $2,954,960.

The District's expenses to construct the PFAS treatment plants at the GSWC Wells includes the capital expense and $121 of the O&M. As previously discussed, the amortized unit capital expense is $148 per acre-foot and OCWD's portion of the estimated O&M expense is $61 per acre-foot. The resulting unit cost of constructing and operating PFAS plants at the wells would be $209 per acre foot, or $897,655 per year using 4,295 acre-feet per year.

Table 8: OCWD Perspective

Project Cost			Lost Revenue		
Description	**Annual Cost**	**Unit Cost**	**Description**	**Annual Cost**	**Unit Cost**
Project Capital	$ 635,660	$ 148	Replenishment Assessment	$ 2,954,960	$ 688
Project O&M	$ 261,995	$ 61			
Total	$ 897,655	$ 209	Total	$ 2,954,960	$ 688

Implementation of PFAS treatment systems at GSWC Wells is estimated to save OCWD $2,057,305 per year by utilizing the treatment plant instead of losing RA revenue.

Method 3: GSWC Perspective

Given the need for GSWC to acquire water supplies to meet the demands of its customers, it is faced with a situation to utilize the PFAS treatment system or to purchase MWD imported water. As previously discussed, the cost to GSWC to purchase 4,295 acre-feet of MWD water would be $6,270,700 per year, or $1,460 per acre-foot.

The costs for GSWC to produce groundwater from the GSWC Wells and operate the PFAS treatment plant include payment of the RA ($688 per acre-foot), their portion of the O&M expenses and well power costs ($60 per acre-foot). The total unit cost would be $748 per acre-foot, or $3,212,660 per year 4,295 acre-feet.

Table 9: GSWC Perspective

Groundwater			MWD Import		
Description	**Annual Cost**	**Unit Cost**	**Description**	**Annual Cost**	**Unit Cost**
Replenishment Assessment	$ 2,954,960	$ 688	Full Service Treated	$ 5,991,525	$ 1,395
Project O&M and Well Power	$ 257,700	$ 60	Readiness to Serve	$ 279,175	$ 65
Total	$ 3,212,660	$ 748	Total	$ 6,270,700	$ 1,460

Implementation of PFAS treatment systems at GSWC Wells is estimated to save GSWC over $3,058,040 per year by utilizing groundwater instead of MWD imported water.

4.5 Reverse Osmosis versus Ion Exchange Unit Cost

RO would provide a more robust, comprehensive, and reliable treatment for long-term removal of PFAS. However, the capital and operating cost of the treatment system are more expensive. If the estimated RO capital cost of $22,000,000 is amortized over 30 years at a 4% interest rate, the annual payment for the RO PFAS treatment plant would be $1,272,262, or $296 per acre-foot for 4,295 acre-feet. The RO PFAS treatment system's O&M expense is estimated to be $418 per acre-foot for 4,295 acre-feet. As shown in Table 9, the total unit cost of the RO treated groundwater would be $714 per acre-foot, or $3,066,630 per year for 4,295 acre-feet. The IX project costs are also summarized on the same table.

Table 10: Reverse Osmosis versus Ion Exchange Unit Cost

IX			RO		
Description	**Annual Cost**	**Unit Cost**	**Description**	**Annual Cost**	**Unit Cost**
Project Capital	$ 635,660	$ 148	Project Capital	$ 1,271,320	$ 296
Project O&M	$ 519,695	$ 121	Project O&M	$ 1,795,310	$ 418
Total	$1,155,355	$269	Total	$ 3,066,630	$ 714

5.0 CONCLUSIONS AND RECOMMENDATIONS

Constructing the proposed IX PFAS Treatment Systems at GSWC Wells: Clair Well 5, Orangewood Well 1, Beach Well 1, Dale Well 1, La Jolla Wells 2 and 3 and Fern Well 1 will:

- Allow the GSWC to continue to utilize its well and infrastructure investment.
- Allow the GSWC to maintain a diversified water supply portfolio with a substantial local supply component.
- Save the OCWD service territory approximately $5,115,345 per year in water supply costs.
- Save OCWD approximately $2,057,305 per year by paying for the treatment plant instead of losing RA revenue.
- Save the GSWC approximately $3,058,040 per year by utilizing groundwater instead of imported water.

Given the financial benefits to the OCWD service territory, OCWD, and GSWC to utilize a less expensive treated groundwater supply instead of MWD water, it is recommended that OCWD proceed with PFAS Treatment System Project for GSWC Wells: Clair Well 5, Beach Well 1, and Dale Well 1. Additionally, GSWC would be able to continue using their well investment and maintain their local water component of their supply portfolio.

6.0 PROPOSED IMPLEMENTATION SCHEDULE (TENTATIVE)

Date	Activity
October 2025	Board authorizes Notice Inviting Bids
November 2025	Advertise for construction bids
February 2026	Board awards construction contract
October 2027	Completion of construction

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: M. Patel / B. Smith

Budgeted: Yes
Proposed Budget: $100,000
Cost Estimate: $100,000
Funding Source: R&R
Program/Line Item No. R24023
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: AUTHORIZE AGREEMENT TO TAIT AND ASSOCIATES, INC. FOR 2025 ASPHALT PAVEMENT REHABILITATION DESIGN

SUMMARY

A Request for Proposals was issued in March for design of the construction work in the first year of the District's pavement management plan to rehabilitate 35-acres of asphalt surface. Staff recommends issuing an agreement with Tait and Associates to perform the first year of rehabilitation design.

RECOMMENDATION

Agendize for May 21 Board meeting: Authorize issuance of Agreement to Tait and Associates, Inc. for an amount not to exceed $100,000 for the 2025 Asphalt Pavement Rehabilitation Design.

BACKGROUND/ANALYSIS

The District's properties include asphalt pavements on roadways, parking lots, and maintenance yards that total an area greater than 35 acres across more than a dozen different sites. The sites are located in the cities of Fountain Valley, Anaheim, Orange, Corona, and unincorporated Orange County areas. Some of the asphalt pavements are failing, while others are in various stages of disrepair. If proactively managed, asphalt pavements can have a long lifespan. Active maintenance of the surfaces reduces the lifecycle costs of asphalt pavements compared to replacements required after catastrophic failures. As part of its Replacement and Rehabilitation (R&R) program, the District sets aside funds each year for pavement maintenance.

In 2024, Staff worked with the consultant Bucknam Infrastructure Group, Inc. to assess existing pavement qualities and to map out a plan for their rehabilitations. The effort culminated in a Pavement Management Plan (PMP) that defines the Pavement Condition Index (PCI) for each section of asphalt, estimates the annual investment amounts that are required to maintain or improve the asphalt conditions, and recommends the sequence of work to be the most cost effective in the long-term. The PCI scale ranges from 0 to 100 and the weighted total PCI for District asphalts was found to be 74. Staff have interpreted the PMP and laid out a multi-year plan to accomplish its recommendations, see Table 1, for which funding would draw from the

R&R fund. The work is not expected to be eligible for grant funding since the pavement areas are generally not open for public use.

Table 1: Asphalt Pavement Management Plan

Fiscal Year	Cost Estimate
2024 - 25	$ 100,000
2025 - 26	$ 1,000,000
2026 - 27	$ 950,000
2027 - 28	$ 750,000
2028 - 29	$ 1,500,000

Staff prepared a Request for Proposals (RFP) for design of the fiscal year 2025-26 asphalt pavement construction work. The scope of work for this year includes approximately 10 acres of asphalt pavement at the Fountain Valley campus (administration and GWRS treatment plant areas), the Green Acres Project's Santa Ana Reservoir, and recharge facility sites at Burris, Riverview, Five Coves, and Kraemer Basins.

The RFP was issued on March 20 via the District's website and was directly sent to potential firms that may be interested in the project. One proposal was received before the RFP due date of April 22. The proposal was independently reviewed and scored by District staff. The scoring of the proposals included evaluating the qualifications of the firms and key staff, project approach, estimated level of effort, and related project experience. After the independent review, the scores were combined, and the sealed fee envelope was opened. Table 2 shows the scoring and fee results.

Table 2: 2025 Asphalt Design Proposals

Firm	Score (out of 100)	Proposed Fee
Tait and Associates	77	$ 65,935 + Optional Tasks

The proposal provided a strong team with relevant prior experience and a good understanding of the project scope. The proposal included several optional items not included in the base proposal fee that will add value to the design and construction projects. Staff recommends award of an agreement to Tait and Associates, Inc. for an amount not to exceed $100,000 for the 2025 Asphalt Pavement Rehabilitation Design, including the base fee and optional items to be performed at the direction of District staff.

PRIOR RELEVANT BOARD ACTION(S)

March 19, 2025, R25-3-34: Authorize issuance of a Request for Proposals for the 2025 Asphalt Pavement Rehabilitation Design.

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: K. O'Toole/Z. Henderson

Budgeted: Yes
Budgeted Amount: $41,198
Cost Estimate: $33,338 (Total $41,198)
Funding Source: General Fund/Outside Partners Reimbursement
Program/Line Item No. 1044.53001
General Counsel Approval: Required
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: ISSUANCE OF SERVICES AGREEMENT WITH TETRA TECH, INC. FOR 2025 PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LIGHT DETECTION RANGING (LIDAR)

SUMMARY

The District periodically collects aerial imaging and LiDAR data of Prado Basin to assist with assessment of vegetation health and sedimentation. To reduce the cost of obtaining aerial data, staff coordinated with and will share the cost with Inland Empire Utilities Agency and Chino Basin Watermaster. Staff recommend awarding an agreement to Tetra Tech, Inc. to collect multispectral aerial imaging and high-pulse count LiDAR data in an amount not to exceed $41,198. OCWD's portion will not exceed $33,338.

Attachment(s):

- Proposal from Tetra Tech, Inc.
- Cost Share Agreement

RECOMMENDATION

Agendize for May 21 Board meeting:

1) Authorize issuance of an Agreement to Tetra Tech, Inc., in the amount of $41,198 for multispectral aerial imaging and high-pulse count LiDAR data collection of Prado Basin; and,

2) Approve and authorize execution of cost share agreement with Inland Empire Utilities Agency and Chino Basin Watermaster for multispectral aerial imagery and LiDAR data collection, subject to approval as to form by the District's General Counsel.

BACKGROUND/ANALYSIS

The District periodically collects aerial imaging and LiDAR data of Prado Basin to assist with assessment of vegetation health, Arundo Donax control, determining sedimentation rates and updating Prado Basin storage elevation contours.

LiDAR of Prado Basin was last collected in 2023; by collecting LiDAR in 2025 it will allow the District to study and evaluate sedimentation rates and locations and identify if there have been changes in vegetation structure and canopy over the prior two years. Understanding possible habitat impacts and sedimentation rates will allow more certainly during future water conservation efforts by OCWD. Collecting multispectral aerial imaging and high pulse count LiDAR in the summer of 2025 allows for the establishment of baseline environmental and sediment conditions prior to beginning the 5-year deviation to test Forecast Informed Reservoir Operations (FIRO) at elevation 508 ft msl. High pulse count LiDAR significantly improves the quality and accuracy of the ground surface contours in areas with dense riparian vegetation. Having accurate ground surface information is critical to understanding sedimentation rates and associated changes to the storage volume of the water conservation pool.

Staff issued a request for proposals to collect aerial imagery and LiDAR data collection on March 20, 2025, and received proposals from three consulting firms as shown in Table 1.

Table 1: 2025 Prado Basin Multispectral Aerial Imagery and High Pulse Count LiDAR Data Collection Quotes

Contractor	Quote
Tetra Tech Inc.	$ 41,198.00
Digital Mapping Inc.	$ 43,425.00
Fugro	$ 149,163.12

The selection committee reviewed the written proposals and conducted evaluations for the three proposers: 1) Tetra Tech, Inc. 2) Digital Imaging, Inc. and 3) Fugro. The evaluation scores are specified in the following table (2):

Table: 2 Prado Basin Multispectral Aerial Imagery and LiDAR Evaluation Scores

Contractor	Ranking	Score (out of 100)
Tetra Tech Inc.	1	94%
Digital Mapping Inc.	2	91%
Fugro	3	52%

Staff reviewed the proposal from Tetra Tech, Inc. and determined that they meet the requirements set forth in the request for proposals. Staff also reviewed references provided by Tetra Tech, Inc. and found that they have successfully completed similar work in Southern California.

In prior years, the District obtained aerial photos with a 50% cost share from the Inland Empire Utilities Agency and Chino Basin Watermaster. OCWD has agreed to a 50/50 cost share for project management and acquisition of visible and infrared spectrum imagery (commonly referred to as 4-band or multispectral imaging). OCWD elected to include high-pulse count LiDAR data as part of this acquisition and will pay 100% of the associated cost. These cost assignments are summarized in Table 3 of the attached cost share agreement.

Table 3: Cost Share Distribution for Agreement

Agency	Cost Share ($)
Orange County Water District [4-Band Aerial Imagery & High Pulse County LiDAR]	$33,338
Chino Basin Watermaster [4-Band Aerial Imagery]	$3,930
Inland Empire Utilities Agency [4-Band Aerial Imagery]	$3,930
Total	**$41,198**

Staff recommends awarding an Agreement to Tetra Tech Inc. in the amount not to exceed $41,198, for which, OCWD's cost-share for this project will not exceed $33,338.

Staff also recommend approval of the attached cost share agreement with Inland Empire Utilities Agency and Chino Basin Watermaster for this work.

PRIOR RELEVANT BOARD ACTION(S) - None

Response to RFP-24-018

2025 Prado Basin Multispectral Aerial Imagery and LiDAR

Technical & Price Proposal

April 15, 2025

Submitted to:

Orange County Water District
Administration Office Building
Attn: Bobby Velasco, Senior Buyer/Warehouse Supervisor
18700 Ward Street
Fountain Valley, CA 92708
Procurement@ocwd.com

Prepared by:

Tetra Tech, Inc.
Geomatic Technologies Group
Attn: Thomas Loecherbach
1999 Harrison Street, Suite 500
Oakland, CA 94612
Thomas.loecherbach@tetratech.com
925.280.7445 (office)
510.433.0830 (fax)

April 15, 2025

Orange County Water District
Attn: Bobby Velasco
18700 Ward Street
Fountain Valley, CA 92708

Dear Mr. Velasco and Members of the Selection Committee:

It is with great pleasure and interest that we submit this proposal for the 2025 Prado Basin Aerial Imagery and LiDAR. We have successfully performed the 2021 and the 2023 project for OCWD and are familiar with the scope, the project area, and the Orange County Water District team's requirements. We have again assembled a team of professionals with the skills required for successful completion of this project. We understand that the Water District is seeking high resolution and spatially accurate multispectral aerial imagery and LiDAR as well as derived products. The unique qualifications of our team members include:

- **Past Performance Record of Successful Delivery of Prado Basin Aerial Imagery to Orange County Water District.** Our team collected and processed aerial imagery data for Orange County Water District in 2021 and imagery and LiDAR in 2023. We collected, processed, and delivered all required scope items on time and with approval of the District.

- **Engineering Services for Southern California and Recent History with the Orange County Water District.** The team that we have assembled has collected and processed LiDAR and imagery data for flood control projects in the Southwest for over 15 years. We have completed numerous projects for public and private clients including work for Orange County Water District, with Mid-Basin Centennial Park and Santiago Pump Station.

- **Depth and Breadth of Expertise.** Our expertise includes a team of ASPRS Certified Photogrammetrists, Imagery and LiDAR Analysts, Professional Licensed Surveyors and remote sensing professionals who have completed similar work to that required of this project throughout California and across the United States.
- **Capacity.** Our team has the capacity to perform the work that is required, and our team is positioned and eager to begin work immediately upon receiving a notice to proceed. Our depth of highly qualified staff allows us to adapt to changes in project requirements and/or scope and minimizing impacts to project schedule.

We appreciate this opportunity to further demonstrate the support our team can provide to the Orange County Water District. If you have any questions about this Proposal, please feel free to contact us.

Sincerely,

Thomas Loecherbach, PhD
Geomatics Director
Tetra Tech, Inc.

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EXPERIENCE AND RECORD OF PAST PERFORMANCE

Reference Project No. 1: OCWD Prado Basin 2023 Aerial Imagery and LiDAR, CA	
Name of Owner/Client	Orange County Water District
Description of project	Tetra Tech was contracted by the Orange County Water District (OCWD) to develop 4 band Orthoimagery for 33.9 square miles in the Prado Basin and to collect 16 ppsm (points per square meter) LiDAR , and to provide derived products .
Services provided	Aerial Imagery and LiDAR Acquisition, Ground Survey, Data Processing, Products
Start Date/End Date	2023
Contract Amount	$42,460 (Original/Final)
Contact Information of Owner/Client	Kevin O'Toole, Orange County Water District, Senior Planner 18700 Ward Steet, Fountain Valley, CA 92708, Phone: 714.378.8248

Project No. 2: Wetzel County WV Orthoimagery	
Name of Owner/Client	Wetzel County, WV
Description of project	Tetra Tech was contracted by Wetzel County (WV) to provide 3 band orthoimagery at a resolution of 0.25' for the entire County (~361 square miles) and perform a change detection. A total of 2,765 images were collected with an UltraCam in three mobilizations.
Services provided	Orthorectification, QC and accuracy reporting, change detection.
Start Date/End Date	2025, ongoing, scheduled delivery 4/30/2025
Contract Amount	$51,071 (Original/Final)
Contact Information of Owner/Client	Scott Lemley, Assessor Slemley@wvassessor.com, 304-455-8216 210 Main St. New Martinsville, WV 26155

Project No. 3: Sunnyslope LiDAR	
Name of Owner/Client	MN8 Energy LLC
Description of project	Tetra Tech provided professional surveying services consisting of a boundary survey, and a topographic survey for 14 parcels of land encompassing 2,337 acres of land in Baker County, OR, including aerial LiDAR collection and CAD processing.
Services provided	LiDAR acquisition, surface model, contours
Start Date/End Date	2025
Contract Amount	$101,600
Contact Information of Owner/Client	Jared Medwar, Civil Engineer Phone: +1 561 246 5687, jared.medwar@mn8energy.com

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Project No. 4: USGS Arizona North-Central, Airborne LiDAR Processing	
Name of Owner/Client	Sanborn Geospatial
Description of project	Through Sanborn Geospatial's USGS Geospatial Products and Services Contract, Tetra Tech performed LiDAR data processing for 2,628 square miles of area in Arizona. The work was completed from July 2024 to October 2024. In accordance with the USGS LiDAR Base Specification. Tetra Tech digitized and delivered 3D breaklines for hydro features. Tetra Tech then used the 3D hydro breaklines and final classified 'class 2' points to create a hydroflattened DEM.
Services provided	LiDAR processing, Quality Control, USGS specifications QC
Role	Subcontractor
Start Date/End Date	2024
Contract Amount	$205,015 (Original/Final)
Contact Information of Owner/Client	Shawn Benham, Vice President of Programs, Mapping Division sbenham@sanborn.com Mobile: (719)502-1296

Project No. 5: Grass Valley – Nevada City Mapping, CA	
Owner/Client	Dundas Geomatics
Description of project	Tetra Tech acquired 3inch digital imagery and 10 ppsm lidar for an area of 30 square miles to support mapping at planimetric mapping 1"=100' and the generation of 1-ft contours for Grass Valley and Nevada City, CA.
Services provided	Aerial Imagery and LiDAR Acquisition, Planimetric Mapping
Date	2020
Contract Amount	$167,000
Contact Information of Owner/Client	Ron Dundas, 159 South Auburn St., Grass Valley, CA 95945, 530.274.1616 rdundas@ddgeo.com

Most of the survey and mapping work completed by our Tetra Tech Geomatic Technologies Group in California is through private firms, and not directly with public agencies. The following is a list of California Public Agency Direct Projects that were completed by our Geomatic Technologies Group over the past 5 years.

Client Name	Date	Title of Project
Los Angeles Department of Water & Power	2020	Owens Lake LiDAR
Pacific Gas and Electric	2020-present	Survey and Mapping MSA
South Orange County Wastewater Authority	2020	Wood Canyon Airborne LiDAR
City of Santa Cruz	2020, 2021	Santa Cruz Aerial Mapping
Orange County Water District	2021, 2023	Prado Basin

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PROJECT TEAM AND QUALIFICATIONS

Tetra Tech, a leading provider of specialized management consulting and technical services, offers an array of infrastructure and environmental services to a diverse base of public and private sector clients. With 30,000 associates in 450 offices in more than 110 countries on six continents. In 2009, Tetra Tech started the Geomatic Technologies Team, providing integrated mapping solutions using state-of-the-art mapping software, airborne sensors and camera systems, and a robust information technology infrastructure. Our staff is supported by a uniform administrative and management system that project teams can access immediately to ensure work is completed effectively. Tetra Tech has assembled a team that offers the Orange County Water District an experienced professional group to effectively respond to all requirements listed in the solicitation. The Org chart in Figure 1 gives an overview of the assembled team structure.

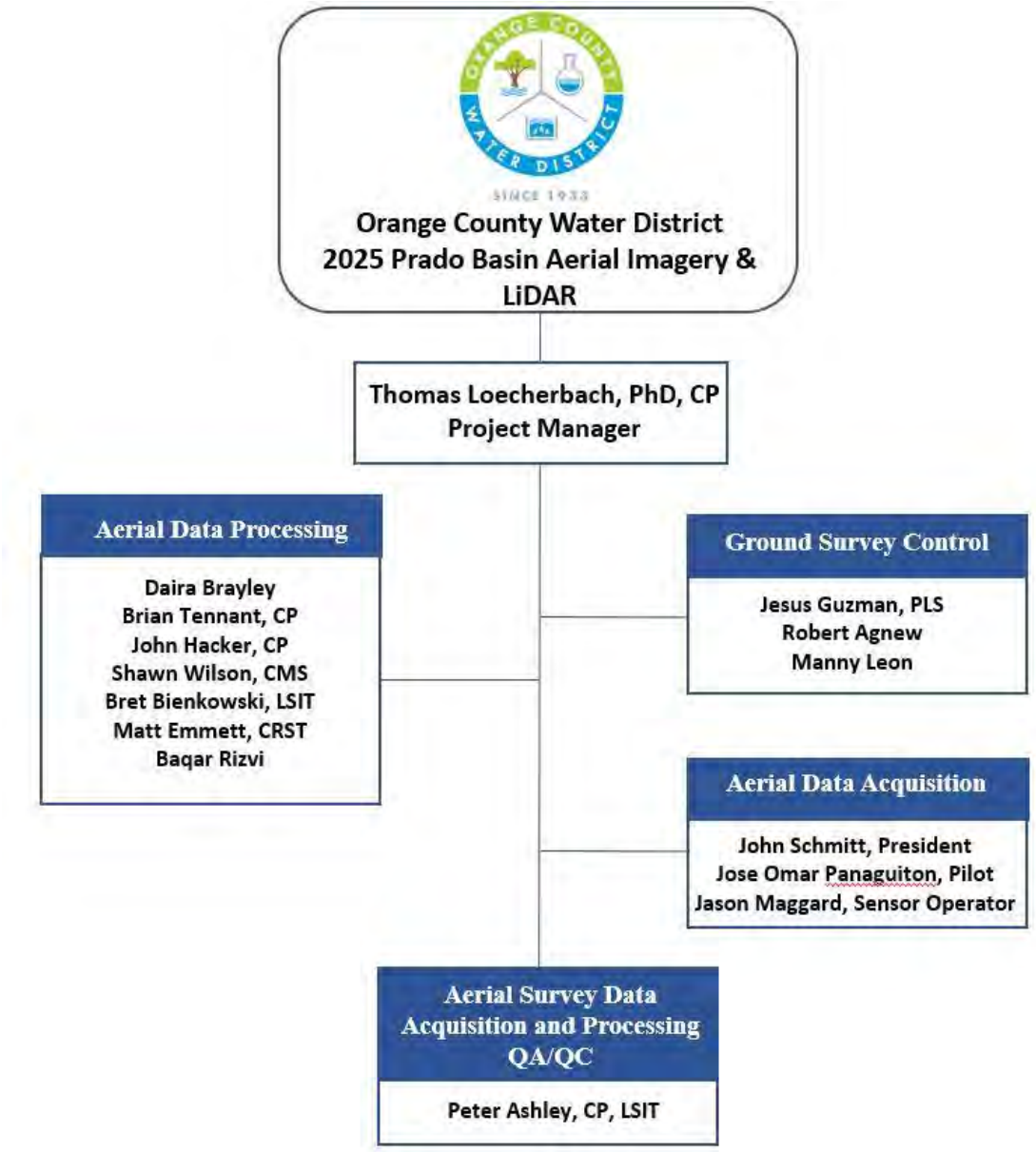

Figure 1: Org Chart for OCWD 2025 Aerial Imagery and LiDAR.

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The following table lists each team members responsibility and location as well as the contact information for the team leads. Additional contact information can be found in the resumes in the appendix. All team member key staff noted below will be available to support this project without substitution and will not be substituted with other staff without prior written approval by OCWD.

Team Member	Role	Anticipated level of involvement	Location	Key Contact
Thomas Loecherbach	**Project Manager** Quality Control	95%	Oakland, CA	thomas.loecherbach@tetratech.com 925.280.7445
John Schmitt	Flight management	10%	Pittsburg, PA	John.Schmitt@vexcelgroup.com
Jose Omar Panaguiton	Pilot	80%	Los Angeles, CA	jose.panaguiton@vexcelgroup.com
Jason Maggard	Sensor Operator	80%	Los Angeles, CA	Jason.maggard@vexcelgroup.com
Jesus Guzman	Survey Lead	20%	Irvine, CA	jesus.guzman@tetratech.com
Robert Agnew	Survey Technician	20%	Irvine, CA	robert.agnew@tetratech.com
Manny Leon	Survey Technician	20%	Irvine, CA	manny.leon@tetratech.com
Daira Brayley	**LiDAR Lead**	90%	Denver, CO	daira.brayley@tetratech.com
Peter Ashely	**QC Lead**	90%	Oakland, CA	peter.ashley@tetratech.com
Brian Tennant	**Image Lead**	90%	Oakland, CA	brian.tennant@tetratech.com
John Hacker	Breakline Compilation	20%	Oakland, CA	john.hacker@tetratech.com
Shawn Wilson	Processing Technician	20%	Bothell, WA	shawn.wilson@tetratech.com
Bret Bienkowski	Survey QC	20%	Tampa, FL	bret.bienkowski@tetratech.com
Matt Emmett	Processing Technician	20%	Denver, CO	matt.emmett@tetratech.com
Baqar Rizvi	LiDAR QC	20%	Sacramento, CA	baqar.rizvi@tetratech.com

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ORANGE COUNTY WATER DISTRICT OCWD OCWD ORTHOIMAGERY AND LIDAR 2025		TASK 01 ORTHOIMAGERY		TASK 02 LIDAR 8PPSM (OPTION 1)		TASK 03 LIDAR 16PPSM (OPTION 2)		TASK 04 MANAGEMENT		TOTAL	
NAME	**UNIT RATE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**
TETRA TECH STAFF											
Ashley, Peter	$ 188.00	4.0	$752	2.0	$376	2.0	$376			8.0	$1,504
Bienkowski, Bret	$ 248.00	2.0	$496	2.0	$496	2.0	$496			6.0	$1,488
Brayley, Daira	$ 128.00			21.0	$2,688	22.0	$2,816			43.0	$5,504
Emmett, Matthew	$ 78.00			6.0	$468	6.0	$468			12.0	$936
Hacker, John	$ 191.00	2.0	$382							2.0	$382
Loecherbach, Thomas	$ 230.00	10.0	$2,300	2.0	$460	2.0	$460	8.0	$1,840	22.0	$5,060
Rizvi, Baqar	$ 154.00			2.0	$308	2.0	$308			4.0	$616
Tennent, Brian	$ 120.00	12.0	$1,440							12.0	$1,440
Warren, Caprice	$ 151.00							4.0	$604	4.0	$604
Wilson, Shawn	$ 227.00			2.0	$454	2.0	$454			4.0	$908
Guzman, Jesus	$ 213.00	4.0	$852							4.0	$852
Agnew, Robert	$ 129.00	9.0	$1,161	3.0	$387	3.0	$387			15.0	$1,935
Leon, Manny	$ 150.00			12.0	$1,800	12.0	$1,800			24.0	$3,600
TOTAL LABOR COST		**43.0**	**$7,383**	**52.0**	**$7,437**	**53.0**	**$7,565**	**12.0**	**$2,444**	**160.0**	**$24,829**
EXTERNAL SUBCONTRACTOR											
Keystone Aerial Surveys	$ 5,260.00	1.0	$5,260							1.0	$5,260
	$ 13,185.00			1.0	$13,185					1.0	$13,185
	$ 16,630.00					1.0	$16,630			1.0	$16,630
GRAND TOTAL			**$13,432**		**$22,600**		**$26,690**		**$2,444**		**$65,166**

PROJECT OVERVIEW AND APPROACH

Understanding of the scope

We understand that OCWD is seeking to collect aerial 4-band imagery and quality level QL1 LiDAR and derived products to support OCWD's mission for a reliable supply of high-quality water to their customers. The area of interest (AOI) comprises an area of about 31.8 square miles described in the file OCWD_PradoBasin_PrjFlightArea.kmz provided by OCWD, with a 50 meter buffer outside the boundaries. The imagery must be flown during Summer 2025, one week before or after July 1, 2025.
The Imagery will have a ground resolution of 3" or better. The camera will collect 4 spectral bands, i.e. natural color RGB and near Infrared, or RGBI. Imagery will be controlled by airborne GPS, will be cloud free, collected between 10am and 2pm local time at a sun angle 45 degrees or higher. The Orthoimagery will meet the required accuracy for 1"=50' scale mapping.
The LiDAR will meet or exceed the USGS (United States Geological Survey) defined requirements for quality level1 (QL1) LiDAR with 8ppsm or optional 16 ppsm. The relative accuracy requirement between overlapping strips for QL1 LiDAR is 8cm or better. We will meet the imagery and lidar requirements outlined in the RFP and in the amendment.

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m²)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

Figure 2: USGS LiDAR Base Specifications. The required pulse density for QL1 LiDAR is 8ppsm.

Quality level	$RMSE_V$ (nonvegetated) (m)
QL0	≤0.050
QL1	≤0.100
QL2	≤0.100
QL3	≤0.200

Figure 3: USGS LiDAR Base Specifications. The required vertical accuracy is 10cm RMSE or better in non vegetated areas.

Deliverables
We understand the following deliverables are requested per RFP:

RGB imagery	GeoTIFF tiles
	MrSid mosaic
	other options can be decided in kick off meeting
4 band image	GeoTIFF tiles
	MrSid mosaic
	4 band images and/or separate 3 band RGB and 3 band color infrared
ancillary data	trajectories (shp format)
	tiling scheme (shp format)
	final report
	FGDC metadata
LiDAR data	Classified LAS 1.4 files
	Bare earth raster surface at 1-m resolution or better

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	Highest hit (first return) raster surface with the same resolution and extent as the bare earth raster surface
	Intensity image
	Shapefiles with flight trajectories, tiling, and swath boundaries
	A report of the work performed describing survey methods, boundaries, coordinate systems and datums, results, spatial accuracy assessment, including RMSE for relative and absolute accuracies and formal metadata as specified by the Federal Geographic Data Committee's (FGDC)
Horizonal coordinate system	State Plane Coordinate System, Zone 6 US feet, Datum NAD83 [WKID: 2230 (Zone 6)
Vertical datum	Elevation data shall be delivered on the North American Vertical Datum of 1988 (NAVD88), and also on the National Geodetic Vertical Datum of 1929 (NGVD29).

The horizontal coordinate system and datum for imagery and LiDAR is California State Plane Coordinate System, Zone 6 US feet, Datum NAD83 [WKID: 2230 (Zone 6), Authority:EPSG]. We understand that the elevation data is required to be delivered on the North American Vertical Datum of 1988 (NAVD88), and also on the National Geodetic Vertical Datum of 1929 (NGVD29). We will be able to deliver on both datums.

Ability for successful completion

Our team understands the scope and project requirements. Our Tetra Tech processing team and survey crew, as well as the Keystone flight crew are familiar with the project and the area. We are local and ready to mobilize on short notice. Keystone's team is familiar with FAA requirements in the area. Processing team is available to process on short notice. All three teams have sufficient experienced backup staff. Our PM, Dr. Loecherbach is available at anytime and ready to dedicate his attention to the project.

Project management and communication approach

Project kick-off. Dr.Thomas Loecherbach has been selected as the project manager for this project. He will be the point of contact for OCWD. He can be reached at any time during the course of the project and will be reporting to OCWD on a regular basis. Once the project has started he will set up a call for a kick-off meeting. The call agenda will include:

- Review the project purpose
- Establish project goals, objectives, and schedule.
- Assesses the potential impacts and impediments to the timely completion of the various project tasks and milestones and adjust accordingly.
- The meeting will conclude with a finalized schedule and preparation of a "responsibility chart."

Communication. Dr. Loecherbach is available in person, via phone, email, and video conference. He has at his disposal a team of experts in surveying, GIS, CAD, civil engineering as well as support from accounting. He will contact the Orange County Water District Project Manager periodically to provide updates and to ensure their satisfaction with our level of service and commitment to each project and will make necessary adjustments.

Cost Control. Tetra Tech has had an excellent record of controlling costs and schedules on projects. We believe our success is a result of several factors that include (1) regular attention to expenditures compared to work completed, (2) proactive scheduling, (3) quality of work, and (4) flexibility on scoped work.

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Tetra Tech's management procedures also focus on continuous review of progress to avoid potential problems before they become serious enough to affect delivery schedules and costs. Our management approach includes various procedures for early identification of issues that could lead to problems and established measures to deal effectively with these issues.

Proposed Schedule. Tetra Tech proposes the following schedule:

Tetra Tech Week Beginning Date (proposed)	2-Jun	9-Jun	16-Jun	23-Jun	30-Jun	7-Jul	14-Jul	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug
Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13
Contract Start													
Kick-Off													
Flight Planning													
Ground Control													
Acquisition (1 week before to 1 week after July 1st - weather depending)													
Airborne GPS processing													
LiDAR calibration													
Image processing													
LiDAR processing													
Edit and QC													
Final delivery													

QA/QC approach

Quality assurance and quality control are integrated into every step of our acquisition and production process. Quality assurance is met by carefully following standard procedures. Quality control is done both by the production staff and as additional, independent control. The Tetra Tech Geomatics Group strives for successful completion of each project, which is ultimately decided by the client.
Mr. Ashley is leading the QC for this project. In the beginning of the project he will assemble a set of project specific QC steps and QC checklists in an Excel spreadsheet format. QC takes place at every step throughout the project from flight planning, aerial acquisition, data calibration, data processing and final product delivery. QC checks include:

- Completeness of coverage
- Cloud coverage, lidar point density and other project specifications
- Horizontal and vertical accuracy reporting
- Relative accuracy of Orthoimagery along seamlines
- Relative accuracy of LiDAR data along strip overlaps
- Radiometric quality

A quality report will be provided as a deliverable at the end of the project.

Technical approach

Imagery is planned to be acquired with a Vexcel UltraCam Falcon prime mapping camera in 16 flight lines with 446 digital images. LiDAR is planned to be acquired with a Galaxy prime sensor. Imagery will be acquired at an altitude above terrain of about 4100', yielding a ground resolution of 4.8 to 7.6 cm (3inch) depending on varying terrain height. LiDAR will be acquired at an altitude above terrain of 3,450' and 30 flight lines for 8ppsm (points per square meter) or 2,790' and 40 flight lines for 16 ppsm.

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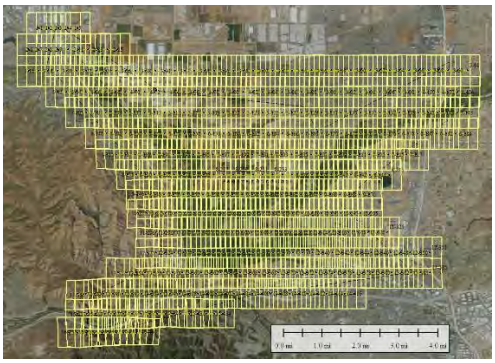

Figure 4: Flight plan imagery, 16 lines, 446 images.

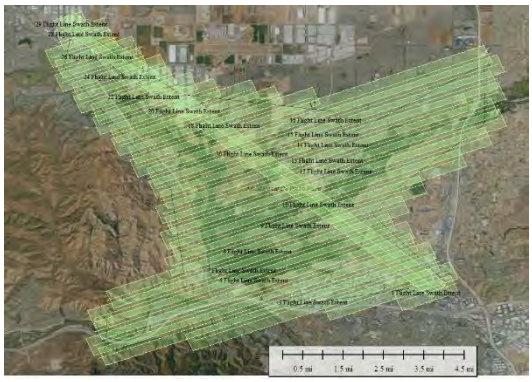

Figure 6: Flight plan LiDAR 8ppsm.

Ground control layout will match the layout used for the 2023 flight. This includes 9 targeted ground control points (panels) for the imagery and an additional minimum of 20 vertical check points for the LiDAR.

Tetra Tech uses the Inpho / Trimble photogrammetry suite for all aerotriangulation and orthophoto production. In the aerotriangulation the imagery will be tied together by measuring tie points and will be tied to the ground by measuring ground control points. The aerotriangulation also uses the airborne GPS and inertial data. The aerial images are then orthorectified using the OrthoMaster tool and mosaicked using OrthoVista.

Tetra Tech will receive calibrated and unclassified LiDAR point cloud from Keystone. Tetra Tech uses TerraSolid software TerraScan and TerraModeler for classification of the lidar data. We use GeoCue LP360 software for generation of the derived products DEM, DSM, and intensity images. LP360 is also used for quality control and header control.

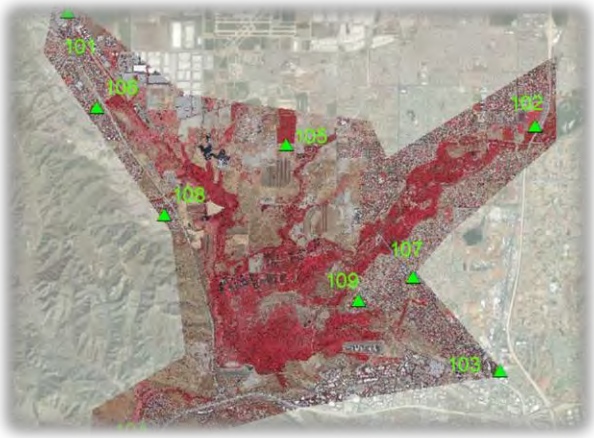

Figure 5:Targeted ground control (panels).

Management of possible constraints

Our team is familiar with project constraints that can occur. Most projects follow a linear workflow, i.e. one process step depends on successful completion of the previous step, from flight planning to final delivery. Constraints can be caused, for example by weather, FAA requirements, scheduled or unscheduled airplane maintenance. Tetra Tech and our partner Keystone have experience, redundant equipment and strong teams so that any constraint will only minimally affect schedule.

ADDITIONAL SERVICES

Tetra Tech teams cover a comprehensive variety of environmental engineering services. The Tetra Tech Geomatics Team offers a full range of services besides airborne LiDAR and photogrammetry. These include bathymetric LiDAR, mobile LiDAR and static LiDAR, drone imagery and LiDAR, change detection, remote sensing, hyperspectral remote sensing, GIS and CAD. Any additional service such as change detection for example can be scoped individually.

PRICE PROPOSAL

Tetra Tech is offering the below cost proposal:

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Task Number	Proposed Fee
1 – Project Management	$2,444.00
2 - Data Collection and Reporting (3 band color and NIR imagery)	$13,274.00
3a - LiDAR Data Collection and Reporting Option 1- USGS QL1 LiDAR [Minimum 8 pulses/m2]	$22,258.00
3b - LiDAR Data Collection and Reporting Option 2 - High Pulse Count USGS QL1 LiDAR [Minimum 16 pulses/m2]	$26,620.00
Not-To-Exceed Total for Tasks 1, 2 and 3a	$37,236.00
Not-To-Exceed Total for Tasks 1, 2 and 3b	$41,198.00

Tetra Tech suggests milestone billing for this project. We suggest billing after aerial acquisition is complete, and we will bill again after the final deliverables are accepted. We are happy to include itemized accounting of hours for personnel hourly rates. We will include a project schedule with each invoice.

STATEMENT OF INSURANCE COMPLIANCE

Tetra Tech has established contracts with Orange County Water District and has read and will comply with the following Orange County Water District insurance requirements noted in the Exhibit A of the RFP:

- $2Million for Commercial General Liability insurance.
- $1Million for Automobile Liability insurance (including additional insured endorsements for both General Liability and Automobile Liability insurance).
- $1Million for Workers' Compensation insurance (including Waiver of Subrogation endorsement for Workers' Compensation
- $1Million for Professional Liability insurance

OCWD STANDARD AGREEMENT

Tetra Tech's legal team has reviewed Orange Counties standard terms and conditions and is prepared to accept them.

BILLING

Tetra Tech will meet the billing requirements stated in the RFP.

CONFLICT OF INTEREST

Tetra Tech does not have any conflict of interest with individuals employed by Tetra Tech or our subcontractors that are associated with OCWD.

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APPENDIX - RESUMES

Robert Agnew, EIT
Design Engineer

Mr. Agnew is experienced in the design and preparation of construction documents and improvement plans. These plans include street and storm drain improvements, community parks, and the implementation of Best Management Practices (BMP) He is also experienced in preparing Stormwater Pollution Prevention Plans (SWPPP), WQMP's and LID reports.

Mr. Agnew is experienced in AutoCAD Civil 3D, AutoCAD 2016, GIS, HEC-HMS,HEC-RAS and county-specific hydrology software for project preparation. He is also experienced in field survey work.

Education:
BS, Civil Engineering, University of California, Irvine, 2023

Registrations/Certifications:

Engineer-In-Training California No 179863, 2023

Office Location:
Irvine, CA

Total Years of Experience:
(06/2022) 2

Years with Tetra Tech:
(06/2022) 2

EXPERIENCE

Transportation

TOS 702 Ramp Design, City of Los Angeles, Bureau of Engineering, Los Angeles, CA. 2022 – Ongoing. Design Engineer. Responsible for providing bridging documents and siting locations in support of StreetsLA's Pavement Preservation Program which maintains a street network of 23,000 lane miles and keeps all improved streets and related throughways in good to excellent condition. Tetra Tech's scope of services includes topographic survey, engineering design, design support during construction, and construction management services for various access ramps throughout the City, in compliance with the Americans with Disabilities Act (ADA).

TOS 33 67th Street and West Boulevard Civil Improvements, City of Los Angeles, Bureau of Engineering, Los Angeles, CA. 2023-Ongoing. Design Engineer. Provides drafting support, curb ramp design, and driveway analysis. The 67th and West Boulevard Street Improvement Project will provide accessible pedestrian and cyclist connectivity from the end of the Rail-to-Rail project to the Fairview Heights Metro station. The project entails street improvements for approximately six city blocks, along 67th Street from 11th Avenue to West Boulevard, and along West Boulevard from 67th Street to 71st Street.

Stormwater Management/Low Impact Development

Santa Ana Downtown Flood Reduction and Stormwater Infiltration, City of Santa Ana, CA. 2022 – Ongoing. Design Engineer. Provides hydrology report research and writing and drafting support. Located in downtown, the City of Santa Ana is reconstructing the 3rd Street parking lot to incorporate Best Management Practices (BMPs). Surrounding catch basins and storm drains are being reconstructed to divert stormwater into the parking lot for treatment and infiltration. The improvement in drainage and treatment alleviates flooding that occurs in the surrounding area and reduces pollutants being discharged into the watershed. The project captures runoff from the 23-acre drainage area into the infiltration system located underneath the parking lot, eventually recharging the groundwater table.

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, CDM Smith for City of Los Angeles, Los Angeles, CA. 2022 – Ongoing. Design Engineer. Responsible for hydrology studies, survey and mapping work, and engineering design and drafting for the Oro Vista Avenue segment of this stormwater improvement project. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Bristol-Tolliver Street Urban Greening Project, City of Santa Ana, Santa Ana, CA. 2023 – Ongoing. Design Engineer. Responsible for providing survey mapping, hydrology studies, harvest and use cistern sizing, bioretention and storm drainpipe design and drafting support. The Bristol Tolliver Street Urban Greening Project involved the construction of a new public park on a vacant lot at the corner of Bristol and Tolliver Streets in Santa Ana. The project included landscaping, a skate park, basketball court, fitness equipment, children's play areas, shade structures, pathways, signage, lighting, benches, picnic tables, and stormwater management features. A storm drain system was designed to capture, store, and reuse stormwater for irrigation, supplemented by potable water when needed.

TETRA TECH

Peter Ashley, MS, CP, LSIT
Senior Project Manager

EXPERIENCE SUMMARY

Mr. Ashley is a senior level professional with more than 30 years of project experience supplemented with a strong academic background in surveying and photogrammetry. Mr. Ashley's practice encompasses every aspect of the mapping process, from aerotriangulation design and computation, to digital map translation. Because of the wide range of his capabilities, he is a vital consultant for our clients on project design and best technical approach for photogrammetry, orthophotography and Airborne LiDAR. Uniquely, Mr. Ashley's has worked extensively with historical aerial imagery archives, some of which date back to the 1930s. His results have been submitted as evidence in state and in federal court where he has been called as an expert witness to discuss his methods and his findings. In the course of his career, Mr. Ashley has managed major mapping projects for public agencies including the U.S. Forestry Service, the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, the Bureau of Land Management, the Los Angeles Department of Water and Power, the Santa Clara Valley Water District, the San Francisco Public Utilities Commission, Pacific Gas and Electric, the Alameda County Flood District and Water Conservation, the City/County of San Francisco, the Napa County Flood Control District, and Vandenberg Air Force Base.

Key areas of experience include: photogrammetry, aerotriangulation, orthophotography, historical aerial photography interpretation, airborne LiDAR surveys, AutoCAD, MicroStation, and ArcGIS.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Senior Project Manager, 12/08 - present

Hammon, Jensen, Wallen & Associates, Photogrammetrist, 9/86 – 11/08

RELEVANT EXPERIENCE

Grass Valley / Nevada City Area Mapping (2020)

Mr. Ashley managed a wide-area mapping of Grass Valley and Nevada City in the California Gold County. Tetra Tech commissioned the acquisition of digital imagery at 7.5cm with simultaneous capture of lidar at 10 pts/m^2 to support mapping at planimetric mapping 1"=100' and the generation of contours on a 1-ft interval of Grass Valley and Nevada City, CA. Total area for mapping was 29.62 square miles. Mapping was delivered in client specified tiles AutoCAD format. A ground class was extracted from the lidar data and supplemented by selected breaklines to create a surface in AutoCAD Civil 3D for the generation of the 1-ft contours. The photography was orthorectified, mosaicked, and delivered in the same tiling scheme as the mapping and classified lidar.

San Nicolas Island Mapping (2020)

Mr. Ashley managed the aerial LiDAR and digital aerial imagery surveys of San Nicolas Island, a US Navy facility 65 miles off the Southern California coast. Tetra Tech commissioned the acquisition of airborne LiDAR data at 8 points per square meter and 4-band digital photography at 5cm resolution of the whole of San Nicolas Island. The lidar was classified and used to create a digital elevation model (DEM) and a digital surface model (DSM). The imagery was the source material for RGB and CIR orthophotos and for the colorization of the lidar. The colorization of lidar proved valuable when the client requested that the vegetation class be stratified into four classes by height. **Size:** 22.5 sq. miles

EDUCATION

M.S., Civil Engineering (Surveying and Photogrammetry), University of California, Berkeley, 1984

B.A., Mathematics, University of Massachusetts, Amherst, 1972

AREAS OF EXPERTISE

Photogrammetry/LiDAR

Project Design

CADD Systems

Archival Photography Mapping

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS, #R1075

California Land Surveyor in Training, LSIT #4936

OFFICE LOCATION

Oakland, CA

YEARS OF EXPERIENCE

40

YEARS WITH FIRM

16

Baqar Rizvi
Topobathymetric LiDAR Strategist

EXPERIENCE SUMMARY

Mr. Rizvi has 10+ years of experience in advanced remote sensing, systems calibration, and LiDAR flight data QA/QC. He has a technical focus in sensor systems integration, workflow automation, and unmanned platform development.

Mr. Rizvi's core competency has been LiDAR calibration, and at large aerial survey/remote sensing (systems, payloads, integration). Much of his time has been spent leading and training groups of calibrators on large scale LiDAR/Photogrammetry projects.

Mr. Rizvi has broad UAS/UGV experience with designing, building and deploying hardware, and processing unmanned data. Additionally, he has skills in terrestrial modeling, design, CAD, electrical transmission modeling, and automation/scripting.

CORPORATE PROJECT EXPERIENCE

Connecticut Department of Energy and Environmental Protection – Coastal Mapping Project. 2024
Performed Lidar Calibration and technical supervision for Whiteout Geospatial, in their effort to map the Connecticut Coastline using Helicopter mounted Topobathymetric lidar systems.

Washington Department of Transportation – Statewide Highway Infrastructure Mapping: 2023-2024
Performed GPS/GNSS processing and Calibration of Moblie Lidar data for WSDOT. Performed Image refinement and processing for pavement and spherical cameras.

NOAA NGS, Shoreline Mapping for the Coastal Mapping Project
Worked as a subcontractor for Fugro to assist on their NOAA NGS Florida shoreline mapping project. Performed the full calibration (line-to-line adjustment) workflow, including intra- and interswath checks for consistency.

UAS Calibration, 2023 – Present
Confidential Client, Priest River Idaho Survey, Idaho
Utilized UAS systems to refly and supplement larger airborne collects. Created workflows to resolve major IMU errors that would have otherwise resulted in a failure of spec.

EDUCATION

BS – Physics: Optics, Portland State University 2021

AREA OF EXPERTISE

- Lidar Calibration
- Bathymetric Lidar Systems
- GNSS inertial processing
- Sensor System Integration
- UAS/UGV Systems
- GIS

REGISTRATIONS/ CERTIFICATIONS

FAA Remote Pilot (Part 107)

(FAA – 3969662)

TRAINING

Beaverton Civilian Emergency Response: SAR 2014

Aviation Survival and Egress Training: 2014

Radiation Safety – Portland State University - 2012

OFFICE

Irvine, CA

YEARS OF EXPERIENCE

10

YEARS WITHIN FIRM

1

Daira Brayley
Topobathymetric LiDAR Strategist

EXPERIENCE SUMMARY

Daira Brayley has over 4 years of experience working in the geospatial field, with a focus on topobathymetric data. Daira's responsibilities are centered around the production side of projects, she mostly works with topobathymetric light detection and ranging (LiDAR) editing, performing QC reviews, and creating final client deliverables. Daira has worked with a wide range of government contracts and contributed to more than a dozen topobathymetric projects. The majority of her projects are for government contracts and utilize the CZMIL SuperNova sensor. While Daira's professional experience has been exclusive to bathymetric LiDAR, during her academic studies, she traveled to Bhutan to conduct field research on her senior thesis, while simultaneously working with a research professor on mapping and digitizing community forest in Bhutan.

EDUCATION

MS, Environment and Development, London School of Economics and Political Science, 2019

BA, Environmental Studies, and Political Science, Eckerd College, 2018

AREA OF EXPERTISE

Airborne Topobathymetric LiDAR

Airborne Topographic LiDAR

REGISTRATIONS/ CERTIFICATIONS

ASPRS Member

OFFICE

Denver, CO

YEARS OF EXPERIENCE

5

YEARS WITHIN FIRM

2

CORPORATE PROJECT EXPERIENCE

LiDAR Strategist, 2024

Brookfield Renewable US, LiDAR Data Acquisition and Processing for Topography and Boundary Survey for the Propose Black River, White River, and Black Scoter Solar Project, Jackson County Arkansas

LiDAR Strategist duties included processing the calibrated LiDAR data and creating the initial gross clean workflow, creating and testing batch macros to run over problem areas, manual editing of the data, performing QC reviews, and creating final deliverables for clients.

LiDAR Strategist, 2024
Atlas Energy, and Golden State Wind, Golden State Wind

The Golden State Wind project had two separate clients, with a significant amount of overlap between the two AOIs. The project covered approximately 10,547 square miles. Duties for the LiDAR Strategist consisted of editing the processed LiDAR point cloud and creating final deliverables for clients.

Bathymetric LiDAR Strategist, 2023
National Oceanic and Atmospheric Administration Office of Coastal Management (NOAA OCM), Whitefish Point to Bay Mills, MI in Eastern Lake Superior

Assisted with the workflow development for the team's first topobathy LiDAR project and working with the CZMIL SuperNova sensor. Topobathymetric LiDAR Strategist duties for this project included, but was not limited to, training bathymetric analysts, editing LiDAR data, performing QC reviews, creating final client deliverables, and writing and testing different macros. The project was commissioned by NOAA OCM in support of their analysis of bathymetric topography and underwater habitat in this region and covers roughly 162 square kilometers.

LiDAR Strategist, 2023
TerraGen, Joshua Tree

Assisted in automating sections of the workflow that involved LiDAR analysis, this involved running a batch macro over the LASD to move data to their correct classification, as well as creating a normalized Digital Surface Model (nDSM) that allowed for automated Euclidean Highet measurements of Joshua Tree. The LiDAR Strategist also worked closely with the project manager during the pilot test area while comparing LiDAR collected trees with trees collected during field survey, additional and a best practices workflow was designed for future projects similar in nature.

TETRA TECH

Bret Bienkowski, LSIT
Mobile Mapping Survey Manager

EXPERIENCE SUMMARY

Mr. Bienkowski is experienced with surveying involving Light Detection and Ranging (LiDAR) and hydrographic surveying specifically in the mobile mapping and UAV formats for LiDAR collection and processing. As a Land-Surveyor-in-Training, he is currently pursuing his Professional Surveying and Mapping License in Florida. He currently holds his Part 107 Remote Pilot License for UAV systems. His talents include records research, calculations, processing of field data, analysis, mapping and reporting, preparation of topographic and boundary surveys, legal descriptions, and sketches. Mr. Bienkowski is proficient using AutoCAD, MicroStation, CAiCE, Carlson, TopoDOT, RiPROCESS, RiSCAN PRO, Recap and many other 3D modeling software packages.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Mobile Mapping Survey Manager, 07/18 - present

KCI Technologies, LiDAR Survey Practice Leader, 04/16 - 07/18

Riegl Laser Measurement Systems, Terrestrial Lidar Manager, 05/12 - 04/16

McKim & Creed, Mobile Mapping Project Surveyor, 04/11 - 05/16

Atkins Global, Geomaticist I, 05/08 - 04/11

RELEVANT EXPERIENCE

Pinellas County Street Level Mobile LiDAR, Pinellas County, FL: Mr. Bienkowski is the project manager for the County-wide Mobile LiDAR collection for 1,800 center line miles of county roads. This data will then be used for the extraction of 108,000 building finish floor elevations and merged into the Tetra Tech FusionMap software for use in sea level rise analysis and hurricane preparations with the use of the FusionMap water inundation viewer.

Priest River UAS Topo Survey, Priest River, ID: Mr. Bienkowski was the Pilot In Command and Project Manager for a topographic survey and ortho image of a 50-acre site in Priest River, Idaho. The team used our heavy lift drone with our LiDAR and Imagery sensor to collect a complete site ortho photo along with LiDAR point cloud. From the point cloud and imagery, a bare earth surface model was generated and a final calibrated ortho imagery was delivered. This data will aid in the projects team to design a new community park along the riverfront.

Bad River UAS LiDAR Biannual Inspection, Ashland, WI: Mr. Bienkowski was the Pilot In Command and Project Manager for a multiyear continuing monitoring project for a portion of the Bad River outside of Ashland Wi. On a biannual basis the team uses precision LiDAR and imagery sensors on a heavy lift drone to fly the site and document the erosion of the river at the point of a meander bend. Each time the site is flown, and a bare earth surface is generated and then evaluated against the previous flights surface.

EDUCATION

B.S. Geomatics, University of Florida, 2008

AREAS OF EXPERTISE

Mobile/ UAS LiDAR

Project Design

CADD Systems

UAV Photography

TRAINING/CERTIFICATIONS

Florida Land Surveyor in Training, LSIT

FAA Part 107 Remote Pilot

#3934223

OFFICE LOCATION

Tampa, FL

YEARS OF EXPERIENCE

16

YEARS WITH FIRM

5

TETRA TECH

Brian Tennant, CP
Certified Photogrammetrist

EXPERIENCE SUMMARY

Brian Tennant has over 19 years of experience in photogrammetric mapping. AT Blue Mountain Aerial Mapping he went from starting as a stereo compiler to being the production manager, managing all mapping projects within the company or to subcontractors to be completed, with over 35 million acres of flight, and mapping projects completed throughout Pennsylvania, Ohio, and West Virginia. He then was one of the first to help start the aerial mapping firm 6 Guns, LLC. As an Aerial Mapping Manager, he is always looking out for the best interest of the client, putting the client's interest first.

RELEVANT EXPERIENCE

UAS Landfill monitoring (2024). In collaboration with Tetra Tech SWE in Green Bay WI, Mr. Tennant has processed the UAS (unmanned aerial system) imagery for over a dozen landfill sites across 6 states in the northern Mid-West. The deliverables include an image derived point cloud, a Civil3D surface with two-foot contours, and an orthophoto. The turn-around time for the processing is around one to three days.

Stockpile mapping (2005-2023). In partnering with coal mines in Pennsylvania, West Virginia and Alabama. Mr. Tennant has processed the UAS imagery over stockpile sites. Mr. Tennant would produce an image derived point cloud, an AutoCAD drawing of the surface with two-foot contours and an orthophoto.

West Virginia 4 Counties Orthophoto (2023). As a contractor to the county assessors of West Virginia Mr. Tennant scheduled flights and produced 0.5' resolution RGB orthoimagery to Monongalia, Wetzel, Harrison, and Ohio counties in the spring of 2023.

Pennsylvania Coal Mine Spring Orthophoto (2021, 2023) Partnered with the Pennsylvania Coal company and a Flight company to produce 0.25' Resolution RGB orthoimagery for over 300,000 acres.

Navajo Nation Abandoned Uranium Mines, Aerial LiDAR and Imagery (2024). Mr., Tennant process ~50 square miles of Aerial LiDAR as part of the Tetra Tech Geomatics Team.

Mine Planimetrics and Orthophotography (2005-2023). Partnered with multiple Coal Mining companies to schedule spring flights that totaled just below 1 million acres of 0.25' resolution RGB orthoimagery. And produce 100' scale mapping in areas of interest.

EDUCATION

Clay-Battelle High School Graduate

AREA OF EXPERTISE

Photogrammetry, airborne LiDAR; Aerial triangulation, DTM generation, planimetric and topographic mapping, Orthorectification; Software packages including Inpho / Trimble, Terrasolid, GlobalMapper, Pix4dMapper, Civil3d

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #CP1653

UAS License- 4583360

OFFICE LOCATION

Morgantown, WV

YEARS OF EXPERIENCE

20

YEARS WITH FIRM

5 months

TETRA TECH

Matt Emmett
LiDAR Analyst

EXPERIENCE SUMMARY

Highly skilled in Geomatics, Survey, Remote Sensing, and Navigation data analysis and processing. Specialized in processing and classification of LiDAR point clouds and associated geospatial deliverables. Extensive experience in feature extraction and generating accurate digital terrain models for engineering and construction design. Proficient in Industry-standard software and tools, including TopoDOT, TerraSolid, ArcGIS, and CADD such as Civil3D and Microstation.

Exceptional problem-solving abilities and attention to detail, ensuring the highest quality data outputs at or above industry standards. Adept at collaborating with multidisciplinary teams and communicating complex technical concepts to both technical and non-technical stakeholders.

Committed to staying updated with the latest advancements in Lidar technology and the geospatial industry, harnessing it to deliver innovative solutions.

CORPORATE PROJECT EXPERIENCE

PG&E System Hardening: Topographic feature extraction of Mobile and Aerial LiDAR point clouds of roadway corridors and the surrounding areas. Point cloud classification and refinement for use of manual and automated extraction tools. QA/QC of technician extracted features and redlines for corrections. Digital Terrain Model creation and QC for engineering and direct client deliverables.

Development of more efficient processes to streamline future efforts in project. Trained technicians on tools and best practices to increase efficiency and quality of data.

WASHDot Mobile Mapping: QC and processing of raw mobile LiDAR data and imagery. Registration of point-clouds to survey trajectory and control points. Imagery processing and mounting for panoramic spherical images and point-cloud colorization.

PREVIOUS EXPERIENCE

Westwood Professional Services, Remote Sensing/Aerial Mapping Technician, 07/22 - 06/23

Aerial, UAV, and Terrestrial LiDAR Data QC and Feature extraction in the Energy distribution, Renewables, and Transportation sectors. Planimetric extraction of UAV imagery for Renewable energy construction planning. TopoDOT process design and extraction for engineering deliverables.

EDUCATION

B.Sc. Geophysical Engineering, Minor in Geology and Remote Sensing, Colorado School of Mines, 2013

AREA OF EXPERTISE

- Mobile/Aerial LiDAR
- Remote Sensing
- Planimetrics
- CADD Systems
- UAV Photogrammetry

REGISTRATIONS/ CERTIFICATIONS

Certified Mapping Technologist – Remote Sensing, ASPRS (RST244)

CPR/FIRST AID Certified Through Feb 2027

TRAINING

Custom AutoCAD Fundamentals, CAD-1, August 2017

Preparation for ASPRS Certification - General Knowledge, ASPRS, September 2020

Preparation for ASPRS Certification - LiDAR, ASPRS, September 2020

OFFICE

Denver, CO

YEARS OF EXPERIENCE

12

YEARS WITHIN FIRM

2

Jesus Guzman, PLS
Senior Land Surveyor

Mr. Guzman is a licensed surveyor with 26 years of experience providing office and field survey support for projects involving engineering, construction, and mapping for highways, utility infrastructure, airport runways, schools, water pipeline tunnels, dams, rivers, and lake improvements. He is experienced with preparation, agency submittal, and recordation of tract maps, parcel maps, final maps, Records of Surveys, tentative maps, corner records, lot mergers, lot line adjustments, ALTA documents, and public roadway abandonments. Mr. Guzman has managed and participated in various land survey activities including field surveying for municipalities, county, state, and federal agencies, and the armed services. His municipal experience includes providing map checking, public improvement plan check, and setting Engineering Conditions of Approval for proposed developments.

Education:
Math studies, California State at Fullerton, 1984-1989

Registrations/Certifications:
Professional Land Surveyor, California No. 8648, 2009

Office Location:
Irvine, CA

Total Years of Experience:
(06/1998) 26

Years with Tetra Tech:
(03/2023) 1

(Wastewater Bio)

Mr. Guzman has managed field crews in the construction of many sewer and storm drain facilities throughout his career, for conduit sizes ranging from 6-inch to 84-inch with appurtenances. He is also experienced in performing as-built surveys of wastewater facilities and preparing the required exhibits. His duties have also included providing calculations for construction staking. Types of structures germane to his experience include head walls, siphons, lift stations, grease interceptors, cleanouts, catch basins, inlets, channels, and infiltration systems.

EXPERIENCE

Water

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, City of Los Angeles, CA. 2022 – Ongoing. Survey Party Chief responsible for overseeing field crews and office staff related to topographic data collection, processing, and base sheet development. The project is currently in the preliminary design phase, and the project team is scoped to provide final design services. Tetra Tech is leading the segment along Oro Vista Avenue, while CDM Smith oversees the portion along Lankershim Boulevard with Tetra Tech's support on the topographic survey. The Oro Vista Avenue project area receives runoff from a tributary watershed of approximately 183 acres and lacks stormwater infrastructure. Runoff is conveyed as surface flow along primarily asphalt curbs and swales before discharging to Haines Canyon Channel at the north end of the project site. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Supplemental Topographic Survey, Simms Park Regional Stormwater Capture, Lower San Gabriel River Watershed Management Group, Bellflower, CA. 2022. Survey Party Chief. Responsible for providing supplemental topography of Simms Park using conventional survey methods, for the design and construction of proposed stormwater capture improvements. Also provided drafting of site topography from collected survey data using AutoCAD Civil 3D.

Street Topography for Design and Construction of Waterline Infrastructure, Cities of Fullerton, Buena Park, and Orange, CA. 2020 – 2023. Project Surveyor. Managed various field crews in the collection of field topography and boundary data for the development of topographies for the design and construction of new water infrastructure in the Cities of Fullerton, Buena Park, and Orange. Mr. Guzman completed right-of-way and parcel mapping, along with reviewing and approving all deliverables.

Transportation

San Miguelito Road Easement Survey, County of Santa Barbara, Santa Barbara, CA. 2024. Project Surveyor. Responsible for overseeing the preparation of easement legal descriptions, plat and exhibit. This project was issued as a task order under an Indefinite Delivery-Indefinite Quantity (IDIQ) Survey contract with the County of Santa Barbara. The services provided are important to assist the County with its transportation project delivery goals, which are vital for meeting the Transportation Division's ongoing mission to provide a clear path, smooth ride, and a safe trip to the traveling public.

TETRA TECH

John Hacker, CP
Production Manager

EXPERIENCE SUMMARY

Mr. Hacker specializes in production oversight for photogrammetry, feature extraction, stereo compilation, CADD standards, softcopy, and DTM generation. His professional background has been focused on production cartography and photogrammetry since 1978 with experience in stereo compilation, map data assembly and digital orthophotography. For the last 20 years, he has been directly responsible for the creation and support of digital mapping standards for several mapping firms. This has included writing collection macros, AutoLisp applications and scripting routines, as well as the day to day management of production department staff.

Key areas of experience include: photogrammetry, feature extraction, stereo compilation, CADD standards, softcopy, DTM generation, map data assembly, digital orthophotography, AutoLisp applications and scripting, and production management.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Production Manager, 11/2008 – present

HJW & Associates, Photogrammetric Lead, 08/1993 – 11/2008

Towill, Inc., Photogrammetrist, 11/1985 – 08/1993

EDUCATION

B.S., Geography, University of California, Los Angeles, 1978

AREAS OF EXPERTISE

Photogrammetry, Stereo Compilation, DTM Generation, CADD Standards

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #R1057

OFFICE LOCATION

Oakland, Ca.

YEARS OF EXPERIENCE

43

YEARS WITH FIRM

12

RELEVANT EXPERIENCE

St. Helena Hospital, St. Helena, California (2021). Large scale digital imagery was collected to support photogrammetric mapping of the hospital facility and environs. The assessment was done to review wildfire damage in the immediate area.

Pine Forest, Pacific Grove, California (2021). Photogrammetric mapping was produced from film-based imagery to support City staff in evaluating plans for redevelopment of a half-block section of urban land.

Clover Flat Landfill, Calistoga, California (2021). Using the VrTwo softcopy mapping system, an annual update of the active fill site is made using photogrammetric means. The resulting DEM is used to confirm calculated fill rates for the active landfill cells.

San Nicholas Island, Ventura County, California (2020). Digital aerial imagery was collected along with LiDAR data to create a digital elevation model (DEM) to support creation of a surface water runoff model.

U.S. Coast Guard Station Barbers Point, Honolulu, HA (2020). Using the VrTwo softcopy system, planimetric information was collected to support infrastructure upgrades in this aircraft operations facility. LiDAR derived contours were loaded into the VrTwo system for stereoscopic review and edit.

Lake Charles Carbon Company Volumes (Quarterly from 2013). Using photogrammetric means, Tetra Tech has provided our internal Tetra Tech client with volume calculations of stored coke arrayed across multiple sites in a Lake Charles, La. coke production facility.

Raw Water Lake, Corpus Christi, Texas (2017). Tetra Tech provided large scale topographic mapping to support other Tetra Tech colleagues' effort to repurpose a former aluminum smelting site into an LNG export facility. The focus of the work was to plan the dismantling an obsolete pond and model possible flood paths in case of a breach.

JASON MAGGARD

Sensor Operator – CA Branch

JOINED KEYSTONE:

- June 2022

YEARS OF EXPERIENCE:

- 13 years

EDUCATION/ CERTIFICATIONS:

- Associate in Science – Hillsborough Community College in Tampa, 2009
- ABO-NCLE Certified, Board Certified Optician

SUMMARY:

Mr. Maggard is responsible for operating and monitoring aerial sensors during flight to collect data for various projects while adhering to all safety protocols and procedures. He performs pre-flight, in-flight and post-flight sensor equipment checks to ensure all systems are functioning properly. Mr. Maggard analyzes collected data and disseminates the checked data as well as accompanying reports to internal teams and clients. He collaborates with pilots to ensure accurate and efficient data collection while maintaining compliance with all aviation regulations. He maintains and troubleshoots sensor equipment as needed to minimize downtime and guarantee accurate data is captured. Mr. Maggard is proficient with Keystone's UCFp, UCE, UCC, and Optech Galaxy sensors.

PROJECT EXPERIENCE:

PROJECT	STATES FLOWN	NUMBER OF MILES OR NUMBER OF SITES
Digital	CA, NV, NM, CO, AZ, OR, WA	Over 2,500 miles
Topo	CA, NV, NM, CO, AZ, OR, WA	Over 1,100 miles
LiDAR	CA, NV, NM, CO, AZ, OR, WA	Over 1,200 miles

JOHN SCHMITT, CP, GISP

President / Principal-in-Charge

JOINED KEYSTONE:

- 1987

YEARS OF EXPERIENCE:

- 37 years

EDUCATION/ CERTIFICATIONS:

- FAA Commercial/Single- & Multi-Engine/Land Certificate
- Certified Geographic Information Systems Professional (GISP) – 61839; 2009
- ASPRS Certified Photogrammetrist – 1389; 2014

SUMMARY:

Keystone's President and Principal-In-Charge, John Schmitt, began his 37-year career with Keystone Aerial Surveys as an aerial sensor operator and quickly became expertly skilled on the company's film cameras. John then attained his pilot's license and became proficient in all of Keystone's aircraft. During his career, John has flown hundreds of survey hours throughout the US and acquired thousands of flight hours on missions for oil, gas, engineering, mapping, federal, state and local government clients.

In 2001, John became Vice President and part owner of Keystone while continuing his professional development by successfully completing his Certified Geographic Information Systems Professional (GISP - 61839) and ASPRS Certified Photogrammetrist (CP - 1389) certifications. Additionally, John assumed a position of business development and built on customer's relationship through superior customer service skills while continuing to contract manage many of Keystone's largest projects. His many years of experience on the road and at home base as both a pilot and operator afforded him the ideal perspective to control an array of difficult items that go into coordinating large and complicated projects while balancing the needs of the customer with the constraints of flight crews, conditions and aircraft. John has estimated, flown and/or managed over 7,500 miles of transportation projects for the State Department of Transportation. He has also estimated, flown and/or managed collection of tens of thousands of images. In 2015, John assumed the role of President of Keystone. He is now primarily responsible for strategic planning and implementation.

PROJECT EXPERIENCE:

- USDA Stewardship Lands Imagery Digital – Ongoing since 2002
- USDA National Resource Inventory – Ongoing since 1998
- Statewide Imagery Acquisition in Alabama – Ongoing since 2019
- Statewide Imagery Acquisition in Maryland – Ongoing since 2018
- Aerial Digital Imagery Acquisition for PG&E – Ongoing since 2019
- Imagery Acquisition for the NCTCOG Project in Texas – Ongoing since 2018
- Texas Department of Transportation, TX – Ongoing since 2013

JOSE "OMAR" PANAGUITON

Aerial Survey Pilot – CA Branch

JOINED KEYSTONE:

- June 2018

YEARS OF EXPERIENCE:

- 10 years

EDUCATION/ CERTIFICATIONS:

- Bachelors, Radiologic Technologist – Iloilo Doctors' College in the Philippines, 2010
- Associates, Professional Aeronautics – Miramar College in San Diego, 2017
- Commercial Pilot License SEL/MEL Rating- 3788691

SUMMARY:

Since Joining Keystone Aerial Surveys in June 2018, Omar has been checked out in multiple types of aircraft from Single Engine Cessna 206 and 210 to multi engine aircraft such as the Piper Aztec, Piper Navajo, and Cessna 310. Omar has also flown a multitude of sensors, including: Vexcel UltraCams, Leica RC30, Leica ADS100, Leica CityMapper, and Teledyne Optech LiDAR systems. Currently, Omar is the full-time pilot for the Keystone California Branch. His duties include but are not limited to coordinating with ATC, preparing the aircraft for every flight, ensuring the aircraft scheduled maintenance are being followed, as well as lead each mission for the California Branch. Omar has over 3,200 hours of total flight time.

PROJECT EXPERIENCE:

PROJECT	STATES FLOWN	NUMBER OF MILES OR NUMBER OF SITES
Digital	CA, NV, NM, DE, ME, NY, NJ, PA, CT, and MA	Over 3,500 miles
Topo	CA, NV, NM, VT, ME, NY, NJ, PA, CT, and MA	Over 2,300 miles
LiDAR	CA, NV, NM, DE, ME, NY, NJ, PA, CT, and MA	Over 1,900 miles

Manuel Leon, EIT
Design Engineer/Surveyor

Mr. Leon is a civil engineering design engineer and survey technician with experience on a wide variety of municipal, state, and federal projects. He is experienced in surveying, grading, hydrologic and hydraulic analysis, preparation of plans, cost estimating, permit process coordination, and engineering report writing. Mr. Leon is well versed in Autodesk's AutoCAD and Civil 3D design software.

Education:
BS, Civil Engineering, California State University Long Beach, 2012

Professional Registrations:
Engineer-in-Training (EIT), No. 172306, 11/2020

Professional Affiliations:
American Society of Civil Engineers (ASCE)

Office Location:
Irvine, CA

Total Years of Experience:
(2014) 9

Years with Tetra Tech:
(2016) 7

EXPERIENCE

Stormwater and Water Systems

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, City of Los Angeles, CA. 2022 – Ongoing. Design Engineer and Surveyor. Responsible for providing an aerial control survey as well as supplemental topographic survey work including existing utility location used to develop a surface terrain implemented on the design of the project. Also responsible for plan production of plan and profile storm drainpipe design in which existing utility location/data was used to avoid horizontal and vertical crossings when feasible. This stormwater project includes two separate project areas in the City of Los Angeles and is funded by the Safe Clean Water Program. The project is currently in the preliminary design phase, and the project team is scoped to provide final design services. Tetra Tech is leading the segment along Oro Vista Avenue, while CDM Smith oversees the portion along Lankershim Boulevard with Tetra Tech's support on the topographic survey. The Oro Vista Avenue project area receives runoff from a tributary watershed of approximately 183 acres and lacks stormwater infrastructure. Runoff is conveyed as surface flow along primarily asphalt curbs and swales before discharging to Haines Canyon Channel at the north end of the project site. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Surveying

Control Network Establishment, Boundary and As-built Survey, Naval Air Facility (NAF) El Centro, NAVFAC SW, El Centro, CA. 2019. Surveyor. Responsible for the establishment of new horizontal and vertical control monuments and new values to existing control monuments at NAF El Centro. New monuments were set at key locations to provide inter-visibility and convenience of location for future construction projects. The new and existing monuments were observed with Static GPS and digital level loops meeting Federal Geodetic Control Committee (FGCC) standards for establishment of horizontal and vertical control networks and level loops. The data was then post processed using Trimble Business Center, performing fully constrained horizontal and vertical adjustments. A report detailing the survey procedure, the coordinates of the new points, the considerations in the adjustment, and the errors in the network were prepared. A boundary survey of the current NAF boundary and an as-built survey of requested facilities within the base boundary was also performed and located in relation to the base control network. Deliverables included a Record of Survey Map, and Exhibit Maps showing the established control network and the surveyed site features in relation to the base boundary for NAVFAC SW.

Yuma SOF Hangar, Barge Design Solutions Inc, US Army Corps of Engineers. 2018 – 2020. Surveyor. Responsible for aerial control survey as well as supplemental topographic survey work including existing utility location used to develop a surface terrain implemented on the design of the project. The purpose of this task was to establish depths and locations of sewer infrastructure, control aerial topographic survey targets and collect runway surface information for improvements and additions to airfield and waste management infrastructure in support of Yuma Proving Grounds' expansion of its Military Freefall School.

TETRA TECH

Thomas Loecherbach, Ph.D., CP
Geomatics Director

EXPERIENCE SUMMARY

Dr. Loecherbach's education is in geodesy and land surveying with emphasis in photogrammetry and adjustment theory. He has 30 years of professional experience in private photogrammetric practice in the U.S. plus five years at university level prior to that. He has been continuously involved in photogrammetry and remote sensing since 1985. Throughout his career he has been instrumental in implementing airborne GPS and INS technology, digital camera systems and other technologies into the mapping workflow. During this time he has managed the technical aspects of hundreds of projects for a wide range of customers. For daily production he developed software tools, established guidelines and streamlined production workflows. As Geomatics Director, he oversees all technical project specifications.

He has also taught classes on photogrammetry, digital image processing and remote sensing to graduate students and professionals and worked on the transitioning of graduate level teaching from analytical photogrammetry to digital photogrammetry and image processing.

RELEVANT EXPERIENCE

Prado Basin Aerial Imagery (2021). Tetra Tech collected 34 square miles of 4-band aerial imageryin the Prado Basin in Orange County. Imagery was acquired in 463 images at a quarter-foot resolution. The ground control survey was performed by Tetra Tech's survey team in San Luis Obispo. Mr. Loecherbach managed the project including aerial acquisition firm and survey team.

Amelia County VA (2024). Tetra Tech acquired 4-band aerial imagery and high density airborne LiDAR for a 1127 acre site in Amelia County in Virginia. Mr. Loecherbach managed the project and provided the data to the Glen Allen office of Tetra Tech. Deliverables included a DEM and a DSM at 1-foot grid spacing, an orthomosaic, and a surface in xml format.

UAS Landfill monitoring (2021, 2022, 2023,2024). In collaboration with Tetra Tech SWE in Green Bay WI, Mr Loecherbach has processed the UAS (unmanned aerial system) imagery for over a dozen landfill sites across 6 states in the northern Mid-West. The deliverables include an image derived point cloud, a Civil3D surface with two-foot contours, and an orthophoto. The turn-around time for the processing is around one to three days.

USGS 3DEP Program, Montana (2023). As a subcontractor to Axis Geospatial, Mr. Loecherbach has managed the QC and processing of 5,500 square miles of LiDAR collected of the state of Montana for the USGS 3DEP program.

Marathon Pipeline (2023). Under contract with Marathon Petroleum, Tetra Tech acquired LiDAR data and aerial imagery along a 1,280 mile long and 400 foot ide corridor across 5 states. Mr. Loecherbach managed the LiDAR point cloud processing and derived products and processed the orthoimagery.

EDUCATION

Ph.D., Photogrammetry, Institute of Photogrammetry, University of Bonn, Germany, 1998

M.S., Geodesy and Land Surveying, University of Bonn, Germany, 1990

AREA OF EXPERTISE

Photogrammetry, airborne LiDAR, Mobile Mapping; Aerial triangulation, DTM generation, planimetric and topographic mapping, Orthorectification, GIS; Software packages including Inpho / Trimble, Terrasolid, LP360, ESRI, GlobalMapper, Pix4dMapper, Civil3d

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #R1306 (certified in 2006, expires Aug 31, 2026)

GIS and Remote Sensing course work, San Francisco State University, 2000

OFFICE LOCATION

CES Oakland, CA

YEARS OF EXPERIENCE

30

YEARS WITH FIRM

16

TETRA TECH

Shawn Wilson
Lidar Project Manager

EXPERIENCE SUMMARY

Shawn Wilson is a Certified Lidar Scientist and Lidar Project Manager focusing on mobile mapping and UAV remote sensing. Shawn brings 19 years of experience in geomatics and engineering for public utilities and government related projects. He has managed and directed the utilization of remote sensing, scanning, imaging and 3D modeling projects for public and private firms. Also, he has been a guest lecturer at the University of Washington in the Engineering program showing the evolution of GPS systems and 3D scanning. Shawn's experience includes Lidar from terrestrial, mobile, aerial and drone platforms, data collection and management, boundary resolution, control transformations and construction calculations. He has managed the development of deliverables in GIS, Civil3D, Microstation and PLS-CADD formats. He graduated from Western Washington University and has a certificate from Stanford University. Shawn also is a FAA Certified UAS Remote Pilot and has participated in NASA's ARSET program training.

RELEVANT EXPERIENCE

Washington State Department of Transportation Enterprise Mobile Lidar; Washington State (2023-present). Led collection, post processing, deliverable generation and project management of survey grade mobile mapping data on nearly 16,700 centerline miles of full right-of-way data. Data was delivered in a in-house built custom sofware for the client to visualize the data based on their LRS network.

System Hardening Utility Planimetric Mapping; California State Wide (2022-present). Led processing, deliverable generation and project management of the development of Civil3D and Microstation deliverables of 300+ miles of right-of-way. Design grade planimetric and surfaces were performed with accelerated deadlines. Custom algotrithms were developed to aid in the identification of individual trees within highly vegetated areas.

Golden State Wind; California Coast (2024). Led processing, deliverable generation and project management of the developnet of a Digital Elevation Model and Digital Surface Model of 3,400 square miles of the California coast.

Leading Light Wind; New Jersey Coast (2023). Led processing, deliverable generation and project management of the developnet of a Digital Elevation Model and Digital Surface Model of 500 square miles of the New Jersey coast.

Burma Road; Kodiak Island, AK (2023). Led processing, deliverable generation and project management of the developnet of a orthophoto, planimetric map, digital elevation model and digital surface model on Kodiak Island in Alaska.

EDUCATION

B.A., Anthropology, Western Washington University, 2006

Professional Certificate: Advanced Project Management, Stanford University, 2011

AREA OF EXPERTISE

Lidar Acquisition, Imagery Acquisition, Remote Sensing Data Post Processing, Operations Management, Remote Sensing Sensor Integration, Planimetric Mapping and Extraction

TRAINING/CERTIFICATIONS

ASPRS Certified Mapping Scientist: Lidar #L061

Expires: 01/2026

FAA UAS Remote Pilot

#4660132

OFFICE LOCATION

CES Bothell, WA

YEARS OF EXPERIENCE

19

YEARS WITH FIRM

7

ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, California 92708

ADDENDUM NO. 1
REQUEST FOR PROPOSALS (RFP-24-018)
PRADO BASIN MUTLISPECTRAL AERIAL IMAGERY AND LiDAR
4/8/2025

This addendum serves as written notice of the following corrections, clarifications, additions and/or deletions to any and all copies of the Request for Proposals for Prado Basin Multispectral Aeiral Imagery and LiDAR for OCWD.

The proposer shall execute the acknowledgment form at the end of this addendum and shall attach it to the proposal submitted.

---

1. Q&A Table

a. Please refer to Attachment A-1 of this Addendum No.1 for the QA Table.

ATTACHMENT A-1

Q & A Table

RFP-24-018
RFP for Prado Basin Multispectral Aerial Imagery and LiDAR
QA Table
4/8/2025

No.	QUESTIONS	ANSWERS
1	Can you provide the project boundary in shp or kmz format?	Yes, the kmz format of the project boundary shall be provided upon email request to Procurement@ocwd.com.
2	The RFP asks for a 13 degree scan angle (26 degree FOV) and an overlap of 50%. With modern lidar sensors, especially with a spinning mirror, all project requirements for accuracy and density can easily be exceeded with a higher FOV of 36 degrees and a reduced overlap of ~30%. A FOV of 26 degrees could double the acquisition cost. Are these hard requirements.	This is not a hard requirement . As long as the accuracy and precision are kept, we are fine with the proposed alternative.

END OF ADDENDUM

MANDATORY FORM

ACKNOWLEDGE RECEIPT OF ADDENDUM NO. 1

REQUEST FOR PROPOSAL
PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LiDAR
(RFP-24-018)

4/8/25

Proposer shall acknowledge receipt of this addendum by detaching, signing and attaching to his/her proposal, one (1) copy of this sheet.

I, Thomas Loecherbach, Tetra Tech

Name of Proposer, Company Name

1999 Harrison Street, Suite 500, Oakland CA 94612

Address, City, State, Zip

Hereby acknowledge receipt of Addendum No. 1 to the **Request for Proposal (RFP-24-018) Prado Basin Multispectral Aerial Imagery and LiDAR** and have considered these revisions in the preparation of my proposal. This addendum, consisting of this acknowledgement, shall become a part of any contract made pursuant thereto.

Proposer's Signature

Thomas Loecherbach

Printed Proposer's Name

4/14/2025

Date

ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, California 92708

ADDENDUM NO. 2
REQUEST FOR PROPOSALS (RFP-24-018)
PRADO BASIN MUTLISPECTRAL AERIAL IMAGERY AND LiDAR
4/10/2025

This addendum serves as written notice of the following corrections, clarifications, additions and/or deletions to any and all copies of the Request for Proposals for Prado Basin Multispectral Aeiral Imagery and LiDAR for OCWD.

The proposer shall execute the acknowledgment form at the end of this addendum and shall attach it to the proposal submitted.

---

1. Q&A Table

a. Please refer to Attachment A-1 of this Addendum No.2 for the QA Table.

2. Revised Request for Proposals (RFP) Submittal Checklist

a. Please refer to Attachment A-2 of this Addendum No. 2 for the revised RFP Submittal checklist.

ATTACHMENT A-1

Q & A Table

RFP-24-018
RFP for Prado Basin Multispectral Aerial Imagery and LiDAR
QA Table
4/10/2025

No.	QUESTIONS	ANSWERS
1	Can you provide the project boundary in shp or kmz format?	Yes, the kmz format of the project boundary shall be provided upon email request to Procurement@ocwd.com.
2	The RFP asks for a 13 degree scan angle (26 degree FOV) and an overlap of 50%. With modern lidar sensors, especially with a spinning mirror, all project requirements for accuracy and density can easily be exceeded with a higher FOV of 36 degrees and a reduced overlap of ~30%. A FOV of 26 degrees could double the acquisition cost. Are these hard requirements.	This is not a hard requirement . As long as the accuracy and precision are kept, we are fine with the proposed alternative.
3	Are the following checklist items required with this submittal? 6 Independence 7 License to Practice 12 Prior Engagements with the District 13 Identification of Anticipated Potential Audit Problems If so, can the County provide any more details on what they would need to see in the proposal?	No, please see the following revised RFP Submittal Checklist.
4	Can the District confirm that aerial photography must conform to 1995 ASPRS Draft Aerial Photography Standard?	As long as the District has an accurate representation of the horizontal and vertical accuracy (as it relates to the orthorectification process) of the resultant orthoimage, and it conforms to the ASPRS accuracy standards represented per ASPRS (2024), the District is fine with the deviation from the 1995 ASPRS Draft Aerial Photography Standard specifically (as it is addressed in the proposed product). The horizontal accuracy should be documented and explained if it is above normal tolerances (above 10"). If a decrease in horizontal accuracy is needed to make the flight cost-effective, then it should be noted. Ideally, the horizontal accuracy of the image should be 6", but again, this should be documented with an explanation as to why the horizontal offset is what it will be.

ATTACHMENT A-2

REVISED REQUEST FOR PROPOSALS (RFP) SUBMITTAL CHECKLIST

Request for Proposals (RFP) Submittal Checklist

The following submittals shall be completed and submitted with each Proposal package (see table below for the "Required Submittal Checklist."). This table has been provided as a convenience for proposers to use as a reference only. Ultimately, it is the Proposer's sole responsibility to ensure that their proposal complies with all requirements of the RFP and all the required submittals are included in the Proposal package before it is formally submitted to OCWD. Proposals may be deemed nonresponsive if they do not respond to all areas specified in the RFP.

Item No.	Required Submittal Checklist	Check (√)
1	Signed Proposal package including:	
2	Title Page	
3	Cover Letter	
4	Table of Contents	
5	Experience and Record of Past Performance	
6	Project Team and Qualifications	
7	Project Overview and Approach	
8	Additional Services	
9	Price Proposal	
10	Statement of Insurance Compliance A statement accepting the requirements stated in Section 6.9 of the RFP.	
11	OCWD Standard Agreement: • A statement accepting the requirements stated in Section 6.10 of the RFP.	
12	Billing • A statement accepting the requirements stated in Section 6 of the RFP.	
13	Conflict of Interest	
14	Addenda Acknowledgement Forms (if applicable)	

END OF ADDENDUM

MANDATORY FORM

ACKNOWLEDGE RECEIPT OF ADDENDUM NO. 2

REQUEST FOR PROPOSAL
PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LiDAR
(RFP-24-018)

4/10/25

Proposer shall acknowledge receipt of this addendum by detaching, signing and attaching to his/her proposal, one (1) copy of this sheet.

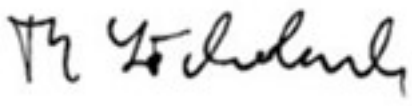
I, Thomas Loecherbach, Tetra Tech

Name of Proposer, Company Name

1999 Harrison Street, Suite 500, Oakland, CA 94612

Address, City, State, Zip

Hereby acknowledge receipt of Addendum No. 1 to the **Request for Proposal (RFP-24-018) Prado Basin Multispectral Aerial Imagery and LiDAR** and have considered these revisions in the preparation of my proposal. This addendum, consisting of this acknowledgement, shall become a part of any contract made pursuant thereto.



Proposer's Signature

Thomas Loecherbach

Printed Proposer's Name

4/15/2025

Date

18700 Ward Street
Fountain Valley, CA 92708

ocwd.com
(714) 378-3200

John Kennedy
Orange County Water District
P.O. Box 8300
Fountain Valley, CA 92728-8300

Todd Corbin
Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

Shivaji Deshmukh
Inland Empire Utilities Agency
6075 Kimball Avenue
Chino, CA 91708

Re: Cost Sharing Letter Agreement: 2025 Prado Basin Multispectral Aerial Imagery and LiDAR Data Collection

This cost sharing letter agreement (Agreement) sets forth the understanding between the undersigned parties regarding the sharing of costs for the 2025 Prado Basin multispectral aerial imagery and LiDAR data collection. Orange County Water District (OCWD) intends to enter into a contract with Tetra Tech Inc. to complete this project. The scope of services with Tetra Tech Inc., which is the subject of this Agreement is set forth in Exhibit A (Scope).

OCWD and the undersigned parties (collectively referred to as Parties and individually as Party) hereby agree to contribute to the cost of the consultant contract pursuant to the provisions set forth below.

1. Scope of Services

Tetra Tech Inc. will perform services as detailed in Tetra Tech Inc. response to Orange County Water District request for proposals for 2025 Prado Basin Multispectral Aerial Imagery and LiDAR dated March 20, 2025. The project scope is described in **Exhibit A** attached hereto and incorporated herein by reference.

2. Cost Sharing

(a) Cost of Services

OCWD has entered into, or intends to enter into, a contract with Tetra Tech Inc. for performance of the Scope with a **not-to-exceed cost of $41,198** (Compensation).

(b) Cost Sharing Between the Undersigned Parties

The Parties hereto each agree to be responsible for reimbursement of the payments made under the Contract with Tetra Tech Inc. based on Table 1 as follows:

Table 1 Cost Share Distribution for Contract

Agency	Cost Share ($)	Cost Share[1] (%)
Orange County Water District [4-Band Aerial Imagery & High Pulse County LiDAR]	$33,338	81%
Chino Basin Watermaster [4-Band Aerial Imagery]	$3,930	9.5%
Inland Empire Utilities Agency [4-Band Aerial Imagery]	$3,930	9.5%
Total	**$41,198**	**100%**

1 To the extent the actual cost of the project is greater or less than $41,198, the Parties agree that costs will be allocated in accordance with the percentages listed for each Party in Table 1.

(i) Upon receipt by OCWD of each written statement from Tetra Tech Inc. regarding the amount due and owing for the applicable time period (Progress Payment), OCWD shall be responsible for payment to Consultant for the amount due and owing.

(ii) The Parties shall be responsible for payment of their share of the amount due and owing under each Progress Payment to be billed by OCWD to each Party, quarterly. None of the Parties shall be responsible for payment of any amounts in excess of its percentage share as set forth herein, without the prior written consent of the Party being requested to pay such additional amount. If project costs are lower than expected, each Party will only be responsible for contributing its proportional share of the total project costs as shown in Table 1.

(iii) OCWD shall provide a copy of the Progress Payment to each Party along with a cover letter setting forth the calculation of the share due and owing by each Party. Within thirty (30) days of the date of said cover letter (Invoice), each Party shall submit payment to OCWD for its share as set forth in this Agreement.

3. Effective Date and Term

This Agreement shall be effective on the date of full execution of this Agreement by all of the Parties (Effective Date). The term of this Agreement shall be from the Effective Date to the date of completion of performance of the Scope under the Tetra Tech Inc. Contract pursuant to the schedule and deadlines set forth in Exhibit A and other schedules and deadlines as may be determined by the Parties and Tetra Tech Inc. The Parties may elect to extend the term in writing.

4. General Provisions

(a) Indemnification

Each Party (Indemnitors) hereby agrees to defend, indemnify and hold free and harmless the other Parties (Indemnitees) from and against any and all liability, expense, including defense costs and legal fees, and claims for damages arising from or connected with Indemnitors' negligent or otherwise wrongful activities undertaken per this Agreement. There are no third-party beneficiaries of this letter Agreement.

(b) Notices

Correspondence to be given to any Party may be sent by first-class mail, addressed and delivered as set forth below in the signature blocks for each Party.

(c) Representation of Authority

Each Party represents to the other that it has the authority to enter into this Agreement and that the individual signing this Agreement on behalf of their respective Party has the authority to execute this Agreement and to bind their respective Party to the terms and conditions of this Agreement.

(d) Counterparts

This Agreement may be executed in several counterparts, all or any of which shall be regarded for all purposes as one original and shall constitute and be but one and the same instrument.

(e) Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the State of California.

(f) Cooperation. The Parties acknowledge that they are entering into an arrangement in which the cooperation of all of the Parties will be required, including the execution of necessary further documents. The Parties agree to cooperate in good faith with each other and review and submit timely documents for the benefit of the Project.

BY SIGNING BELOW, THE PARTIES AGREE TO BE BOUND BY THE PROVISIONS OF THIS AGREEMENT

ORANGE COUNTY WATER DISTRICT

By: _____
John Kennedy, General Manager

Dated: _____

CHINO BASIN WATERMASTER

By: _____
Todd Corbin, General Manager

Dated: _____

INLAND EMPIRE UTILITIES AGENCY

By: _____
Shivaji Deshmukh, General Manager

Dated: _____

Exhibit A

Tetra Tech Inc.

2025 Prado Basin Multispectral Aerial Imagery and LiDAR
Technical & Price Proposal

Response to RFP-24-018

2025 Prado Basin Multispectral Aerial Imagery and LiDAR

Technical & Price Proposal

April 15, 2025

Submitted to:

Orange County Water District
Administration Office Building
Attn: Bobby Velasco, Senior Buyer/Warehouse Supervisor
18700 Ward Street
Fountain Valley, CA 92708
Procurement@ocwd.com

Prepared by:

Tetra Tech, Inc.
Geomatic Technologies Group
Attn: Thomas Loecherbach
1999 Harrison Street, Suite 500
Oakland, CA 94612
Thomas.loecherbach@tetratech.com
925.280.7445 (office)
510.433.0830 (fax)

TETRA TECH

April 15, 2025

Orange County Water District
Attn: Bobby Velasco
18700 Ward Street
Fountain Valley, CA 92708

Dear Mr. Velasco and Members of the Selection Committee:

It is with great pleasure and interest that we submit this proposal for the 2025 Prado Basin Aerial Imagery and LiDAR. We have successfully performed the 2021 and the 2023 project for OCWD and are familiar with the scope, the project area, and the Orange County Water District team's requirements. We have again assembled a team of professionals with the skills required for successful completion of this project. We understand that the Water District is seeking high resolution and spatially accurate multispectral aerial imagery and LiDAR as well as derived products. The unique qualifications of our team members include:

- **Past Performance Record of Successful Delivery of Prado Basin Aerial Imagery to Orange County Water District.** Our team collected and processed aerial imagery data for Orange County Water District in 2021 and imagery and LiDAR in 2023. We collected, processed, and delivered all required scope items on time and with approval of the District.

- **Engineering Services for Southern California and Recent History with the Orange County Water District.** The team that we have assembled has collected and processed LiDAR and imagery data for flood control projects in the Southwest for over 15 years. We have completed numerous projects for public and private clients including work for Orange County Water District, with Mid-Basin Centennial Park and Santiago Pump Station.

- **Depth and Breadth of Expertise.** Our expertise includes a team of ASPRS Certified Photogrammetrists, Imagery and LiDAR Analysts, Professional Licensed Surveyors and remote sensing professionals who have completed similar work to that required of this project throughout California and across the United States.
- **Capacity.** Our team has the capacity to perform the work that is required, and our team is positioned and eager to begin work immediately upon receiving a notice to proceed. Our depth of highly qualified staff allows us to adapt to changes in project requirements and/or scope and minimizing impacts to project schedule.

We appreciate this opportunity to further demonstrate the support our team can provide to the Orange County Water District. If you have any questions about this Proposal, please feel free to contact us.

Sincerely,

Thomas Loecherbach, PhD
Geomatics Director
Tetra Tech, Inc.

Tetra Tech, Inc.
1999 Harrison Street, Suite 500, Oakland, California 94612
Tel 925.584.0049 www.tetratech.com

Contents

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EXPERIENCE AND RECORD OF PAST PERFORMANCE

Reference Project No. 1: OCWD Prado Basin 2023 Aerial Imagery and LiDAR, CA	
Name of Owner/Client	Orange County Water District
Description of project	Tetra Tech was contracted by the Orange County Water District (OCWD) to develop 4 band Orthoimagery for 33.9 square miles in the Prado Basin and to collect 16 ppsm (points per square meter) LiDAR , and to provide derived products .
Services provided	Aerial Imagery and LiDAR Acquisition, Ground Survey, Data Processing, Products
Start Date/End Date	2023
Contract Amount	$42,460 (Original/Final)
Contact Information of Owner/Client	Kevin O'Toole, Orange County Water District, Senior Planner 18700 Ward Steet, Fountain Valley, CA 92708, Phone: 714.378.8248

Project No. 2: Wetzel County WV Orthoimagery	
Name of Owner/Client	Wetzel County, WV
Description of project	Tetra Tech was contracted by Wetzel County (WV) to provide 3 band orthoimagery at a resolution of 0.25' for the entire County (~361 square miles) and perform a change detection. A total of 2,765 images were collected with an UltraCam in three mobilizations.
Services provided	Orthorectification, QC and accuracy reporting, change detection.
Start Date/End Date	2025, ongoing, scheduled delivery 4/30/2025
Contract Amount	$51,071 (Original/Final)
Contact Information of Owner/Client	Scott Lemley, Assessor Slemley@wvassessor.com, 304-455-8216 210 Main St. New Martinsville, WV 26155

Project No. 3: Sunnyslope LiDAR	
Name of Owner/Client	MN8 Energy LLC
Description of project	Tetra Tech provided professional surveying services consisting of a boundary survey, and a topographic survey for 14 parcels of land encompassing 2,337 acres of land in Baker County, OR, including aerial LiDAR collection and CAD processing.
Services provided	LiDAR acquisition, surface model, contours
Start Date/End Date	2025
Contract Amount	$101,600
Contact Information of Owner/Client	Jared Medwar, Civil Engineer Phone: +1 561 246 5687, jared.medwar@mn8energy.com

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Project No. 4: USGS Arizona North-Central, Airborne LiDAR Processing	
Name of Owner/Client	Sanborn Geospatial
Description of project	Through Sanborn Geospatial's USGS Geospatial Products and Services Contract, Tetra Tech performed LiDAR data processing for 2,628 square miles of area in Arizona. The work was completed from July 2024 to October 2024. In accordance with the USGS LiDAR Base Specification. Tetra Tech digitized and delivered 3D breaklines for hydro features. Tetra Tech then used the 3D hydro breaklines and final classified 'class 2' points to create a hydroflattened DEM.
Services provided	LiDAR processing, Quality Control, USGS specifications QC
Role	Subcontractor
Start Date/End Date	2024
Contract Amount	$205,015 (Original/Final)
Contact Information of Owner/Client	Shawn Benham, Vice President of Programs, Mapping Division sbenham@sanborn.com Mobile: (719)502-1296

Project No. 5: Grass Valley – Nevada City Mapping, CA	
Owner/Client	Dundas Geomatics
Description of project	Tetra Tech acquired 3inch digital imagery and 10 ppsm lidar for an area of 30 square miles to support mapping at planimetric mapping 1"=100' and the generation of 1-ft contours for Grass Valley and Nevada City, CA.
Services provided	Aerial Imagery and LiDAR Acquisition, Planimetric Mapping
Date	2020
Contract Amount	$167,000
Contact Information of Owner/Client	Ron Dundas, 159 South Auburn St., Grass Valley, CA 95945, 530.274.1616 rdundas@ddgeo.com

Most of the survey and mapping work completed by our Tetra Tech Geomatic Technologies Group in California is through private firms, and not directly with public agencies. The following is a list of California Public Agency Direct Projects that were completed by our Geomatic Technologies Group over the past 5 years.

Client Name	Date	Title of Project
Los Angeles Department of Water & Power	2020	Owens Lake LiDAR
Pacific Gas and Electric	2020-present	Survey and Mapping MSA
South Orange County Wastewater Authority	2020	Wood Canyon Airborne LiDAR
City of Santa Cruz	2020, 2021	Santa Cruz Aerial Mapping
Orange County Water District	2021, 2023	Prado Basin

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PROJECT TEAM AND QUALIFICATIONS

Tetra Tech, a leading provider of specialized management consulting and technical services, offers an array of infrastructure and environmental services to a diverse base of public and private sector clients. With 30,000 associates in 450 offices in more than 110 countries on six continents. In 2009, Tetra Tech started the Geomatic Technologies Team, providing integrated mapping solutions using state-of-the-art mapping software, airborne sensors and camera systems, and a robust information technology infrastructure. Our staff is supported by a uniform administrative and management system that project teams can access immediately to ensure work is completed effectively. Tetra Tech has assembled a team that offers the Orange County Water District an experienced professional group to effectively respond to all requirements listed in the solicitation. The Org chart in Figure 1 gives an overview of the assembled team structure.

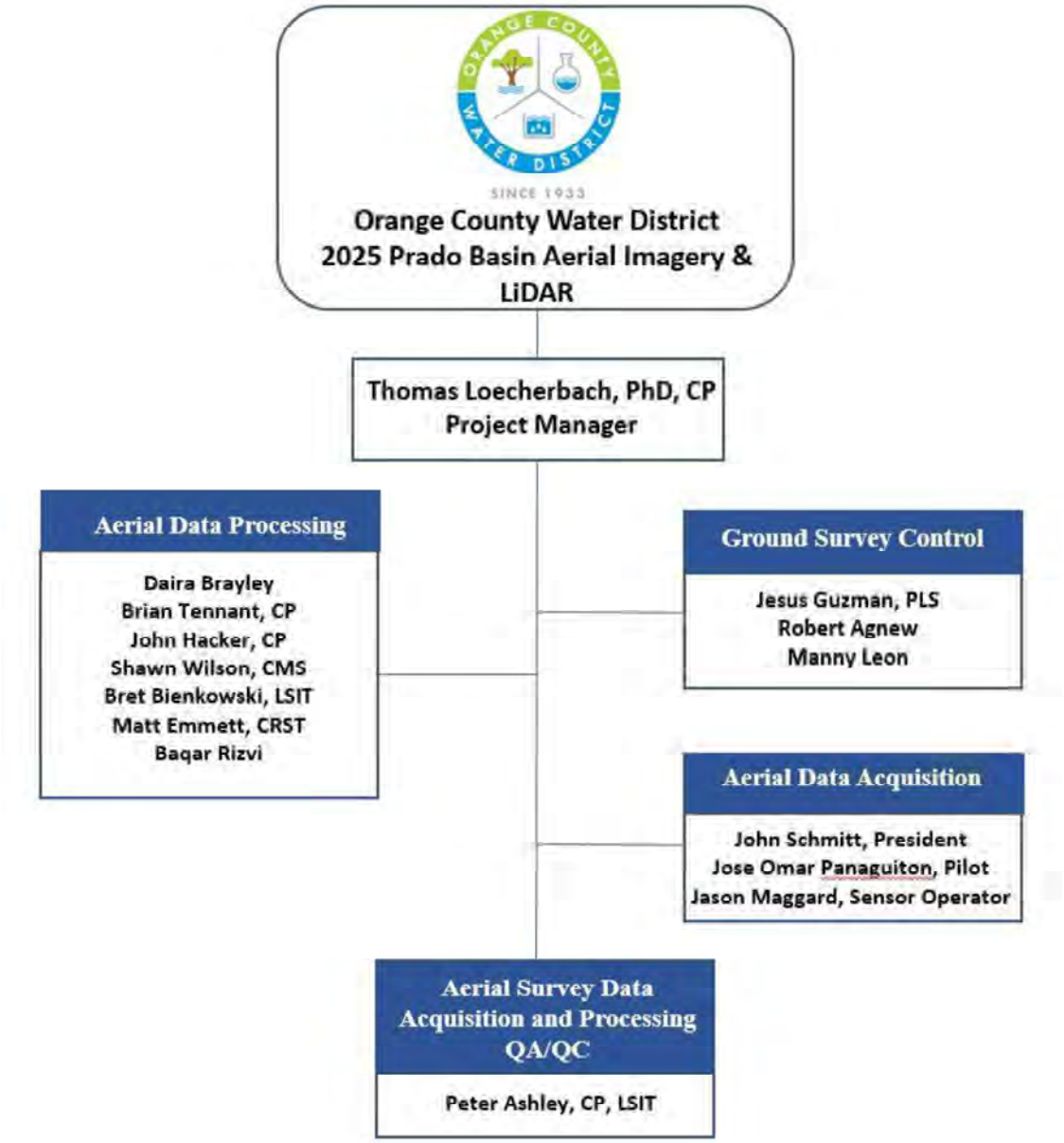

Figure 1: Org Chart for OCWD 2025 Aerial Imagery and LiDAR.

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The following table lists each team members responsibility and location as well as the contact information for the team leads. Additional contact information can be found in the resumes in the appendix. All team member key staff noted below will be available to support this project without substitution and will not be substituted with other staff without prior written approval by OCWD.

Team Member	Role	Anticipated level of involvement	Location	Key Contact
Thomas Loecherbach	**Project Manager** Quality Control	95%	Oakland, CA	thomas.loecherbach@tetratech.com 925.280.7445
John Schmitt	Flight management	10%	Pittsburg, PA	John.Schmitt@vexcelgroup.com
Jose Omar Panaguiton	Pilot	80%	Los Angeles, CA	jose.panaguiton@vexcelgroup.com
Jason Maggard	Sensor Operator	80%	Los Angeles, CA	Jason.maggard@vexcelgroup.com
Jesus Guzman	Survey Lead	20%	Irvine, CA	jesus.guzman@tetratech.com
Robert Agnew	Survey Technician	20%	Irvine, CA	robert.agnew@tetratech.com
Manny Leon	Survey Technician	20%	Irvine, CA	manny.leon@tetratech.com
Daira Brayley	**LiDAR Lead**	90%	Denver, CO	daira.brayley@tetratech.com
Peter Ashely	**QC Lead**	90%	Oakland, CA	peter.ashley@tetratech.com
Brian Tennant	**Image Lead**	90%	Oakland, CA	brian.tennant@tetratech.com
John Hacker	Breakline Compilation	20%	Oakland, CA	john.hacker@tetratech.com
Shawn Wilson	Processing Technician	20%	Bothell, WA	shawn.wilson@tetratech.com
Bret Bienkowski	Survey QC	20%	Tampa, FL	bret.bienkowski@tetratech.com
Matt Emmett	Processing Technician	20%	Denver, CO	matt.emmett@tetratech.com
Baqar Rizvi	LiDAR QC	20%	Sacramento, CA	baqar.rizvi@tetratech.com

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ORANGE COUNTY WATER DISTRICT OCWD OCWD ORTHOIMAGERY AND LIDAR 2025		TASK 01 ORTHOIMAGERY		TASK 02 LIDAR 8PPSM (OPTION 1)		TASK 03 LIDAR 16PPSM (OPTION 2)		TASK 04 MANAGEMENT		TOTAL	
NAME	**UNIT RATE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**	**QTY**	**PRICE**
TETRA TECH STAFF											
Ashley, Peter	$ 188.00	4.0	$752	2.0	$376	2.0	$376			8.0	$1,504
Bienkowski, Bret	$ 248.00	2.0	$496	2.0	$496	2.0	$496			6.0	$1,488
Brayley, Daira	$ 128.00			21.0	$2,688	22.0	$2,816			43.0	$5,504
Emmett, Matthew	$ 78.00			6.0	$468	6.0	$468			12.0	$936
Hacker, John	$ 191.00	2.0	$382							2.0	$382
Loecherbach, Thomas	$ 230.00	10.0	$2,300	2.0	$460	2.0	$460	8.0	$1,840	22.0	$5,060
Rizvi, Baqar	$ 154.00			2.0	$308	2.0	$308			4.0	$616
Tennent, Brian	$ 120.00	12.0	$1,440							12.0	$1,440
Warren, Caprice	$ 151.00							4.0	$604	4.0	$604
Wilson, Shawn	$ 227.00			2.0	$454	2.0	$454			4.0	$908
Guzman, Jesus	$ 213.00	4.0	$852							4.0	$852
Agnew, Robert	$ 129.00	9.0	$1,161	3.0	$387	3.0	$387			15.0	$1,935
Leon, Manny	$ 150.00			12.0	$1,800	12.0	$1,800			24.0	$3,600
TOTAL LABOR COST		**43.0**	**$7,383**	**52.0**	**$7,437**	**53.0**	**$7,565**	**12.0**	**$2,444**	**160.0**	**$24,829**
EXTERNAL SUBCONTRACTOR											
Keystone Aerial Surveys	$ 5,260.00	1.0	$5,260							1.0	$5,260
	$ 13,185.00			1.0	$13,185					1.0	$13,185
	$ 16,630.00					1.0	$16,630			1.0	$16,630
GRAND TOTAL			**$13,432**		**$22,600**		**$26,690**		**$2,444**		**$65,166**

PROJECT OVERVIEW AND APPROACH

Understanding of the scope

We understand that OCWD is seeking to collect aerial 4-band imagery and quality level QL1 LiDAR and derived products to support OCWD's mission for a reliable supply of high-quality water to their customers. The area of interest (AOI) comprises an area of about 31.8 square miles described in the file OCWD_PradoBasin_PrjFlightArea.kmz provided by OCWD, with a 50 meter buffer outside the boundaries. The imagery must be flown during Summer 2025, one week before or after July 1, 2025.
The Imagery will have a ground resolution of 3" or better. The camera will collect 4 spectral bands, i.e. natural color RGB and near Infrared, or RGBI. Imagery will be controlled by airborne GPS, will be cloud free, collected between 10am and 2pm local time at a sun angle 45 degrees or higher. The Orthoimagery will meet the required accuracy for 1"=50' scale mapping.
The LiDAR will meet or exceed the USGS (United States Geological Survey) defined requirements for quality level1 (QL1) LiDAR with 8ppsm or optional 16 ppsm. The relative accuracy requirement between overlapping strips for QL1 LiDAR is 8cm or better. We will meet the imagery and lidar requirements outlined in the RFP and in the amendment.

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m²)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

Figure 2: USGS LiDAR Base Specifications. The required pulse density for QL1 LiDAR is 8ppsm.

Quality level	$RMSE_V$ (nonvegetated) (m)
QL0	≤0.050
QL1	≤0.100
QL2	≤0.100
QL3	≤0.200

Figure 3: USGS LiDAR Base Specifications. The required vertical accuracy is 10cm RMSE or better in non vegetated areas.

Deliverables
We understand the following deliverables are requested per RFP:

RGB imagery	GeoTIFF tiles
	MrSid mosaic
	other options can be decided in kick off meeting
4 band image	GeoTIFF tiles
	MrSid mosaic
	4 band images and/or separate 3 band RGB and 3 band color infrared
ancillary data	trajectories (shp format)
	tiling scheme (shp format)
	final report
	FGDC metadata
LiDAR data	Classified LAS 1.4 files
	Bare earth raster surface at 1-m resolution or better

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	Highest hit (first return) raster surface with the same resolution and extent as the bare earth raster surface
	Intensity image
	Shapefiles with flight trajectories, tiling, and swath boundaries
	A report of the work performed describing survey methods, boundaries, coordinate systems and datums, results, spatial accuracy assessment, including RMSE for relative and absolute accuracies and formal metadata as specified by the Federal Geographic Data Committee's (FGDC)
Horizonal coordinate system	State Plane Coordinate System, Zone 6 US feet, Datum NAD83 [WKID: 2230 (Zone 6)
Vertical datum	Elevation data shall be delivered on the North American Vertical Datum of 1988 (NAVD88), and also on the National Geodetic Vertical Datum of 1929 (NGVD29).

The horizontal coordinate system and datum for imagery and LiDAR is California State Plane Coordinate System, Zone 6 US feet, Datum NAD83 [WKID: 2230 (Zone 6), Authority:EPSG]. We understand that the elevation data is required to be delivered on the North American Vertical Datum of 1988 (NAVD88), and also on the National Geodetic Vertical Datum of 1929 (NGVD29). We will be able to deliver on both datums.

Ability for successful completion

Our team understands the scope and project requirements. Our Tetra Tech processing team and survey crew, as well as the Keystone flight crew are familiar with the project and the area. We are local and ready to mobilize on short notice. Keystone's team is familiar with FAA requirements in the area. Processing team is available to process on short notice. All three teams have sufficient experienced backup staff. Our PM, Dr. Loecherbach is available at anytime and ready to dedicate his attention to the project.

Project management and communication approach

Project kick-off. Dr.Thomas Loecherbach has been selected as the project manager for this project. He will be the point of contact for OCWD. He can be reached at any time during the course of the project and will be reporting to OCWD on a regular basis. Once the project has started he will set up a call for a kick-off meeting. The call agenda will include:

- Review the project purpose
- Establish project goals, objectives, and schedule.
- Assesses the potential impacts and impediments to the timely completion of the various project tasks and milestones and adjust accordingly.
- The meeting will conclude with a finalized schedule and preparation of a "responsibility chart."

Communication. Dr. Loecherbach is available in person, via phone, email, and video conference. He has at his disposal a team of experts in surveying, GIS, CAD, civil engineering as well as support from accounting. He will contact the Orange County Water District Project Manager periodically to provide updates and to ensure their satisfaction with our level of service and commitment to each project and will make necessary adjustments.

Cost Control. Tetra Tech has had an excellent record of controlling costs and schedules on projects. We believe our success is a result of several factors that include (1) regular attention to expenditures compared to work completed, (2) proactive scheduling, (3) quality of work, and (4) flexibility on scoped work.

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Tetra Tech's management procedures also focus on continuous review of progress to avoid potential problems before they become serious enough to affect delivery schedules and costs. Our management approach includes various procedures for early identification of issues that could lead to problems and established measures to deal effectively with these issues.

Proposed Schedule. Tetra Tech proposes the following schedule:

Tetra Tech Week Beginning Date (proposed)	2-Jun	9-Jun	16-Jun	23-Jun	30-Jun	7-Jul	14-Jul	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug
Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13
Contract Start													
Kick-Off													
Flight Planning													
Ground Control													
Acquisition (1 week before to 1 week after July 1st - weather depending)													
Airborne GPS processing													
LiDAR calibration													
Image processing													
LiDAR processing													
Edit and QC													
Final delivery													

QA/QC approach

Quality assurance and quality control are integrated into every step of our acquisition and production process. Quality assurance is met by carefully following standard procedures. Quality control is done both by the production staff and as additional, independent control. The Tetra Tech Geomatics Group strives for successful completion of each project, which is ultimately decided by the client.
Mr. Ashley is leading the QC for this project. In the beginning of the project he will assemble a set of project specific QC steps and QC checklists in an Excel spreadsheet format. QC takes place at every step throughout the project from flight planning, aerial acquisition, data calibration, data processing and final product delivery. QC checks include:

- Completeness of coverage
- Cloud coverage, lidar point density and other project specifications
- Horizontal and vertical accuracy reporting
- Relative accuracy of Orthoimagery along seamlines
- Relative accuracy of LiDAR data along strip overlaps
- Radiometric quality

A quality report will be provided as a deliverable at the end of the project.

Technical approach

Imagery is planned to be acquired with a Vexcel UltraCam Falcon prime mapping camera in 16 flight lines with 446 digital images. LiDAR is planned to be acquired with a Galaxy prime sensor. Imagery will be acquired at an altitude above terrain of about 4100', yielding a ground resolution of 4.8 to 7.6 cm (3inch) depending on varying terrain height. LiDAR will be acquired at an altitude above terrain of 3,450' and 30 flight lines for 8ppsm (points per square meter) or 2,790' and 40 flight lines for 16 ppsm.

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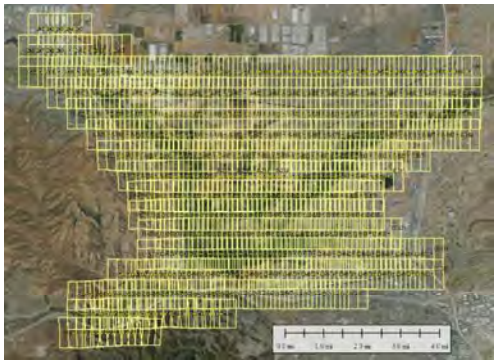

Figure 4: Flight plan imagery, 16 lines, 446 images.

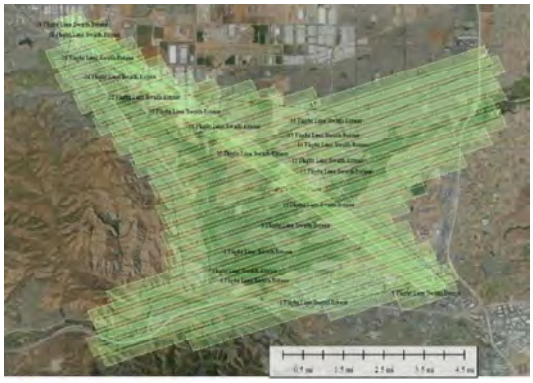

Figure 6: Flight plan LiDAR 8ppsm.

Ground control layout will match the layout used for the 2023 flight. This includes 9 targeted ground control points (panels) for the imagery and an additional minimum of 20 vertical check points for the LiDAR.

Tetra Tech uses the Inpho / Trimble photogrammetry suite for all aerotriangulation and orthophoto production. In the aerotriangulation the imagery will be tied together by measuring tie points and will be tied to the ground by measuring ground control points. The aerotriangulation also uses the airborne GPS and inertial data. The aerial images are then orthorectified using the OrthoMaster tool and mosaicked using OrthoVista.

Tetra Tech will receive calibrated and unclassified LiDAR point cloud from Keystone. Tetra Tech uses TerraSolid software TerraScan and TerraModeler for classification of the lidar data. We use GeoCue LP360 software for generation of the derived products DEM, DSM, and intensity images. LP360 is also used for quality control and header control.

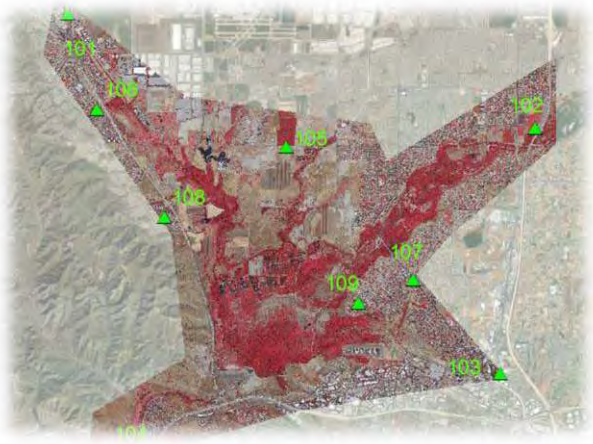

Figure 5:Targeted ground control (panels).

Management of possible constraints

Our team is familiar with project constraints that can occur. Most projects follow a linear workflow, i.e. one process step depends on successful completion of the previous step, from flight planning to final delivery. Constraints can be caused, for example by weather, FAA requirements, scheduled or unscheduled airplane maintenance. Tetra Tech and our partner Keystone have experience, redundant equipment and strong teams so that any constraint will only minimally affect schedule.

ADDITIONAL SERVICES

Tetra Tech teams cover a comprehensive variety of environmental engineering services. The Tetra Tech Geomatics Team offers a full range of services besides airborne LiDAR and photogrammetry. These include bathymetric LiDAR, mobile LiDAR and static LiDAR, drone imagery and LiDAR, change detection, remote sensing, hyperspectral remote sensing, GIS and CAD. Any additional service such as change detection for example can be scoped individually.

PRICE PROPOSAL

Tetra Tech is offering the below cost proposal:

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Task Number	Proposed Fee
1 – Project Management	$2,444.00
2 - Data Collection and Reporting (3 band color and NIR imagery)	$13,274.00
3a - LiDAR Data Collection and Reporting Option 1- USGS QL1 LiDAR [Minimum 8 pulses/m2]	$22,258.00
3b - LiDAR Data Collection and Reporting Option 2 - High Pulse Count USGS QL1 LiDAR [Minimum 16 pulses/m2]	$26,620.00
Not-To-Exceed Total for Tasks 1, 2 and 3a	$37,236.00
Not-To-Exceed Total for Tasks 1, 2 and 3b	$41,198.00

Tetra Tech suggests milestone billing for this project. We suggest billing after aerial acquisition is complete, and we will bill again after the final deliverables are accepted. We are happy to include itemized accounting of hours for personnel hourly rates. We will include a project schedule with each invoice.

STATEMENT OF INSURANCE COMPLIANCE

Tetra Tech has established contracts with Orange County Water District and has read and will comply with the following Orange County Water District insurance requirements noted in the Exhibit A of the RFP:

- $2Million for Commercial General Liability insurance.
- $1Million for Automobile Liability insurance (including additional insured endorsements for both General Liability and Automobile Liability insurance).
- $1Million for Workers' Compensation insurance (including Waiver of Subrogation endorsement for Workers' Compensation
- $1Million for Professional Liability insurance

OCWD STANDARD AGREEMENT

Tetra Tech's legal team has reviewed Orange Counties standard terms and conditions and is prepared to accept them.

BILLING

Tetra Tech will meet the billing requirements stated in the RFP.

CONFLICT OF INTEREST

Tetra Tech does not have any conflict of interest with individuals employed by Tetra Tech or our subcontractors that are associated with OCWD.

Tetra Tech, Inc.
1999 Harrison Street, Suite 500, Oakland, California 94612
Tel 925.584.0049 www.tetratech.com

APPENDIX - RESUMES

Robert Agnew, EIT
Design Engineer

Mr. Agnew is experienced in the design and preparation of construction documents and improvement plans. These plans include street and storm drain improvements, community parks, and the implementation of Best Management Practices (BMP) He is also experienced in preparing Stormwater Pollution Prevention Plans (SWPPP), WQMP's and LID reports.

Mr. Agnew is experienced in AutoCAD Civil 3D, AutoCAD 2016, GIS, HEC-HMS,HEC-RAS and county-specific hydrology software for project preparation. He is also experienced in field survey work.

Education:
BS, Civil Engineering, University of California, Irvine, 2023

Registrations/Certifications:

Engineer-In-Training California No 179863, 2023

Office Location:
Irvine, CA

Total Years of Experience:
(06/2022) 2

Years with Tetra Tech:
(06/2022) 2

EXPERIENCE

Transportation

TOS 702 Ramp Design, City of Los Angeles, Bureau of Engineering, Los Angeles, CA. 2022 – Ongoing. Design Engineer. Responsible for providing bridging documents and siting locations in support of StreetsLA's Pavement Preservation Program which maintains a street network of 23,000 lane miles and keeps all improved streets and related throughways in good to excellent condition. Tetra Tech's scope of services includes topographic survey, engineering design, design support during construction, and construction management services for various access ramps throughout the City, in compliance with the Americans with Disabilities Act (ADA).

TOS 33 67th Street and West Boulevard Civil Improvements, City of Los Angeles, Bureau of Engineering, Los Angeles, CA. 2023-Ongoing. Design Engineer. Provides drafting support, curb ramp design, and driveway analysis. The 67th and West Boulevard Street Improvement Project will provide accessible pedestrian and cyclist connectivity from the end of the Rail-to-Rail project to the Fairview Heights Metro station. The project entails street improvements for approximately six city blocks, along 67th Street from 11th Avenue to West Boulevard, and along West Boulevard from 67th Street to 71st Street.

Stormwater Management/Low Impact Development

Santa Ana Downtown Flood Reduction and Stormwater Infiltration, City of Santa Ana, CA. 2022 – Ongoing. Design Engineer. Provides hydrology report research and writing and drafting support. Located in downtown, the City of Santa Ana is reconstructing the 3rd Street parking lot to incorporate Best Management Practices (BMPs). Surrounding catch basins and storm drains are being reconstructed to divert stormwater into the parking lot for treatment and infiltration. The improvement in drainage and treatment alleviates flooding that occurs in the surrounding area and reduces pollutants being discharged into the watershed. The project captures runoff from the 23-acre drainage area into the infiltration system located underneath the parking lot, eventually recharging the groundwater table.

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, CDM Smith for City of Los Angeles, Los Angeles, CA. 2022 – Ongoing. Design Engineer. Responsible for hydrology studies, survey and mapping work, and engineering design and drafting for the Oro Vista Avenue segment of this stormwater improvement project. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Bristol-Tolliver Street Urban Greening Project, City of Santa Ana, Santa Ana, CA. 2023 – Ongoing. Design Engineer. Responsible for providing survey mapping, hydrology studies, harvest and use cistern sizing, bioretention and storm drainpipe design and drafting support. The Bristol Tolliver Street Urban Greening Project involved the construction of a new public park on a vacant lot at the corner of Bristol and Tolliver Streets in Santa Ana. The project included landscaping, a skate park, basketball court, fitness equipment, children's play areas, shade structures, pathways, signage, lighting, benches, picnic tables, and stormwater management features. A storm drain system was designed to capture, store, and reuse stormwater for irrigation, supplemented by potable water when needed.

TETRA TECH

Peter Ashley, MS, CP, LSIT
Senior Project Manager

EXPERIENCE SUMMARY

Mr. Ashley is a senior level professional with more than 30 years of project experience supplemented with a strong academic background in surveying and photogrammetry. Mr. Ashley's practice encompasses every aspect of the mapping process, from aerotriangulation design and computation, to digital map translation. Because of the wide range of his capabilities, he is a vital consultant for our clients on project design and best technical approach for photogrammetry, orthophotography and Airborne LiDAR. Uniquely, Mr. Ashley's has worked extensively with historical aerial imagery archives, some of which date back to the 1930s. His results have been submitted as evidence in state and in federal court where he has been called as an expert witness to discuss his methods and his findings. In the course of his career, Mr. Ashley has managed major mapping projects for public agencies including the U.S. Forestry Service, the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, the Bureau of Land Management, the Los Angeles Department of Water and Power, the Santa Clara Valley Water District, the San Francisco Public Utilities Commission, Pacific Gas and Electric, the Alameda County Flood District and Water Conservation, the City/County of San Francisco, the Napa County Flood Control District, and Vandenberg Air Force Base.

Key areas of experience include: photogrammetry, aerotriangulation, orthophotography, historical aerial photography interpretation, airborne LiDAR surveys, AutoCAD, MicroStation, and ArcGIS.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Senior Project Manager, 12/08 - present

Hammon, Jensen, Wallen & Associates, Photogrammetrist, 9/86 – 11/08

RELEVANT EXPERIENCE

Grass Valley / Nevada City Area Mapping (2020)

Mr. Ashley managed a wide-area mapping of Grass Valley and Nevada City in the California Gold County. Tetra Tech commissioned the acquisition of digital imagery at 7.5cm with simultaneous capture of lidar at 10 pts/m^2 to support mapping at planimetric mapping 1"=100' and the generation of contours on a 1-ft interval of Grass Valley and Nevada City, CA. Total area for mapping was 29.62 square miles. Mapping was delivered in client specified tiles AutoCAD format. A ground class was extracted from the lidar data and supplemented by selected breaklines to create a surface in AutoCAD Civil 3D for the generation of the 1-ft contours. The photography was orthorectified, mosaicked, and delivered in the same tiling scheme as the mapping and classified lidar.

San Nicolas Island Mapping (2020)

Mr. Ashley managed the aerial LiDAR and digital aerial imagery surveys of San Nicolas Island, a US Navy facility 65 miles off the Southern California coast. Tetra Tech commissioned the acquisition of airborne LiDAR data at 8 points per square meter and 4-band digital photography at 5cm resolution of the whole of San Nicolas Island. The lidar was classified and used to create a digital elevation model (DEM) and a digital surface model (DSM). The imagery was the source material for RGB and CIR orthophotos and for the colorization of the lidar. The colorization of lidar proved valuable when the client requested that the vegetation class be stratified into four classes by height. **Size:** 22.5 sq. miles

EDUCATION

M.S., Civil Engineering (Surveying and Photogrammetry), University of California, Berkeley, 1984

B.A., Mathematics, University of Massachusetts, Amherst, 1972

AREAS OF EXPERTISE

Photogrammetry/LiDAR

Project Design

CADD Systems

Archival Photography Mapping

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS, #R1075

California Land Surveyor in Training, LSIT #4936

OFFICE LOCATION

Oakland, CA

YEARS OF EXPERIENCE

40

YEARS WITH FIRM

16

Baqar Rizvi
Topobathymetric LiDAR Strategist

EXPERIENCE SUMMARY

Mr. Rizvi has 10+ years of experience in advanced remote sensing, systems calibration, and LiDAR flight data QA/QC. He has a technical focus in sensor systems integration, workflow automation, and unmanned platform development.

Mr. Rizvi's core competency has been LiDAR calibration, and at large aerial survey/remote sensing (systems, payloads, integration). Much of his time has been spent leading and training groups of calibrators on large scale LiDAR/Photogrammetry projects.

Mr. Rizvi has broad UAS/UGV experience with designing, building and deploying hardware, and processing unmanned data. Additionally, he has skills in terrestrial modeling, design, CAD, electrical transmission modeling, and automation/scripting.

CORPORATE PROJECT EXPERIENCE

Connecticut Department of Energy and Environmental Protection – Coastal Mapping Project. 2024
Performed Lidar Calibration and technical supervision for Whiteout Geospatial, in their effort to map the Connecticut Coastline using Helicopter mounted Topobathymetric lidar systems.

Washington Department of Transportation – Statewide Highway Infrastructure Mapping: 2023-2024
Performed GPS/GNSS processing and Calibration of Moblie Lidar data for WSDOT. Performed Image refinement and processing for pavement and spherical cameras.

NOAA NGS, Shoreline Mapping for the Coastal Mapping Project
Worked as a subcontractor for Fugro to assist on their NOAA NGS Florida shoreline mapping project. Performed the full calibration (line-to-line adjustment) workflow, including intra- and interswath checks for consistency.

UAS Calibration, 2023 – Present
Confidential Client, Priest River Idaho Survey, Idaho
Utilized UAS systems to refly and supplement larger airborne collects. Created workflows to resolve major IMU errors that would have otherwise resulted in a failure of spec.

EDUCATION

BS – Physics: Optics, Portland State University 2021

AREA OF EXPERTISE

- Lidar Calibration
- Bathymetric Lidar Systems
- GNSS inertial processing
- Sensor System Integration
- UAS/UGV Systems
- GIS

REGISTRATIONS/ CERTIFICATIONS

FAA Remote Pilot (Part 107)

(FAA – 3969662)

TRAINING

Beaverton Civilian Emergency Response: SAR 2014

Aviation Survival and Egress Training: 2014

Radiation Safety – Portland State University - 2012

OFFICE

Irvine, CA

YEARS OF EXPERIENCE

10

YEARS WITHIN FIRM

1

Daira Brayley
Topobathymetric LiDAR Strategist

EXPERIENCE SUMMARY

Daira Brayley has over 4 years of experience working in the geospatial field, with a focus on topobathymetric data. Daira's responsibilities are centered around the production side of projects, she mostly works with topobathymetric light detection and ranging (LiDAR) editing, performing QC reviews, and creating final client deliverables. Daira has worked with a wide range of government contracts and contributed to more than a dozen topobathymetric projects. The majority of her projects are for government contracts and utilize the CZMIL SuperNova sensor. While Daira's professional experience has been exclusive to bathymetric LiDAR, during her academic studies, she traveled to Bhutan to conduct field research on her senior thesis, while simultaneously working with a research professor on mapping and digitizing community forest in Bhutan.

EDUCATION

MS, Environment and Development, London School of Economics and Political Science, 2019

BA, Environmental Studies, and Political Science, Eckerd College, 2018

AREA OF EXPERTISE

Airborne Topobathymetric LiDAR

Airborne Topographic LiDAR

REGISTRATIONS/ CERTIFICATIONS

ASPRS Member

OFFICE

Denver, CO

YEARS OF EXPERIENCE

5

YEARS WITHIN FIRM

2

CORPORATE PROJECT EXPERIENCE

LiDAR Strategist, 2024

Brookfield Renewable US, LiDAR Data Acquisition and Processing for Topography and Boundary Survey for the Propose Black River, White River, and Black Scoter Solar Project, Jackson County Arkansas

LiDAR Strategist duties included processing the calibrated LiDAR data and creating the initial gross clean workflow, creating and testing batch macros to run over problem areas, manual editing of the data, performing QC reviews, and creating final deliverables for clients.

LiDAR Strategist, 2024
Atlas Energy, and Golden State Wind, Golden State Wind

The Golden State Wind project had two separate clients, with a significant amount of overlap between the two AOIs. The project covered approximately 10,547 square miles. Duties for the LiDAR Strategist consisted of editing the processed LiDAR point cloud and creating final deliverables for clients.

Bathymetric LiDAR Strategist, 2023
National Oceanic and Atmospheric Administration Office of Coastal Management (NOAA OCM), Whitefish Point to Bay Mills, MI in Eastern Lake Superior

Assisted with the workflow development for the team's first topobathy LiDAR project and working with the CZMIL SuperNova sensor. Topobathymetric LiDAR Strategist duties for this project included, but was not limited to, training bathymetric analysts, editing LiDAR data, performing QC reviews, creating final client deliverables, and writing and testing different macros. The project was commissioned by NOAA OCM in support of their analysis of bathymetric topography and underwater habitat in this region and covers roughly 162 square kilometers.

LiDAR Strategist, 2023
TerraGen, Joshua Tree

Assisted in automating sections of the workflow that involved LiDAR analysis, this involved running a batch macro over the LASD to move data to their correct classification, as well as creating a normalized Digital Surface Model (nDSM) that allowed for automated Euclidean Highet measurements of Joshua Tree. The LiDAR Strategist also worked closely with the project manager during the pilot test area while comparing LiDAR collected trees with trees collected during field survey, additional and a best practices workflow was designed for future projects similar in nature.

TETRA TECH

Bret Bienkowski, LSIT
Mobile Mapping Survey Manager

EXPERIENCE SUMMARY

Mr. Bienkowski is experienced with surveying involving Light Detection and Ranging (LiDAR) and hydrographic surveying specifically in the mobile mapping and UAV formats for LiDAR collection and processing. As a Land-Surveyor-in-Training, he is currently pursuing his Professional Surveying and Mapping License in Florida. He currently holds his Part 107 Remote Pilot License for UAV systems. His talents include records research, calculations, processing of field data, analysis, mapping and reporting, preparation of topographic and boundary surveys, legal descriptions, and sketches. Mr. Bienkowski is proficient using AutoCAD, MicroStation, CAiCE, Carlson, TopoDOT, RiPROCESS, RiSCAN PRO, Recap and many other 3D modeling software packages.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Mobile Mapping Survey Manager, 07/18 - present

KCI Technologies, LiDAR Survey Practice Leader, 04/16 - 07/18

Riegl Laser Measurement Systems, Terrestrial Lidar Manager, 05/12 - 04/16

McKim & Creed, Mobile Mapping Project Surveyor, 04/11 - 05/16

Atkins Global, Geomaticist I, 05/08 - 04/11

RELEVANT EXPERIENCE

Pinellas County Street Level Mobile LiDAR, Pinellas County, FL: Mr. Bienkowski is the project manager for the County-wide Mobile LiDAR collection for 1,800 center line miles of county roads. This data will then be used for the extraction of 108,000 building finish floor elevations and merged into the Tetra Tech FusionMap software for use in sea level rise analysis and hurricane preparations with the use of the FusionMap water inundation viewer.

Priest River UAS Topo Survey, Priest River, ID: Mr. Bienkowski was the Pilot In Command and Project Manager for a topographic survey and ortho image of a 50-acre site in Priest River, Idaho. The team used our heavy lift drone with our LiDAR and Imagery sensor to collect a complete site ortho photo along with LiDAR point cloud. From the point cloud and imagery, a bare earth surface model was generated and a final calibrated ortho imagery was delivered. This data will aid in the projects team to design a new community park along the riverfront.

Bad River UAS LiDAR Biannual Inspection, Ashland, WI: Mr. Bienkowski was the Pilot In Command and Project Manager for a multiyear continuing monitoring project for a portion of the Bad River outside of Ashland Wi. On a biannual basis the team uses precision LiDAR and imagery sensors on a heavy lift drone to fly the site and document the erosion of the river at the point of a meander bend. Each time the site is flown, and a bare earth surface is generated and then evaluated against the previous flights surface.

EDUCATION

B.S. Geomatics, University of Florida, 2008

AREAS OF EXPERTISE

Mobile/ UAS LiDAR

Project Design

CADD Systems

UAV Photography

TRAINING/CERTIFICATIONS

Florida Land Surveyor in Training, LSIT

FAA Part 107 Remote Pilot

#3934223

OFFICE LOCATION

Tampa, FL

YEARS OF EXPERIENCE

16

YEARS WITH FIRM

5

TETRA TECH

Brian Tennant, CP
Certified Photogrammetrist

EXPERIENCE SUMMARY

Brian Tennant has over 19 years of experience in photogrammetric mapping. AT Blue Mountain Aerial Mapping he went from starting as a stereo compiler to being the production manager, managing all mapping projects within the company or to subcontractors to be completed, with over 35 million acres of flight, and mapping projects completed throughout Pennsylvania, Ohio, and West Virginia. He then was one of the first to help start the aerial mapping firm 6 Guns, LLC. As an Aerial Mapping Manager, he is always looking out for the best interest of the client, putting the client's interest first.

RELEVANT EXPERIENCE

UAS Landfill monitoring (2024). In collaboration with Tetra Tech SWE in Green Bay WI, Mr. Tennant has processed the UAS (unmanned aerial system) imagery for over a dozen landfill sites across 6 states in the northern Mid-West. The deliverables include an image derived point cloud, a Civil3D surface with two-foot contours, and an orthophoto. The turn-around time for the processing is around one to three days.

Stockpile mapping (2005-2023). In partnering with coal mines in Pennsylvania, West Virginia and Alabama. Mr. Tennant has processed the UAS imagery over stockpile sites. Mr. Tennant would produce an image derived point cloud, an AutoCAD drawing of the surface with two-foot contours and an orthophoto.

West Virginia 4 Counties Orthophoto (2023). As a contractor to the county assessors of West Virginia Mr. Tennant scheduled flights and produced 0.5' resolution RGB orthoimagery to Monongalia, Wetzel, Harrison, and Ohio counties in the spring of 2023.

Pennsylvania Coal Mine Spring Orthophoto (2021, 2023) Partnered with the Pennsylvania Coal company and a Flight company to produce 0.25' Resolution RGB orthoimagery for over 300,000 acres.

Navajo Nation Abandoned Uranium Mines, Aerial LiDAR and Imagery (2024). Mr., Tennant process ~50 square miles of Aerial LiDAR as part of the Tetra Tech Geomatics Team.

Mine Planimetrics and Orthophotography (2005-2023). Partnered with multiple Coal Mining companies to schedule spring flights that totaled just below 1 million acres of 0.25' resolution RGB orthoimagery. And produce 100' scale mapping in areas of interest.

EDUCATION

Clay-Battelle High School Graduate

AREA OF EXPERTISE

Photogrammetry, airborne LiDAR; Aerial triangulation, DTM generation, planimetric and topographic mapping, Orthorectification; Software packages including Inpho / Trimble, Terrasolid, GlobalMapper, Pix4dMapper, Civil3d

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #CP1653

UAS License- 4583360

OFFICE LOCATION

Morgantown, WV

YEARS OF EXPERIENCE

20

YEARS WITH FIRM

5 months

TETRA TECH

Matt Emmett
LiDAR Analyst

EXPERIENCE SUMMARY

Highly skilled in Geomatics, Survey, Remote Sensing, and Navigation data analysis and processing. Specialized in processing and classification of LiDAR point clouds and associated geospatial deliverables. Extensive experience in feature extraction and generating accurate digital terrain models for engineering and construction design. Proficient in Industry-standard software and tools, including TopoDOT, TerraSolid, ArcGIS, and CADD such as Civil3D and Microstation.

Exceptional problem-solving abilities and attention to detail, ensuring the highest quality data outputs at or above industry standards. Adept at collaborating with multidisciplinary teams and communicating complex technical concepts to both technical and non-technical stakeholders.

Committed to staying updated with the latest advancements in Lidar technology and the geospatial industry, harnessing it to deliver innovative solutions.

CORPORATE PROJECT EXPERIENCE

PG&E System Hardening: Topographic feature extraction of Mobile and Aerial LiDAR point clouds of roadway corridors and the surrounding areas. Point cloud classification and refinement for use of manual and automated extraction tools. QA/QC of technician extracted features and redlines for corrections. Digital Terrain Model creation and QC for engineering and direct client deliverables.

Development of more efficient processes to streamline future efforts in project. Trained technicians on tools and best practices to increase efficiency and quality of data.

WASHDot Mobile Mapping: QC and processing of raw mobile LiDAR data and imagery. Registration of point-clouds to survey trajectory and control points. Imagery processing and mounting for panoramic spherical images and point-cloud colorization.

PREVIOUS EXPERIENCE

Westwood Professional Services, Remote Sensing/Aerial Mapping Technician, 07/22 - 06/23

Aerial, UAV, and Terrestrial LiDAR Data QC and Feature extraction in the Energy distribution, Renewables, and Transportation sectors. Planimetric extraction of UAV imagery for Renewable energy construction planning. TopoDOT process design and extraction for engineering deliverables.

EDUCATION

B.Sc. Geophysical Engineering, Minor in Geology and Remote Sensing, Colorado School of Mines, 2013

AREA OF EXPERTISE

- Mobile/Aerial LiDAR
- Remote Sensing
- Planimetrics
- CADD Systems
- UAV Photogrammetry

REGISTRATIONS/ CERTIFICATIONS

Certified Mapping Technologist – Remote Sensing, ASPRS (RST244)

CPR/FIRST AID Certified Through Feb 2027

TRAINING

Custom AutoCAD Fundamentals, CAD-1, August 2017

Preparation for ASPRS Certification - General Knowledge, ASPRS, September 2020

Preparation for ASPRS Certification - LiDAR, ASPRS, September 2020

OFFICE

Denver, CO

YEARS OF EXPERIENCE

12

YEARS WITHIN FIRM

2

Jesus Guzman, PLS
Senior Land Surveyor

Mr. Guzman is a licensed surveyor with 26 years of experience providing office and field survey support for projects involving engineering, construction, and mapping for highways, utility infrastructure, airport runways, schools, water pipeline tunnels, dams, rivers, and lake improvements. He is experienced with preparation, agency submittal, and recordation of tract maps, parcel maps, final maps, Records of Surveys, tentative maps, corner records, lot mergers, lot line adjustments, ALTA documents, and public roadway abandonments. Mr. Guzman has managed and participated in various land survey activities including field surveying for municipalities, county, state, and federal agencies, and the armed services. His municipal experience includes providing map checking, public improvement plan check, and setting Engineering Conditions of Approval for proposed developments.

Education:
Math studies, California State at Fullerton, 1984-1989

Registrations/Certifications:
Professional Land Surveyor, California No. 8648, 2009

Office Location:
Irvine, CA

Total Years of Experience:
(06/1998) 26

Years with Tetra Tech:
(03/2023) 1

(Wastewater Bio)

Mr. Guzman has managed field crews in the construction of many sewer and storm drain facilities throughout his career, for conduit sizes ranging from 6-inch to 84-inch with appurtenances. He is also experienced in performing as-built surveys of wastewater facilities and preparing the required exhibits. His duties have also included providing calculations for construction staking. Types of structures germane to his experience include head walls, siphons, lift stations, grease interceptors, cleanouts, catch basins, inlets, channels, and infiltration systems.

EXPERIENCE

Water

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, City of Los Angeles, CA. 2022 – Ongoing. Survey Party Chief responsible for overseeing field crews and office staff related to topographic data collection, processing, and base sheet development. The project is currently in the preliminary design phase, and the project team is scoped to provide final design services. Tetra Tech is leading the segment along Oro Vista Avenue, while CDM Smith oversees the portion along Lankershim Boulevard with Tetra Tech's support on the topographic survey. The Oro Vista Avenue project area receives runoff from a tributary watershed of approximately 183 acres and lacks stormwater infrastructure. Runoff is conveyed as surface flow along primarily asphalt curbs and swales before discharging to Haines Canyon Channel at the north end of the project site. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Supplemental Topographic Survey, Simms Park Regional Stormwater Capture, Lower San Gabriel River Watershed Management Group, Bellflower, CA. 2022. Survey Party Chief. Responsible for providing supplemental topography of Simms Park using conventional survey methods, for the design and construction of proposed stormwater capture improvements. Also provided drafting of site topography from collected survey data using AutoCAD Civil 3D.

Street Topography for Design and Construction of Waterline Infrastructure, Cities of Fullerton, Buena Park, and Orange, CA. 2020 – 2023. Project Surveyor. Managed various field crews in the collection of field topography and boundary data for the development of topographies for the design and construction of new water infrastructure in the Cities of Fullerton, Buena Park, and Orange. Mr. Guzman completed right-of-way and parcel mapping, along with reviewing and approving all deliverables.

Transportation

San Miguelito Road Easement Survey, County of Santa Barbara, Santa Barbara, CA. 2024. Project Surveyor. Responsible for overseeing the preparation of easement legal descriptions, plat and exhibit. This project was issued as a task order under an Indefinite Delivery-Indefinite Quantity (IDIQ) Survey contract with the County of Santa Barbara. The services provided are important to assist the County with its transportation project delivery goals, which are vital for meeting the Transportation Division's ongoing mission to provide a clear path, smooth ride, and a safe trip to the traveling public.

TETRA TECH

John Hacker, CP
Production Manager

EXPERIENCE SUMMARY

Mr. Hacker specializes in production oversight for photogrammetry, feature extraction, stereo compilation, CADD standards, softcopy, and DTM generation. His professional background has been focused on production cartography and photogrammetry since 1978 with experience in stereo compilation, map data assembly and digital orthophotography. For the last 20 years, he has been directly responsible for the creation and support of digital mapping standards for several mapping firms. This has included writing collection macros, AutoLisp applications and scripting routines, as well as the day to day management of production department staff.

Key areas of experience include: photogrammetry, feature extraction, stereo compilation, CADD standards, softcopy, DTM generation, map data assembly, digital orthophotography, AutoLisp applications and scripting, and production management.

EMPLOYMENT HISTORY

Tetra Tech, Inc., Production Manager, 11/2008 – present

HJW & Associates, Photogrammetric Lead, 08/1993 – 11/2008

Towill, Inc., Photogrammetrist, 11/1985 – 08/1993

EDUCATION

B.S., Geography, University of California, Los Angeles, 1978

AREAS OF EXPERTISE

Photogrammetry, Stereo Compilation, DTM Generation, CADD Standards

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #R1057

OFFICE LOCATION

Oakland, Ca.

YEARS OF EXPERIENCE

43

YEARS WITH FIRM

12

RELEVANT EXPERIENCE

St. Helena Hospital, St. Helena, California (2021). Large scale digital imagery was collected to support photogrammetric mapping of the hospital facility and environs. The assessment was done to review wildfire damage in the immediate area.

Pine Forest, Pacific Grove, California (2021). Photogrammetric mapping was produced from film-based imagery to support City staff in evaluating plans for redevelopment of a half-block section of urban land.

Clover Flat Landfill, Calistoga, California (2021). Using the VrTwo softcopy mapping system, an annual update of the active fill site is made using photogrammetric means. The resulting DEM is used to confirm calculated fill rates for the active landfill cells.

San Nicholas Island, Ventura County, California (2020). Digital aerial imagery was collected along with LiDAR data to create a digital elevation model (DEM) to support creation of a surface water runoff model.

U.S. Coast Guard Station Barbers Point, Honolulu, HA (2020). Using the VrTwo softcopy system, planimetric information was collected to support infrastructure upgrades in this aircraft operations facility. LiDAR derived contours were loaded into the VrTwo system for stereoscopic review and edit.

Lake Charles Carbon Company Volumes (Quarterly from 2013). Using photogrammetric means, Tetra Tech has provided our internal Tetra Tech client with volume calculations of stored coke arrayed across multiple sites in a Lake Charles, La. coke production facility.

Raw Water Lake, Corpus Christi, Texas (2017). Tetra Tech provided large scale topographic mapping to support other Tetra Tech colleagues' effort to repurpose a former aluminum smelting site into an LNG export facility. The focus of the work was to plan the dismantling an obsolete pond and model possible flood paths in case of a breach.

JASON MAGGARD

Sensor Operator – CA Branch

JOINED KEYSTONE:

- June 2022

YEARS OF EXPERIENCE:

- 13 years

EDUCATION/ CERTIFICATIONS:

- Associate in Science – Hillsborough Community College in Tampa, 2009
- ABO-NCLE Certified, Board Certified Optician

SUMMARY:

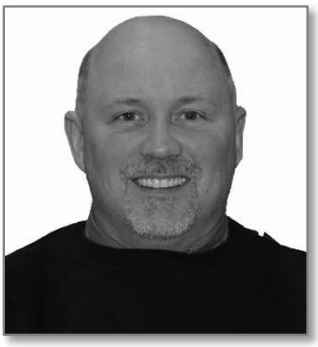
Mr. Maggard is responsible for operating and monitoring aerial sensors during flight to collect data for various projects while adhering to all safety protocols and procedures. He performs pre-flight, in-flight and post-flight sensor equipment checks to ensure all systems are functioning properly. Mr. Maggard analyzes collected data and disseminates the checked data as well as accompanying reports to internal teams and clients. He collaborates with pilots to ensure accurate and efficient data collection while maintaining compliance with all aviation regulations. He maintains and troubleshoots sensor equipment as needed to minimize downtime and guarantee accurate data is captured. Mr. Maggard is proficient with Keystone's UCFp, UCE, UCC, and Optech Galaxy sensors.

PROJECT EXPERIENCE:

PROJECT	STATES FLOWN	NUMBER OF MILES OR NUMBER OF SITES
Digital	CA, NV, NM, CO, AZ, OR, WA	Over 2,500 miles
Topo	CA, NV, NM, CO, AZ, OR, WA	Over 1,100 miles
LiDAR	CA, NV, NM, CO, AZ, OR, WA	Over 1,200 miles

JOHN SCHMITT, CP, GISP

President / Principal-in-Charge



JOINED KEYSTONE:

- 1987

YEARS OF EXPERIENCE:

- 37 years

EDUCATION/ CERTIFICATIONS:

- FAA Commercial/Single- & Multi-Engine/Land Certificate
- Certified Geographic Information Systems Professional (GISP) – 61839; 2009
- ASPRS Certified Photogrammetrist – 1389; 2014

SUMMARY:

Keystone's President and Principal-In-Charge, John Schmitt, began his 37-year career with Keystone Aerial Surveys as an aerial sensor operator and quickly became expertly skilled on the company's film cameras. John then attained his pilot's license and became proficient in all of Keystone's aircraft. During his career, John has flown hundreds of survey hours throughout the US and acquired thousands of flight hours on missions for oil, gas, engineering, mapping, federal, state and local government clients.

In 2001, John became Vice President and part owner of Keystone while continuing his professional development by successfully completing his Certified Geographic Information Systems Professional (GISP - 61839) and ASPRS Certified Photogrammetrist (CP - 1389) certifications. Additionally, John assumed a position of business development and built on customer's relationship through superior customer service skills while continuing to contract manage many of Keystone's largest projects. His many years of experience on the road and at home base as both a pilot and operator afforded him the ideal perspective to control an array of difficult items that go into coordinating large and complicated projects while balancing the needs of the customer with the constraints of flight crews, conditions and aircraft. John has estimated, flown and/or managed over 7,500 miles of transportation projects for the State Department of Transportation. He has also estimated, flown and/or managed collection of tens of thousands of images. In 2015, John assumed the role of President of Keystone. He is now primarily responsible for strategic planning and implementation.

PROJECT EXPERIENCE:

- USDA Stewardship Lands Imagery Digital – Ongoing since 2002
- USDA National Resource Inventory – Ongoing since 1998
- Statewide Imagery Acquisition in Alabama – Ongoing since 2019
- Statewide Imagery Acquisition in Maryland – Ongoing since 2018
- Aerial Digital Imagery Acquisition for PG&E – Ongoing since 2019
- Imagery Acquisition for the NCTCOG Project in Texas – Ongoing since 2018
- Texas Department of Transportation, TX – Ongoing since 2013

JOSE "OMAR" PANAGUITON

Aerial Survey Pilot – CA Branch

JOINED KEYSTONE:

- June 2018

YEARS OF EXPERIENCE:

- 10 years

EDUCATION/ CERTIFICATIONS:

- Bachelors, Radiologic Technologist – Iloilo Doctors' College in the Philippines, 2010
- Associates, Professional Aeronautics – Miramar College in San Diego, 2017
- Commercial Pilot License SEL/MEL Rating- 3788691

SUMMARY:

Since Joining Keystone Aerial Surveys in June 2018, Omar has been checked out in multiple types of aircraft from Single Engine Cessna 206 and 210 to multi engine aircraft such as the Piper Aztec, Piper Navajo, and Cessna 310. Omar has also flown a multitude of sensors, including: Vexcel UltraCams, Leica RC30, Leica ADS100, Leica CityMapper, and Teledyne Optech LiDAR systems. Currently, Omar is the full-time pilot for the Keystone California Branch. His duties include but are not limited to coordinating with ATC, preparing the aircraft for every flight, ensuring the aircraft scheduled maintenance are being followed, as well as lead each mission for the California Branch. Omar has over 3,200 hours of total flight time.

PROJECT EXPERIENCE:

PROJECT	STATES FLOWN	NUMBER OF MILES OR NUMBER OF SITES
Digital	CA, NV, NM, DE, ME, NY, NJ, PA, CT, and MA	Over 3,500 miles
Topo	CA, NV, NM, VT, ME, NY, NJ, PA, CT, and MA	Over 2,300 miles
LiDAR	CA, NV, NM, DE, ME, NY, NJ, PA, CT, and MA	Over 1,900 miles

Manuel Leon, EIT
Design Engineer/Surveyor

Mr. Leon is a civil engineering design engineer and survey technician with experience on a wide variety of municipal, state, and federal projects. He is experienced in surveying, grading, hydrologic and hydraulic analysis, preparation of plans, cost estimating, permit process coordination, and engineering report writing. Mr. Leon is well versed in Autodesk's AutoCAD and Civil 3D design software.

Education:
BS, Civil Engineering, California State University Long Beach, 2012

Professional Registrations:
Engineer-in-Training (EIT), No. 172306, 11/2020

Professional Affiliations:
American Society of Civil Engineers (ASCE)

Office Location:
Irvine, CA

Total Years of Experience:
(2014) 9

Years with Tetra Tech:
(2016) 7

EXPERIENCE

Stormwater and Water Systems

Lankershim Boulevard and Oro Vista Avenue Local Area Urban Flow Management, City of Los Angeles, CA. 2022 – Ongoing. Design Engineer and Surveyor. Responsible for providing an aerial control survey as well as supplemental topographic survey work including existing utility location used to develop a surface terrain implemented on the design of the project. Also responsible for plan production of plan and profile storm drainpipe design in which existing utility location/data was used to avoid horizontal and vertical crossings when feasible. This stormwater project includes two separate project areas in the City of Los Angeles and is funded by the Safe Clean Water Program. The project is currently in the preliminary design phase, and the project team is scoped to provide final design services. Tetra Tech is leading the segment along Oro Vista Avenue, while CDM Smith oversees the portion along Lankershim Boulevard with Tetra Tech's support on the topographic survey. The Oro Vista Avenue project area receives runoff from a tributary watershed of approximately 183 acres and lacks stormwater infrastructure. Runoff is conveyed as surface flow along primarily asphalt curbs and swales before discharging to Haines Canyon Channel at the north end of the project site. The project aims to infiltrate stormwater runoff to improve water quality and increase underground water supplies, provide community enhancements with the addition of greening elements, reduce flooding along the corridor with the installation of new piping and catch basin inlets, install new concrete curb and gutter, and construct new sidewalks to improve pedestrian accessibility throughout the corridor.

Surveying

Control Network Establishment, Boundary and As-built Survey, Naval Air Facility (NAF) El Centro, NAVFAC SW, El Centro, CA. 2019. Surveyor. Responsible for the establishment of new horizontal and vertical control monuments and new values to existing control monuments at NAF El Centro. New monuments were set at key locations to provide inter-visibility and convenience of location for future construction projects. The new and existing monuments were observed with Static GPS and digital level loops meeting Federal Geodetic Control Committee (FGCC) standards for establishment of horizontal and vertical control networks and level loops. The data was then post processed using Trimble Business Center, performing fully constrained horizontal and vertical adjustments. A report detailing the survey procedure, the coordinates of the new points, the considerations in the adjustment, and the errors in the network were prepared. A boundary survey of the current NAF boundary and an as-built survey of requested facilities within the base boundary was also performed and located in relation to the base control network. Deliverables included a Record of Survey Map, and Exhibit Maps showing the established control network and the surveyed site features in relation to the base boundary for NAVFAC SW.

Yuma SOF Hangar, Barge Design Solutions Inc, US Army Corps of Engineers. 2018 – 2020. Surveyor. Responsible for aerial control survey as well as supplemental topographic survey work including existing utility location used to develop a surface terrain implemented on the design of the project. The purpose of this task was to establish depths and locations of sewer infrastructure, control aerial topographic survey targets and collect runway surface information for improvements and additions to airfield and waste management infrastructure in support of Yuma Proving Grounds' expansion of its Military Freefall School.

Thomas Loecherbach, Ph.D., CP
Geomatics Director

EXPERIENCE SUMMARY

Dr. Loecherbach's education is in geodesy and land surveying with emphasis in photogrammetry and adjustment theory. He has 30 years of professional experience in private photogrammetric practice in the U.S. plus five years at university level prior to that. He has been continuously involved in photogrammetry and remote sensing since 1985. Throughout his career he has been instrumental in implementing airborne GPS and INS technology, digital camera systems and other technologies into the mapping workflow. During this time he has managed the technical aspects of hundreds of projects for a wide range of customers. For daily production he developed software tools, established guidelines and streamlined production workflows. As Geomatics Director, he oversees all technical project specifications.

He has also taught classes on photogrammetry, digital image processing and remote sensing to graduate students and professionals and worked on the transitioning of graduate level teaching from analytical photogrammetry to digital photogrammetry and image processing.

RELEVANT EXPERIENCE

Prado Basin Aerial Imagery (2021). Tetra Tech collected 34 square miles of 4-band aerial imageryin the Prado Basin in Orange County. Imagery was acquired in 463 images at a quarter-foot resolution. The ground control survey was performed by Tetra Tech's survey team in San Luis Obispo. Mr. Loecherbach managed the project including aerial acquisition firm and survey team.

Amelia County VA (2024). Tetra Tech acquired 4-band aerial imagery and high density airborne LiDAR for a 1127 acre site in Amelia County in Virginia. Mr. Loecherbach managed the project and provided the data to the Glen Allen office of Tetra Tech. Deliverables included a DEM and a DSM at 1-foot grid spacing, an orthomosaic, and a surface in xml format.

UAS Landfill monitoring (2021, 2022, 2023,2024). In collaboration with Tetra Tech SWE in Green Bay WI, Mr Loecherbach has processed the UAS (unmanned aerial system) imagery for over a dozen landfill sites across 6 states in the northern Mid-West. The deliverables include an image derived point cloud, a Civil3D surface with two-foot contours, and an orthophoto. The turn-around time for the processing is around one to three days.

USGS 3DEP Program, Montana (2023). As a subcontractor to Axis Geospatial, Mr. Loecherbach has managed the QC and processing of 5,500 square miles of LiDAR collected of the state of Montana for the USGS 3DEP program.

Marathon Pipeline (2023). Under contract with Marathon Petroleum, Tetra Tech acquired LiDAR data and aerial imagery along a 1,280 mile long and 400 foot ide corridor across 5 states. Mr. Loecherbach managed the LiDAR point cloud processing and derived products and processed the orthoimagery.

EDUCATION

Ph.D., Photogrammetry, Institute of Photogrammetry, University of Bonn, Germany, 1998

M.S., Geodesy and Land Surveying, University of Bonn, Germany, 1990

AREA OF EXPERTISE

Photogrammetry, airborne LiDAR, Mobile Mapping; Aerial triangulation, DTM generation, planimetric and topographic mapping, Orthorectification, GIS; Software packages including Inpho / Trimble, Terrasolid, LP360, ESRI, GlobalMapper, Pix4dMapper, Civil3d

TRAINING/CERTIFICATIONS

Certified Photogrammetrist, ASPRS – #R1306 (certified in 2006, expires Aug 31, 2026)

GIS and Remote Sensing course work, San Francisco State University, 2000

OFFICE LOCATION

CES Oakland, CA

YEARS OF EXPERIENCE

30

YEARS WITH FIRM

16

TETRA TECH

Shawn Wilson
Lidar Project Manager

EXPERIENCE SUMMARY

Shawn Wilson is a Certified Lidar Scientist and Lidar Project Manager focusing on mobile mapping and UAV remote sensing. Shawn brings 19 years of experience in geomatics and engineering for public utilities and government related projects. He has managed and directed the utilization of remote sensing, scanning, imaging and 3D modeling projects for public and private firms. Also, he has been a guest lecturer at the University of Washington in the Engineering program showing the evolution of GPS systems and 3D scanning. Shawn's experience includes Lidar from terrestrial, mobile, aerial and drone platforms, data collection and management, boundary resolution, control transformations and construction calculations. He has managed the development of deliverables in GIS, Civil3D, Microstation and PLS-CADD formats. He graduated from Western Washington University and has a certificate from Stanford University. Shawn also is a FAA Certified UAS Remote Pilot and has participated in NASA's ARSET program training.

RELEVANT EXPERIENCE

Washington State Department of Transportation Enterprise Mobile Lidar; Washington State (2023-present). Led collection, post processing, deliverable generation and project management of survey grade mobile mapping data on nearly 16,700 centerline miles of full right-of-way data. Data was delivered in a in-house built custom sofware for the client to visualize the data based on their LRS network.

System Hardening Utility Planimetric Mapping; California State Wide (2022-present). Led processing, deliverable generation and project management of the development of Civil3D and Microstation deliverables of 300+ miles of right-of-way. Design grade planimetric and surfaces were performed with accelerated deadlines. Custom algotrithms were developed to aid in the identification of individual trees within highly vegetated areas.

Golden State Wind; California Coast (2024). Led processing, deliverable generation and project management of the developnet of a Digital Elevation Model and Digital Surface Model of 3,400 square miles of the California coast.

Leading Light Wind; New Jersey Coast (2023). Led processing, deliverable generation and project management of the developnet of a Digital Elevation Model and Digital Surface Model of 500 square miles of the New Jersey coast.

Burma Road; Kodiak Island, AK (2023). Led processing, deliverable generation and project management of the developnet of a orthophoto, planimetric map, digital elevation model and digital surface model on Kodiak Island in Alaska.

EDUCATION

B.A., Anthropology, Western Washington University, 2006

Professional Certificate: Advanced Project Management, Stanford University, 2011

AREA OF EXPERTISE

Lidar Acquisition, Imagery Acquisition, Remote Sensing Data Post Processing, Operations Management, Remote Sensing Sensor Integration, Planimetric Mapping and Extraction

TRAINING/CERTIFICATIONS

ASPRS Certified Mapping Scientist: Lidar #L061

Expires: 01/2026

FAA UAS Remote Pilot

#4660132

OFFICE LOCATION

CES Bothell, WA

YEARS OF EXPERIENCE

19

YEARS WITH FIRM

7

ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, California 92708

ADDENDUM NO. 1
REQUEST FOR PROPOSALS (RFP-24-018)
PRADO BASIN MUTLISPECTRAL AERIAL IMAGERY AND LiDAR
4/8/2025

This addendum serves as written notice of the following corrections, clarifications, additions and/or deletions to any and all copies of the Request for Proposals for Prado Basin Multispectral Aeiral Imagery and LiDAR for OCWD.

The proposer shall execute the acknowledgment form at the end of this addendum and shall attach it to the proposal submitted.

---

1. Q&A Table

a. Please refer to Attachment A-1 of this Addendum No.1 for the QA Table.

ATTACHMENT A-1

Q & A Table

RFP-24-018
RFP for Prado Basin Multispectral Aerial Imagery and LiDAR
QA Table
4/8/2025

No.	QUESTIONS	ANSWERS
1	Can you provide the project boundary in shp or kmz format?	Yes, the kmz format of the project boundary shall be provided upon email request to Procurement@ocwd.com.
2	The RFP asks for a 13 degree scan angle (26 degree FOV) and an overlap of 50%. With modern lidar sensors, especially with a spinning mirror, all project requirements for accuracy and density can easily be exceeded with a higher FOV of 36 degrees and a reduced overlap of ~30%. A FOV of 26 degrees could double the acquisition cost. Are these hard requirements.	This is not a hard requirement . As long as the accuracy and precision are kept, we are fine with the proposed alternative.

END OF ADDENDUM

MANDATORY FORM

ACKNOWLEDGE RECEIPT OF ADDENDUM NO. 1

REQUEST FOR PROPOSAL
PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LiDAR
(RFP-24-018)

4/8/25

Proposer shall acknowledge receipt of this addendum by detaching, signing and attaching to his/her proposal, one (1) copy of this sheet.

I, Thomas Loecherbach, Tetra Tech

Name of Proposer, Company Name

1999 Harrison Street, Suite 500, Oakland CA 94612

Address, City, State, Zip

Hereby acknowledge receipt of Addendum No. 1 to the **Request for Proposal (RFP-24-018) Prado Basin Multispectral Aerial Imagery and LiDAR** and have considered these revisions in the preparation of my proposal. This addendum, consisting of this acknowledgement, shall become a part of any contract made pursuant thereto.

Proposer's Signature

Thomas Loecherbach

Printed Proposer's Name

4/14/2025

Date

ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, California 92708

ADDENDUM NO. 2
REQUEST FOR PROPOSALS (RFP-24-018)
PRADO BASIN MUTLISPECTRAL AERIAL IMAGERY AND LiDAR
4/10/2025

This addendum serves as written notice of the following corrections, clarifications, additions and/or deletions to any and all copies of the Request for Proposals for Prado Basin Multispectral Aeiral Imagery and LiDAR for OCWD.

The proposer shall execute the acknowledgment form at the end of this addendum and shall attach it to the proposal submitted.

---

1. Q&A Table

a. Please refer to Attachment A-1 of this Addendum No.2 for the QA Table.

2. Revised Request for Proposals (RFP) Submittal Checklist

a. Please refer to Attachment A-2 of this Addendum No. 2 for the revised RFP Submittal checklist.

ATTACHMENT A-1

Q & A Table

RFP-24-018
RFP for Prado Basin Multispectral Aerial Imagery and LiDAR
QA Table
4/10/2025

No.	QUESTIONS	ANSWERS
1	Can you provide the project boundary in shp or kmz format?	Yes, the kmz format of the project boundary shall be provided upon email request to Procurement@ocwd.com.
2	The RFP asks for a 13 degree scan angle (26 degree FOV) and an overlap of 50%. With modern lidar sensors, especially with a spinning mirror, all project requirements for accuracy and density can easily be exceeded with a higher FOV of 36 degrees and a reduced overlap of ~30%. A FOV of 26 degrees could double the acquisition cost. Are these hard requirements.	This is not a hard requirement . As long as the accuracy and precision are kept, we are fine with the proposed alternative.
3	Are the following checklist items required with this submittal? 6 Independence 7 License to Practice 12 Prior Engagements with the District 13 Identification of Anticipated Potential Audit Problems If so, can the County provide any more details on what they would need to see in the proposal?	No, please see the following revised RFP Submittal Checklist.
4	Can the District confirm that aerial photography must conform to 1995 ASPRS Draft Aerial Photography Standard?	As long as the District has an accurate representation of the horizontal and vertical accuracy (as it relates to the orthorectification process) of the resultant orthoimage, and it conforms to the ASPRS accuracy standards represented per ASPRS (2024), the District is fine with the deviation from the 1995 ASPRS Draft Aerial Photography Standard specifically (as it is addressed in the proposed product). The horizontal accuracy should be documented and explained if it is above normal tolerances (above 10"). If a decrease in horizontal accuracy is needed to make the flight cost-effective, then it should be noted. Ideally, the horizontal accuracy of the image should be 6", but again, this should be documented with an explanation as to why the horizontal offset is what it will be.

ATTACHMENT A-2

REVISED REQUEST FOR PROPOSALS (RFP) SUBMITTAL CHECKLIST

Request for Proposals (RFP) Submittal Checklist

The following submittals shall be completed and submitted with each Proposal package (see table below for the "Required Submittal Checklist."). This table has been provided as a convenience for proposers to use as a reference only. Ultimately, it is the Proposer's sole responsibility to ensure that their proposal complies with all requirements of the RFP and all the required submittals are included in the Proposal package before it is formally submitted to OCWD. Proposals may be deemed nonresponsive if they do not respond to all areas specified in the RFP.

Item No.	Required Submittal Checklist	Check (√)
1	Signed Proposal package including:	
2	Title Page	
3	Cover Letter	
4	Table of Contents	
5	Experience and Record of Past Performance	
6	Project Team and Qualifications	
7	Project Overview and Approach	
8	Additional Services	
9	Price Proposal	
10	Statement of Insurance Compliance A statement accepting the requirements stated in Section 6.9 of the RFP.	
11	OCWD Standard Agreement: • A statement accepting the requirements stated in Section 6.10 of the RFP.	
12	Billing • A statement accepting the requirements stated in Section 6 of the RFP.	
13	Conflict of Interest	
14	Addenda Acknowledgement Forms (if applicable)	

END OF ADDENDUM

MANDATORY FORM

ACKNOWLEDGE RECEIPT OF ADDENDUM NO. 2

REQUEST FOR PROPOSAL
PRADO BASIN MULTISPECTRAL AERIAL IMAGERY AND LiDAR
(RFP-24-018)

4/10/25

Proposer shall acknowledge receipt of this addendum by detaching, signing and attaching to his/her proposal, one (1) copy of this sheet.

I, Thomas Loecherbach, Tetra Tech

Name of Proposer, Company Name

1999 Harrison Street, Suite 500, Oakland, CA 94612

Address, City, State, Zip

Hereby acknowledge receipt of Addendum No. 1 to the **Request for Proposal (RFP-24-018) Prado Basin Multispectral Aerial Imagery and LiDAR** and have considered these revisions in the preparation of my proposal. This addendum, consisting of this acknowledgement, shall become a part of any contract made pursuant thereto.

Proposer's Signature

Thomas Loecherbach

Printed Proposer's Name

4/15/2025

Date

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: P. Bouyounes/S. Dosier

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: N/A
Program/Line-Item No.: N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: AUTHORIZATION TO ENTER INTO A MEMORANDUM OF UNDERSTANDING (MOU) WITH THE COUNTY OF ORANGE FOR THE CONTINUED USE OF THE COUNTY'S ALERTOC

SUMMARY

The County of Orange renewed the Mass Notification contract with Everbridge to continue providing service for AlertOC. Along with the renewal, it is necessary to renew the Memorandum of Understanding (MOU) between the County of Orange and agencies with access to the system. This Mou will allow the District to continue using the County's Mass Notification System, AlertOC. The District may participate in the countywide System at no charge when used for emergency purposes until December 30, 2029.

Attachments:

- Memorandum of Understanding between Orange County Water District and the County of Orange
- County of Orange and Orange County Operational Area Countywide Public Mass Notification System Operating Guidelines.

RECOMMENDATION

Agendize for May 21 Board meeting: Authorize the General Manager to sign the Memorandum of Understanding (MOU) between the Orange County Water District and the County of Orange for the continued use of the County's Mass Notification System, AlertOC, administered through Everbridge, Inc.

BACKGROUND INFORMATION

AlertOC has been used since its inception in 2008 to contact hundreds of thousands of Orange County residents in times of emergency. Public safety agencies have employed AlertOC for a wide range of notifications, including missing children reports, wildland fire events, severe weather warnings, post-disaster instructions, and evacuation orders.

On June 18, 2013, the Board approved a Memorandum of Understanding with Orange County incorporated cities, public universities and water/wastewater special districts allowing their use of the County's Countywide Mass Notification System under the terms and conditions of the Operating Guidelines and agreements. Over the past 12 years, the MOU has been updated

every four (4) years, requiring agencies to sign each new version.

To participate, a water/wastewater special district needs to sign a Memorandum of Understanding (MOU) with the County and attend training on the use of the system. Since the County is sponsoring this program, there is no cost to Orange County Water District to use the system.

In partnership with the County of Orange, the Water Emergency Response Organization of Orange County (WEROC), serving as the Operational Area Water and Wastewater Mutual Aid Coordinator, is supporting the County in the implementation of Memorandums of Understanding (MOUs) with all water and wastewater special districts electing to use the AlertOC notification system. WEROC's role includes the following responsibilities:

- Providing oversight of the MOUs and maintaining a record of participating agencies.
- Monitoring the execution status of each MOU.
- Facilitating the execution of end-user agreements for individual system users.
- Ensuring system training is delivered to designated users.
- Delivering training on the coordination process as outlined in the AlertOC Policy and Standard Operating Procedure (SOP).
- Maintaining universal communication templates for water and wastewater agencies that comply with state and federal regulatory language requirements (e.g., "Do Not Use" advisories).

This collaborative effort ensures consistent and coordinated emergency communication across the region's water and wastewater agencies.

If County funding of the System becomes unavailable, participants will be given a six-month advance notice per the termination terms outlined in Paragraph VIII of the MOU.

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE COUNTY OF ORANGE
AND
PARTICIPANTS
FOR USE OF COUNTYWIDE MASS NOTIFICATION SYSTEM

This Memorandum of Understanding, hereinafter referred to as "MOU," dated December 30, 2024, which date is stated for purposes of reference only, is entered into by and between the County of Orange, a political subdivision of the State of California, hereinafter referred to as "COUNTY," and the undersigned municipalities, public universities and water agencies responsible for protecting a resident population and maintaining a dedicated public safety answering point (PSAP) within the County of Orange, hereinafter referred to individually as "PARTICIPANT" or collectively as "PARTICIPANTS."

This MOU is intended to establish governance and terms of use for a Countywide Public Mass Notification System.

RECITALS

WHEREAS, COUNTY is sponsoring a Countywide Public Mass Notification System ("System") for the primary intent of providing timely communication to the public during times of emergency; and

WHEREAS, the County is making use of the System available to all cities and agencies within the County of Orange who have the responsibility for protecting a resident population and maintaining a dedicated public safety answering point (PSAP); and

WHEREAS, COUNTY entered into Orange County Agreement No MA-060-25010178 ("Agreement") with Everbridge, Inc., for the provision of Public Mass Notification System Services, on or about December 30, 2024 attached hereto as Attachment A, to disseminate critical, time-sensitive emergency information to COUNTY's residents and businesses through phone and e-mail devices for emergency notification purposes; and

WHEREAS, COUNTY agrees to provide to PARTICIPANTS access to the services provided by Everbridge, Inc. as contained in the Agreement in exchange for abiding by the terms set forth in this MOU; and

WHEREAS, PARTICIPANTS agree to uphold the same terms and conditions of the Agreement, to use the System in compliance with all usage agreements, including but not limited to the End User License Agreement, identified and incorporated herein as Attachment A (Orange County Agreement No. MA-060-25010178 and Attachment B (Countywide Public Mass Notification System Policy and Guideline) and the terms of this MOU to receive the benefits under the Agreement

NOW, THEREFORE, the parties agree as follows:

I. Definitions:

"Agreement" shall refer to Orange County Agreement No. MA-060-25010178 between COUNTY and Everbridge, Inc.

"Countywide" shall mean all geographic locations in Orange County, California.

"Contact information" shall mean PARTICIPANT and public contact data stored in the System for the purpose of disseminating communication in accordance with this MOU and its Attachments.

"Confidential Information" shall include but not be limited to personal identifying information about an individual such as address, phone number, Social Security number, or any other identifier protected from disclosure by law, and/or any other information otherwise protected from disclosure by law, for example, the identity of a victim of a sex crime or a juvenile.

"Emergency" shall include, but not be limited to, instances of fire, flood, storm, epidemic, riots, or disease that threaten the safety and welfare of the citizens and property located within the boundaries of the COUNTY and PARTICIPANTS' respective jurisdictions.

"Emergency information" shall mean information relevant to the safety and welfare of recipients in the event of an Emergency. Such information shall include but not be limited to instructions and directions to alleviate or avoid the impact of an emergency.

"Emergency notification situation" shall mean instances when emergency information is to be distributed through the System.

"Individual User" shall mean an agent, officer, employee or representative of PARTICIPANT that has been granted access to the System as set forth in this MOU.

"Non-emergency information" shall refer to information that is not relevant to the safety and welfare of recipients but has been deemed to be of significant importance to a PARTICIPANT's jurisdiction to justify the use of the System to distribute such information.

"Non-emergency notification situation" shall mean instances when a PARTICIPANT deems non-emergency information to be of significance to a PARTICIPANT'S jurisdiction and the PARTICIPANT uses the System to distribute such information.

"System" shall mean the Public Mass Notification System as provided by Everbridge, Inc. to COUNTY under the Agreement. The System is designed to disseminate information by utilizing common communications, i.e. telephone and e-mail communications to community members and businesses as permitted under the Agreement.

II. **Hold Harmless:** PARTICIPANT will defend, indemnify and save harmless COUNTY, its elected officials, officers, agents, employees, volunteers and those special districts and agencies which COUNTY's Board of Supervisors acts as the governing Board ("COUNTY INDEMNITEES") from and against any and all claims, demands, losses, damages, expenses or liabilities of any kind or nature which COUNTY, its officers, agents, employees or volunteers may sustain or incur or which may be imposed upon them for injury to or death of persons, or damages to property as a result of, or arising out of the acts, errors or omissions of PARTICIPANT, its officers, agents, employees, subtenants, invitees, licensees, or contracted vendors. COUNTY will defend, indemnify and save harmless PARTICIPANT, its officers, agents, employees and volunteers from and against any and all claims, demands, losses, damages, expenses or liabilities of any kind or nature which PARTICIPANT, its officers, agents, employees or volunteers may sustain or incur or which may be imposed upon them for injury to or death of persons, or damages to property as a result of, or arising out of the acts, errors or omissions of COUNTY, its officers, agents, employees, subtenants, invitees, licensees, or contracted vendors.

III. **Term:** This MOU shall be in effect from December 30, 2024, and shall expire on December 30, 2029 unless COUNTY funding of the System becomes unavailable at which time PARTICIPANTS will be given six-month advance notice per the termination terms found in Paragraph VIII. Termination, below.

IV. **Scope of Services**: PARTICIPANTS shall receive from COUNTY access to the same services being provided by Everbridge, Inc. to the COUNTY under the Agreement. COUNTY's involvement in this MOU is limited only to extending the availability of the terms and conditions of the Agreement to the PARTICIPANTS.

V. **Use:** Use of the System and its data, including but not limited to contact information, is governed by the terms, conditions and restrictions set forth in the terms provided in Attachment A, B, and C. All PARTICIPANTS agree to the terms and conditions contained in Attachments A, B, and C. COUNTY retains the right to update Attachments A, B, and C as needed, in whole or in part, during the life of this MOU. Any and all revised Attachments will be distributed to PARTICIPANTS within five business days of the revision date and shall be incorporated into this MOU. Such modifications to the Attachments shall not be deemed an amendment for the purposes of Paragraph IX. Amendments, below.

PARTICIPANT, including each of its agents, officers, employees, and representatives who are given access to the System, agrees to abide by the individual terms of each agreement and the additional conditions incorporated herein. Breach of use may result in individual user or PARTICIPANT access account termination.

PARTICIPANT agrees to require each Individual User to execute an Individual User Agreement (Attachment C) regarding their obligations to maintain the confidentiality of login and password information; ensure that they will use the System in accordance with

all applicable laws and regulations, including those relating to use of personal information; that they may be responsible for any breach of the terms of the Agreement with Everbridge and/or this MOU; and the confidentiality provisions of this MOU. PARTICIPANT further agrees to provide a copy of the signed Individual User Agreement to COUNTY and notify COUNTY, in writing, if an individual user withdraws their consent to the Individual User Agreement at anytime during the term of this MOU. PARTICIPANT further agrees the COUNTY may update the Individual User Agreement and require a copy of the updated signed Individual User Agreement to the COUNTY.

The scope of services under the Agreement is limited to using the System to distribute business communication to PARTICIPANT inter-departmental resources and/or emergency information to the public in emergency notification situations.

All PARTICIPANTS have read and accept the terms and conditions found in COUNTY's "Countywide Public Mass Notification System Policy and Guideline (October 15, 2024)," attached hereto as Attachment B.

VI. Notice: Any notice or notices required or permitted to be given pursuant to this MOU shall be submitted in writing and delivered in person, via electronic mail or via United States mail as follows:

COUNTY:

County of Orange – Sheriff-Coroner Department
Emergency Management Division
Attn: Director of Emergency Management
2644 Santiago Canyon Road
Silverado, CA 92676

PARTICIPANTS: Each PARTICIPANT shall provide to COUNTY a contact person and notice information upon entering into this MOU. Each PARTICIPANT shall notify COUNTY if there is an updated contact person.

Notice shall be considered tendered at the time it is received by the intended recipient.

VII. Confidentiality: Each party agrees to maintain the confidentiality of confidential records and information to which they have access a result of their use of the System and pursuant to all statutory laws relating to privacy and confidentiality that currently exist or exist at any time during the term of this MOU. All information and use of the System shall be in compliance with California Public Utilities Code section 2872. No party shall post confidential information as part of a mass notification unless the law allows such information to be released.

VIII. Termination: The COUNTY or any PARTICIPANT may terminate its participation in this MOU at any time for any reason whatsoever. If any PARTICIPANT chooses to terminate its participation in this MOU, the terminating PARTICIPANT shall provide written notification in accordance with Paragraph VI. Notice, above. Such notice shall be

delivered to the COUNTY 30 days prior to the determined termination date. A terminating PARTICIPANT shall uphold the obligations contained in Paragraph II. Hold Harmless, in its entirety and Paragraph VII. Confidentiality, above. Upon termination, PARTICIPANT agrees to inform each PARTICIPANT user to stop using the System and to relinquish all System access, user accounts, passwords and non-PARTICIPANT data to COUNTY immediately. PARTICIPANT may choose to delete and/or export non-public PARTICIPANT (aka inter-departmental) owned contact information, as well as export resident provided contact information prior to termination. Resident provided contact information acquired through PARTICIPANT sources shall remain in the System and available to the County for regional or multi-jurisdictional notification use as needed.

Should COUNTY discontinue its funding for the System, which shall be grounds for COUNTY's termination of its participation, COUNTY shall give PARTICIPANTS one month advance courtesy notice prior to terminating the Agreement. All other reasons for terminating by COUNTY shall be valid upon providing notice to the PARTICIPANTS. Upon termination by COUNTY, this MOU shall no longer be in effect.

Termination by a PARTICIPANT shall not be deemed an amendment to this MOU as defined in Paragraph IX. Amendments, below.

IX. Amendments: This MOU may be amended only by mutual written consent of the parties involved unless otherwise provided for in this MOU. The modifications shall have no force and effect unless such modifications are in writing and signed by an authorized representative of each party. Termination by a PARTICIPANT or adding a new PARTICIPANT to this MOU shall not be deemed an amendment.

IN WITNESS WHEREOF, the parties hereto have caused this Memorandum of Understanding to be executed by their duly authorized representatives as of the dates opposite the signatures.

COUNTY OF ORANGE

By: _____ Date: 12/13/2024
Don Barnes, Sheriff-Coroner
County of Orange

By: DocuSigned by: Wendy Phillips _____ Date: 10/23/2024
Wendy Phillips, County Counsel
County of Orange

PARTICIPANT: _____

By: _____ Date: _____
Authorized Signature

_____
Print Name and Title

County of Orange and Orange County Operational Area
Countywide Public Mass Notification System
Operating Guidelines

Effective: June 30, 2008 Revised: October 15, 2024

I. PURPOSE

The purpose of these Operating Guidelines is to describe the use and administration of AlertOC, the Orange County Public Mass Notification System ("System") by the County of Orange ("County"), County agencies and departments ("Agencies"), and local jurisdictions authorized by the County Board of Supervisors ("Jurisdictions"). This document will provide roles and responsibilities at the regional level. Individual Jurisdictions/Agencies should create and maintain subordinate procedures which incorporate the regional concepts outlined below. The step-by step procedures for activation and use will be maintained in a separate document maintained by each jurisdiction/agency as a part of their emergency response plans for overall planning and response efforts. A copy of these guidelines shall be maintained in PrepareOC.

This document does not supersede any policy and procedures outlined in the Memorandum of Understandings signed by participating agencies, but should be used to support the use of the System.

Authorized users must respect the integrity of the System, understand the regulatory and privacy issues, and fully comply with the guidelines outlined in this document.

II. SYSTEM DESCRIPTION

The primary intent of the System is to disseminate early warning and time sensitive information to County businesses and community members during an emergency event. The System is only one component of the County of Orange public warning system. As deemed fit by local authorities, the System should be used in conjunction with the other public warning mechanisms including, but not limited to: route alerting, the Emergency Alert System, outdoor warning systems, and press releases.

The System is available 24/7 and has been pre-loaded with Orange County landline phone numbers (including unlisted) and countywide geographic maps. Additionally, community members have the option to provide additional contact information via self-registration portal AlertOC.gov with link access from county and all participating entity websites. The System will be used to send messages, describing the situation, impacted area, and recommended action the public should take, to affected businesses and community members via telephone, e-mail, and/or text.

The County is the sponsor of the System and will take appropriate measures to ensure that the System is in a state of operational readiness at all times. It is the responsibility of all participating Agencies to maximize community member benefits from the System.

While the County's intent for implementing and maintaining the System is for "emergency" use, upon consent from local authorities, cities may optionally use the System to disseminate "government-related" non-emergency notifications to community members and organization resources within its jurisdiction.

III. OVERVIEW OF GENERAL SYSTEM FEATURES

At minimum, the Orange County Sheriff's Department Emergency Management Division shall acquire and maintain a System capable of meeting the following requirements:

A. Licensed for use throughout the County's entire region
B. Capable of sending Wireless Emergency Alerts and Emergency Alert System notifications
C. Capacity to send a 45 second message to 10,000 community members and businesses within 10 minutes
D. Capacity to send messages via phone, e-mail and text
E. Accessible via the public internet
F. Provides audit trail logging and reporting
G. GIS map interface for geographic call list generation
H. Community member self-registration web portal (available in threshold languages)
I. Interactive phone survey technology and reporting
J. Interactive Voice Response based notification setup and execution
K. Unlimited vendor support, with access to vendor available for Jurisdictions as needed

IV. REGULATIONS AND AUTHORITIES

The System is operated in compliance with laws and regulations which are incorporated by reference into these Operating Guidelines.

- 47 C.F.R. Part 11 – Emergency Alert System
- 47 C.F.R. Part 10 – Wireless Emergency Alerts
- American with Disabilities Act

The System uses the E911 database to complete the notifications. The use of the E911 database is regulated by the California Public Utilities Code (CPUC) sections 2872 and 2891 *et seq*. The information contained in the E911 database is confidential and proprietary and shall not be disclosed or used except by authorized personnel for the purpose of emergency notifications. Any agency in violation of this regulation is subject to criminal charges as described in the CPUC.

V. GOVERNANCE

The County Board of Supervisors has authority over the System governance.

The Orange County Sheriff's Department Emergency Management Division (OCSD-EMD) will manage the System as a countywide asset on a day-to-day basis. The OCSD-EMD will draft, implement and maintain policies, processes, and data related to the System. The OCSD-EMD is responsible for ensuring that the provisions of the Vendor contract are implemented properly.

The Emergency Management Council Subcommittee and the Orange County Emergency Management Organization-Technology Subcommittee are responsible for recommending plans, procedures, and policies related to the System for approval.

The Orange County Emergency Management Council and County of Orange Operational Area Executive Board are responsible for approving plans, procedures, and policies related to the System.

VI. AUTHORIZED USERS

Use of the System by each Agency and Jurisdiction is contingent upon that Agency or Jurisdiction abiding by the contract with the mass notification vendor, and the protocols established by the Emergency Management Council and Operational Area Executive Board.

The System is designed to be a countywide asset, available to all Jurisdictions that have a dedicated public safety answering point (PSAP) and/or a residential population for whom they are responsible for making protective action recommendations.

An Agency may participate in the countywide System at no charge when used for emergency purposes until December 30, 2029.

Entities authorized to join the system at no cost are limited to the County, Orange County Cities, the Municipal Water District of Orange County and Orange County Retail Water Agencies, and the University of California, Irvine. Each participating Jurisdiction must sign a Memorandum of Understanding (MOU) and will maintain, at minimum, a Local Administrator responsible for implementing and administering use of the System at the local level.

A. County Level

1. County Administrator

The OCSD-EMD will assign and maintain a designated County Administrator responsible for overall acquisition, accessibility, maintenance, compliance and management of all components required to provide an effective countywide mass notification system.

The County Administrator is responsible for:

1. System acquisition and contract management.
2. Policy management and as needed modification (in consultation with public safety, emergency management and emergency response personnel.)
3. Audit compliance: routine monitoring of System use to insure policy and contract compliance.
4. Access management: record management of signed MOU from each participating Agency, distribution of local administrator accounts and updated Local Administrator contact list.
5. Data management: E911 data acquisition, update and compliance monitoring. Countywide map file acquisition, update and overall geo-coding.
6. Testing: facilitate routine System-wide test exercise, document overall test results and recommend and execute, as needed, corrective action at the County level.
7. User Testing: verify and document County Alert and Warning Users are performing monthly tests.
8. Public education campaign: initiate and facilitate public education campaign aimed at making the public aware of the countywide public mass notification system initiative and individual registration web portal.

9. Exclusion List: maintaining exclusion lists, provided by Local Administrators, in the System.
10. System support: provide support to County Users and Local Administrators.

2. County User

The County will have two levels of users: Alert & Warning Users and Agency Users. Both Alert and Warning Users and Agency Users are responsible for obtaining Multi-Factor Authentication (MFA) software and will require MFA software to be functional for access to the System.

Alert & Warning Users

Orange County Sheriff's Department Emergency Communication Bureau (9-1-1 dispatch), Control One and Emergency Management Division personnel will be setup as Alert & Warning Users. Alert & Warning Users will have permission to access and launch emergency notifications to all jurisdictions within Orange County consistent with the County of Orange and Orange County Operational Area Alert and Warning Plan.

Alert and Warning users should perform monthly tests including:

1. Logging into AlertOC
2. Sending a test message to one or more contacts
3. Checking message receipt to ensure message was delivered

A Jurisdiction that contracts with the Orange County Sheriff's Department for police services authorizes the OCSD-Control One, OCSD-Dispatch, or OCSD-EMD personnel to launch on their behalf if requested by contracted field personnel in order to launch messages in a timely manner. These jurisdictions can also launch on their own behalf.

Agency User

Agency Users will have permission to execute inter-department notifications. Unincorporated areas of Orange County will have emergency messaging to the public launched by the Orange County Sheriff's Department. All other County Agencies may have access to use the System for interdepartmental use. Each participating Agency shall develop and maintain written procedures to identify and address the Agency's specific use of the System within the scope of this policy guide and provide this guideline to the Orange County Sheriff's Department Emergency Management Division. Each participating County agency shall maintain a level of training for their users consistent with the County of Orange and Orange County Operational Area Alert and Warning Plan.

B. Jurisdictions

Jurisdictions wishing to participate may do so by having an authoritative representative sign the "Orange County Public Mass Notification System" MOU. Upon signing the MOU, the Jurisdiction will identify a Local Administrator. The Local Administrator completed specified training and certifications before being provided with an account. Throughout the term of the MOU, the Jurisdiction may use the System to send an unlimited number of emergency notifications to the public as well as an unlimited number of emergency and non-emergency inter-department messages. Each participating Jurisdiction shall develop and maintain written procedures to identify and address the Jurisdiction's specific use of the System within the scope of this guideline. Each participating Jurisdiction shall maintain a level of training

for their users consistent with the County of Orange and Orange County Operational Area Alert and Warning Plan.

1. **Local Administrator**
   Participating Jurisdictions agree to appoint a designated Local Administrator responsible for leading, coordinating, monitoring and optimizing use of the System at the local level. Local Administrator shall act as the Jurisdiction's central point of contact and will work collaboratively with the County Administrator to ensure local use of the system is within MOU and Operating Guidelines.

   Local Administrator is responsible for:

   1. Contract acquisition if Agency will use the system for non-emergency purposes.
   2. Local Agency Mass Notification Operating Procedure development and management.
   3. Use compliance: routine monitoring to ensure System is used within the conditions and terms of this document and associated MOU.
   4. Access management: Local User account distribution and management, including an annual audit of accounts; annual attestation that all Local Administrators and Local Users are authorized to continue accessing the system. Record management of MOU(s) and signed Local User certifications.
   5. Testing: facilitate routine local System test exercise, document local test results and recommend and execute, as needed, corrective action at the local level.
   6. User Testing: verify and document Local Users with Alert and Warning responsibilities are performing monthly tests.
   7. Public education campaign: initiate and facilitate public education campaign aimed at making the local community aware of the intended use of the System and individual registration web portal.
   8. System support: provide support to Local Users.
   9. Providing logins and procedural training to key individuals within their Agency responsible for using the System.
   10. Exclusion Lists: provide annually a review of the exclusion list for businesses, phone numbers, and organizations in the Participating Jurisdiction.
   11. Training: ensuring Local Users complete security awareness training that covers at a minimum the following areas: proper protection, handling, dissemination, and destruction of confidential information (CI); threats, vulnerabilities, and risks associated with handling of CI; social engineering; system responsibilities and expected behavior; account usage and management – including password creation, protection, and frequency of changes; system usage – allowed vs. prohibited; incident response; physical security; email protection – phishing threats and business account compromise
   12. Incident Response: Local Administrator is responsible to immediately notify OCSD of any incidents that could lead to the unauthorized or accidental use, modification, disclosure, or destruction of any information contained within the system.

2. **Local User:**

Participating Jurisdictions may have an unlimited number of Local Users. Local Users will have access to community member contact records within their Jurisdiction or Service District. Local Users will be authorized and managed by the Local Administrator and may have varied system permissions. For Water Retail Water Agencies, Local Users may use the System to send emergency notifications to the public by using pre-established GIS shape files or the system's interactive map feature to identify their water users.

Local Users are responsible for obtaining Multi-Factor Authentication (MFA) software and will require MFA software to be functional for access to the System.

If a local user has access to send Alert and Warning messaging to the public then the local user should perform monthly tests including:

1. Logging into AlertOC
2. Sending a test message to one or more contacts (this can be the Alert and Warning User)
3. Checking message receipt to ensure message was delivered

VII. AUTHORIZED USE

A. Emergency Public Notifications

Legal restrictions exist related to issuing different types of messages through the System. All Users are required to know and understand these restrictions. The Form in Attachment B delineates the requirements for each type of message.

As a general principle, the System is to be used when the public is being asked to take some action (e.g. evacuate, prepare to evacuate, shelter in place, boil tap water before drinking, local assistance centers and other follow up information, re-entry to an area after evacuation orders have been lifted or termination of the emergency because the danger has passed).

Use of the System for emergency activity contains two components: (1) the need to disseminate critical, safety-related information to individuals regarding emergency events occurring now, follow up information regarding the event and termination of the emergency event, and (2) communicating with safety-responder staff, volunteers and involved parties about the emergency event.

Emergency Public Notifications are limited to:

1. Imminent or perceived threat to life or property
2. Disaster notifications
3. Evacuation notices
4. Public health emergencies
5. Public safety emergencies
6. Any notification to provide emergency information to a defined community

The following criteria should be used to assist with determining the need to issue an alert:

1. Severity. Is there a significant threat to public life and safety?
2. Public Protection. Is there a need for members of the public to take a protective action in order to reduce loss of life or substantial loss of property?
3. Warning. Will providing warning information assist members of the public in making the decision to take proper and prudent action?
4. Timing. Does the situation require immediate public knowledge in order to avoid adverse impact?
5. Geographical area. Is the situation limited to a defined geographical area? Is that area of a size that will allow for an effective use of the system, given the outgoing call capacity?
6. Are other means of disseminating the information inadequate to ensure proper and time delivery of the information?
7. Is the message being sent follow up information to an emergency event in progress?

If the answer to ALL of these questions is “Yes”, then an activation of the System for emergency purposes may be warranted.

Illustrations of incidents which may be Emergency Public Notifications are included in Attachment A.

Participating Agencies are authorized to develop pre-established notification lists and messages related to specific types of emergencies. The circumstances for using these lists should be documented within County emergency plans and annexes approved by the Emergency Management Council, and their establishment coordinated with the County Administrator. Such documentation should include which forms of System notification will be used (e.g., opt-in agency data). During emergencies, messages will be coordinated with the Operational Area Emergency Operations Center or OCSD-EMD. These lists may include special populations (e.g. in-home care, schools, etc.) or those susceptible to certain risks (e.g. homes within dam inundation zone). It is the responsibility of the participating Agency to create, maintain and update these lists.

B. Emergency Responder Notifications

Emergency Responder Notifications are limited to:

1. Contacting first responders to advise of an emergency
2. Contacting first responders to report for duty due to an emergency
3. Contacting key staff regarding an emergency or crisis situation
4. Contacting agency employees/DSWs to report at a different time or location (or provide an update) due to an emergency
5. Exercises

Emergency considerations:

1. Notification shall clearly state situation is an emergency
2. Message length shall not exceed 60 seconds
3. Message shall have a call back number specific to the agency issuing the notification.
4. It is highly recommended all messages are recorded using a real voice and not the computer transcriber.
5. It is highly recommended to provide a phone number or website where the public can obtain additional or updated information
6. An all clear notification should be sent when applicable

C. Non-Emergency Public Notifications

Non-emergency **public** notification use is **prohibited** for any of the following purposes:

1. Any message of commercial nature
2. Any message of a political nature
3. Any non-official business (e.g. articles, retirement announcements, etc.)
4. To send a message to an E911 obtained data source

E911 data is cannot be used for non-emergency use except for testing according to the law California Public Utilities Code (CPUC) sections 2872 and 2891.1 and violators may be subject to criminal enforcement. Any Agency or Jurisdiction in violation of this term may have their use of the System suspended or their individual access revoked.

No Jurisdiction shall use the System for non-emergency public announcements unless a separate contract with the Vendor is established. Cost associated with non-emergency public notifications is the responsibility of the local Jurisdiction. Jurisdictions will be limited to using the self-registering portal entry data only when launching non-emergency messages.

Jurisdictions who contract to use the System for non-emergency activity agree to give precedence to emergency notification call-outs by delaying or terminating non-emergency notification sessions if needed to increase emergency message success. The primary concern for point of failure in this situation is not the System, but the telephone port capacity of local phone providers responsible for delivering calls to community members and businesses.

D. Inter-Department Communication

Each participating Agency and Jurisdiction is authorized to create employee/volunteer and department call lists and pre-recorded messages. Agencies and Jurisdictions may use the System for non-emergency inter-departmental business communication as needed, without cost. It is recommended that individual Agencies identify where this would add value to their operations and establish separate written protocols and procedures for this use. Inter-departmental users will have permission to inter-departmental contact information only and are authorized to use the System solely for inter-departmental communication including but limited to first responder or volunteer call-outs.

VIII. ACTIVATION OF THE SYSTEM

Each Jurisdiction is responsible for launching messages to affected community members and businesses within their Jurisdiction or Service District.

- For messages launched by Jurisdictions on their own behalf, Jurisdictions are responsible for identifying and documenting who has the authority to launch messages.
- For messages launched by the County on behalf of Jurisdictions, the County requires the message be authorized by either the City Manager, City Police Chief, City Fire Chief, City Emergency Manager, or by public safety personnel on the incident scene with Incident Commander approval. Exigent circumstances will be evaluated on a case-by-case basis if the preceding individuals are not available.

The County of Orange and Orange County Operational Area Alert and Warning Plan is incorporated by reference. This document delineates the processes for coordinating all alert and warning notifications, including those transmitted using this System.

IX. LIMITATIONS OF THE SYSTEM

Every effort will be made by the County to ensure the System operates in the manner described in the SOP. However there are limitations of technology which may cause the system to fail or provide inconsistent message delivery. Some of these limitations include:

- Cell Phone Disruptions
- Cell Phone Reception Coverage
- Public Safety Power Shutoff events

X. ROUTINE TESTING

Monthly System tests will be conducted to ensure that use of the System in an emergency is optimized and users are familiar with operation. All users should perform monthly message proficiency tests. Users who do not login and perform a message proficiency test at least yearly are subject to removal as a user from the System.

The System will have an annual regional test. This includes testing operational readiness, activation procedures and system effectiveness as well as validating data and system processes. Through the annual test exercise, System administrators and users will be able to observe the mode of operation to augment and refresh System and process knowledge.

Specific test exercise routines, roles, responsibilities and schedule will be detailed in the County of Orange and Operational Area Alert and Warning Plan.

By signing the Mass Notification System MOU, participating Jurisdictions agree to take part in System drills and exercises.

XI. CONFIDENTIALITY AND SECURITY

Through the "Memorandum of Understanding between the County of Orange and Participants for use of Countywide Mass Notification System," each agency is bound in writing to the confidentiality obligations sufficient to permit agencies to fully perform its obligations under this policy or the vendor agreement. Jurisdictions and Agencies shall be responsible for:

1. Ensuring users have completed an appropriate background check and undergone annual security awareness training.
2. Protecting Confidential Information (CI) contained within the system against accidental or unauthorized use, modification, dissemination, or destruction.
3. Ensuring that users maintain the confidentiality of all user login and password information;
4. Ensuring that users follow the 90 day password expiration limit;
5. Ensuring that users use the service in accordance with all applicable laws and regulations, including those relating to use of personal information;
6. Immediately notifying the County Administrator of any security incident that could lead to the unauthorized access, use, modification, dissemination, or destruction of CI contained within the system.
7. Any breach of the terms of this policy or the vendor agreement by any user; and
8. All communications by users using the service.

XII. COSTS

The County of Orange agrees to fund the System for notifications classified as "emergency use." The County of Orange also agrees to continue to obtain updated E911 telephone data and geographic maps.

Costs associated with use of the System for non-emergency activity is the responsibility of the local Jurisdiction through separate contract with the Vendor.

XIII. DEFINITIONS

System – All components of the Mass Notification System including hardware, software, access portals, contact data and GIS maps.

Community members – Comprises individuals and businesses.

Emergency - "Emergency" shall include, but not be limited to, instances of fire, flood, storm, epidemic, riots, or disease that threaten the safety and welfare of the individuals and property located within the boundaries of the county and participants' respective jurisdictions.

XIV. REVISION HISTORY

Revision Date	Author	Description
April 18, 2008	PMNS Policy Committee	Document originated
May 19, 2008	PMNS Executive Review Team	Non-emergency session termination in Section V., Item C.
June 16, 2008	Teara LeBlanc	Exception clause in Section VII, Item A., bullet 2.
May 2010	Vicki Osborn	Revision of all sections
June 2012	Raymond Cheung	Revision for OCSD transition
May 2013	Raymond Cheung	Revision for new vendor contract
May 2016	Raymond Cheung	Added confidentiality item to Section V., Item C. and allowed non-emergency use in Section V., Item B. and Section VIII.
June 2021	Harmon "Jay" Ward	Revision for new contract Revision of Sections II, III, IV, V, IX, and XI.
October 2024	Harmon "Jay" Ward	Revision for new contract; added User Testing for County and Local Jurisdictions in Sections VI and X; added City Emergency Manager as Authorized Requestor in Section VIII; added Section IX; added password expiration in Section XI.

XV. ATTACHMENT A – INCIDENT ILLUSTRATIONS

This is a non-exhaustive list provided as examples.

Type of Incident	Description	Meets Public Safety Criteria
Active Shooter	A shooting with armed individual or individuals is occurring in a known area.	Yes
Boil Water Orders	An unsafe water supply issue requiring the public to boil water before use.	Yes
Building Fire	A fire occurring in an urban area requiring evacuation or shelter in place for the immediate area.	Yes
Violent Crimes	Violent crimes that just occurred such as robbery, assault, murder, etc.	Yes
Felony Suspect at Large	Law enforcement is currently searching for a felony suspect that is suspected to be in a certain area.	Yes
HazMat	Hazardous Materials incidents that require a fire/hazmat response and may include evacuations or shelter-in-place orders.	Yes
Health Orders	Any public health order made pursuant to County Health Officer recommendations.	Yes
Missing Adult (920A) with special circs	12- 17 yrs with decreased mental capacity or medical condition	Yes
Missing Child (920C)	12 yrs or younger	Yes
Missing Juvenile (920J)with special circs	18 yrs and older 12- 17 yrs with decreased mental capacity or medical condition	Yes
Severe Weather Related	Weather warnings that forecast an occurring or imminent threat to public safety or coincide with protective action recommendations such as voluntary or mandatory evacuation orders.	Yes
Evacuation or Shelter-in-Place	Voluntary or mandatory evacuation or shelter-in-place orders.	Yes
Wildland Fire	A fire occurring in a wildland urban interface area requiring immediate evacuation or shelter-in-place.	Yes
Road Closures	Unplanned road closures due to an emergency situation.	Yes
Planned Events	Road closures due to community events planned in advance.	No

XVI. Attachment B – AlertOC/WEA/EAS Activation Form

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: M. Patel/R. Bouley/A. Perry

Budgeted: No
Proposed Budget: $500,000
Cost Estimate: $500,000
Funding Source: R&R
Program/Line Item No.: R22011
General Counsel Approval: Yes
Engineers Report: N/A
CEQA Compliance: N/A

Subject: AWARD CONTRACT NO. GWRS-2025-1 REVERSE OSMOSIS CIP VALVE RELOCATION TO MURRAY COMPANY

SUMMARY

A total of five construction bids were received on April 8, 2025, for the Reverse Osmosis Clean-In-Place (CIP) Valve Relocation Project, Contract GWRS-2025-1. Based on a review of the bids received, staff recommend awarding a contract to Murray Company in the amount of $340,885 and establishing a total project budget of $500,000.

Attachment: Affidavit of Publication for Notice Inviting Bids for Contract GWRS-2025-1

RECOMMENDATION

Agendize for May 21 Board meeting:

1. Receive and file Affidavit of Publication of Notice Inviting Bids for Contract GWRS-2025-1 Reverse Osmosis CIP Valve Relocation Project;

2. Ratify issuance of Addendum No. 1 to provide responses to potential bidder's questions; and

3. Accept bid and award contract GWRS-2025-1 to the lowest responsive bid and responsible bidder, Murray Company, in the amount of $340,885; and

4. Establish the Reverse Osmosis CIP Valve Relocation Project budget in the amount of $500,000.

BACKGROUND/ANALYSIS

During construction of the GWRS Final Expansion (GWRSFE), fifteen inter-stage booster pumps were installed on the existing finished floor grating for the original fifteen GWRS Reverse Osmosis (RO) treatment units. Upon completion of the GWRSFE construction project and the pumps were in operation, staff realized that the location of three of the fifteen new pumps interfered with Operations staff's ability to safely open and close three valves on the CIP lines that feed cleaning solution to the RO units. Staff examined the system and determined that relocating the valves to be operated from the ground floor of the RO building is much safer, instead of having to enter the basement and navigate around several large pipes to access the valves directly. In addition, staff

had already realized that some of the original PVC piping for the CIP system was starting to fail and had established a project to replace the failing piping with stainless steel piping that has a much longer lifespan. There is an opportunity to add the costs of relocating these valves to existing budgeted CIP PVC Piping System Replacement project, R22011, to minimize additional costs that would come later if the two projects were kept separate.

Due to their familiarity with the project, staff contacted Black and Veatch for a proposal to develop plans and specifications to relocate the valves. Black and Veatch recently completed design of the GWRS Final Expansion and was able to produce construction plans and specifications for the valve relocations under their existing GWRS Final Expansion agreement with OCWD since there is sufficient remaining balance.

Five construction bids were received on April 8, 2025, for contract GWRS-2025-1. The bid advertisement period commenced February 26, 2025, and spanned 41 calendar days. Addendum No. 1 was issued March 27, 2025, to provide responses to potential bidder's questions.

A summary of the five bids is shown below in Table 1.

Table 1: RO CIP Valve Relocation Bid Summary

Contractor	Bid Amount
Murray Company	$340,885
Estate Design & Construction	$350,000
Innovative Construction Solutions	$363,800
Vicon Enterprise	$365,500
MMC, Inc.	$420,000

Staff reviewed the bid of Murray Company and confirmed that its contractor's license is current, active, and in good standing with the State of California.

The CIP Valve Relocation Project was added to the currently budgeted CIP PVC Piping System Replacement Project. The project budget for the valve relocation portion of the project is summarized in Table 2.

Table 2: RO CIP Valve Relocation Budget Summary

Description	Budget
Design	
Black and Veatch	$49,150
Design Subtotal	**$49,150**
Construction	
Contract GWRS-2025-1	$340,885
Permits and Advertisement Costs	$50,000
Staff Expenses	$40,000
Construction Subtotal	**$430,885**
Project Contingency	$19,965
Total Project Budget	**$500,000**

Construction is anticipated to take approximately two weeks at each location. Work will be completed in a manner that will not interrupt any planned RO membrane cleaning events. Table 3 shows the overall project schedule summary.

Table 3: RO CIP Valve Relocation Schedule

Description	Completion Date
Design	October 2024
Advertise for Bids	February 2025
Bid Opening	April 2025
Construction	Fall 2025

Staff recommends establishing a project budget of $500,000 and awarding the construction contract to Murray Company as the lowest responsive bidder in the amount of $340,885 for Contract No. GWRS-2025-1, Reverse Osmosis CIP Valve Relocation Project.

PRIOR RELEVANT BOARD ACTION(S)

11/14/24, R24-11-145: Authorizing Publication of Notice Inviting Bids for Contract No. GWRS-2024-1, Reverse Osmosis CIP Valve Relocation Project

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Orange County Water District
18700 Ward Street
Fountain Valley, California 92708

Account Number:	5179533
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Customer's Reference/PO Number:	
Publication:	The Orange County Register
Publication Dates:	02/27/2025
Total Amount:	$1366.57
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Notice ID:	A11YuI2c96RZ8M1F35n3
Invoice Text:	

THE ORANGE COUNTY
REGISTER
The Orange County Register
1920 Main Street, Suite 209
Irvine, California 92614
(714) 796-7000

0011721876

Orange County Water District
18700 Ward Street
Fountain Valley, California 92708

PROOF OF PUBLICATION
(2015.5 C.C.P.)

STATE OF CALIFORNIA
County of Orange

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not party to or interested in the above-entitled matter. I am the principal clerk of the printer of The Orange County Register, a newspaper of general circulation, printed and published in the City of Irvine*, County of Orange, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of County of Orange, State of California, under the date of November 19, 1905, Case No.A-21046. The notice, of which the annexed is a printed copy (set in type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

02/27/2025

I certify (or declare) under the penalty of perjury that the foregoing is true and correct.

Dated at Irvine, California

On this 27th day of February, 2025.

Sandra Campos
Signature

NOTICE INVITING BIDS
RO VALVE RELOCATION
CONTRACT NO. GWRS-2025-1

PLEASE TAKE NOTICE that sealed bids will be received at the office of the Contracts Administrator of the Orange County Water District ("District"), 18700 Ward Street, Fountain Valley, CA 92708 (mailing address: P.O. Box 8300, Fountain Valley, CA 92728-8300), no later than 2:00p.m. PT, local time on April 8, 2025 at which time the bids will be publicly opened and read aloud for performing all work and furnishing all labor, materials and equipment for:The Contractor shall furnish all labor, materials, equipment and incidentals required to complete construction of the RO CIP Valve Relocation Project per the plans and specifications, including: removal and relocation of three existing valves located in the basement of the Reverse Osmosis building. The project also includes replacement of PVC sections of pipeline with stainless steel. The work is within the existing Reverse Osmosis building within the treatment facility at the District's main office. The address is 18700 Ward Street, Fountain Valley, CA 92708.
The Contractor shall complete Work in sequence listed below. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.
1. Preparation of a construction schedule and schedule of values.
2. Construction of a temporary work area and staging area for use during construction.
3. Removal and relocation of existing valve (only one train to be worked on at a time).
4. Replacement of PVC pipe with stainless steel.
5. Modify existing floor level grating to accommodate new valve operating stem location.
6. Site cleanup and demobilization.

NON-MANDATORY PRE-BID CONFERENCE: A pre-bid conference will be held at the District Office, 18700 Ward Street, Fountain Valley, CA on March 13, 2025 at 2:00pm PT. All potential bidders, contractors and other interested parties are required to attend this conference conducted by the District and Engineer. Any potential bidder that does not attend the pre-bid conference will be charged with knowledge of all information that was available at the pre-bid conference.

PROJECT ADMINISTRATION: All questions regarding the Bid must be submitted in writing before the deadline due date of March 20, 2025, at 2:00pm PT. Questions received after the questions due date may not be considered. All questions relative to this project prior to the opening of bids shall be directed, in writing, to OCWD:

ORANGE COUNTY WATER DISTRICT
18700 Ward Street
Fountain Valley, CA 92708

Mailing Address:
P.O. Box 8300
Fountain Valley, CA 92728-8300

Attention: Audrey Perry, Project Manager
Telephone: (714) 378-3369
Email : procurement@ocwd.com

COMPLETION OF WORK AND LIQUIDATED DAMAGES: All Work must be substantially completed within ONE-HUNDRED TWENTY (120) consecutive calendar days from the date of the Notice to Proceed issued by the District. Failure to complete the Work within the time set forth herein will result in the imposition of liquidated damages for each day of delay, in the amount set forth in the Information for Bidders.

OBTAINING CONTRACT DOCUMENTS: Plans and specifications and all contract documents must be purchased through HB Digital at www.ocwdplanroom.com. Payment will not be refunded and the plans and specifications and contract documents are not required to be returned.

BID GUARANTEE: Each Bid shall be accompanied by one of the following: a certified or cashier's check, or bid bond in an amount not less than ten percent (10%) of the total bid price, payable to the Orange County Water District, as a guarantee that the Bidder, if its Bid is accepted, shall promptly execute the Agreement, furnish a satisfactory Faithful Performance Bond in an amount not less than one hundred percent (100%) of the total bid price, furnish a Labor and Material Bond in an amount not less than one hundred percent (100%) of the total bid price, and furnish certificates evidencing that the required insurance is in effect in the amounts set forth in the Insurance Conditions. The Faithful Performance Bond shall remain in full force and effect through the guarantee period as specified in the General Provisions. All surety companies shall be admitted surety insurers and shall comply with the provisions of Code of Civil Procedure Section 995.630.

DISTRICT'S RIGHTS RESERVED: The Orange County Water District reserves the right to reject any or all bids, and to waive any informality in any bid.

Dated: February 27, 2025

ORANGE COUNTY WATER DISTRICT

By: John C. Kennedy, General Manager

The Orange County Register
Published: 2/27/25

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: M. Patel

Budgeted: Yes
Budget Amount: NA
Cost Estimate: NA
Funding Source: General Fund
Program/Line Item No.: 1050.54505
General Counsel Approval: Yes
CEQA Compliance: N/A
Engineers/Feasibility Report: No

Subject: AWARD DIRECT ACCESS ELECTRICITY CONTRACT FOR GROUNDWATER REPLENISHMENT SYSTEM, BURRIS PUMP STATION, AND GREEN ACRES PROJECT SANTA ANA RESERVOIR

SUMMARY

Electricity to the district's Fountain Valley campus, Burris Pump Station, and Green Aces Project (GAP) Santa Ana Reservoir facilities are provided through a Direct Access (DA) agreement with Constellation New Energy (CNE). The Fountain Valley campus electricity requirements make up the majority of the District's demand and include the Groundwater Replenishment System (GWRS) Advanced Water Purification Facility (AWPF), GAP treatment plant, Advanced Water Quality Assurance Laboratory, and District administration buildings. The current DA agreement with CNE will expire on June 30, 2025, so a request for proposals (RFP) document was issued. Based on proposals received staff is requesting issuance of a contract to obtain pricing from DA energy service providers.

RECOMMENDATION

Agendize for May 21 Board Meeting: Authorize the general manager in consultation with the board president to enter into a five-year contract ending June 30, 2030, for Direct Access electricity procurement with Constellation New Energy, NRG/Direct Energy or Shell Energy for the OCWD Kiwi Substation, Burris Pump Station, and Green Acres Project Santa Ana Reservoir based upon pricing received on May 22, 2025.

DISCUSSION/ANALYSIS

The District has an existing five-year contract with Constellation New Energy (CNE) to provide electricity (power) to three separate OCWD facilities through a DA agreement. This contract is due to expire at the end of June 2025. To ensure electricity service is not interrupted and pricing is known; a renewal of the DA electric service contract is now required. On April 2, 2025, the board approved the issuance of a request for proposals to seek renewal pricing for DA electricity service.

DA is a retail electric service where customers purchase electricity from a competitive provider called an Electric Service Provider (ESP), instead of from a regulated electric utility such as Southern California Edison (SCE). With DA electric service the

transmission and distribution of the electricity occurs over SCE infrastructure. This means that OCWD receives billings from the DA ESP for electricity used as well as billings from SCE to cover the cost of transmitting the electricity.

The advantage of procuring electricity through a DA provider is the ability to take advantage of market pricing, on and off-peak real time pricing, and the ability to obtain a fixed unit cost of electricity. The district has been on a DA contract to provide power to the Fountain Valley campus (where the majority of the electrical usage is for the GWRS AWPF) since January 2013. DA electric service to the Santa Ana Reservoir began in 2015 and to the Burris Pump Station in January 2025. Staff feels the enrollment in DA has provided a savings over bundled service from SCE and will protect the district from electricity market uncertainty going forward. The electricity market in California is volatile due to numerous reasons including electrical grid stress in times of high usage, California goals for renewable energy, and the slower than anticipated rollout of renewable energy facilities (including large scale battery storage capacity to offset solar energy loss periods). In addition, electricity pricing has increased significantly from both SCE and DA providers due to fees approved through the California Public Utilities Commission that ensure standby electricity capacity and investment in renewable energy is in place by ESPs. These fees are known as Resource Adequacy (RA) and Renewable Portfolio Standards (RPS).

In order to leverage the total electricity demand of all three district facilities currently supplied with electricity service through DA an RFP was developed that requests one fixed price to supply these facilities. As a result of the RFP, pricing proposals were received from three entities: Constellation New Energy (CNE), NRG/Direct Energy, and Shell Energy. Since electricity is procured on the commodities market, prices are quoted daily and the pricing below was received on May 8, 2025 for a five-year contract. As noted previously the prices do not reflect the total cost of electricity. There is a separate cost component for SCE transmission and distribution charges. Those charges averaged five cents per kilowatt hour in 2024.

Pricing Received on May 8, 2025	**NRG/Direct Energy**	**Shell Energy**	**Constellation New Energy**
5-Year Average Load Following Price ($/MWH)	$54.08	$55.48	$51.49
Resource Adequacy (RA) ($/MWH)	$15.23	$19.45	$19.52
Reliable Portfolio Standard (RPS) ($/MWH)	$15.06	$15.25	$16.67
Other Fees ($/MWH)	$9.32	Included in base cost	$6.03
Total Cost ($/kWH)	**$0.094**	**$0.090**	**$0.094**

As of May 8, 2025 Shell was offering the lowest price but NRG/Direct Energy and Constellation New Energy had a similar average price for a five-year period from July

2025 to June 3030. Staff is requesting authorization for the general manager, in consultation with the board president, to enter into a contract with Constellation New Energy, NRG/Direct Energy or Shell Energy. This will allow staff to seek up to date pricing all the way to the full board approval date of May 21, 2025 to seek a direct access contract renewal since electricity commodity pricing changes daily. The electricity cost procured from a direct access electricity provider is based upon market commodity prices on the day a contract is signed, which is anticipated to be on May 22, 2025.

PRIOR RELEVANT BOARD ACTIONS

May 22, 2013, R13-5-57 B: Amendment to Shell Energy North America Energy America Energy Sales Agreement & Solicit Proposals for Purchase of Direct Access Electricity for GWRS

August 28, 2001, R01-8-127: 45 Day Power Contract with AES New Energy

AGENDA ITEM SUBMITTAL

Meeting Date: May 14, 2025

To: Water Issues Committee
Board of Directors

From: John Kennedy

Staff Contact: A. Hutchinson/A. Waite/
L. Haney

Budgeted: Yes
Budgeted Amount: $75,000 (FY25-26)
Cost Estimate: $75,000
Funding Source: General Fund
Program/Line Item No. 1044.53001
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: RESULTS OF RIVERBED FILTRATION SYSTEM DEMONSTRATION PROJECT AND AUTHORIZATION TO ISSUE REQUEST FOR PROPOSALS FOR FEASIBILITY STUDY (Resilience Plan Priority Project No. 11)

SUMMARY

Clogging caused by the accumulation of suspended solids is a key constraint limiting the capacity of OCWD's recharge facilities. To take advantage of the natural filtration properties of Santa Ana riverbed sediments, a Riverbed Filtration System (RFS) was constructed and tested from 2015 to 2023. The RFS was effective in removing 96 percent of the suspended solids from the Santa Ana water, which resulted in a doubling of the recharge capacity of Olive Basin. Given the potential to increase OCWD's recharge capacity, staff recommends issuing a Request for Proposals to study the feasibility of expanding the RFS.

Attachments:
- Presentation
- Final Project Report
- Draft Requests for Proposals for the Riverbed Filtration System Feasibility Study

RECOMMENDATION

Agendize for May 21 Board meeting: Authorize issuance of Request for Proposals for the Riverbed Filtration System Feasibility Study.

BACKGROUND/ANALYSIS

Clogging due to the accumulation of suspended solids is a constraint that limits the capacity of the OCWD's surface water recharge system. To examine methods that could be employed to decrease clogging and increase system capacity, OCWD conducted a multi-year Recharge Water Sediment Removal Feasibility Study which was completed in 2010. This study found, based on extensive pilot testing of multiple methods designed to remove suspended solids from Santa Ana River (SAR) water and the resultant impact on recharge, that Riverbed Filtration, which is a variation of Riverbank Filtration, was shown to be highly effective in removing total suspended

solids (TSS) and increasing recharge rates. As a result, in 2013, OCWD constructed a large-scale demonstration Riverbed Filtration System (RFS) in the Off-River Channel that covers approximately 10 acres and produces up to 20 cubic feet per second (cfs) of treated water using gravity flow. The treated water is conveyed to Olive Basin which had historically received untreated SAR water. Figure 1 shows the location of the demonstration RFS.

Figure 1: Location of Demonstration Riverbed Filtration System

Extensive data collection and testing of the RFS was conducted from 2015 to 2023. The scope of testing included measuring the capacity of the RFS using different types of subsurface collection-system materials, measuring the impact on recharge rates in Olive Basin, and measuring reductions in TSS concentrations and other water quality parameters. In summary, the RFS removed an average of 96 percent of the TSS in SAR water and more than doubled the recharge capacity of Olive Basin. The increased recharge capacity of Olive Basin is consistent with increases seen in other recharge basins receiving low TSS imported water and highly treated recycled water produced by the Groundwater Replenishment System. A final project report documenting the results of testing is attached.

The demonstration test results show that the RFS has the potential to increase recharge system capacity, particularly within the Terminal Recharge Basins, which is a series of eight shallow and deep recharge basins starting at Warner Basin and extending to Raymond Basin. These basins are particularly prone to clogging because suspended solids accumulate on the recharge surface in the placid waters of the basins.

Simulations conducted with OCWD's Recharge Facilities Model suggest that supplying the Terminal Recharge Basins with water from an expanded RFS could provide an average of 8,000 to 10,000 acre-feet per year of additional recharge of SAR water that would otherwise be lost to the ocean.

Given the significant potential for increased recharge and capturing water that would otherwise be lost to the ocean, staff is recommending that a feasibility be conducted to evaluate the appropriate size, location, and costs of a full-scale RFS. This would include an analysis of using gravity, pumping, or some combination to draw water out of the RFS and convey it to the Terminal Recharge Basins. With this information, a more detailed cost/benefit analysis can be conducted to assess the viability of further expanding the RFS.

This effort is part of OCWD's Resilience Plan Priority Project No. 11, Desilting Satna Ana River Flows.

Staff recommend issuing a Request for Proposals for the Riverbed Filtration System Feasibility Study.

PRIOR RELEVANT BOARD ACTION(S) N/A

2/19/25, R25-2-19 – Receive and File OCWD Resilience Plan and Authorize Filing of a Notice of Exemption

4/15/15, R15-4-46 - Ratify issuance of the following Change Orders 1-4 to Mike Bubalo Construction, Co.; Change Order 1 for $6,260; Change Order 2 for $3,836; Change Order 3 for $70,485; and Change Order 4 for a no cost time extension; and Accept completion of work and authorize filing of Notice of Completion for Contract No. SAR-2013-1, Riverbed Filtration Desilting Demonstration Project.

5/22/13, R13-5-55 – Receive and file Affidavit of Publication of Notice Inviting Bids for Contract No. SAR-2013-1: Riverbed Filtration Desilting Demonstration Project; and ratify issuance of Addendum No. 1; and accept lowest responsive bid of Mike Bubalo Construction Co.; and authorize execution of Agreement with Mike Bubalo Construction Co. for Contract No. SAR-2013-1: Riverbed Filtration Desilting Demonstration Project

3/20/13, R13-3-26 - Authorize issuance of Amendment No. 1 to Agreement No. 836 with RMC Water and Environment for an amount not to exceed $14,970 for an amended total of $73,762; and authorize publication of Notice Inviting Bids for Contract No. SAR-2013-1: Riverbed Filtration Desilting Demonstration Project

9/12/12, R12-9-00: Contract No. SAR-2010-2: Cloth Filter Desilting Demonstration Project – Notice of Completion (4-CON Engineers, Inc.).

5/16/12, R12-5-50 - Authorize execution of Agreement to RMC in the amount of $58,792 for design of the Riverbed Filtration Desilting Demonstration Project

3/21/12, M12-43 - Issue Request for Proposals for the design of the Riverbed Filtration component of the Desilting Demonstration Project

9/21/11, R11-9-139: Receive and file Affidavit of Publication of Notice Inviting Bids for Contract No. SAR-2010-2, Cloth Filter Desilting Demonstration Project, ratify issuance of Addendum Nos. 1 and 2, and accept bid, and accept withdrawal of SCW bid without penalty, and award contract to 4-Con Engineering, Inc. for an amount not to exceed $989,406; and Authorize issuance of Amendment No. 2 to Agreement No. 0679 with Mead & Hunt for design of the Cloth Filter Desilting Demonstration Project for an amount not to exceed $32,248 for an amended total of $76,803; and Authorize issuance of Agreement with Ninyo & Moore for geotechnical testing services during construction of the Cloth Filter Desilting Demonstration Project for an amount not to exceed $24,290; and Revise Cloth Filter Desilting Demonstration Project budget.

4/21/10, R10-4-61 - Authorize the Desilting Demonstration Project; authorize the project budget in the amount of $1,570,000; and Authorize issuance of the Request for Proposals for Design of Cloth Filter component of Desilting Demonstration Project

4/16/08, R08-4-64 - Issue Professional Services Agreement to HDR Engineering for an amount not to exceed $428,500 for preparation of a Feasibility Study on the removal of sediment from Santa Ana River water.

Riverbed Filtration System Demonstration Project Results

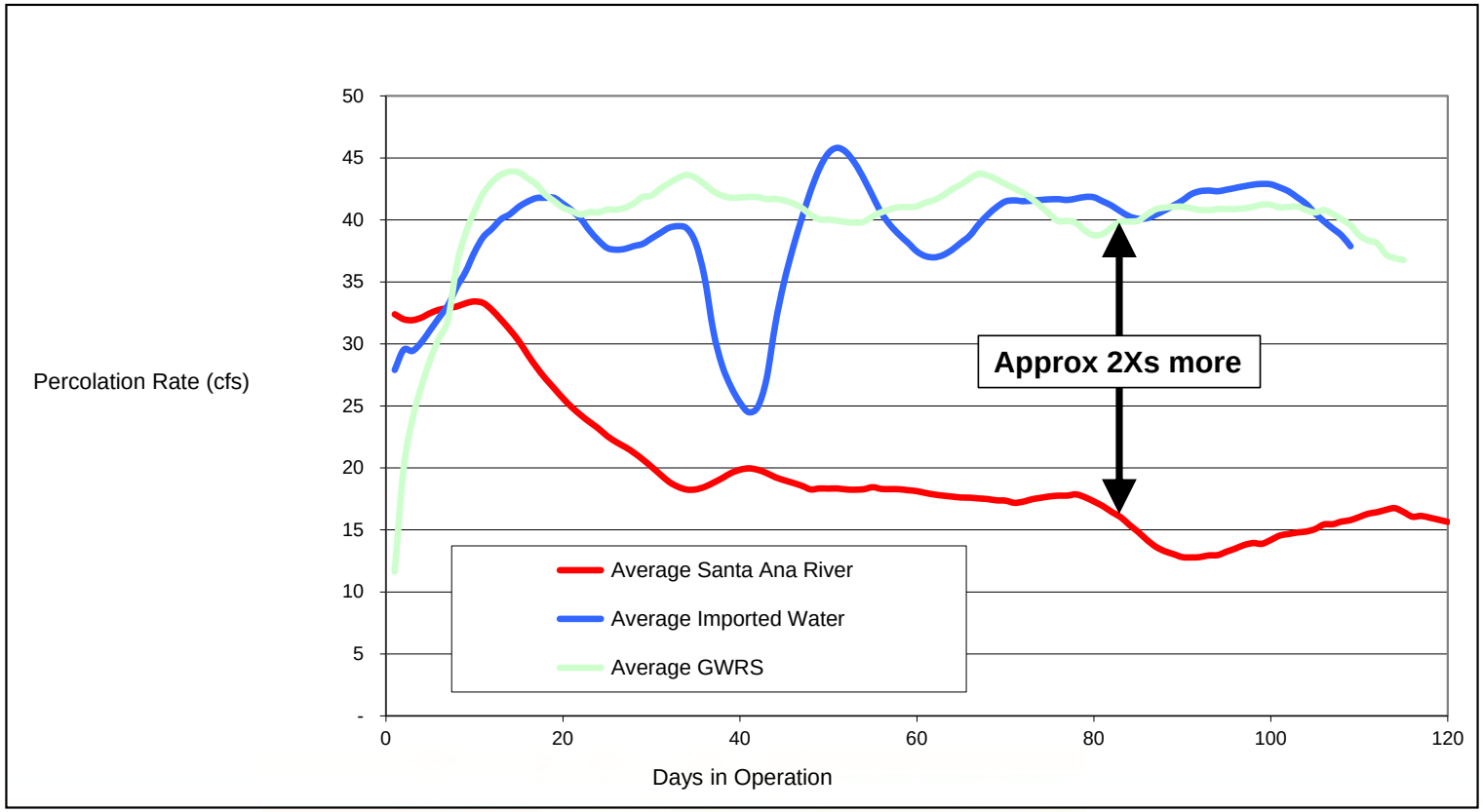
Adam Hutchinson
Recharge Planning Manager

May 14, 2025
Water Issues Committee

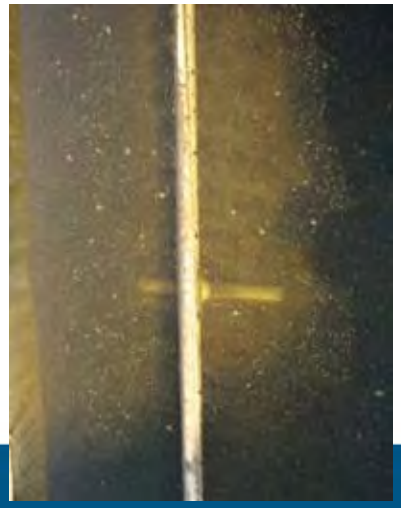
Why are we doing this?

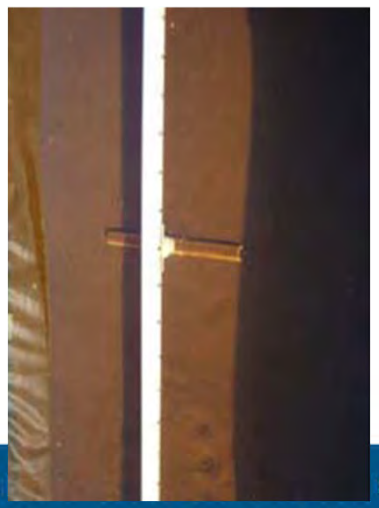
- All recharge facilities clog!
- Thousands of tons of sediment are annually captured by recharge system
  - 50,000 afy of storm flow at 200 mg/L = 13,000 tons/year
- Clogging is key constraint to maximizing surface recharge capacity
- Can we reduce clogging and increase recharge capacity?

Recharge of imported and GWRS water in Miller Basin provided a glimpse of what is possible with a cleaner water source.



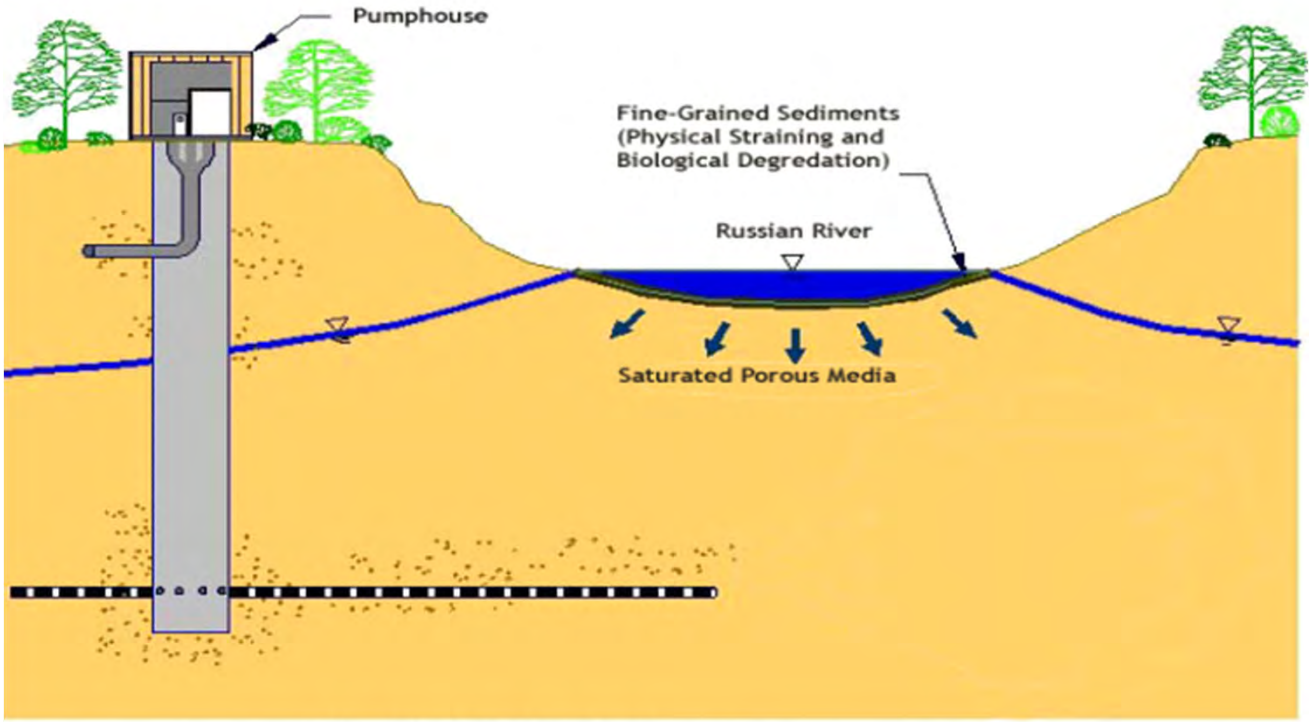
Recharge Water Sediment Removal Feasibility Study (2008)





The Riverbed Filtration System (RFS) is a series of collection pipes buried below the surface and is designed to remove TSS.

Riverbank Filtration (RBF) has been used for 100's of years to purify surface water prior to extraction.



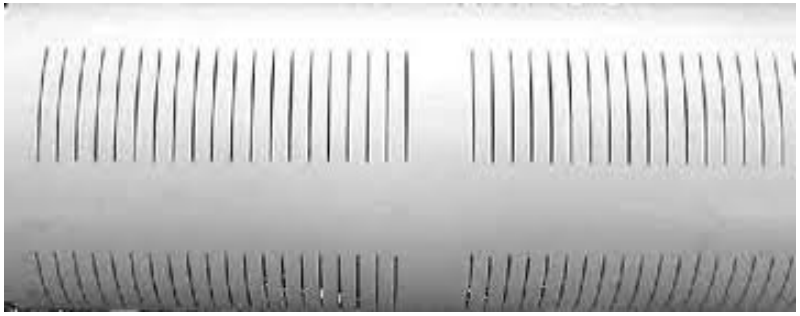
Natural Filtration Processes
Physical - Straining and Absorbtion
Chemical - Oxidation, Reduction, Ion Exchange and Absorbtion
Biological - Degredation

Courtesy of Sonoma Water

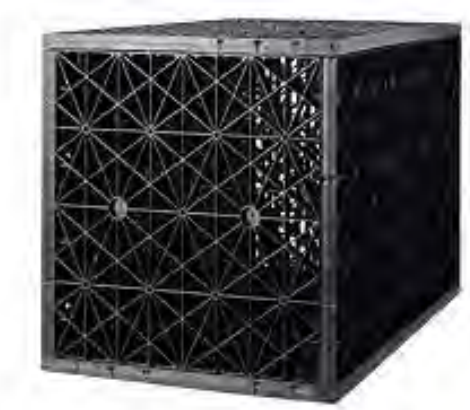
A demonstration scale RFS was constructed in the Off-River channel.

The RFS was constructed of two types of laterals to compare system performance.

- Perforated PVC pipe
- Installed within a gravel bed



- Rain Tanks (Collection Cells)
- Installed in native soil with filter fabric



The filtered water is conveyed to Olive Basin in a dedicated pipeline.

9-Years of Testing Completed

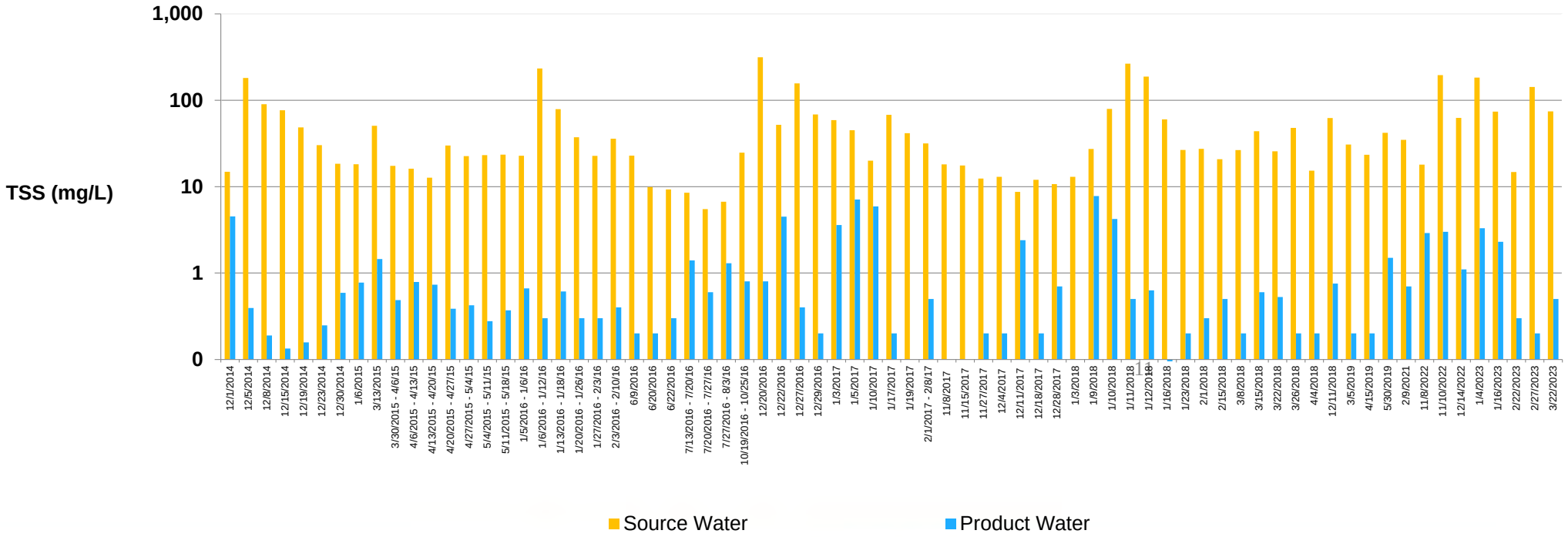
- March 2014 to 2023
- Comprehensive performance and water quality testing conducted

Building Test System in SAR Chanel

Opening a Collection Lateral

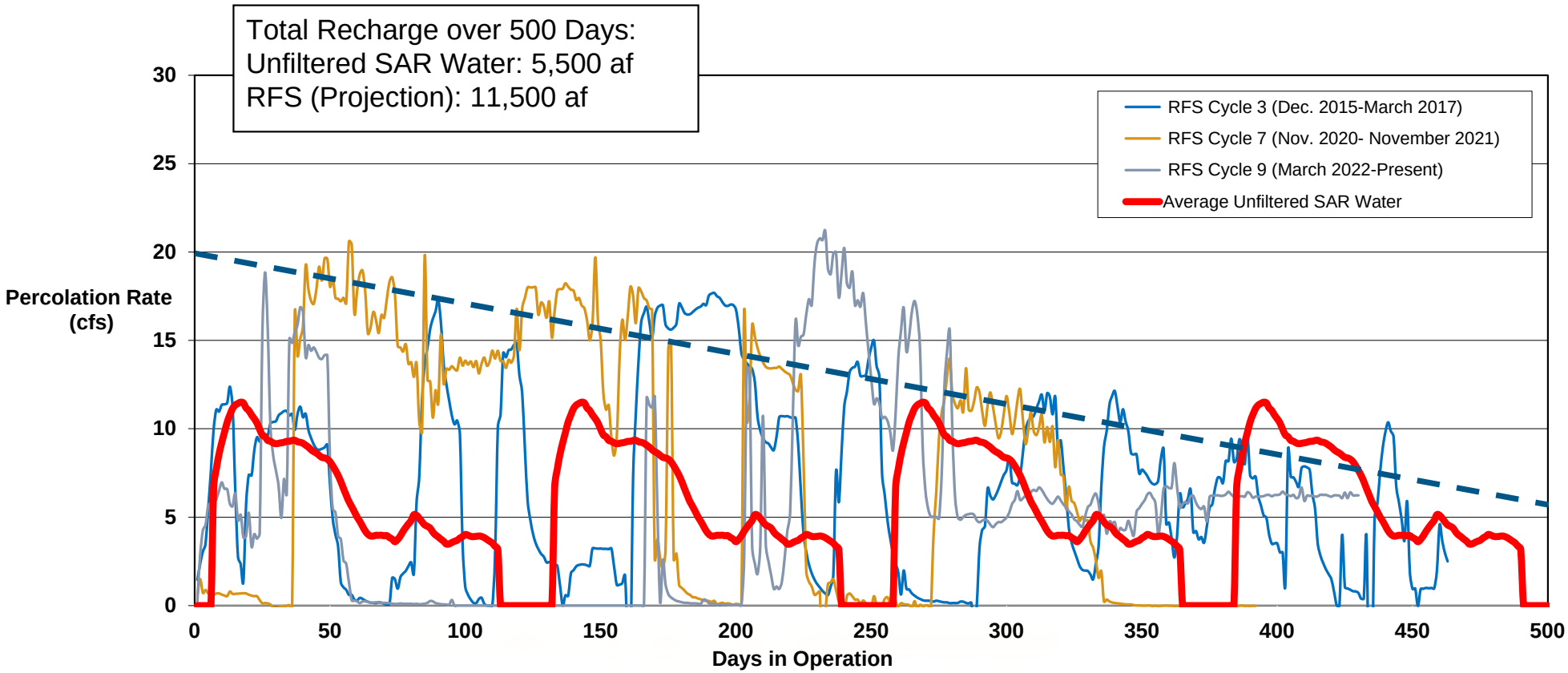
Pump used to obtain RFS samples from pipeline

The RFS removes an average of 96 percent of total suspended solids (TSS).



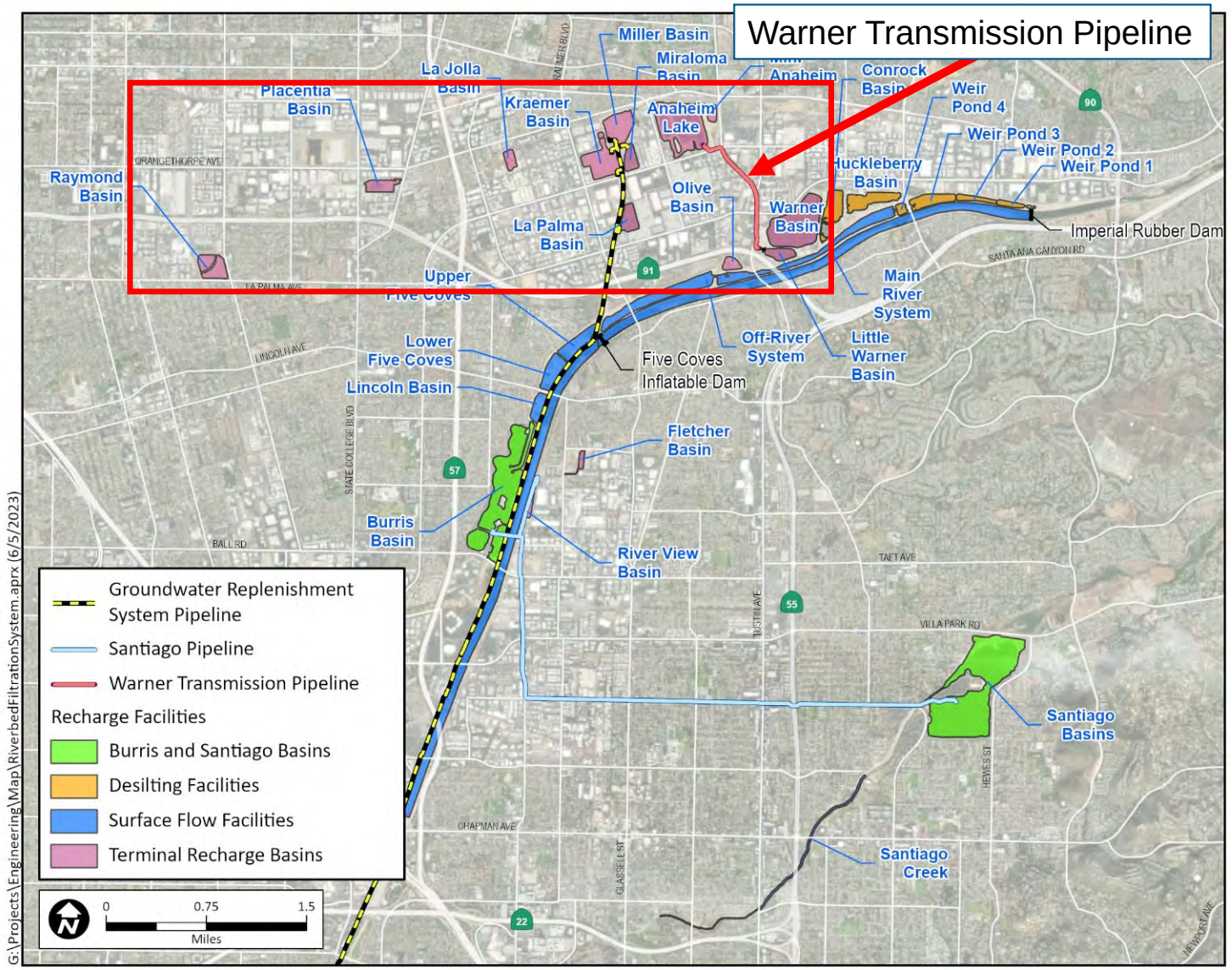
Note Log Scale on Y-axis.

RFS water is projected to double the recharge capacity of Olive Basin over unfiltered water.

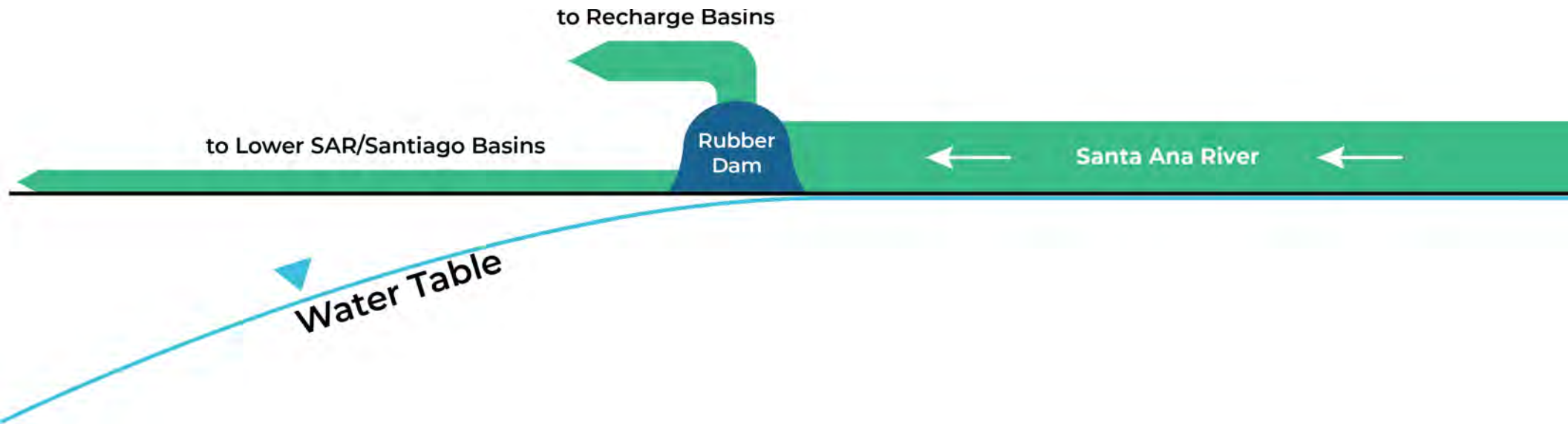


Where is the biggest bang for the buck?

- The Terminal Recharge Basins are most prone to clogging.
- These are basins where RFS water would provide greatest benefit.
- Warner Transmission Pipeline connecting Warner to Anaheim Lake is potential bottleneck.

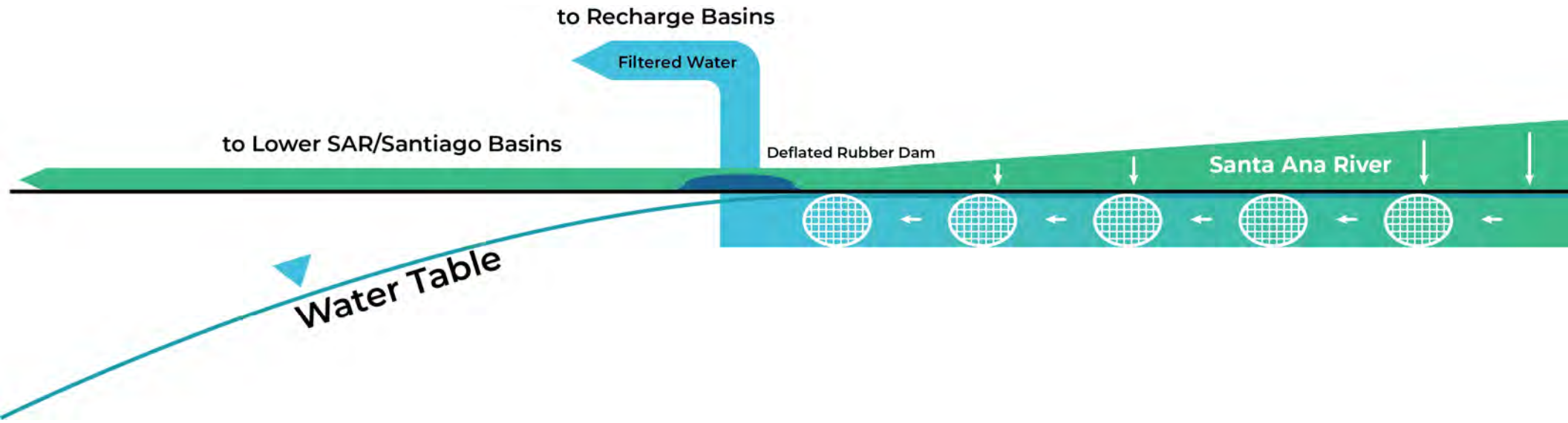


The Big Idea: Divert water from SAR using the RFS and not rubber dams.



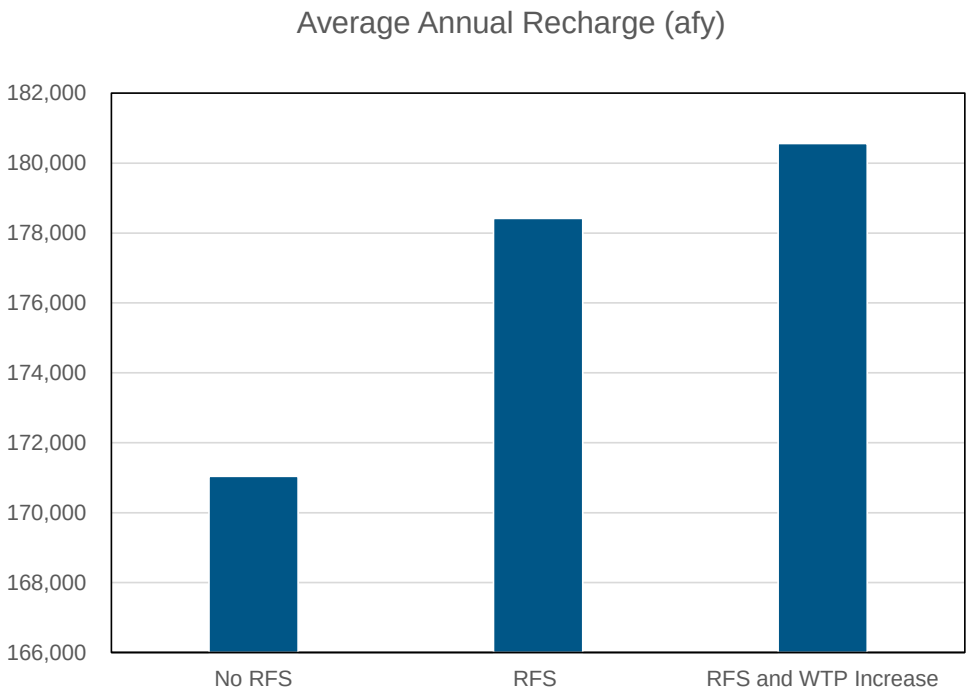
Schematic of Current Diversion Operations Using Rubber Dams

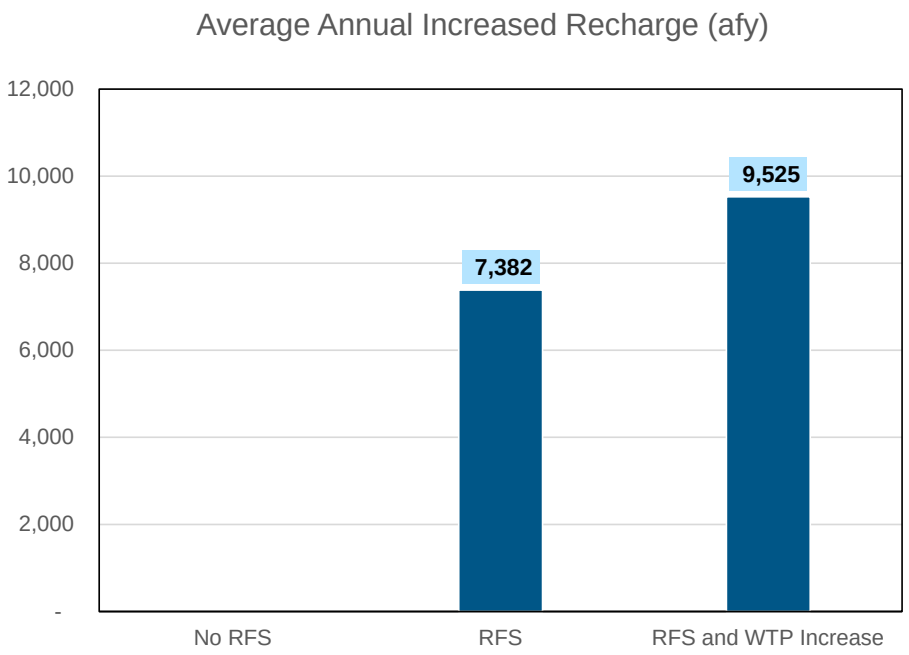
The Big Idea: Divert water from SAR using the RFS and not rubber dams.



Schematic of Potential Diversion Operations Using Riverbed Filtration System

The OCWD Recharge Facilities Model was used to evaluate potential increased recharge and reduced losses to the ocean.





Approx. 2,000 afy gained by increasing WTP Capacity

Turlock Irrigation District

- Subsurface collection system constructed to recapture environmental flows released from Don Pedro Dam
- Total Capacity: 100 cfs
- Constructed in 2001-03, $1M

The RFS provides multiple benefits.

- Increased recharge
  - Increases water supply and reduces water lost to the ocean
  - Filtered water can be mixed with GWRS or imported water without causing clogging
    - This will increase both stormwater and GWRS recharge during wet years
- Can divert water when rubber dams must be deflated (1,300 afy of additional recharge)
- Reduces number of basin cleanings required
  - Reduces costs and wear and tear on equipment

Next Steps

- Conduct Feasibility/Preliminary Design Study in FY25-26
  - Study potential design options
    - Location
    - Pump/Gravity options
    - Modifications to existing infrastructure (e.g., Warner Transmission Pipeline)
  - Review with US Army Corps of Engineers and Orange County Public Works
  - Develop range of costs
  - Evaluate costs/benefits

Recommendation

Agendize for the May 21 Board meeting: Authorize issuance of Request for Proposals for the Riverbed Filtration System Feasibility Study.

Questions?

Adam Hutchinson
(714) 378-3214
ahutchinson@ocwd.com
www.OCWD.com
@OCWaterDistrict
Orange County Water District
18700 Ward Street, Fountain Valley, CA 92708

Orange County Water District

RIVERBED FILTRATION SYSTEM

Demonstration Project Results and Recommendations

Prepared By:
Adam Hutchinson, PG, CHG, Recharge Planning Manager
Christine Pham, Senior Scientist

October 2024

Acknowledgments:

This project would not have been possible without the contributions of many dedicated staff at OCWD as well as outside experts. We would like to acknowledge the support of the following:

Grisel Rodriquez, Sr Scientist, OCWD (Retired)

Greg Woodside, OCWD, Now with San Bernardino Valley MWD

Sandy Scott Roberts, Engineer, OCWD, Now with Brown and Caldwell

Brendan Neel, Hydrogeologist, OCWD

Gary Yoshiba, Hydrogeologist, OCWD

Megan Plumlee, Research Director, OCWD

OCWD Recharge Operations Staff

Mike Milczarek, President, Geosystems Analysis (GSA)

Sections

Tables

Figures

Appendices

Acronyms and Abbreviations

Ac: acres

Afy: Acre-feet per year

AOC: Assimilable Organic Carbon

CEC: Constituents of Emerging Concern

Cfs: Cubic feet per second

DOC: Dissolved Organic Carbon

F: Fahrenheit

Ft: Feet

Ft msl: Feet mean sea level

GWRS: Groundwater Replenishment System

HDPE: High-Density Polyethylene

IAH: International Association of Hydrogeologist

In: Inches

Mi^2: Square miles

Mg/L: Milligrams per liter

MWD: Metropolitan Water District of Southern California

OCWD: Orange County Water District

PVC: Polyvinyl Chloride

RBF: Riverbank Filtration

RFS: Riverbed Filtration System

SAR: Santa Ana River

SAT: Soil Aquifer Treatment

Study: Recharge Water Sediment Removal Feasibility Study

TOC: Total Organic Carbon

TSS: Total Suspended Solids

TID: Turlock Irrigation District

USACE: United States Army Corps of Engineers

WCM: Water Control Manual

Executive Summary

Clogging due to the accumulation of suspended solids is a constraint that limits the capacity of the Orange County Water District's (OCWD) surface water recharge system. To decrease clogging and increase system capacity, OCWD conducted extensive pilot testing of multiple methods designed to remove suspended solids from Santa Ana River (SAR) water and the resultant impact on recharge. Based on these tests, Riverbed Filtration, which is a variation of Riverbank Filtration, was shown to be highly effective in removing total suspended solids (TSS) and increasing recharge rates. As a result, in 2013, OCWD constructed a large-scale demonstration Riverbed Filtration System (RFS) that covers approximately 10 acres and produces up to 20 cubic feet per second (cfs) of treated water using gravity flow. The treated water is conveyed to Olive Basin which had historically received untreated SAR water.

Extensive data collection and testing of the RFS was conducted from 2015 to 2023. The scope of testing included measuring the capacity of the RFS using different types of subsurface collection system materials, measuring the impact on recharge rates in Olive Basin, and measuring reductions in TSS concentrations and other water quality parameters. In summary, the RFS removed an average of 96 percent of the TSS in SAR water and more than doubled the recharge capacity of Olive Basin. The increased recharge capacity of Olive Basin is consistent with increases seen in other recharge basins receiving low TSS imported water and highly treated recycled water produced by the Groundwater Replenishment System.

The demonstration test results show that the RFS has the potential to increase recharge system capacity, particularly within the Terminal Recharge Basins, which is a series of eight shallow and deep recharge basins starting at Warner Basin and extending to Raymond Basin. These basins are particularly prone to clogging because suspended solids rapidly accumulate on the recharge surface in the placid waters of the basins. Simulations conducted with OCWD's Recharge Facilities Model suggest that an average of 8,000 to 10,000 acre-feet per year of additional SAR water could be captured and recharged that would otherwise be lost to the ocean.

Given the significant potential for increased recharge and capturing water that would otherwise be lost to the ocean, it is recommended that additional work be done to evaluate the appropriate size, location, and costs of a full-scale RFS in the SAR channel. This would include an analysis of using gravity, pumping, or some combination to draw water out of the RFS and convey it to the Terminal Recharge Basins.

1.0 Background

The Orange County Water District (OCWD) is a special governmental water agency that was created by the state of California in 1933 to manage the surface water and groundwater resources in northern and central Orange County. OCWD covers an area of approximately 350 square miles and serves a population of 2.5 million. Orange County is at the downstream end of the Santa Ana River watershed (Figure 1). The Mediterranean-type climate in Orange County is generally mild, with annual rainfall of approximately 14 inches, and average monthly temperatures ranging from 58 to 75°F. Most of the rainfall occurs from December through March. OCWD programs include aquifer replenishment or managed aquifer recharge (MAR), seawater intrusion control, water quality protection and improvement, water recycling, and stormwater conservation (OCWD, 2015; OCWD, 2017a).

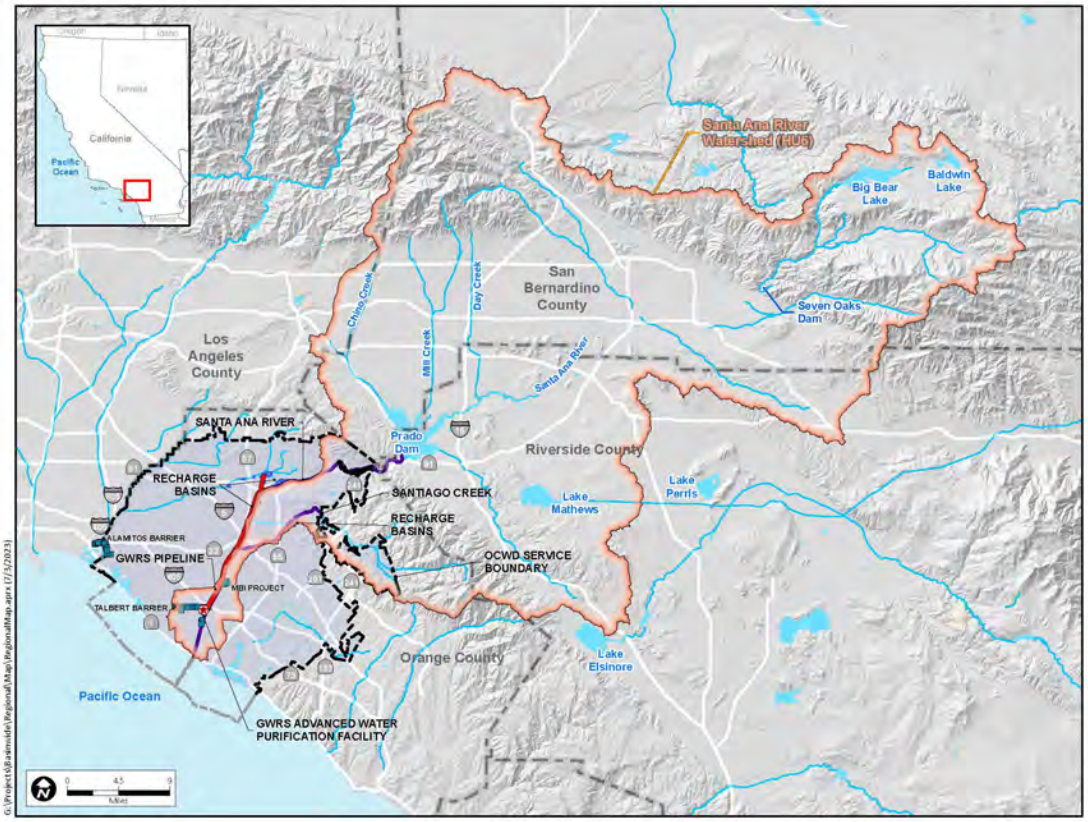


Figure 1: Santa Ana River Watershed

The key source of recharge water to the Orange County groundwater basin is the Santa Ana River (SAR), the longest coastal river in southern California. SAR flows are generally composed of treated wastewater discharged from upstream sewage treatment plants and seasonal storm flows. OCWD also recharges advanced treated (Reverse Osmosis and Advanced Oxidation) recycled wastewater from the Groundwater

Replenishment System (GWRS) and purchases imported water as an additional recharge source. Lastly, the groundwater basin receives unmeasured recharge from precipitation, subsurface inflow from surrounding foothills, and infiltration of irrigation water (OCWD, 2015).

The base flow of the SAR has declined in recent years from a high of 150,000 acre-feet in 2005 to approximately 65,000 to 70,000 acre-feet in recent years. Further declines in SAR base flow are expected due to increased wastewater recycling and conservation by agencies in the upper SAR watershed. As a result, stormwater represents an important source of local supply that should be captured and recharged to the maximum extent possible. Central to being able to capture large volumes of stormwater is Prado Dam, which is located upstream of OCWD's recharge facilities (See Figure 2).

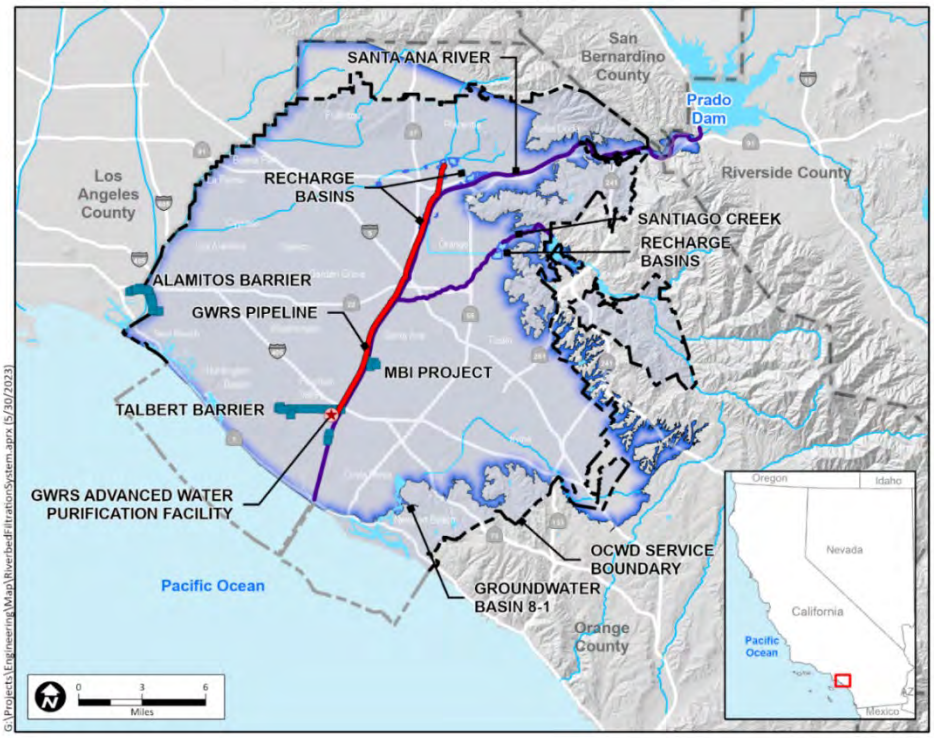


Figure 2: Location of Prado Dam and OCWD Recharge Facilities

Since the dam was originally constructed in 1941, OCWD and the US Army Corps of Engineers (USACE) have collaborated to utilize Prado Dam to increase the capture and recharge of stormwater to the OCWD groundwater basin. Over the years, the volume of stormwater that can be temporarily impounded behind Prado Dam in what is called the Water Conservation Pool has increased to the current elevation of 505 feet msl, which equates to approximately 20,000 acre-feet of storage. Captured stormwater is released slowly by the USACE at a rate that can be captured by OCWD recharge facilities downstream of Prado Dam.

Starting in 2017, OCWD has been working with the USACE and other stakeholders to evaluate using Forecast Informed Reservoir Operations (FIRO) to further increase the amount of stormwater that can be temporarily impounded behind Prado Dam without compromising the primary flood risk management purpose of the dam. FIRO is an innovative research and operations partnership that uses modern weather forecasting, runoff modeling, and watershed monitoring to help water managers selectively retain or release water from reservoirs that reflect current and forecasted conditions. FIRO's application of modern science and technology can optimize the use of limited water resources and represents a cost-effective option to adapt to extreme weather events unique to the U.S. West Coast. The ultimate goal of FIRO is to inform the update of USACE's Water Control Manual (WCM) for Prado Dam to allow flexible FIRO operations. The WCM is the official document that governs the operation of the reservoir, and modifying it requires various degrees of analysis and review, depending on the proposed changes.

The Final Viability Assessment of FIRO at Prado Dam was published in November 2023 (Prado FIRO Final Viability Assessment). This report found that FIRO is viable at Prado Dam and that 4,000 to 6,000 afy of additional stormwater could be captured on average depending on the final target elevation (510 ft or 512 ft, NGVD29).

While FIRO will increase the volume of water that can be captured in the Water Conservation Pool, there is still the problem of clogging of the recharge basins that receive this water. Clogging of OCWD's recharge facilities is caused primarily by suspended sediments in SAR water and to a lesser extent, by biological growth fueled by organic carbon and nutrients in the recharge water. Since suspended sediment concentrations are much higher in stormflow, clogging rates are much higher when recharging stormwater. So, to maximize the benefits of increased stormwater capture at Prado Dam, OCWD must find a way to minimize clogging of its recharge facilities. We know this is possible because recharge rates achieved when using water with little to no suspended sediment, such as imported water from the Metropolitan Water District of Southern California (MWD) and highly treated recycled water from OCWD's GWRS facility, are 2 to five times greater than what is achieved with SAR water.

Another driver for maximizing the recharge capacity of existing recharge facilities is the price of land. Land in Orange County is expensive. OCWD's most recent purchase of land in 2014 for a surface recharge facility cost $1.6M per acre. Moreover, the availability of land where recharge is most feasible is limited and in high demand.

This report documents the work OCWD has done to:

1) Study clogging mechanisms impacting OCWD's recharge basins and suspended solids loading from diverting and recharging Santa Ana River water;
2) Studying multiple methods to remove suspended solids from Santa Ana River water;
3) Testing Riverbed Filtration as a means to remove suspended solids from Santa Ana River water prior to recharge; and,
4) Evaluating the potential increased recharge if Riverbed Filtration were scaled up.

2.0 Clogging and Forebay Solids Monitoring Project

Dr. Herman Bouwer once wrote:

> *Clogging of the infiltration surface and resulting reductions in infiltration rates are the bane of all artificial recharge systems (Bouwer, 2002).*

In many cases, clogging is what limits the capacity of managed aquifer recharge (MAR) facilities. To maximize the capacity of MAR facilities, understanding clogging and developing successful mitigation strategies are critical.

Over time, all surface water spreading facilities will clog (Baveye et al., 1998; Bouwer et al., 2001; Bouwer and Rice, 2001; Bouwer, 2002; Schubert, 2004). Surface waters used for recharge often contain significant quantities of suspended sediments and microorganisms, which lead to clogging (Behnke, 1969; Bouwer and Rice, 1989). It must be noted that the clogging seen in spreading basins is different than in rivers and stream channels due to the self-cleaning potential of rivers and stream channels, which can reduce clogging depending on the timing and magnitude of runoff events (Lacher, 1996; Schubert, 2004; Rehg et al., 2005). For more information on clogging, see the clogging monographs published by the International Association of Hydrogeologists (IAH) at https://recharge.iah.org. The IAH clogging monograph includes a case study of OCWD's recharge system.

Clogging can be caused by physical, biological, and chemical processes. Each of these processes can work individually or collectively to reduce infiltration rates. Factors that influence the development and extent of a clogging layer include effluent water quality, basin soil texture, ponding depth, hydraulic loading rate and cycle, and vegetation.

As shown in Figure 3, the OCWD surface water recharge facilities have been grouped into different systems. With respect to clogging, these systems behave differently and can be placed into four categories:

1. Burris and Santiago Basins
2. Desilting Facilities
3. Surface Flow Facilities
4. Terminal Recharge Basins

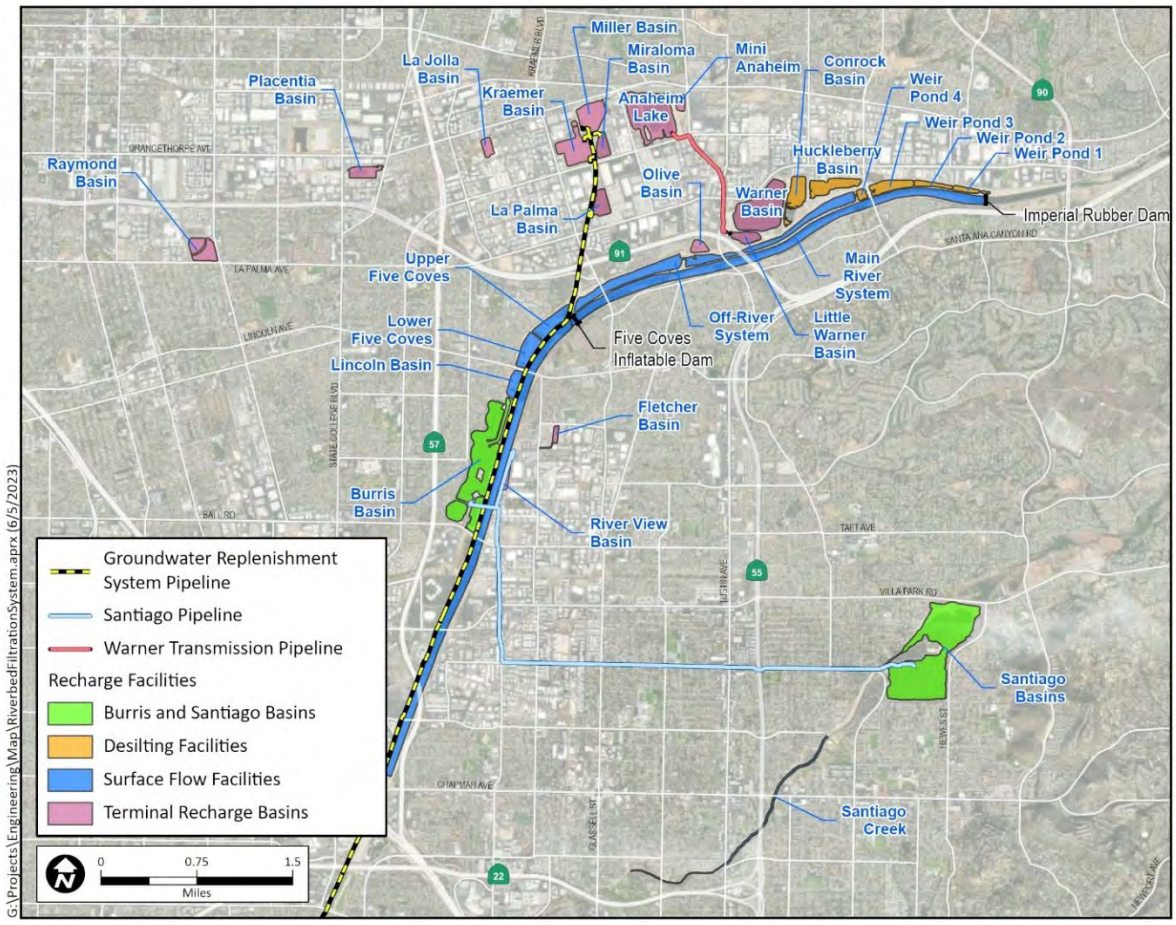


Figure 3: OCWD Surface Water Recharge Facilities

For Burris and Santiago Basins, recharge rates are mainly a function of water level elevation. The Santiago Basins are former gravel pits with nearly vertical side walls of very coarse sediments. As a result, the recharge capacity of Santiago Basins is mainly a function of the water level in the basin, with increasing percolation rates as the water level increases. While clogging may be occurring, it appears that the annual draining process largely restores the basin's recharge capacity.

The Desilting Facilities (Weir Ponds 1, 2, 3, and 4) are located immediately downstream of Imperial Rubber Dam. These facilities are primarily used to remove the heavier sediment load from water diverted off the SAR and contribute little to no recharge to the basin.

Clogging is not a significant issue in the Surface Flow Facilities, which include the SAR Channel, Off-River Channel, and Santiago Creek, because these facilities receive a supply of constantly moving water. Clogging still occurs at a low rate and is remedied by using heavy equipment to disturb the clogging layer while water is flowing through the facility.

Where clogging has the greatest impact on recharge capacity is in the Terminal Recharge Basins, that is, basins where water is pooled for recharge purposes, where the relatively calm conditions within the basins allow suspended sediments in the source water to settle out and clog the basin surface. The largest capacity terminal basins that receive SAR water are within the Warner System and Upper Recharge System and include the following basins: Warner Basin, Anaheim Lake, Miller Basin, and Kraemer Basin. Smaller terminal basins in these systems include Mini-Anaheim Lake, La Jolla Basin, Placentia Basin, and Raymond Basin. Figure 3 shows the location of the Terminal Recharge Basins.

Maximum percolation rates in the terminal basins are achieved immediately after they are drained, dried, and cleaned. OCWD operations staff will target cleaning the basins once the percolation capacity has declined by 60 percent or more; however, many factors affect when the basins can be cleaned and thus percolation rates may decline lower than the target rate before they can be cleaned. Table 1 lists the maximum storage capacity, maximum percolation rate, and target percolation rate for cleaning the Terminal Recharge Basins.

Table 1: Storage, Maximum Percolation Rate, and Target Percolation Rate for Cleaning: Terminal Recharge Basins*

Basin	Max Storage (af)	Maximum Percolation Rate (cfs)	Target Percolation Rate for Cleaning (cfs)
Warner Basin	2,620	70	20
Anaheim Lake	2,260	100	40
Mini-Anaheim Lake	13	20	8
Miller Basin**	300	45	18
Kraemer Basin	1,170	120	45
La Jolla Basin	26	30	10
Placentia Basin**	350	10	4
Raymond Basin**	370	10	4
Total	**7,109**	**405**	**149**

*Olive Basin is not included because it utilizes the Demonstration Scale Riverbed Filtration System as a permanent feature.
**These basins are owned by the Orange County Flood Control District and can be affected by flood control operations.

An example of how clogging affects the terminal recharge basins is the performance of Miller Basin using three different sources of water. Figure 4 shows the weekly moving average percolation rate with SAR water, imported water from MWD, and GWRS water. The average SAR rate is from eight recharge cycles spanning 2004-08. Imported water percolation rates are from two cycles in 2006-07. GWRS percolation rates are from four cycles from 2008-10. The variability in recharge rate with imported water is not due to changes in basin percolation capacity but supply constraints. Figure 4 shows that SAR percolation rates decline exponentially while the percolation rate with imported and GWRS water remains very stable over the period shown. Over 90 days, the total recharge achieved with imported and GWRS water is **double** that achieved with SAR water.

This behavior is confirmed with more recent data from Miraloma and La Palma Basins, which are dedicated to the recharge of GWRS water. Percolation rates in these basins remain very stable for as much as a year or longer before cleaning is needed.

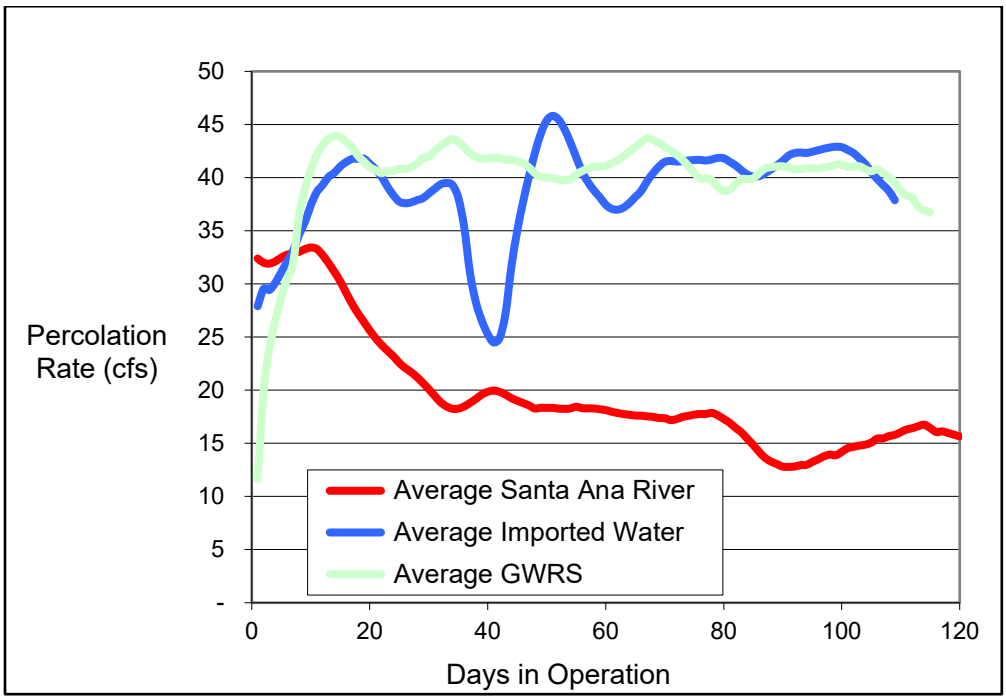


Figure 4: Weekly Moving Average Percolation Rates in Miller Basin with SAR, Imported, and GWRS Water

The performance of Miller Basin with different sources of water has been replicated in other terminal basins. These observations reveal that clogging significantly limits the capacity of these terminal basins. However, there exists substantial potential to enhance recharge capacity if cost-effective measures can be implemented to mitigate clogging caused by suspended solids in SAR water.

To better understand the clogging potential of SAR water and how it changes within the recharge system, a multi-year Forebay Solids Monitoring Project (2007-2016) was implemented to quantify the transport of total suspended solids (TSS) and to attempt to determine their overall impact on clogging over an extended period encompassing seasonal variations in TSS quantity and quality (OCWD, 2017b). This study improved OCWD's understanding of the spatial and temporal distribution of the TSS in the SAR and OCWD's recharge system. TSS data collected at the Imperial Rubber Dam (also called Imperial Highway), Wier Pond 4, and Little Warner Basin outlet represents the source of SAR supply to the Terminal Recharge Basins (see Figure 3).

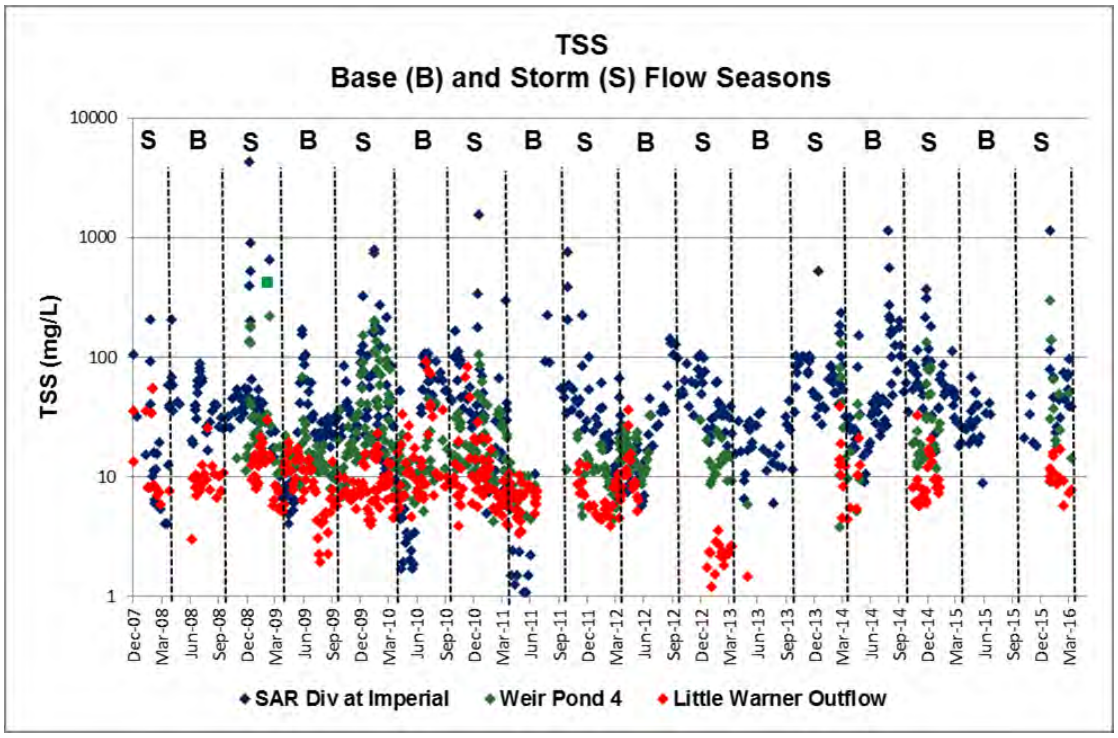


Figure 5: Raw TSS Concentrations for Imperial Dam (blue), Weir Pond 4 (green), and Little Warner Outflow (red)

As shown in Figure 5, TSS concentrations are highest during the storm flow season (Oct-March) and lower during the Base flow season (April-Sept) with TSS concentrations declining, primarily due to gravity settling, as diverted water moves through the recharge system. During the study period, the maximum SAR TSS concentration of 4,250 mg/L was measured on December 8, 2008.

The TSS data was averaged with respect to the base flow and storm flow seasons (Figure 6). Storm flow season TSS entering the desilting system from the SAR was, as anticipated, significantly greater (by 43 mg/L, on average); however, following passage through the Desilting System and Warner Basin, the average TSS output to the downstream terminal recharge basins via Little Warner Outflow was reduced.

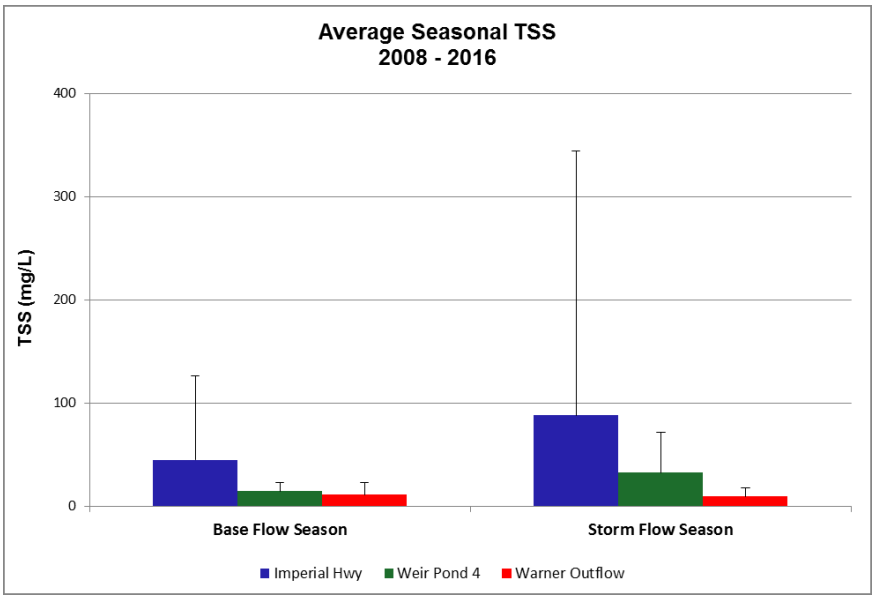


Figure 6: Average TSS for Base Flow Season (from April 1 to September 30) and Storm Flow Season (from October 1 to March 31) at Imperial Highway, Weir Pond 4 and Warner Outflow

The Forebay Solids Monitoring Study showed that there is a substantially higher TSS load during the storm season and that, despite the effectiveness of the Desilting System and Warner Basin in reducing TSS concentrations (Figure 7), clogging of terminal recharge basins using SAR water still represents a significant constraint to maximizing basin recharge capacity as demonstrated by clogging trends presented in Figure 4.

The potential benefits of reducing TSS concentrations in recharged water were verified through an OCWD Clogging Study at the Field Research Lab (FRL). In this study, both laboratory and field data were used to develop a relatively simple mathematical model capable of describing basin percolation kinetics. Laboratory data was obtained using column studies. The columns, shown in Figure 8, were filled with clean, native sediment from one of OCWD's recharge basins and then supplied with water with mixtures of locally derived suspended solids (also called foulants) to create water with a range of known TSS concentrations. The TSS deposited at the sediment/water interface was estimated as a function of time by the product of the TSS concentration and the total volume of water percolated through the column. A log-decay expression was fitted to this data using the method of Marquardt nonlinear regression (Statgraphics, Centurion XV, Statpoint Incorporated, Herndon, VA).

Figure 7: False-Color Overlay Image of Sediment Load and Removal in Warner System*

*False-color overlay depicting sediment load and removal in the Upper Desilting System based on the March 7, 2011, image. To produce the false color map, ImagePro was used to extract the red channel as a monochrome image, and a relative false color scale was produced in which the portion of the Weir Pond system visually corresponding to the heaviest sediment loading in the original image was set to red, and the portion of Warner Basin corresponding visually to the least sediment loading was set to blue. Following a rendering of this false-color image, the features corresponding to the Upper Desilting System were extracted and pasted back into the original image again.

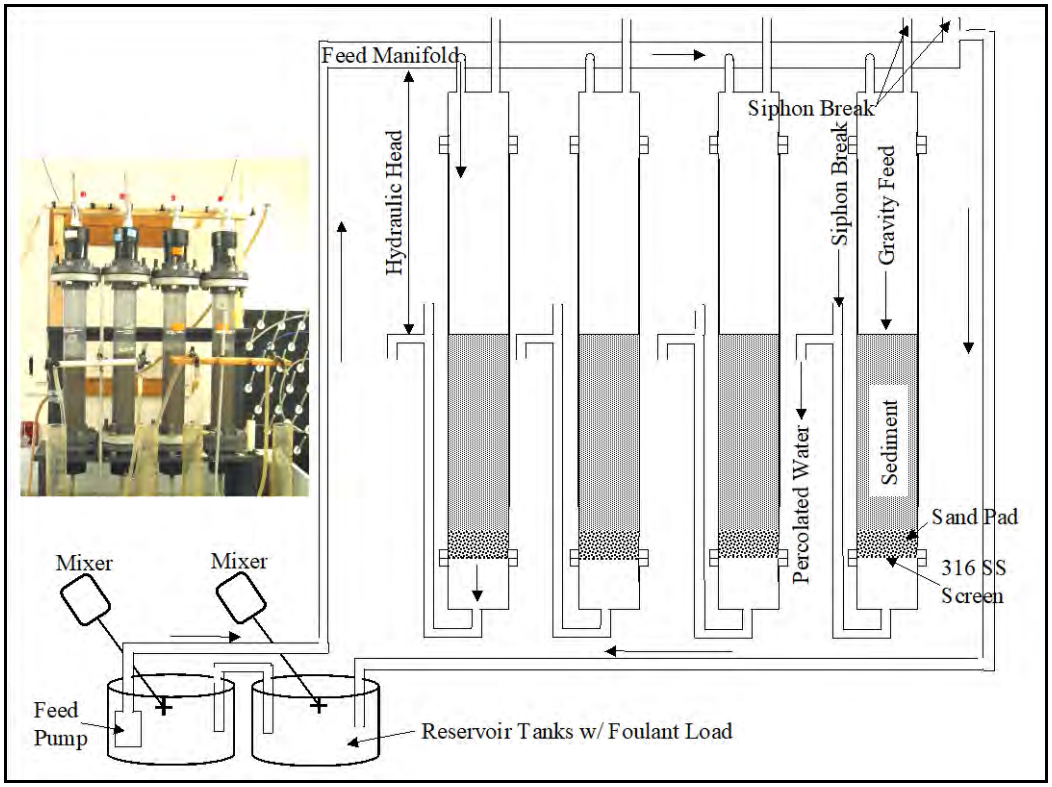


Figure 8: Sediment Column Schematic

This log-decay expression was then applied to percolation data obtained in Kraemer Basin for SAR water for three cycles, from 1997-98, 2004-05, and 2005. The results of this analysis are shown in Figure 9. The model was able to describe the overall kinetics of percolation decay quite well, suggesting a general similarity between the behavior of the laboratory sediment columns and the basin. The average foulant concentration predicted by this model was 8.20 mg/L, which is in line with the TSS data measured at the Little Warner Outflow in the Forebay Solids Monitoring Study (Figure 6). The model was also able to predict the clogging behavior of Kraemer Basin using low TSS imported water. This model suggests that initial percolation rate, TSS concentration (aka foulant loading), and the interaction between TSS and sediment at or near the sediment/water interface can describe the decay (aka clogging) of percolation over time. Simulating the performance of a recharge basin indicates that the reduction of overall TSS concentration loading is perhaps the most effective method of improving recharge basin efficiency (Phipps, Lyon, and Hutchinson, 2007).

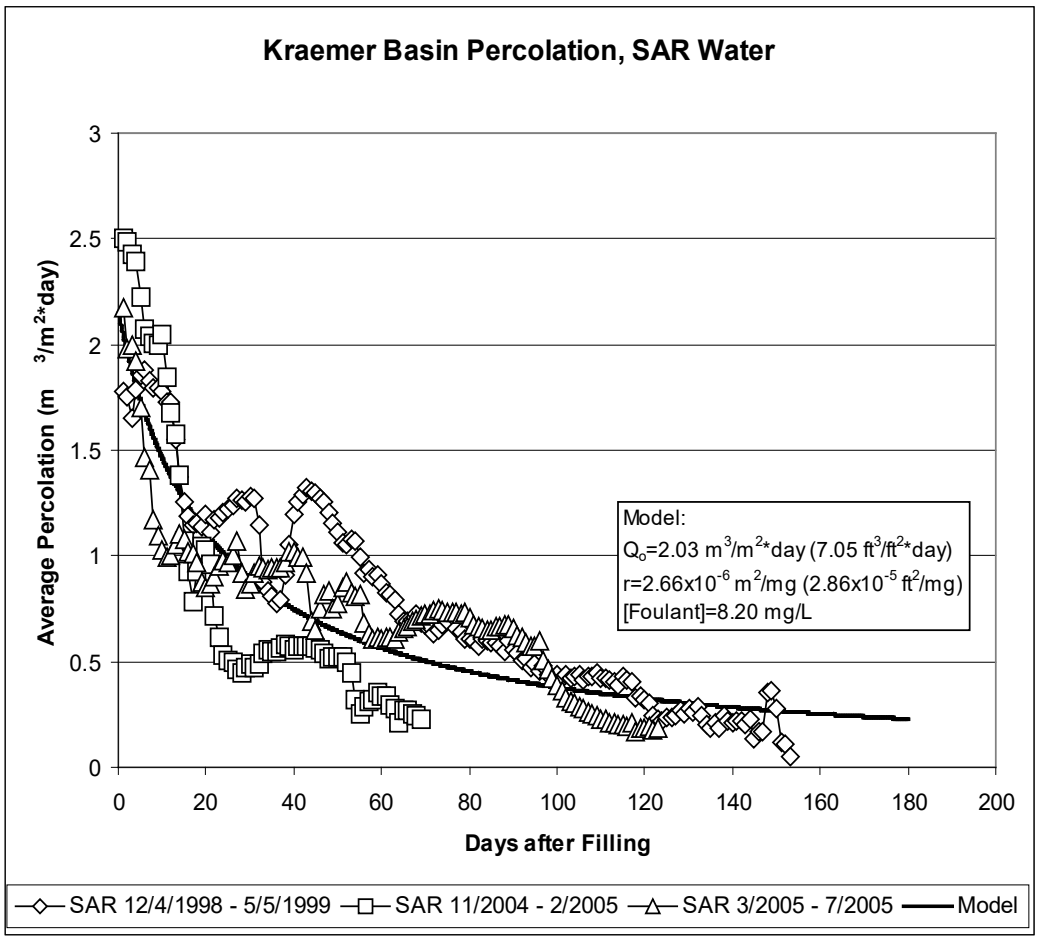


Figure 9: Modeling Kraemer Basin Percolation Decay with SAR water

Finally, it must be noted that percolation decay equations were developed for many of the basins, including the terminal basins, and incorporated into OCWD's Recharge Facilities Model (RFM) (OCWD, 2009). Incorporating these decay equations in the RFM was crucial in being able to calibrate the model to historical data. As a result, the RFM has become a valuable planning tool in evaluating the recharge impacts of various projects, such as constructing additional recharge facilities or changes in the availability of SAR flows.

For this report, the RFM will be a key tool to evaluate the potential additional recharge that could be achieved by reducing TSS concentrations in SAR water.

3.0 Recharge Water Sediment Removal Study

Recognizing that TSS was a constraint in maximizing OCWD's capacity to recharge SAR water, particularly stormwater, OCWD embarked on a multi-phased Recharge Water Sediment Removal Feasibility Study (Study) in 2008 to evaluate the feasibility of removing sediment from SAR water.

The Study included three phases:

Phase 1
- Evaluate existing recharge operations and water quality data
- Establish preliminary goals and objectives
- Review treatment technologies

Phase 2
- Conduct testing of selected treatment technologies using small-scale units at OCWD's Field Research Lab

Phase 3
- Conceptual design
- Prepare a Feasibility Study report

Based on Phase 1 findings, Phase 2 included small-scale testing of five different treatment technologies, including:

- Flocculation-Sedimentation (Floc-Sed)
- Dissolved Air Floatation (DAF)
- Ballasted Sedimentation (Actiflo)
- Cloth Filtration (with and without chemical pre-treatment)
- Riverbed Filtration (Passive, RFS)

Raw, untreated SAR water served as the control.

Multiple evaluation methods were used to assess the performance of these methods, including:

- Turbidity and TSS
- Laboratory percolation columns
- Percolation test cells
- Modified fouling index (MFI) (Schippers and Verdouw, 1980)
- Particle size distribution

Figure 10 is a picture of the percolation test cells being supplied with water treated using different technologies.

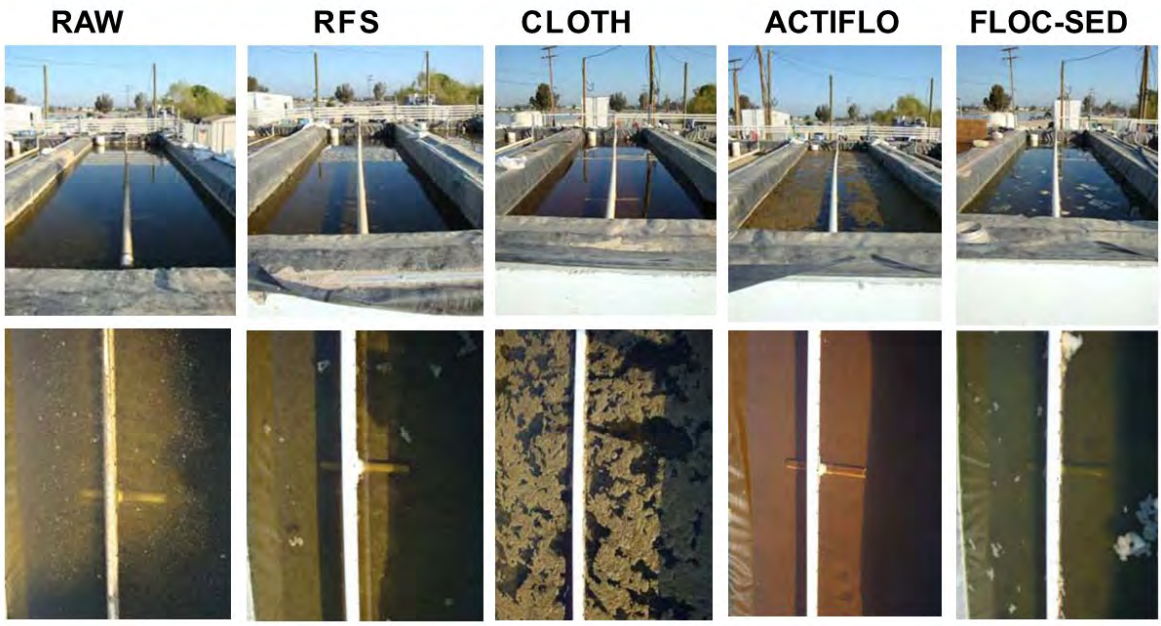


Figure 10: Percolation Test Cells Being Supplied with SAR Water Treated Using Different Technologies. Raw water is untreated SAR water (control).

Phase 2 testing showed that Riverbed Filtration System (RBS) was the superior treatment method with flocculation-sedimentation being the worst (OCWD, 2010). One of the unexpected outcomes of the Study was that any treatment method that used chemical additions, such as flocculants and polymers, while able to produce low turbidity water, resulted in elevated rates of clogging. It is suspected that residual flocculants or polymers remaining in the recharge water interacted with fine-grained sediments (silts and clays) within the native sand to cause clogging.

Following completion of the Study, Demonstration Scale testing of Cloth Filtration, using no pre-treatment chemicals, and RFS was conducted. Testing of Cloth Filtration was conducted from 2012 -16 and showed that this method of treatment can only handle water with a relatively limited range of TSS concentrations (10-30 mg/L) and, even with treatment, it was not possible to measure improvements in recharge rates. Due to these limitations, it was determined that the opportunities to deploy Cloth Filtration in other parts of the recharge system were limited. A summary of Cloth Filtration testing is summarized in Appendix A.

4.0 Riverbed Filtration

The Riverbed Filtration System (RFS) is a variant of Riverbank Filtration (RBF). Riverbank Filtration is used to withdraw water through a riverbank or under a river channel or lake by placing a production well adjacent to the surface water body. RBF has been used for many years to acquire surface water. European water suppliers have been using this technology in conjunction with conventional treatment methods for over a century due to its relatively inexpensive and sustainable means of improving the quality of surface waters (Hiscock and Grischeck, 2002). In contrast, the use of RBF in the United States began less than 50 years ago (Ray et al., 2002). RBF provides passive exposure to processes such as adsorption, oxidation/reduction reactions, and physical-chemical filtration and also provides biodegradation and dilution that can significantly improve water quality (Weiss et al., 2003). Through these mechanisms, RBF changes surface water into water with characteristics close to that of groundwater (Kuehn and Mueller, 2000; Speth et al., 2002; USBR, 2006).

While RBF seeks to obtain significantly improved water quality for water to be used for potable purposes, the RFS studied by OCWD seeks primarily to remove suspended solids to minimize clogging and thus enhance the performance of groundwater recharge facilities. The RFS provides other water quality improvements, but these are secondary to removing TSS from the recharge water.

4.1 Riverbed Filtration System Pilot Testing

As part of Phase 2 of the Study, a pilot-scale RFS was constructed in the upper portion of OCWD's Off-River channel as shown in Figure 11. The Off-River channel was formerly part of the main SAR channel until the Center Levee was constructed in 1972. This is an ideal location to study the RFS because the geology is similar to the SAR channel and OCWD controls the flow in the Off-River channel.

The pilot system was constructed of eight 8-inch diameter slotted PVC laterals that are 180 feet long, buried approximately 3 to 4 feet below the channel surface (red lines on Figure 11) (Milczarek et al., 2010; Keller et al., 2010). A ten-foot blank section connected the slotted sections to the 14-inch diameter collector pipe (yellow line in Figure 11). A collection vault was positioned in the center with four laterals on each side. Pumps were installed in the vault to provide a hydraulic low point to induce water to flow through the laterals and to extract water from the system. An extensive monitoring well network was installed to monitor levels and temperatures of surface water and groundwater (wells with prefix P and MW in Figure 11). Figure 12 is a photograph showing the construction of the Pilot RFS.

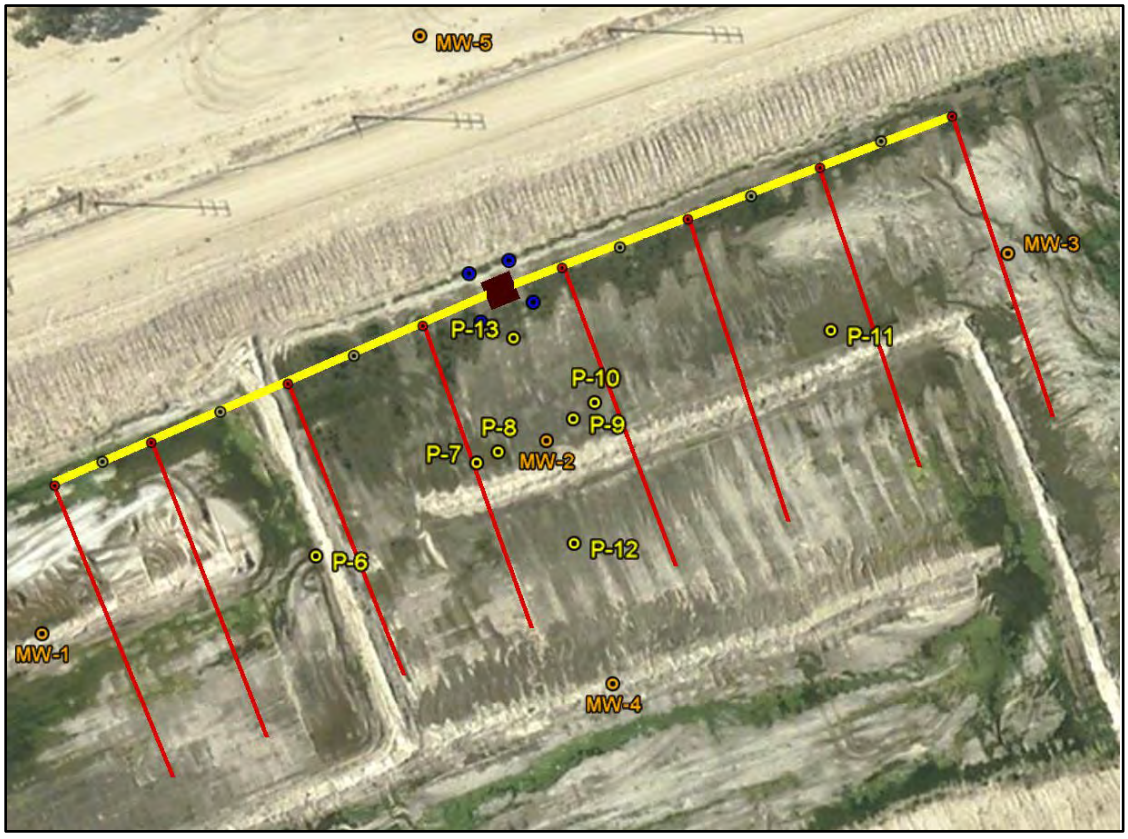


Figure 11: Pilot Riverbed Filtration System

Figure 12: Construction of the Pilot Riverbed Filtration System

The pilot system produced 3 to 4.5 cubic feet per second (cfs), which was lower than expected due to unsaturated conditions in the area of the four upstream laterals. Water level and temperature data were used to evaluate the amount of surface water immediately above the laterals that flowed vertically to the laterals versus lateral flow from previously recharged water. This work showed that approximately 80 percent of the water produced by the system was induced surface water flow to the laterals with the other 20 percent previously recharged water (GeoSystems Analysis, 2009).

The quality of the water produced by the pilot system was excellent with no detectable suspended solids in the water (OCWD, 2010). This resulted in high, sustained percolation rates compared to the control, which was untreated SAR water (see Section 3.0).

4.2 Riverbed Filtration System Demonstration Project

The RFS Demonstration Project was constructed in 2013 using the uppermost section of the pilot system and expanding the system downstream as shown in Figures 13 and 14.

The RFS Demonstration Project was constructed with two types of collectors:

- Slotted PVC pipe
- Flo-Tanks (aka Rain Tanks)

The Flo-Tanks were added as a collector type to assess any potential differences in performance, costs, and future maintenance, particularly if there was a need to repair collectors that could be damaged in a full-scale system by scour in the main SAR channel.

All the collectors were placed a minimum of 3 feet below the ground surface and ranged in length from 180 – 200 feet. The slotted PVC pipes are 8 inches in diameter and buried in a gravel mixture. Native material was then placed on top of the gravel to the ground surface. The Atlantis Flo-Tank® (Atlantis Corporation, Australia) modules were placed end to end and wrapped in geotextile fabric. Once buried, native material was placed around and above the tanks on the ground surface. Each Flo-Tank module is 17.7 inches high, 16 inches wide, and 27 inches long. Figure 15 is a photo of one module. The RFS footprint covers approximately 10 acres.

Each set of slotted PVC or Flo-Tank collectors, other than the four pilot study collectors, drained to a manifold that could be controlled by a single valve. This allowed for testing various combinations of collector types and orientations as one set of collectors was constructed parallel to the flow in the Off-River channel and the others perpendicular to the flow (see Figure 14). All of the collectors drained to a main 36-inch HPDE carrier pipeline that conveyed the filtered water to Olive Basin. A SonTek IQ flowmeter (https://www.ysi.com/sontek-iq-series) was installed near the end of the carrier pipeline to measure flows into Olive Basin.

Figure 13: Location and Layout of the Riverbed Filtration System (RFS) Demonstration Project

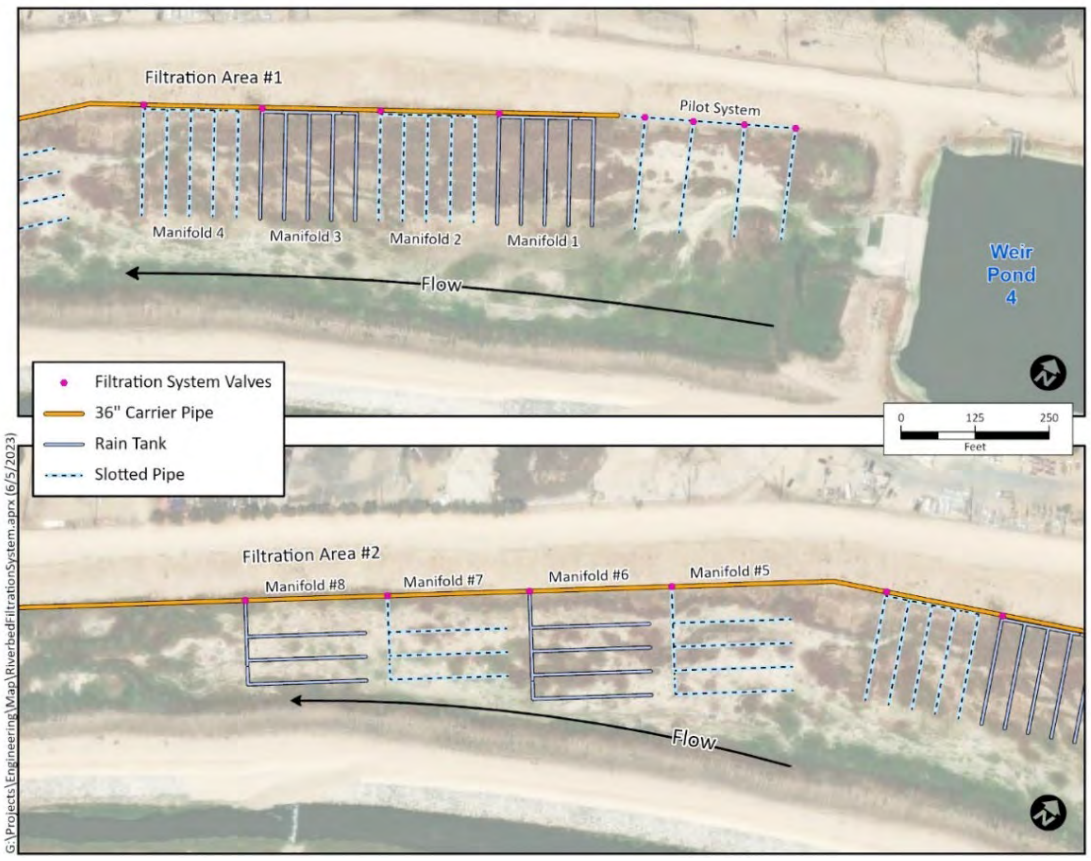


Figure 14: Location RFS Demonstration Project Manifolds

Figure 15: Atlantis Flo-Tank Module

The target capacity was 15 cfs, which is based on a percolation rate of 3 feet/day over the approximate 10-acre RFS area.

The RFS was put into operation in March 2014. There were several issues with the flowmeter that prevented obtaining recharge rate measurements until the flowmeter was replaced in 2015. So, although the basin was used for recharge, inflow data is only available starting in March 2015.

4.2.1 Olive Basin

The receiving recharge basin, Olive Basin, is a former sand and gravel borrow pit that was purchased by OCWD in 1972 (see Figure 13). When full, the basin has a wetted area of 5.8 acres and a maximum depth of 40 feet. Historically, surface water from the SAR was diverted to the basin for recharge. In 2008, a project to relocate the inflow pipeline from mid-way up the basin bank to the basin bottom was completed. This was done to reduce the amount of erosion that took place when the basin was filled. This project alone greatly increased the recharge capacity of the basin. Starting in March 2015, only filtered SAR water from the RFS water was supplied to the basin. A comparison of historical recharge performance using unfiltered SAR water and RFS water provides a measure of the increased recharge due to the RFS.

To characterize the recharge and water quality impacts of the RFS, two groundwater monitoring wells were installed adjacent to Olive Basin, AM-51 and AM-51A. Well AM-51 is screened in the deeper principal aquifer while AM-51A is shallow and was designed to intercept water recharged at Olive Basin. When groundwater basin levels are low, AM-51A only receives water recently recharged at Olive Basin, however, when groundwater basin levels are high, deeper groundwater levels rise to levels higher than the bottom of Olive Basin. Figure 16 shows how the wells were constructed.

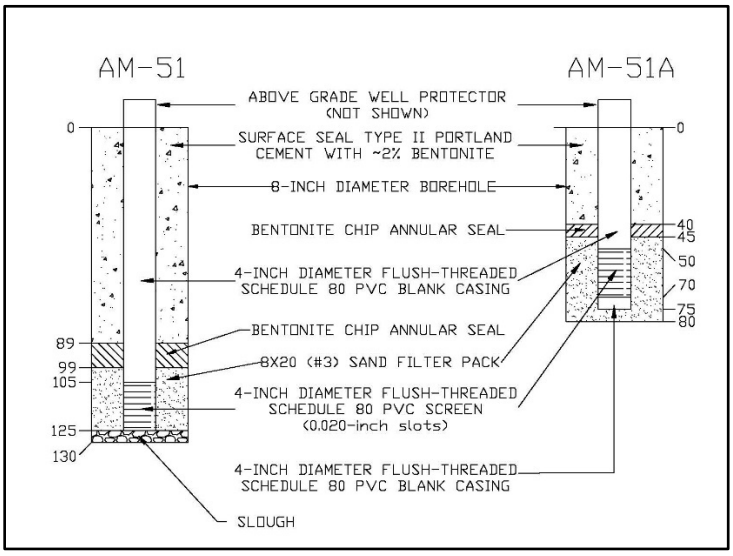


Figure 16: As-Built Diagram of Monitoring Wells AM-51 and -51A (Not to Scale)

Water level data from monitoring wells AM-51 and AM-51A from 2014 to 2023 are shown in Figure 17. What is noteworthy is that there are periods when water levels are higher than the base of Olive Basin. These periods of mounding must be considered when evaluating the recharge performance of Olive Basin, as mounding can reduce percolation rates in the basin. Figure 17 also shows periods when there is no water in AM-51A (horizontal orange line at 167.8 ft msl).

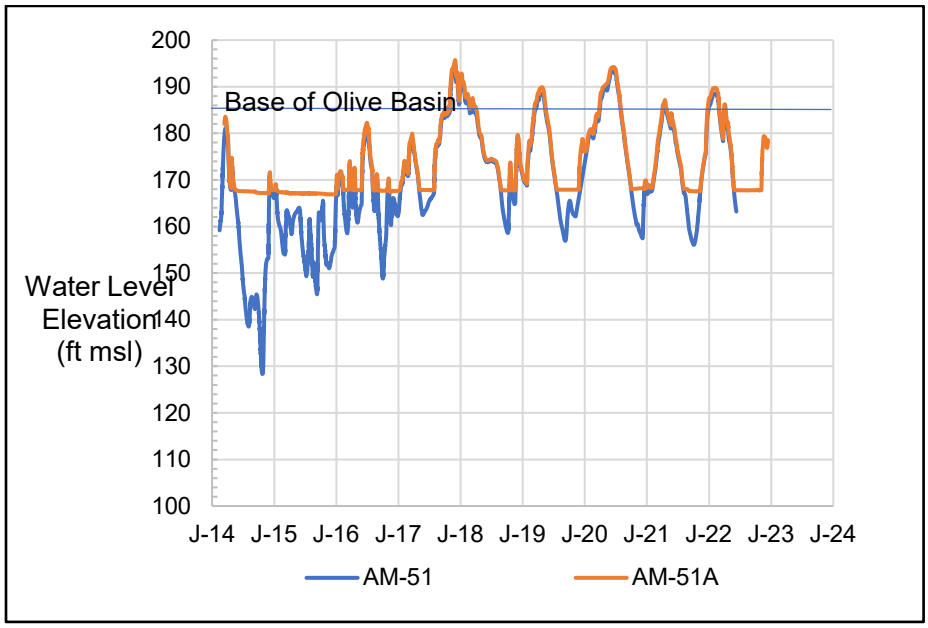


Figure 17: Groundwater Levels in Monitoring Wells AM-51 and -51A

4.3 Demonstration Project Objectives and Metrics

The objectives and metrics of the RFS Demonstration Project are summarized in Table 2.

Table 2: Objectives and Metrics of RFS Demonstration Project

Objectives	Metric(s)
Assess the Impact of RFS on Clogging and Basin Performance.	• Difference in Olive Basin percolation rate with unfiltered SAR water and RFS water • Projected percolation rate with RFS water
Assess the Impact of RFS on Water Quality	• Changes in water quality in the source water (Weir Pond 4) and the RFS water (Olive Basin) • Changes in water quality in RFS water (Olive Basin) and recharged water (Monitoring Well AM-51A) • Changes in RFS water quality as a function of TSS loading
Assess RFS Capacity and Optimal Design Parameters	Flow generated by RFS with: • Different collector types • Different collector orientation • Different collector spacing • Different surface water flow rates • Different depths to groundwater

4.4 RFS Demonstration Project Test Results

RFS was put into operation in March 2014; however, there were issues with the inflow meter that ultimately required replacing the meter. As a result, recharge data using the RFS are available starting in March 2015. The RFS results are presented in sections corresponding to the objectives presented in Table 2.

4.4.1 Impact of RFS on Clogging and Basin Performance

Olive Basin percolation rate data from 2007 to 2012 was compiled and plotted to establish baseline basin performance with unfiltered SAR water, shown in Figure 18 except for data for the first two operational cycles covering January 2008 to April 2009 because the estimates of inflow to the basin during this period are uncertain. Inflow to the basin was measured using a sharp-crested weir. A total of seven operational cycles were defined ranging in length from 50 to 170 days. An operational cycle starts when the basin is placed into service following a cleaning event and stops when the basin is taken out of service for cleaning.

Within each operational cycle, the percolation rate follows the typical slow rise as the basin is filled, reaching a maximum when the basin becomes full. Soon after reaching its maximum, clogging sets in and the percolation rate begins to decline. Based on Cycles 3 through 7, the average percolation rate declines from approximately 11 cfs to 4 cfs over 60 days. Figure 18 shows the daily percolation rates for Cycles 3 through 7 and the moving average of these five cycles. The next section compares this performance to RFS-treated water.

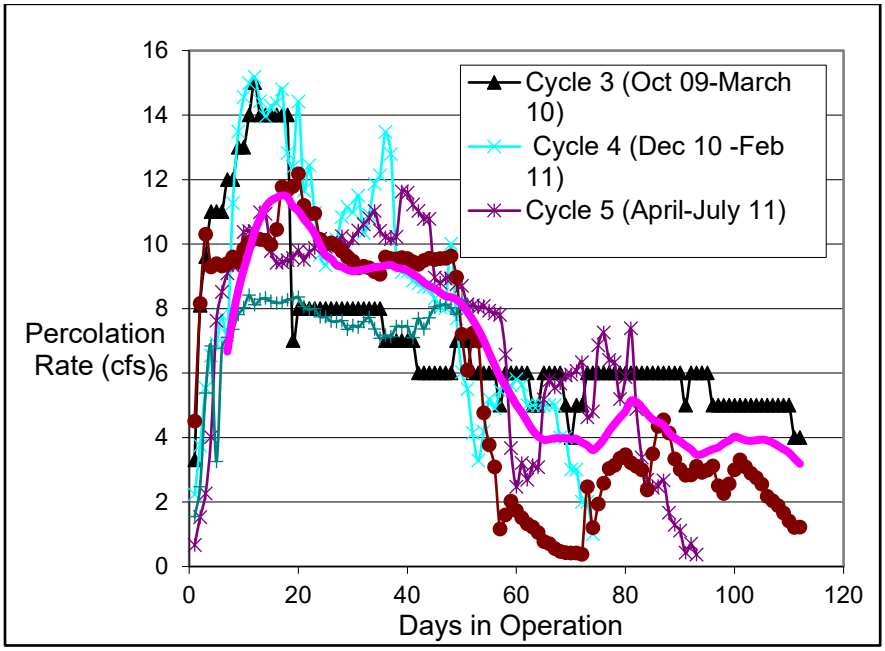


Figure 18: Olive Basin Percolation Rate with Unfiltered Santa Ana River Water October 2009 to January 2012

Figure 19 shows the monthly recharge in Olive Basin from 2001 to 2023. It is clear that relocating the inflow pipeline in 2008 greatly improved the recharge capacity of the basin. Installation of the RFS in 2013 also improved the recharge capacity of the basin. One challenge in analyzing basin performance is that the supply of water to the basin tends to be inconsistent. This is partially because sending water to the upper Off-River channel is a lower priority compared to other facilities and also due to the low supply of SAR base flow in the summer months. Also embedded in this are changes in operational approaches to managing the entire recharge system. Table 3 summarizes the recharge rates during these periods.

Table 3: Olive Basin Recharge Rates

Period	Total Recharge (af)	Total Months	Months in Operation	Avg Recharge when in Operation (af/month)	Change in Avg Recharge (%)	Maximum Monthly Recharge (af)
2001-2008	1,361	84	40	34	N/A	129
2008-2013, Post Inflow Pipe Relocation	13,186	74	50	264	+780%	700
2013-2023, RFS	28,127	111	83	339	+130%	1,046

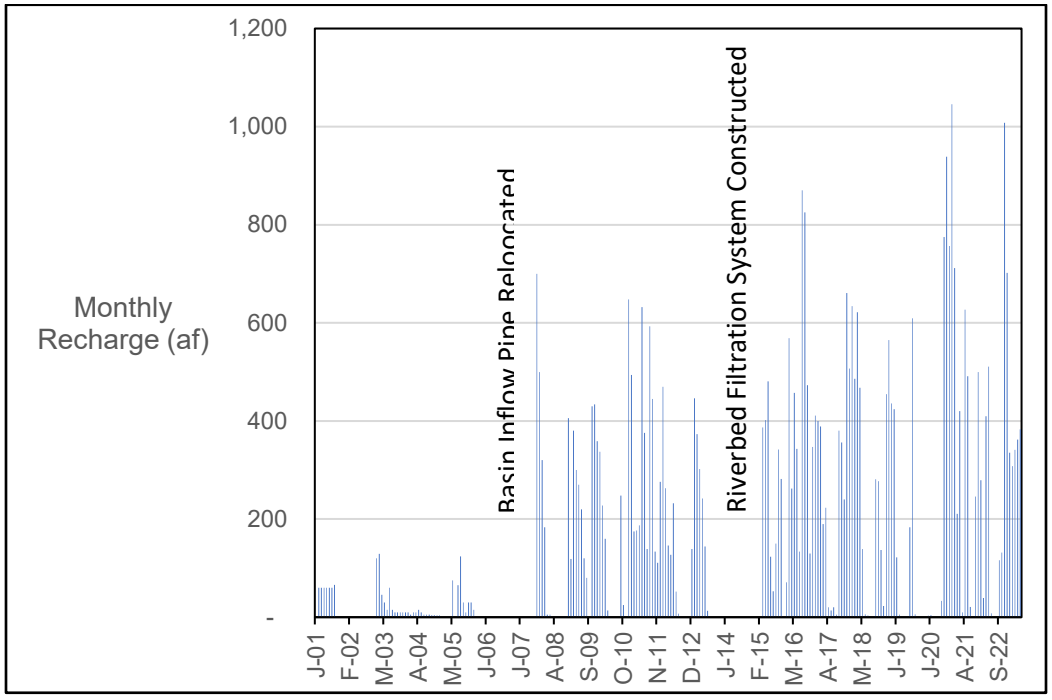


Figure 19: Monthly Recharge in Olive Basin, 2001-2023

Figure 20 shows the daily basin water level and percolation rate from 2015 to 2023 and when the basin was cleaned. Using these cleaning events as endpoints results in 9 recharge cycles over 8 years.

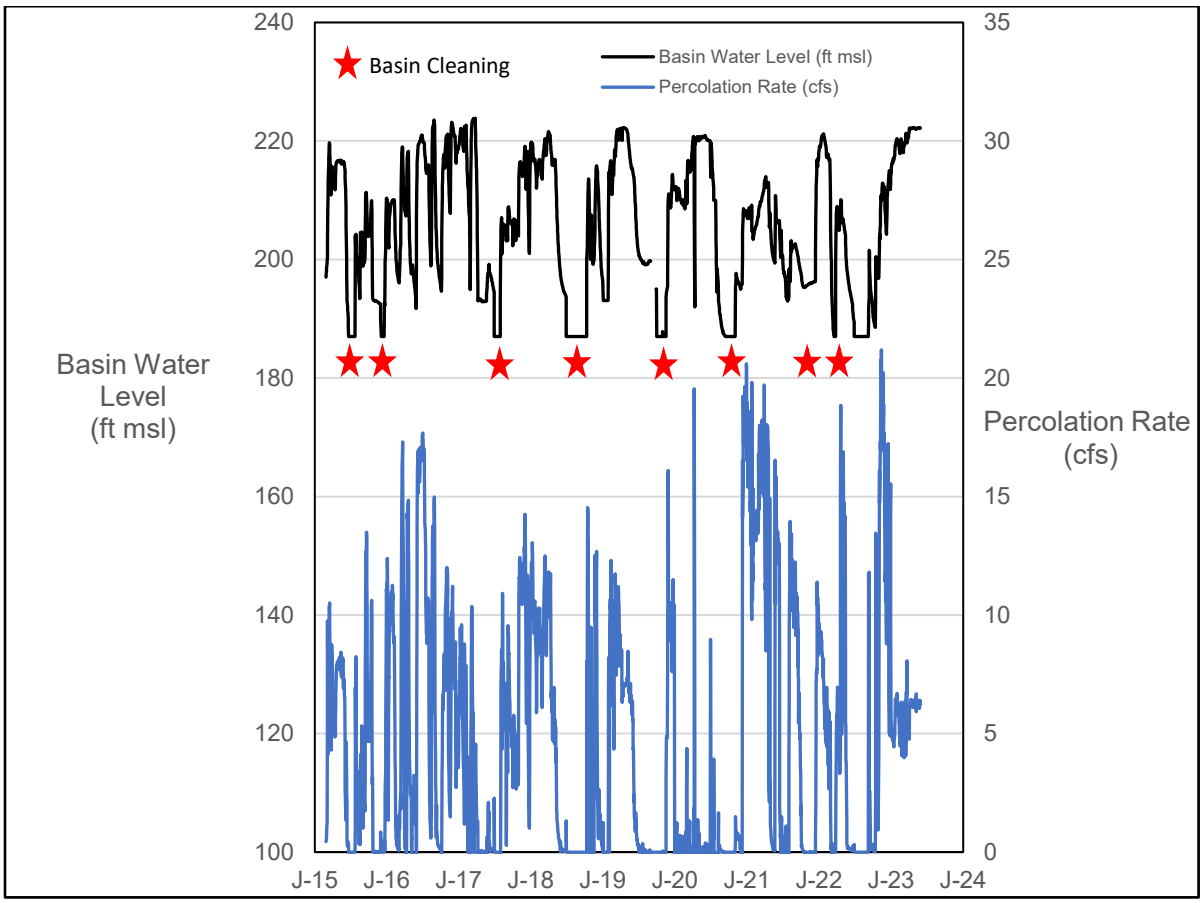


Figure 20: Daily Olive Basin Water Level and Percolation Rate, 2015-2023

Figure 21 shows the daily percolation rate for each operational cycle. For comparison, the average percolation rate for unfiltered SAR water is also shown. Table 4 summarizes the total recharge, length of each cycle, maximum percolation rate achieved, and average percolation rate for each operational cycle. The same information for unfiltered SAR water is also shown. Note that due to the variability in supply to the basin, the average percolation rate does not represent a true average.

Table 4: Olive Basin RFS Operational Cycles

Cycle	Total Recharge (af)	Length (days)	Maximum Daily Percolation Rate (cfs)	Avg Percolation Rate (cfs)
1 (Mar-June 2015)	1,340	97	11	7
2 (July-Oct. 2015)	800	85	14	5
3 (Dec. 2015-March 2017)	6,120	463	18	7
4 (Aug. 2017-May 2018)	4,500	290	14	8
5 (Oct. 2018-Sept. 2019)	2,730	262	15	5
6 (Nov. 2019-July 2020)	800	243	20	2
7 (Nov. 2020-Nov. 2021)	6,060	392	21	8
8 (Dec. 2021-March 2022)	1,050	95	11	6
9 (March 2022-May 2023)	4,655	430	21	5
Unfiltered SAR	1,420	110	12	6

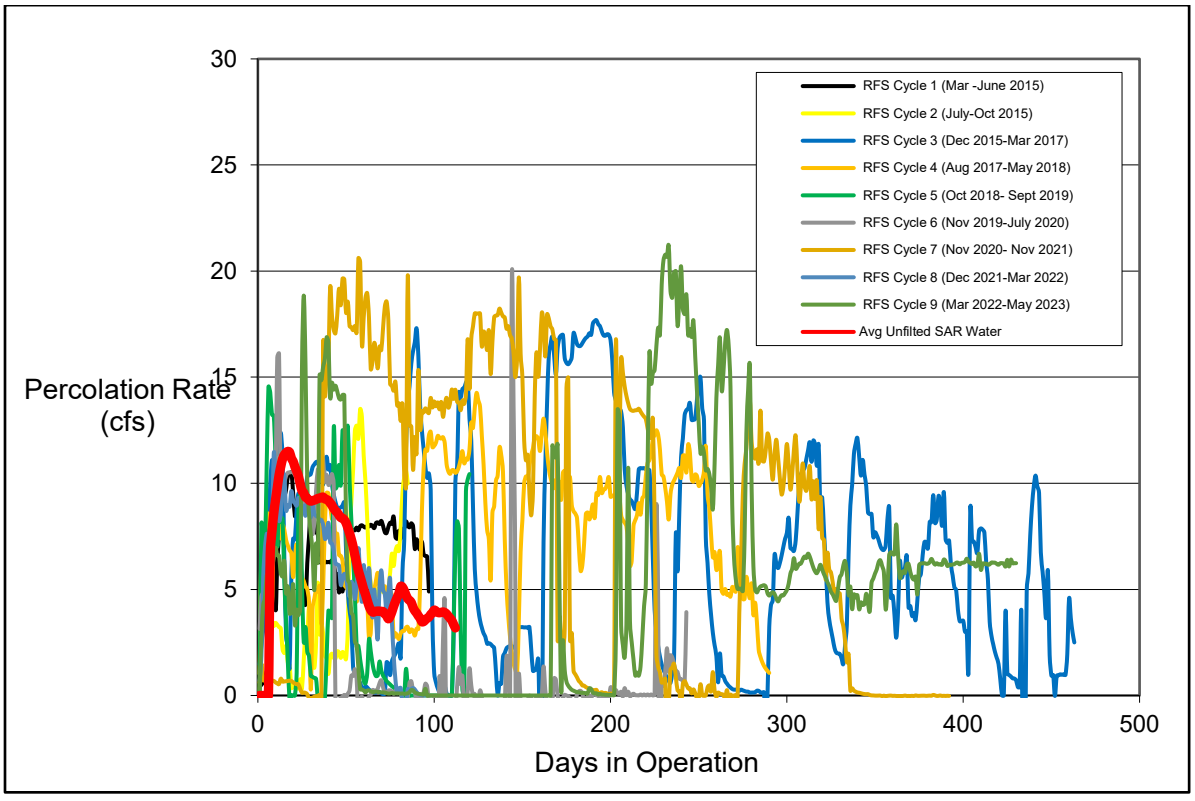


Figure 21: Daily Olive Basin Percolation Rate for 9 Operational Cycles

It is clear from Figure 21 that percolation rates are significantly higher with the RFS compared to using unfiltered SAR water. To assess the relative performance of RFS water, a percolation decay trend based on the three longest operational cycles (Cycles 3, 7 and 9) is compared to multiple cycles of unfiltered SAR water, assuming that 20 calendar days are needed to drain, dry, and clean the basin. Cycles 3, 7 and 9 ran for 463, 392 and 430 days, respectively. Using the percolation decay trend for these cycles and adding 20 days on the end for cleaning, totals approximately 500 days. Figure 22 shows that over 500 days, the estimated percolation rate of RFS water would start at 20 cfs and decay to approximately 6 cfs, for a total recharge volume of 11,500 af. Over this same period, unfiltered SAR water would require three cleanings and recharge a total of 5,500 af. This analysis suggests that RFS water would achieve double the recharge volume of unfiltered SAR water. This is consistent with the performance of recharge basins using imported or GWRS water (see Section 2, Figure 4).

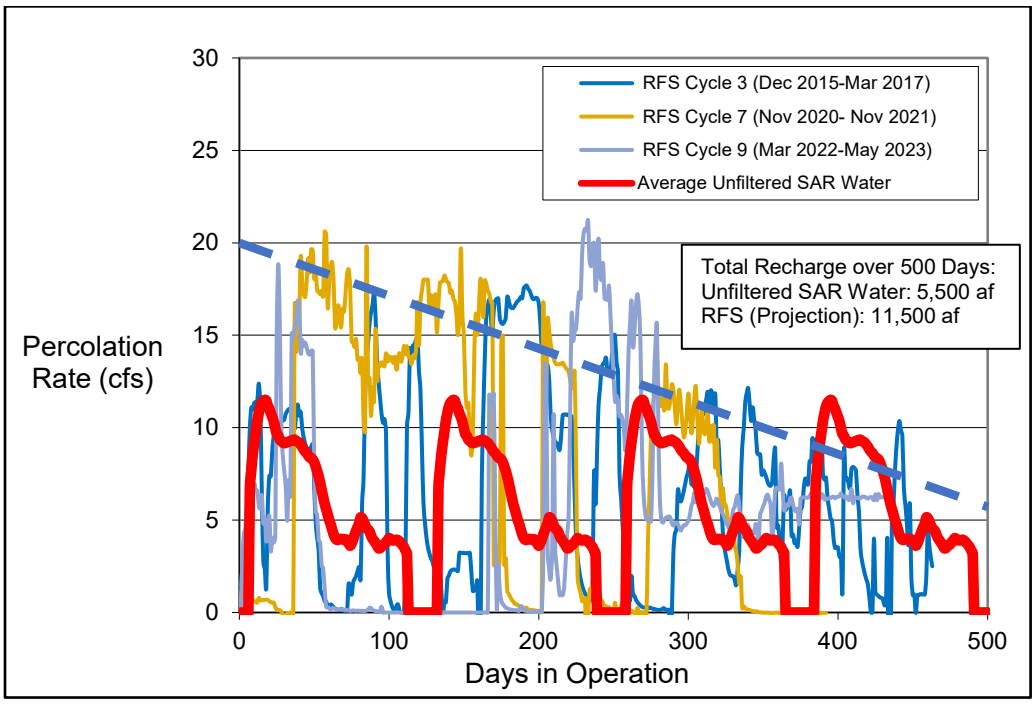


Figure 22: Percolation Rate in Olive Basin with Unfiltered SAR Water and RFS Cycles 3/7/9 Projection

Under natural conditions, the typical percolation rate in the SAR channel adjacent to the Off-River channel ranges from 0.1 – 0.7 feet/day. Based on the maximum inflow to Olive Basin of 21 cfs (or 42 acre-feet per day) generated within the 10-acre footprint of the RFS means that the average unit percolation rate over the RFS is approximately 4 feet/day. This means that the RFS is inducing greater percolation rates than what occurs naturally.

4.4.2 Impact of RFS on Water Quality

Water quality data of interest can be placed into two categories: 1) Parameters that impact clogging; and 2) Parameters that impact public health. Table 5 lists the constituents and parameters tested for.

Water quality samples were obtained from the following locations:

1. Weir Pond 4 (Represents source water)
2. Collector Pipe at Olive Basin (Represents filtered water, also called Product Water)
3. Surface water in Olive Basin
4. Monitoring Wells AM-51/51A.

Samples from Weir Pond 4 were obtained using standard surface water collection methods. To obtain water from the RFS collector pipe, a submersible Dayton Plug-In Utility Pump (110V AC, ½ HP, 74 GPM flowrate) was used. The pump and collection equipment were contained within a metal shed as shown in Figure 23.

Figure 23: Pumping Equipment for Obtaining Samples from Collector Pipe

Surface water from Olive Basin was obtained using standard surface water collection methods. Groundwater samples obtained from monitoring wells AM-51 and AM-51A were obtained with temporary submersible pumps.

Table 5: Water Quality Testing for RFS

Category	Parameters
Physical Clogging	• TSS, particle size distribution
Biological Clogging	• Nitrogen • Phosphorus • TOC and DOC
Chemical Clogging	• Precipitable cations/anions (e.g., Ca, Mg, Na, HCO_3, SO_4, Cl) • pH
Public Health	• Indicator bacteria • Arsenic and other metals • Organic halides (TOX) • Constituents of Emerging Concern (CECs)

4.4.2.1 Parameters Related to Clogging

As listed in Table 5, clogging mechanisms fall into three broad categories: Physical Clogging, Biological Clogging, and Chemical Clogging. Over many years of research, OCWD has found that the primary driver of clogging within OCWD's recharge system is physical clogging caused by the accumulation of suspended solids on the recharge surface. A measure of the physical clogging potential of water is the concentration of Total Suspended Solids (TSS). TSS concentrations were measured by OCWD staff using USEPA standard method #2540D. For completeness, water quality data for other clogging mechanisms were collected and are presented in Appendix B. For the major cations/ anions (e.g. Ca, Mg, Na, HCO_3, SO_4, Cl) that are commonly associated with chemical clogging, no statistically significant differences were observed between the average concentrations in the source and product waters.

Figure 24 shows TSS concentrations in the source water, which is water flowing over Weir Pond 4, and the product water, which is the filtered water obtained from the RFS collector pipe from 2014-2023.

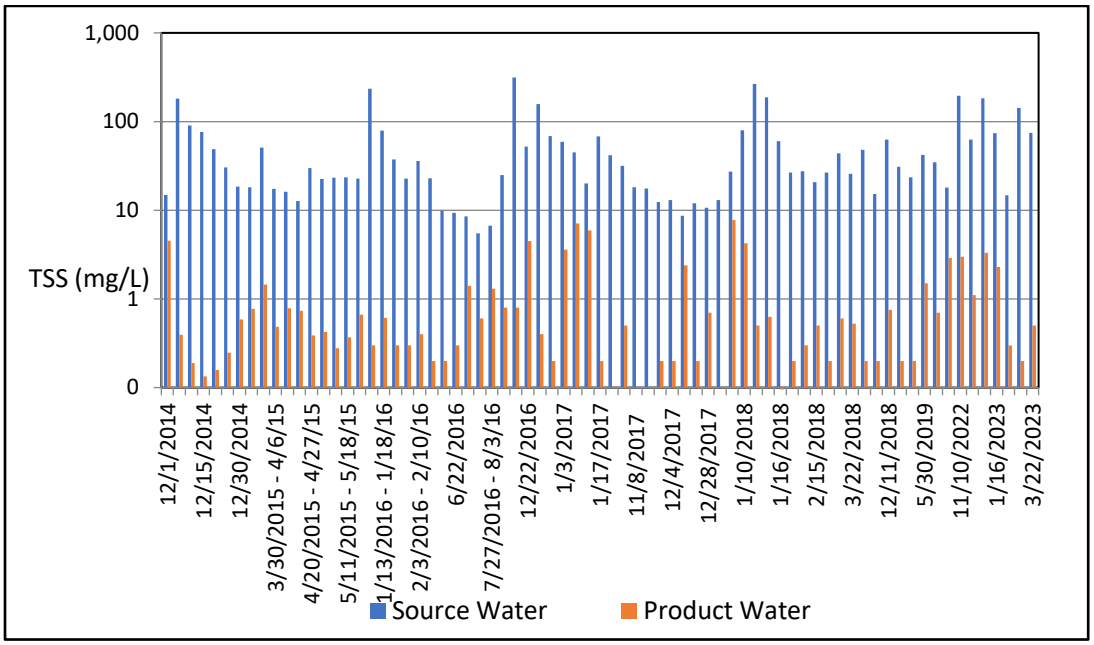


Figure 24: Total Suspended Solids in Influent Source Water and Product Water from RFS

(Note Log Scale; samples with a date range are weekly averages)

TSS concentrations of the source water ranged from 6 mg/L to a high of 315 mg/L. TSS concentrations in the product water ranged from non-detect to 8 mg/L. TSS removal by the RFS ranged from 70 to 99 percent and averaged 96 percent.

Particle size distribution data (n=34) was collected between 2014 - 2017 to characterize the removal efficiency of the various size particles ranging from an apparent diameter of 0.6 to 60 um that comprise the suspended solids. Figure 25 shows the average particle size distribution for SAR water and product water. SAR water has a significantly higher concentration of particles and larger sizes (up to 1.2 x 10^8 um^3/L within the 7-9um range) compared to the product water (up to 4.8 x 10^6 um^3/L within the same particle range). This demonstrates the high capacity of the RFS in removing suspended solids within the colloidal, clay, and silt size ranges.

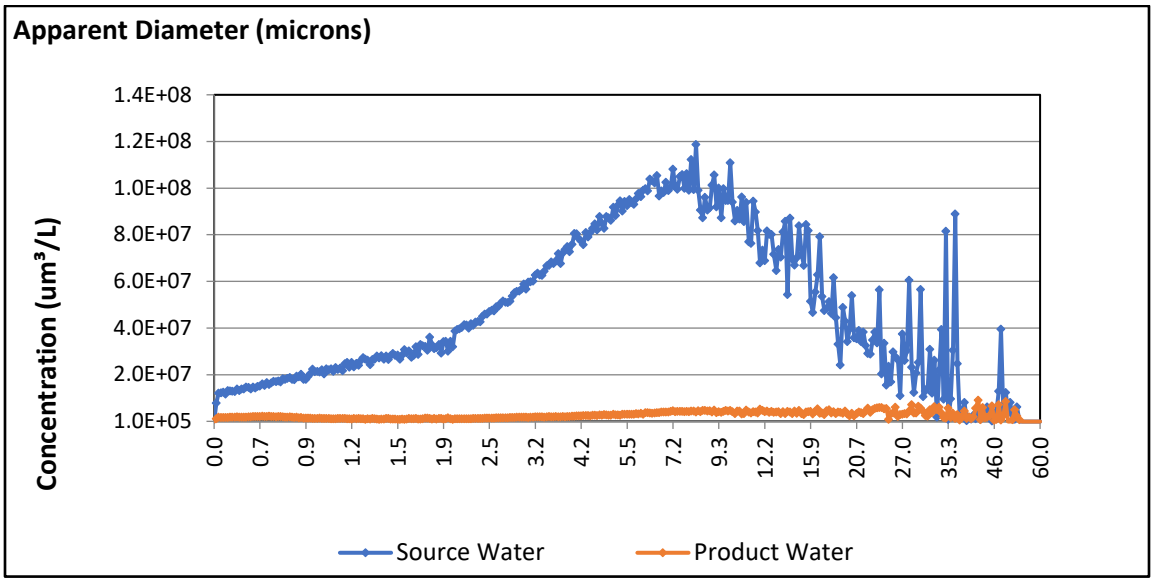


Figure 25: Average Particle Size Distribution of TSS in Influent Source Water and Product Water from RFS

TSS concentrations in the source water at Wier Pond 4 are lower than in the SAR channel because the water has had the chance to move through several desilting ponds. As shown in Figure 24, the maximum TSS concentration measured at Weir Pond 4 during this study was 315 mg/L. To assess RFS performance under a higher TSS load, a small-scale SAR RFS was installed in 2018 in the SAR channel, given that any future, full-scale implementation of RFS would likely encounter these greater TSS loads. The SAR RFS was constructed of one 20-foot long, 4" diameter slotted PVC pipe with (0.010" slot size) and buried in a gravel envelope with native sand placed above it (see Figure 26). This is the same design as the larger RFS in the Off-River channel. A small submersible pump with a power connector and discharge pipe with a locking cap was used to pump filtered water from the system to measure TSS concentrations during high TSS (>300 mg/L) loading events. Due to drought and lack of large storm events, only four events were sampled from 2018 - 2023 that exceeded the 300 mg/L threshold with TSS concentrations ranging from 392 to 551 mg/L. For all samples obtained, the TSS removal averaged 99 percent (Figure 27). The SAR RFS results indicate that even at higher TSS loads, the RFS remains an effective means to reduce TSS concentrations in the source water.

Figure 26: Construction of SAR RFS System in the SAR Channel

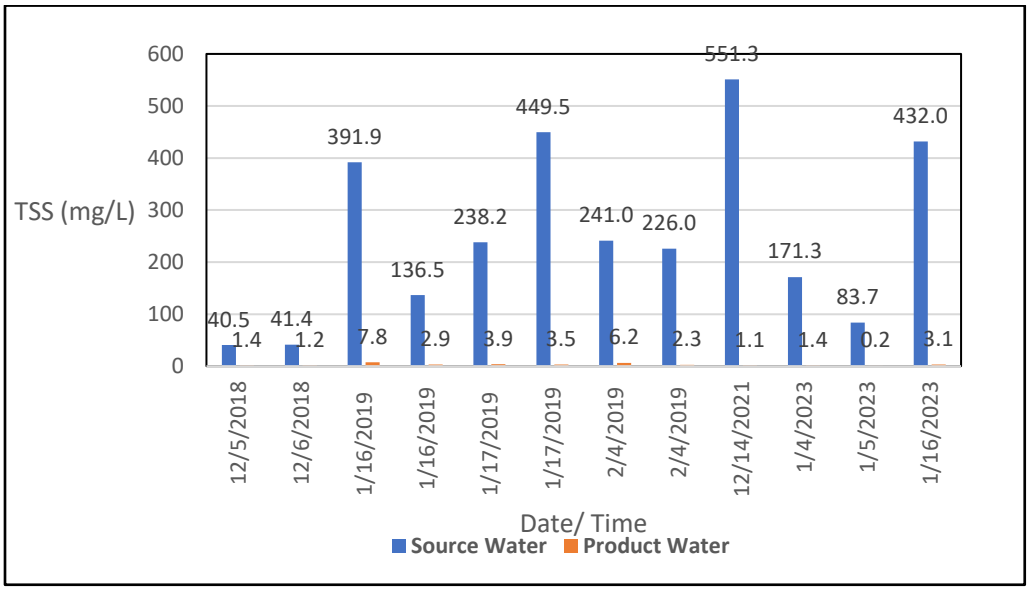


Figure 27: Total Suspended Solids in Source Water (SAR) and Product Water from SAR RFS System

In summary, the RFS in the Off-River channel and the SAR channel were very effective in removing suspended solids removing an average of 96 to 99 percent of the TSS in the source water.

Total and Dissolved Organic Carbon (TOC and DOC) were monitored to assess the potential for biological clogging. TOC is the bulk measurement of organic content, whereas DOC represents the amount of organic carbon excluding colloidal and

particulate organic matter. As shown in Table 6, TOC and DOC removal were 53 and 50 percent, respectively, which is consistent with historical soil aquifer treatment (SAT) data (Laws et al., 2011, Mia et al., 2012; Murray, 2020). TOC and DOC removal in SAT is typically dominated by biodegradation and adsorption mechanisms.

Nutrients, specifically total nitrogen and phosphate phosphorous (orthophosphate) were also monitored as they can contribute to biological growth and are associated with biological clogging. Slight reductions were observed between the source water and product water, with approximately 5 percent of total nitrogen removed compared to approximately 9 percent removal of phosphate phosphorous (orthophosphate) (Table 6).

Table 6: Water Quality Testing for Biological Clogging Parameters (2014- 2019)

	Source Water (WP4)	Product Water*	Change
Parameter	**Total Organic Carbon (mg/L) (n=11, 8*)**		
Maximum	10.90	3.93	
Minimum	5.49	2.77	
Median	6.47	3.52	
Average	7.40	3.45	53.4% reduction
Standard Deviation (±)	1.87	0.36	
Parameter	**Dissolved Organic Carbon (mg/L) (n=11, 8*)**		
Maximum	9.85	3.79	
Minimum	4.31	2.69	
Median	6.47	3.45	
Average	6.75	3.35	50.4% reduction
Standard Deviation (±)	1.56	0.41	
Parameter	**Total Nitrogen (mg/L) (n=11, 8*)**		
Maximum	5.50	4.20	
Minimum	1.12	1.80	
Median	2.80	2.30	
Average	2.80	2.55	8.8% reduction
Standard Deviation (±)	1.39	0.85	
Parameter	**Phosphate Phosphorous (orthophosphate) (mg/L) (n=11, 8*)**		
Maximum	1.32	0.78	
Minimum	0.41	0.55	
Median	0.59	0.69	
Average	0.70	0.67	4.8% reduction
Standard Deviation (±)	0.27	0.09	

* = Number of Product Water Samples

4.4.2.2 Parameters Related to Public Health

Parameters measured relating to public health included bacterial parameters and constituents of emerging concern (CECs). Bacterial indicators such as total coliform, E. coli, and enterococcus showed greater than 98 percent removal across the system as shown in Table 7. This is consistent with other studies showing soil straining and inactivation of pathogens near the soil surface (Ausland et al., 2002; Guessab et al., 1993; Gerba & Goyal, 1985; NRC, 1994; Quanrud, 1998; Sallway, et al., 2020).

Table 7: Water Quality Testing for Bacterial Parameters (2014- 2019)

	Source Water (WP4)	Product Water*	Change
Parameter	**Total Coliform (CFU/100) (n=13, 8*)**		
Maximum	24000.00	300.00	
Minimum	220.00	1.00	
Median	1900.00	36.00	
Average	4490.77	80.63	98.2% reduction
Standard Deviation (±)	6756.39	107.59	
Parameter	**E. Coli (CFU/100) (n=16, 8*)**		
Maximum	1340.00	17.00	
Minimum	19.00	0.10	
Median	121.00	1.00	
Average	176.31	3.29	98.1% reduction
Standard Deviation (±)	363.3	5.78	
Parameter	**Enterococcus (CFU/100) (n=9, 3*)**		
Maximum	390.00	3.00	
Minimum	4.00	0.10	
Median	140.00	2.00	
Average	134.1	1.70	99.2% reduction
Standard Deviation (±)	139.17	1.47	

* = Number of Product Water Samples

Water quality data collected between 2014-2019 show differences in CEC removal rates with the RFS. Of the 18 CECs detected, which are listed in Table 8, 10 show statistically significant differences ($p < 0.05$) between median concentrations in the source water and filtered product water (Figure 28). The CECs were placed into three removal categories: Efficient (> 80%), Moderate (30- 80%), or Poor (< 30%). These compounds likely originated from treated wastewater effluent discharge at upstream sites into the river. The increased concentrations observed in Simazine (SIMAZ) and Sulfamethoxazole (SULTHZ) are not statistically significant and may be due to the

accuracy of the measurement. The variability in removal depends on compound properties (i.e., biodegradable and sorption characteristics of compounds result in greater removal over shorter travel times). The removals seen in this study are consistent with other studies on SAT removal of CECs (Yu et al., 2006; Laws et al., 2011).

Table 8: Water Quality Testing for CEC's (2016- 2019)

Parameter	Average Source Water Concentration (ng/L) n = 6	Average Product Water Concentration (ng/L) n = 6	% Removal	Removal Efficiency
Gemfibrozil (GMFIBZ)	8.23 ± 10.0	0.1 ± 0.0	98.8	Efficient (> 80%)
Ibuprofen (IBPRFN)	18.3 ± 14.6	0.2 ± 0.2	98.7	
Caffeine (CAFFEI)	171.0 ± 116.0	5.6 ± 3.2	96.7	
Atenolol (ATENOL)	14.3 ± 11.6	0.5 ± 0.0	96.5	
Naproxen (NAPRXN)	11.7 ± 16.0	0.7 ± 0.3	94.3	
Iopromide (IOPRMD)	117.0 ± 30.8	9.6 ± 10.7	91.8	
Iohexol (IOHEXL)	2030.0 ± 1110.0	231.0 ± 229.0	88.6	
Diuron (DIURON)	225.0 ± 258.0	46.5 ± 32.8	79.3	Moderate (30-80%)
Meprobamate (MEPROB)	81.1 ± 62.6	20.5 ± 11.8	74.7	
N,N-diethyl-m-toluamide (DEET)	28.3 ± 6.4	7.4 ± 3.5	73.7	
Tris-2-chlorethyl phosphate (TCEP)	90.6 ± 24.9	37.8 ± 18.6	58.3	
Dilantin (DILANT)	38.0 ± 15.7	28.5 ± 9.4	25.0	Poor (< 30%)
Sucralose (SUCRAL)	20800.0 ± 7710.0	15700.0 ± 4220.0	24.5	
Atrazine (ATRAZ)	2.7 ± 3.1	2.5 ± 3.2	6.4	
Primidone (PRIMDN)	38.8 ± 28.8	37.9 ± 25.0	2.3	
Carbamazepine (CBMAZP)	70.1 ± 24.5	68.7 ± 18.7	2.0	
Simazine (SIMAZ)	23.7 ± 16.0	26.0 ± 14.6	-9.7	
Sulfamethoxazole (SULTHZ)	56.2 ± 39.9	62.6 ± 31.2	-11.4	

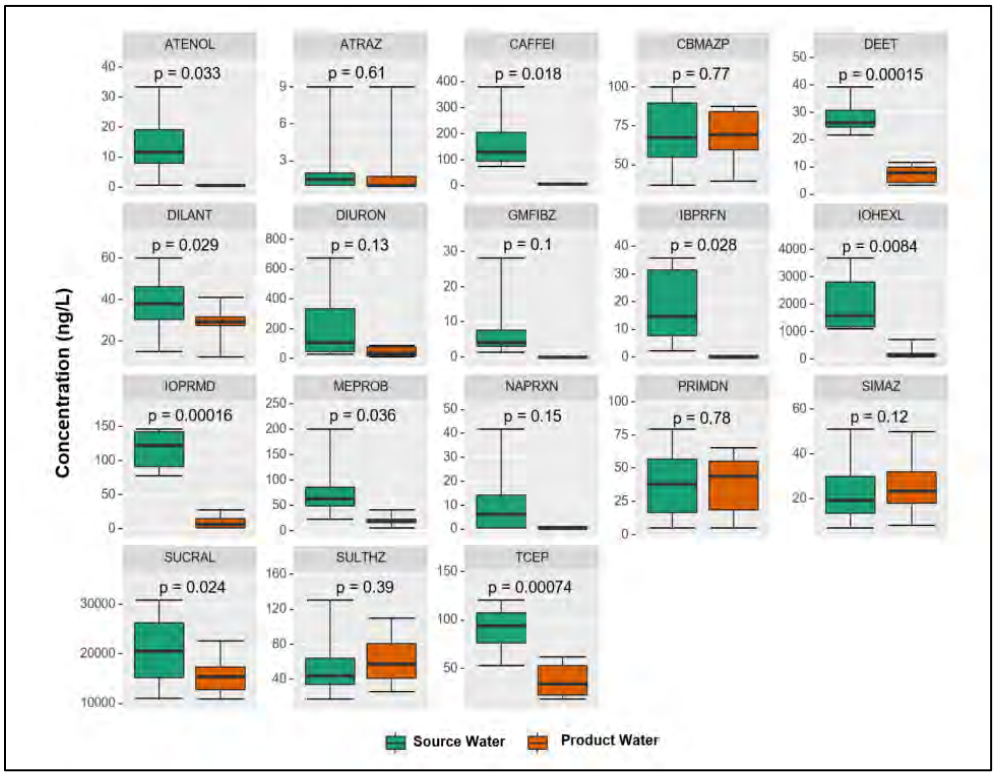


Figure 28: Removal Efficiencies for CECs (2016- 2019)

($p < 0.05$ indicates compounds that have statistically significant difference)

4.4.3 RFS Capacity and Design Considerations

The RFS was designed to identify critical factors affecting RFS capacity and efficiency. To identify these factors, the RFS was designed with two different types of collectors and with sets of collectors oriented parallel and perpendicular to surface water flow. Table 9 summarizes the RFS design parameters. Figure 14 shows the layout of the RFS.

Table 9: RFS Design Parameters

Collector	Material	Open Area/Slotted Pipe (ft)	Orientation to Surface Flow
Pilot System	4-inch Slotted PVC	720	Perpendicular
Manifold 1	Flo-Tanks (aka Rain Tanks).	720	Perpendicular
Manifold 2	4-inch Slotted PVC	720	Perpendicular
Manifold 3	Flo-Tanks (aka Rain Tanks).	720	Perpendicular
Manifold 4	4-inch Slotted PVC	720	Perpendicular
Manifold 5	4-inch Slotted PVC	720	Parallel
Manifold 6	Flo-Tanks (aka Rain Tanks).	720	Parallel
Manifold 7	4-inch Slotted PVC	540	Parallel
Manifold 8	Flo-Tanks (aka Rain Tanks).	540	Parallel

During testing of the various combinations of collector types and orientation, it became clear that there were other factors affecting flows generated by the RFS. These include:

1. Flow rate of surface water over the RFS
2. Flow rate of surface water in the adjacent Santa Ana River channel
3. Water level in Olive Basin

It proved challenging to establish conditions when all these variables were similar to provide reproducible results. As a result, it was not possible to test all potential manifold combinations; however, in over three years of testing, 15 separate combinations were tested, and attempts were made to reproduce the test results for each combination. These test results are presented in Appendix C.

In general, total flow increases with the number of open collectors, ranging from 3 cfs with one collector open to 18 cfs with all of them open as shown in Table 10 and Figure 29. The average flow per open collector is presented; however, since some of the collectors have different open area/slotted pipe lengths, the average flow per 1,000 ft of open area/slotted pipe is also calculated.

Table 10: RFS Collector Testing Summary

# Open Collectors	1	2	3	4	5	6	9
Number of Test Combinations	1	4	2	3	3	1	1
Avg Total Flow (cfs)	3.0	5.1	8.2	10.0	12.3	14.9	17.5
Avg Flow/Collector (cfs)	3.0	2.6	2.7	2.5	2.5	2.5	1.9
Total Length of Open Area/Slotted Pipe (ft)	720	1,350	2,070	2,820	3,480	4,320	6,120
Avg Flow (cfs)/1,000 ft of Open Area/Slotted Pipe	4.2	3.8	4.0	3.6	3.5	3.4	2.9

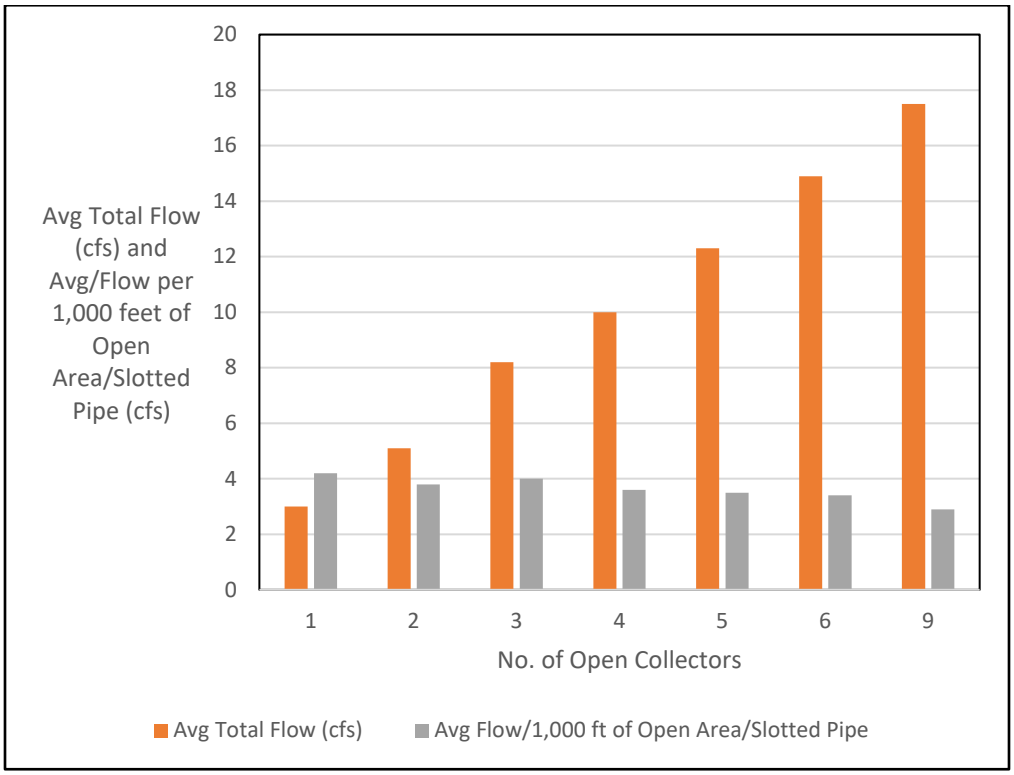


Figure 29: RFS Collector Flow Testing Results

The notable test results are as follows:

1. The average flow per 1,000 feet of open area/slotted pipe decreases as more sections are open.
2. There is no indication that the type of lateral (PVC or Flo-tank) or orientation relative to surface flow has any significant impact on performance.

These results suggest that system performance is not sensitive to collector system construction or orientation to surface water flow direction. It does appear to be sensitive to spacing in that flow per unit of open area/slotted pipe is higher when alternate manifolds are open. This suggests that the number of collectors exceeded the sustainable recharge rate of the overlying sediments. As a result, optimizing the spacing of the collectors is something that should be carefully considered in the design of a full-scale system. Another aspect that should be evaluated is the capacity of the carrier pipeline as this could have a role in impacting system capacity at the higher flow rates.

4.5 RFS Test Summary

Based on data collected over 10 years from 2013 to 2023, the RFS is effective in reducing TSS concentrations by an average of 96 percent. RFS removal efficiency does not appear to be affected by higher TSS loads as demonstrated by the removal seen in the SAR Pilot RFS. The reduced TSS concentration approximately doubles the recharge capacity of Olive Basin. This increased recharge is consistent with the performance of other recharge basins receiving low-TSS imported or GWRS water.

The RFS improves overall water quality in a manner consistent with what occurs in SAT, despite the relatively short 2–3 feet distance between the channel surface and the RFS. There are no indications that biological or chemical clogging of the RFS is taking place. Bacteria removal was very effective and the CEC removal variable.

RFS efficiency is not sensitive to collector system construction or orientation to surface water flow direction; however, it does appear to be sensitive to spacing. Pipe diameter could also be a factor limiting the potential yield of the RFS (Geosystems Analysis, 2009). These are factors that should be considered during the design of a full-scale system.

5.0 RFS Expansion Potential

Historically, diverting and capturing storm water from the Santa Ana River has been done on the surface using sand berms and inflatable rubber dams. The RFS presents a fundamental shift in capturing and diverting storm water below the surface. If you were to compare both systems side by side with the same flow in the Santa Ana River, more water would be diverted and recharged by the RFS over time due to reduced clogging and thus result in more water being captured over the long-term.

Another benefit of the RFS is that it can be installed in reaches of the Santa Ana River channel where there is little to no recharge due to shallow groundwater conditions. The RFS would take advantage of the permeable channel sediments by creating a system that would induce downward flow through these sediments into buried subsurface laterals. The shallow depth of the RFS reduces the potential of extracting water that has been previously recharged. In fact, testing of the Pilot RFS showed that 80 percent of the water captured was induced by the RFS.

An expanded RFS has the greatest potential to increase the recharge rates of the Terminal Recharge Basins because they are most prone to clogging. This means the RFS would need to be constructed so the outflow can be conveyed to the Warner System or to other infrastructure conveying flow to downstream Terminal Recharge Basins. Conceptually, the potential area where a full-scale RFS could be constructed is shown in Figure 30.

There is also the potential to deploy the RFS in the Off-River channel and SAR channel downstream of Wier Pond 4 to supply Five Coves Basins, Santiago Basins, and Santiago Creek. Although these facilities would benefit from receiving filtered water, they are less sensitive to clogging compared to the Terminal Recharge Basins. For this report, these facilities are not considered; however, they could be examined as part of a future phase.

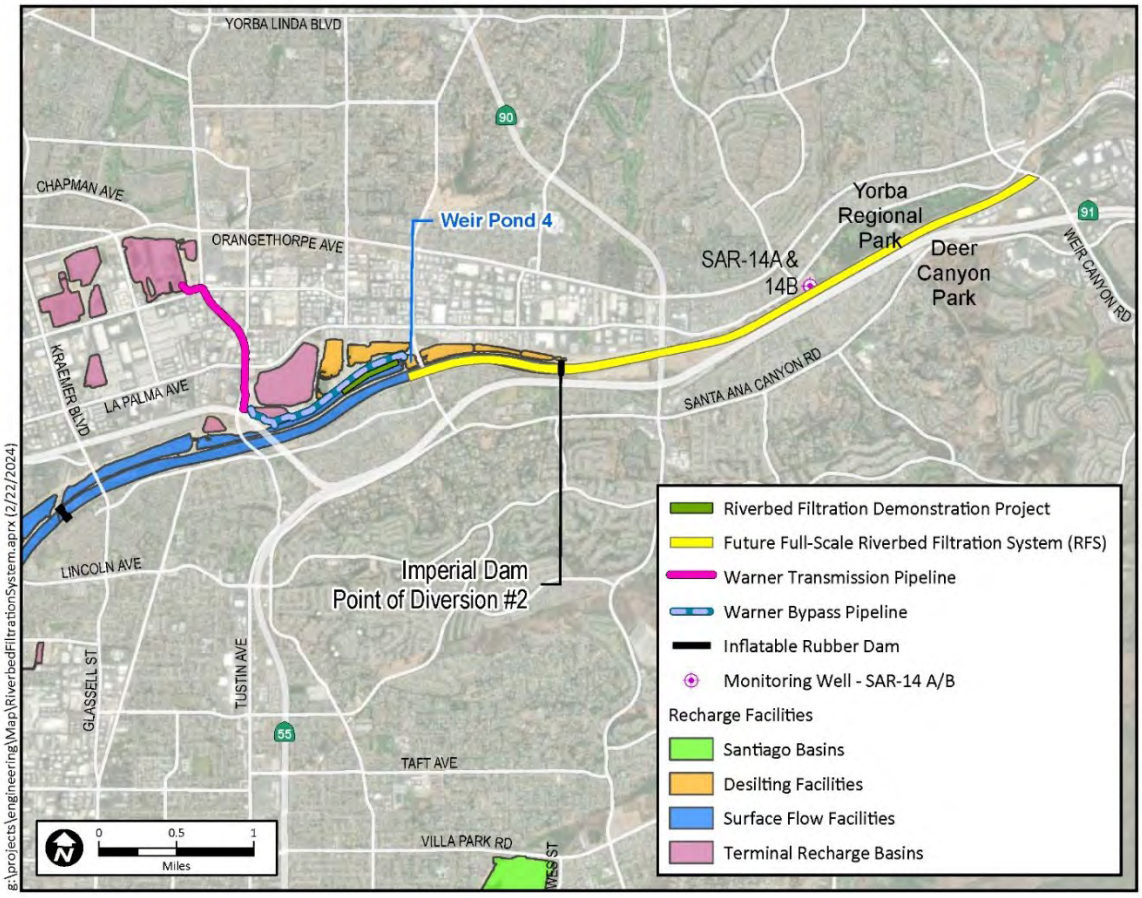


Figure 30: Potential Area of Full-Scale RFS

The maximum flow rate that can be conveyed through the Weir Ponds to the Warner System is 400 cfs. The outflow from the Warner System to downstream basins is limited to 170 cfs through the Warner Transmission Pipeline. Historically, these conveyance capacities have been adequate because clogging of the recharge basins quickly reduces the need for flow once basin storage is exhausted. With the RFS, reduced clogging will mean that increased flows will be needed to satisfy the recharge capacities of the basins. As a result, the current conveyance capacities could become the limiting factor. Table 11 shows how the maximum storage and percolation rates of the receiving basins compare with current conveyance capacities. The total maximum capacity of basins supplied by the Warner Transmission Pipeline is 405 cfs, which is much greater than the 170 cfs capacity of the pipeline. Optimizing the capacity of the Warner Transmission Pipeline will be explored in a later section of this report.

Table 11: Storage, Maximum Percolation Rate, and Current Conveyance Capacities: Terminal Recharge Basins*

Basin	Max Storage (af)	Maximum Percolation Rate (cfs)	Current Conveyance Capacity (cfs)
Weir Pond/Warner Basin System			**400**
Warner Basin System*	4,320	70	
Warner Transmission Pipeline			**170**
Anaheim Lake	2,260	100	
Mini-Anaheim Lake	13	20	
Miller Basin	300	45	
Kraemer Basin	1,170	120	
La Jolla Basin	26	30	
Placentia Basin	350	10	
Raymond Basin	370	10	
Total	**7,109**	**405**	

*Includes Huckleberry Basin, Conrock Basin, and Little Warner Basin

The SAR channel upstream of Weir Pond 4 to Weir Canyon Road is a highly engineered channel with a relatively uniform channel bottom ranging from 280 to 300 feet wide. A review of numerous soil borings and other geotechnical information collected by the USACE as part of its design of the Santa Ana River Mainstem Project (SARM) in this reach showed that the geologic conditions are favorable with generally permeable sediments in the upper 10 to 20 feet of the SAR channel.

Two types of RFS could be constructed in this reach. The first is a gravity system and the second is a pumped system. The advantage of a gravity system is it is relatively simple with no pumping-related infrastructure required. The disadvantage is that the flow generated by the system is constrained by the elevation difference from the collection point to the discharge location. In addition, larger pipe diameters are required to ensure that there are no constraints to the flows that can be generated. The surface area of the SAR channel from Imperial Highway to Weir Canyon Road, a stretch approximately 14,000 feet long (2.7 miles), is approximately 90 acres. For the Demonstration RFS, the maximum flow of 17.5 cfs was produced when all the collectors were open within the 10-acre footprint of the Demonstration RFS. Assuming a similar production rate of 1.8 cfs/acre in the upper SAR channel, an RFS covering the entire 90 acres could generate up to 157 cfs by gravity flow.

The portion of the SAR channel between Weir Canyon Road and the Imperial Rubber Dam has an elevation change of 314 ft msl to 265 ft msl (WGS84) over a distance of 17,350 ft, which yields a slope of 0.0028. Given this slope, Table 12 lists the potential flow rates that could be conveyed by gravity using different diameter HDPE pipes and rectangular concrete pipe. Note that the flows presented in Table 12 do not account for the percolation capacity of river channel sediments.

Table 12: Estimated Gravity RFS Conveyance Dimensions and Maximum Flow Rates

Material	Diameter (ft)	Flowrate (cfs)
HDPE	4	99
	5	180

	Width (ft)	Height (ft)	Flowrate (cfs)
Concrete	6	2	65
	4	3	71
	5	3	94
	6	3	118

In addition to a gravity flow RFS, an RFS that is supplied by pumped water could also be considered. The Turlock Irrigation District (TID) constructed an infiltration gallery in the Tuolumne River downstream of La Grange Dam to recapture releases made to promote salmon habitat. The system was designed as follows:

1. 16 horizontal laterals in groups of four
2. The laterals are made up of 24-inch diameter wire-wrapped steel well screens
3. Each lateral has 45 feet of screen
4. Each group of four laterals is combined into a 30-inch header which then increases to a 36-inch collection line that connects to a wet well with a series of pumps.
5. The laterals were installed 5 ft below the river bottom
6. The laterals were encased in 4 feet of pea gravel (2 ft below and 2 ft above) with native material in the upper 3 feet
7. The footprint of the infiltration gallery covers 0.32 acres (220 ft x 64 ft).

Figure 31 shows some design details. Figure 32 is a photo taken during construction.

The system was designed to yield 100 cfs and during testing produced 108-110 cfs (Bill Penny, TID, personal communication July 24, 2023). Given a footprint of 0.32 acres and a design rate of 100 cfs, the unit yield is 309 cfs/acre. It is not expected that this yield could be achieved in the SAR channel given sediment conditions are different and the SAR has a higher sediment load. Nevertheless, the potential yield of a pumped RFS will be considerably higher than the 1.8 cfs/acre achieved using gravity flow.

Another advantage of the RFS is that it removes limitations associated with the inflatable rubber dams. Water is currently diverted from the SAR to the recharge system using two inflatable rubber dams. These dams are effective in diverting flows up to 1,000 cfs. At flow rates greater than 1,000 cfs, the dams must be deflated, which can limit the ability of the District to divert and capture stormwater. With the RFS, water could continue to be diverted from the SAR at flows greater than 1,000 cfs, when the rubber dams would ordinarily be deflated.

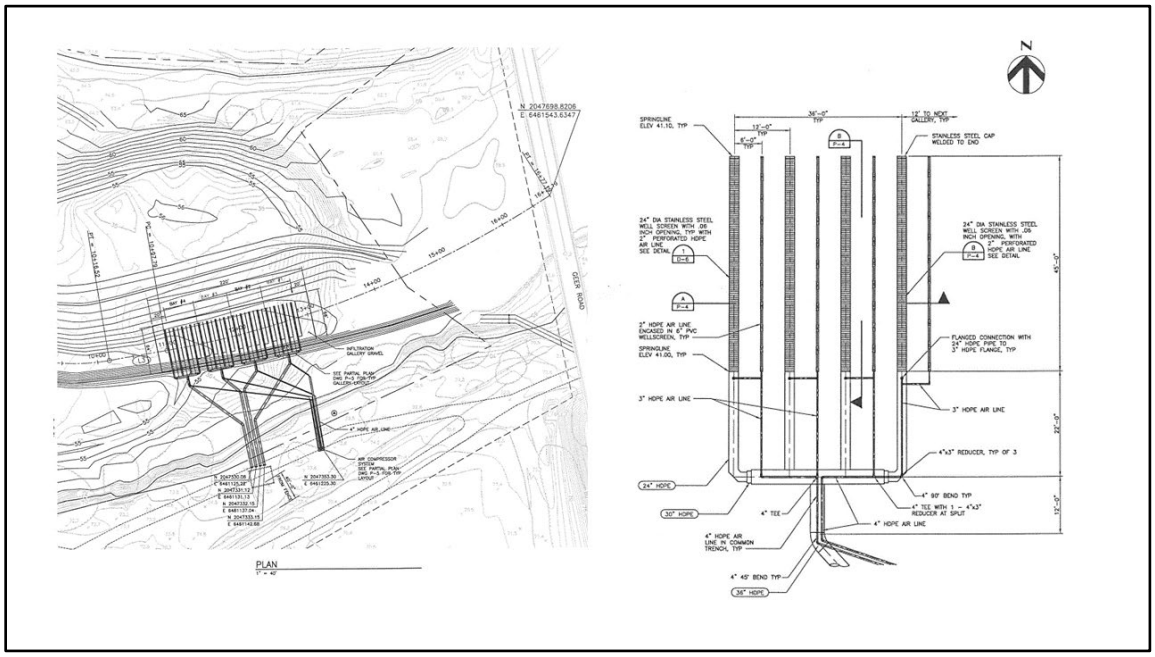


Figure 31: Turlock Irrigation District Infiltration Gallery Design

Figure 32: Construction of Infiltration Gallery in Tuolumne River

To obtain more information about hydrogeologic conditions in the SAR channel upstream of Imperial Highway, monitoring wells SAR-14 and SAR-14A were installed in Yorba Park adjacent to the SAR channel in 2019. The location SAR-14/14A is shown in Figure 30.

Figure 33 shows how groundwater levels change over time as well as the discharge rate from Prado Dam, which is located upstream. Figure 33 also shows the elevation of the SAR channel near the monitoring wells. These data suggest that water in the SAR channel is flowing away from the channel, except for when high flows cause water levels to rise higher than the SAR channel, which occurred in winter 2023 and 2024. Following these peaks, water groundwater levels rapidly declined, which is likely due to the draining of the groundwater back into the river. These data are consistent with a full alluvial aquifer and will be ideal for a large scale RFS.

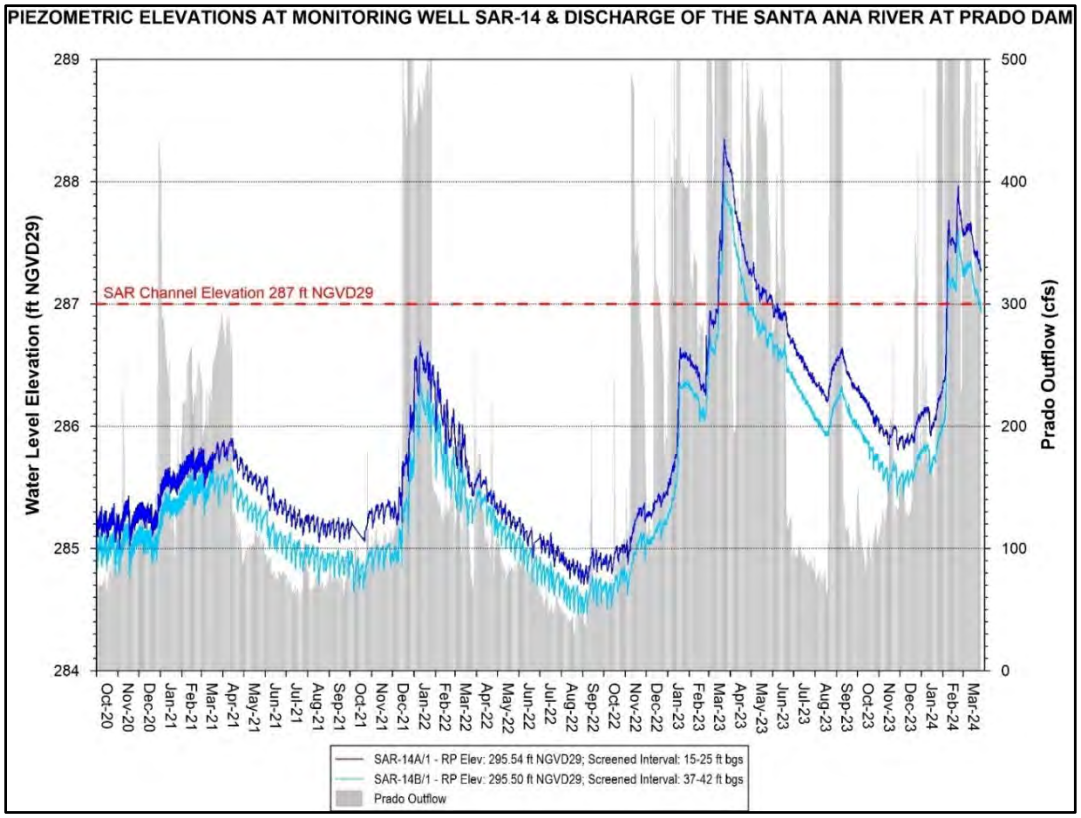


Figure 33: Groundwater Levels at SAR-14 and Flow in the SAR

5.1 Potential Yield Estimates Using Recharge Facilities Model

The potential benefits of a future RFS were evaluated using OCWD's Recharge Facilities Model (RFM) (OCWD, 2009). OCWD worked with Jacobs Engineering, Inc. to update the RFM (Jacobs, 2023), extending the period of historical inflow and then running various scenarios simulating the benefits of a future RFS. The technical memorandum describing this work is presented in Appendix D. The baseline period for the modeling is the daily historical inflow to the recharge system from FY02-03 to FY19-20. It must be noted that using historical inflows is a conservative approach because the future availability of stormwater will increase as OCWD increases the volume of stormwater that can be temporarily impounded at Prado Dam using Forecast Informed Reservoir Operations (FIRO).

Six RFS alternatives were developed and two are presented here as follows:

Alternative 3a:

- Maximum RFS flow to Terminal Basin System: 450 cfs
- Flow in SAR greater than 450 cfs is conveyed to the Off-River System
- Maximum flow through Warner Transmission Pipeline: 170 cfs
- No clogging caused by recharge water

Alternative 3b:

- Same conditions as above, except:
- No max flow limit in Warner Transmission Pipeline

The purpose of Alternative 3a is to examine the potential benefit of maximizing the diversion of RFS water directly to the Warner System, which has a conveyance capacity of 400 cfs. Any additional untreated surface water (green line) available for diversion would be done with the existing facilities but would remain segregated from RFS flows (blue line) as shown in Figure 34. The details of how these flows would be conveyed or separated will be explored during a future phase of work. The maximum flow from the Warner System to the downstream facilities would be limited to the current maximum of 170 cfs. To examine the maximum potential of using RFS water, no clogging is assumed.

Alternative 3b is the same as Alternative 3a except the capacity of the Warner Transmission Pipeline is undefined in that it will supply whatever flows are needed in the downstream basins. This was done to see what the peak demand of the downstream basins is and as a starting point to optimize the capacity of this pipeline in a future phase of work. Figure 34 shows the conceptual flow of RFS (treated) and untreated SAR water through the recharge system and to the Terminal Recharge Basins. Figure 34 also shows conceptually how a gravity fed RFS located upstream of Imperial Rubber Dam and a smaller, pumped RFS could be constructed. Further study is required to find out which type of RFS or combination is most cost effective.

Figure 35 shows the increased annual recharge achieved using RFS water for Alternatives 3a and 3b. Alternative 3a shows that the additional recharge using RFS could be as high as 7,900 afy. When flow constraints are removed on the Warner Transmission Pipeline capacity in Alternative 3b, the annual additional recharge is approximately 10,000 afy. This indicates that with the RFS, removing the flow constraint of the Warner Transmission Pipeline could produce an additional 1,100 afy of recharge. Additional work needs to be done to evaluate the benefits of the additional recharge versus the cost of expanding the pipeline's capacity. This could also include a phased approach to constructing the RFS to assess the production capacity of each phase before moving to the next phase until the appropriate capacity is developed.

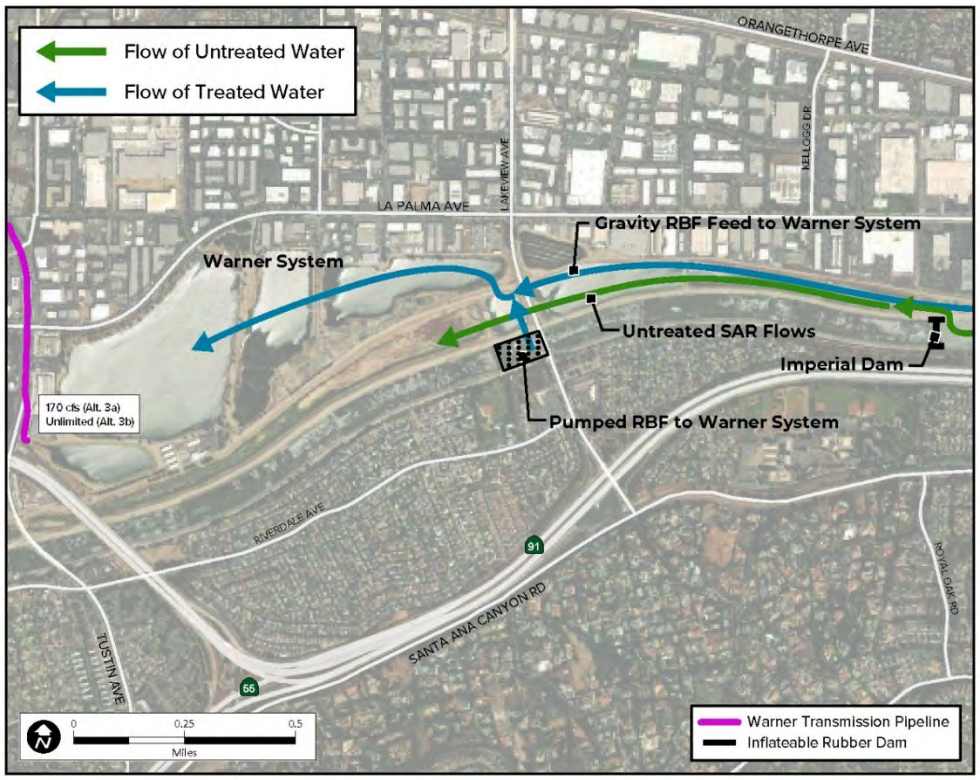


Figure 34: Potential Conveyance of RFS Water to Terminal Basin System

One of the benefits of using filtered water is a reduction in the number of times a basin needs to be cleaned, which reduces Operations and Maintenance (O&M) costs. Based on the modeling described above, there is a 40% reduction in the number of cleaning events needed for Alternatives 3a and 3b (see Table 2 in Jacobs, 2023, Appendix D).

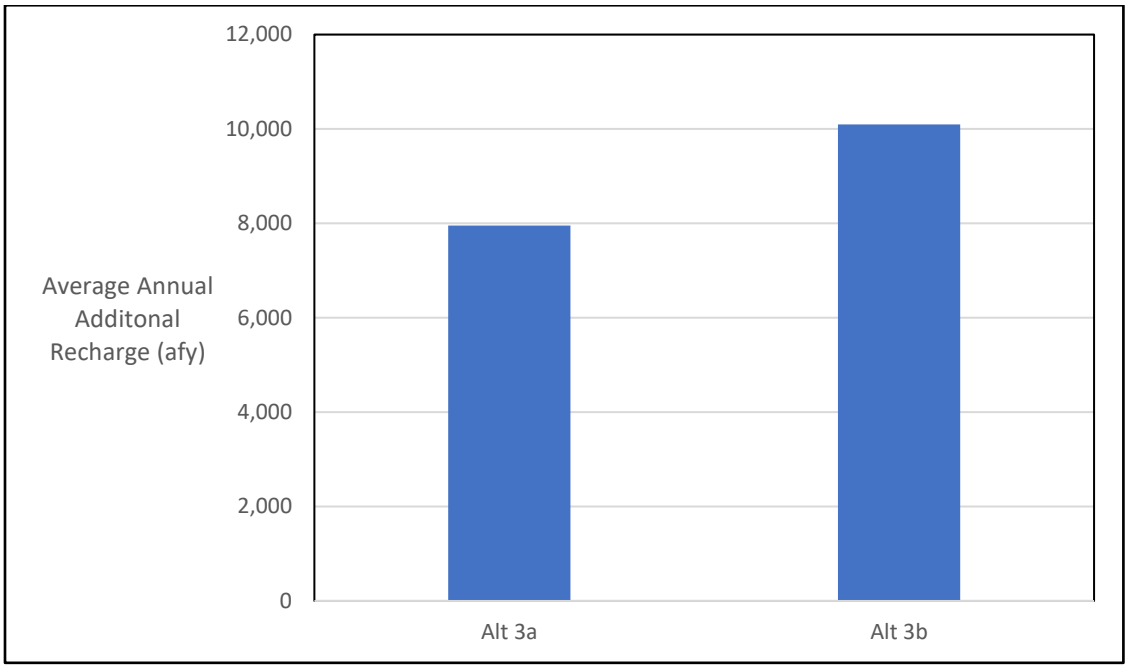


Figure 35: Average Annual Additional Recharge, Alternatives 3a and 3b

5.2 Next Steps

The work conducted thus far shows that the RFS is effective at removing TSS from SAR water and has the potential to greatly increase OCWD's recharge capacity and potentially reduce future O&M costs. More work needs to be done to refine the potential configuration of a future RFS and develop more detailed cost and benefit estimates. Below is a list of potential next steps and additional work that may be required to better define and evaluate a potential full-scale RFS.

Conduct hydraulic evaluation

- Define how much flow can be generated from a gravity fed system
- Define how much flow can be generated from a pumped system
- Define capacity of the Terminal Basin System using existing Warner Transmission Pipeline
- Evaluate potential cost and benefits of increasing the Warner Transmission Pipeline capacity

- Conduct hydrogeologic evaluation
  - What is the potential for mounding in receiving basins using RFS water
  - If mounding does occur, how much would it constrain recharge?
  - Develop a model of a shallow SAR channel to develop estimates of the potential yield of gravity and pumped RFS systems and design parameters

- Conduct engineering evaluation
    - Constructability analysis of gravity RFS in the SAR channel
    - Constructability analysis of pumped RFS in the SAR channel
- Constructability analysis of increasing the capacity of Warner Transmission Pipeline
- Permitting feasibility with USACE, OC Public Works and others.
- Conduct additional recharge modeling
    - Refine recharge estimates by including some level of basin clogging
    - Refine recharge estimates using future Prado Dam operations with a higher level of stormwater capture with FIRO
    - Develop cost estimates of O&M savings due to fewer basin cleanings
- Develop Preliminary Design
    - Develop cost estimate
    - Develop benefits based on modeling done in previous tasks

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Appendix A

Summary of Cloth Filtration Testing

Cloth Filtration Pilot Testing

Cloth filter treatment units employ a series of large circular disks covered with a specially designed fabric. Water passes through the fabric, leaving sediment behind. When the fabric becomes clogged, the flow stops, and a backwash cycle begins where specially designed suction pads clean off the accumulated sediment and send it to waste. Once cleaned, the flow reverses, and treatment resumes.

For cloth filtration pilot testing, an AquaDisk cloth filter unit manufactured by Aqua-Aerobics Systems, Inc. was installed at Riverview Basin.

The cloth filter unit was tested over four stormwater "seasons" from 2012-13 to 2015-16. Key test results are as follows:

1. Sediment removal efficiency, as measured by the reduction in Total Suspended Solids (TSS) concentration, ranged from 16 to 71 percent.
2. TSS removal is most effective when total TSS concentrations fall within a relatively narrow range (10-30 mg/L).
3. A minimal increase in recharge in the Riverview Basin was observed.
4. Other than reduced TSS concentrations, the cloth filter produced minimal changes in water quality, which was expected.
5. The current cloth filter unit is undersized (5 cfs) relative to a maximum capacity of Riverview Basin (12 cfs).

In addition, modeling using the Recharge Facilities Model (RFM) indicated that future potential increases in recharge at Riverview Basin using the cloth filter were low and not cost-effective when considering the capital and operational costs associated with the cloth filter unit.

In summary, cloth filter testing showed that this method of treatment can only handle water with a relatively limited range of TSS concentrations (10-30 mg/L). This greatly restricts where it could be deployed within the District's recharge system. For example, TSS concentrations in the SAR where it is diverted at Imperial Highway during the storm season average nearly 90 mg/L and can be as high as 4,200 mg/L (2008-2016), making it impractical to use a cloth filter at this location. This limited treatment range and concomitant minor improvement in recharge rates where it could potentially be deployed means that this technology is not considered cost-effective at this time.

Appendix B

Water Quality Data

Weir Pond 4 Water Quality Summary Data (2014-2019)

PARAMETER NAME	MEDIAN	MEAN	N=	MINIMUM	MAXIMUM	25th PERCENTILE	75th PERCENTILE	UNITS	MIN RDL	MAX RDL	# of NDs	# of DETECTS
BIOLOGICAL												
E. Coli (Membrane Filtration - CFU/100ml)	121.00	233.58	12.00	19.00	1340.00	50.75	194.75	CFU/100	1.00	1.00	0.00	12
E. Coli (by IDEXX (Colilert 18))	81.00	81.00	2.00	1.00	161.00	41.00	121.00	MPN	1.00	10.00	1.00	1
Enterococcus by IDEXX (Enterolert)	501.00	501.00	2.00	41.00	961.00	271.00	731.00	MPN	1.00	1.00	0.00	2
Enterococcus(Membrane Filtration-CFU/100ml)	140.00	134.14	7.00	4.00	390.00	17.50	185.00	CFU/100	1.00	1.00	0.00	7
Fecal Coliform (Membrane Filtration-CFU/100ml)	177.00	204.25	4.00	33.00	430.00	56.25	325.00	CFU/100	1.00	1.00	0.00	4
Fecal Coliform (Mult. Tube Fermentation)	38.00	38.00	2.00	27.00	49.00	32.50	43.50	MPN	1.80	1.80	0.00	2
Total Coliform (Membrane Filtration-CFU/100ml)	1900.00	4490.77	13.00	220.00	24000.00	900.00	3900.00	CFU/100	1.00	1.00	0.00	13
Total Coliform (Mult. Tube Fermentation)	615.00	615.00	2.00	310.00	920.00	462.50	767.50	MPN	1.80	1.80	0.00	2
Total Coliform by IDEXX (Colilert 18)	7359.00	7359.00	2.00	1722.00	12996.00	4540.50	10177.50	MPN	1.00	1.00	0.00	2
FIELD MEASUREMENTS												
Field Dissolved Oxygen	9.53	9.74	11.00	8.70	10.80	9.23	10.50	mg/L	0.00	0.01	0.00	11
Field Electrical Conductivity	813.00	791.18	11.00	456.00	1160.00	625.50	905.00	uS/cm	0.00	1.00	0.00	11
Field Oxidation-Reduction Potential	167.00	162.73	11.00	52.00	297.00	104.00	219.50	mV	-1000.00	-1000.00	0.00	11
Field Temperature	15.80	15.73	11.00	11.80	19.70	13.50	17.85	C	0.00	1.00	0.00	11
Field pH	8.00	7.92	11.00	7.50	8.30	7.75	8.05	UNITS	0.00	1.00	0.00	11

INORGANIC												
Alkalinity-Phenolphthalein	0.10	0.10	11.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	11.00	0
Aluminum (dissolved)	13.10	20.12	11.00	5.90	51.00	8.30	31.50	ug/L	1.00	1.00	0.00	11
Ammonia Nitrogen	0.01	0.01	10.00	0.01	0.01	0.01	0.01	mg/L	0.10	0.10	10.00	0
INORGANIC (cont'd)												
Ammonia Nitrogen NH3-N	0.10	0.10	1.00	0.10	0.10	0.10	0.10	mg/L	0.10	0.10	0.00	1
Antimony (dissolved)	0.10	0.29	11.00	0.05	1.10	0.10	0.35	ug/L	0.50	1.00	8.00	3
Arsenic (dissolved)	1.90	1.85	11.00	0.10	3.20	1.15	2.80	ug/L	1.00	1.00	2.00	9
Barium (dissolved)	36.30	36.57	11.00	24.80	46.60	30.05	43.20	ug/L	1.00	1.00	0.00	11
Beryllium (dissolved)	0.10	0.09	11.00	0.05	0.10	0.08	0.10	ug/L	0.50	1.00	11.00	0
Bicarbonate (as CaCO3)	161.00	165.06	11.00	98.70	235.00	134.00	189.00	mg/L	1.00	1.00	0.00	11
Bicarbonate (as HCO3)	196.30	201.22	11.00	120.30	286.50	163.35	230.35	mg/L	1.20	1.20	0.00	11
Boron (dissolved)	0.20	0.19	11.00	0.10	0.30	0.15	0.20	mg/L	1.20	1.20	0.00	11
Bromide	0.13	0.12	11.00	0.01	0.29	0.06	0.17	mg/L	1.20	1.20	3.00	8
Cadmium (dissolved)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	11.00	0
Calcium (dissolved)	57.80	62.54	11.00	38.10	90.00	52.15	73.00	mg/L	1.20	1.20	0.00	11
Carbonate (as CaCO3)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	mg/L	1.20	1.20	11.00	0
Cation-Anion meq balance	-0.82	-0.93	8.00	-4.32	2.79	-2.67	0.08	RATIO			0.00	8
Chloride	95.80	90.69	11.00	45.50	136.00	66.30	110.00	mg/L	0.50	2.00	0.00	11
Chromium (dissolved)	0.10	0.19	11.00	0.10	1.10	0.10	0.10	ug/L	1.00	1.00	10.00	1
Cobalt (dissolved)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	11.00	0
Copper (dissolved)	2.30	2.41	11.00	1.60	3.30	1.90	3.05	ug/L	1.00	1.00	0.00	11
Electrical Conductivity	796.00	790.45	11.00	462.00	1170.00	632.50	912.50	uS/cm	1.00	1.00	0.00	11
Fluoride	0.32	0.32	11.00	0.25	0.41	0.28	0.35	mg/L	0.10	0.10	0.00	11
Gadolinium (dissolved)	56.00	59.72	11.00	25.00	110.00	50.15	62.40	ng/L	10.00	10.00	0.00	11
Hydroxide (as CaCO3)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	11.00	0
Iron (dissolved)	27.50	38.21	11.00	12.80	92.50	20.70	52.55	ug/L	1.00	5.00	0.00	11
Lead (dissolved)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	11.00	0
Magnesium (dissolved)	14.10	15.12	11.00	8.50	23.00	12.30	18.10	mg/L	0.50	0.50	0.00	11
Manganese (dissolved)	30.90	34.35	11.00	0.10	93.50	11.00	53.30	ug/L	1.00	1.00	1.00	10

Mercury (dissolved)	0.10	0.07	11.00	0.01	0.10	0.01	0.10	ug/L	0.10	1.00	11.00	0
Nickel (dissolved)	2.20	2.21	11.00	0.10	4.80	1.70	2.60	ug/L	1.00	1.00	1.00	10
Nitrate	8.20	8.54	11.00	1.10	19.20	4.50	12.25	mg/L	0.40	0.40	0.00	11
Nitrate + Nitrite Nitrogen	1.92	1.98	11.00	0.27	4.39	1.07	2.84	mg/L	0.10	0.10	0.00	11
Nitrate Nitrogen	1.85	1.93	11.00	0.24	4.34	1.02	2.78	mg/L	0.10	0.10	0.00	11
Nitrite	0.13	0.15	11.00	0.10	0.23	0.11	0.21	mg/L	0.00	0.01	0.00	11
Nitrite Nitrogen	0.04	0.05	11.00	0.03	0.08	0.04	0.07	mg/L	0.00	0.00	0.00	11
Organic Nitrogen	0.80	0.73	11.00	0.30	1.30	0.50	0.85	mg/L	0.10	0.10	0.00	11
Phosphate Phosphorus (orthophosphate)	0.59	0.70	11.00	0.41	1.32	0.54	0.77	mg/L	0.01	0.01	0.00	11
Potassium (dissolved)	10.10	10.49	11.00	7.90	14.40	8.75	11.80	mg/L	0.50	0.50	0.00	11
Selenium (dissolved)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	11.00	0
Silica	13.00	13.50	11.00	5.40	21.70	11.00	16.35	mg/L	1.00	1.00	0.00	11
Silver (dissolved)	0.10	0.10	11.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	11.00	0
Sodium (dissolved)	77.80	72.73	11.00	37.50	108.00	53.75	87.30	mg/L	0.50	0.50	0.00	11
Sulfate	87.10	85.94	11.00	47.10	128.00	74.35	102.00	mg/L	0.50	2.00	0.00	11
Suspended Solids	22.00	29.17	7.00	9.20	66.00	16.50	37.00	mg/L	1.00	2.50	0.00	7
Temperature (Laboratory)	21.80	21.70	3.00	21.00	22.30	21.40	22.05	C	1.00	1.00	0.00	3
Thallium (dissolved)	0.10	0.09	11.00	0.05	0.10	0.08	0.10	ug/L	0.50	1.00	11.00	0
Title 22 Total Anions	8.00	7.80	11.00	4.29	11.43	6.27	9.07	meq/L			0.00	11
Total Alkalinity (as CaCO3)	161.00	165.06	11.00	98.70	235.00	134.00	189.00	mg/L	1.00	5.00	0.00	11
Total Anions	7.47	7.66	8.00	4.31	11.47	5.80	9.25	meq/L	0.00	0.00	0.00	8
Total Cations	7.22	7.59	8.00	4.43	11.40	5.74	9.24	meq/L	0.00	0.00	0.00	8
Total Dissolved Solids	514.00	476.73	11.00	282.00	674.00	394.00	528.00	mg/L	1.00	2.50	0.00	11
Total Hardness (as CaCO3) (dissolved)	202.00	218.45	11.00	130.00	320.00	181.00	257.00	mg/L	1.00	1.00	0.00	11
Total Kjeldahl Nitrogen	0.80	0.82	11.00	0.40	1.40	0.60	0.95	mg/L	0.20	0.20	0.00	11
Total Nitrogen	2.80	2.80	11.00	1.12	5.50	1.73	3.73	mg/L	0.20	0.20	0.00	11
Total Organic Carbon (Unfiltered)	6.47	7.40	11.00	5.49	10.90	6.21	8.47	mg/L	0.05	0.05	0.00	11
Turbidity	34.00	31.05	11.00	8.30	85.00	13.00	37.00	NTU	0.10	0.10	0.00	11

UV Absorbance/TOC (unfiltered) ratio	0.03	0.03	11.00	0.02	0.05	0.03	0.04	L/mg-cm	0.00	0.00	0.00	11
Ultraviolet (absorbance)	0.24	0.24	11.00	0.14	0.38	0.17	0.29	1/cm	0.01	0.01	0.00	11
Vanadium (dissolved)	3.80	3.95	11.00	3.10	5.10	3.60	4.15	ug/L	1.00	1.00	0.00	11
Zinc (dissolved)	6.60	11.80	11.00	3.30	60.60	5.65	8.20	ug/L	1.00	1.00	0.00	11
pH	8.00	8.05	11.00	7.80	8.30	8.00	8.20	UNITS	1.00	1.00	0.00	11
ORGANIC												
17a-Estradiol	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	1.00	0
17a-Ethynylestradiol	1.00	1.00	1.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	1.00	0
17b-Estradiol	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0
4-Androstene-3,17-dione	0.20	0.20	2.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	2.00	0
4-n-Octylphenol	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
4-tert-Octylphenol	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
Aspartame	10.00	10.00	8.00	10.00	10.00	10.00	10.00	ng/L	100.00	100.00	8.00	0
Atenolol	11.80	14.43	8.00	0.50	33.40	6.88	21.85	ng/L	5.00	10.00	1.00	7
Bisphenol A	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
Diclofenac	0.50	0.50	8.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	8.00	0
Diethylstilbestrol	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0
Dilantin	37.85	37.43	8.00	14.90	60.10	29.75	43.43	ng/L	10.00	10.00	0.00	8
Dissolved Organic Carbon	6.47	6.75	11.00	4.31	9.85	5.78	7.31	mg/L	0.05	0.05	0.00	11
Epitestosterone (cis-Testosterone)	0.55	0.55	2.00	0.10	1.00	0.33	0.78	ng/L	1.00	10.00	2.00	0
Equilin	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	1.00	0
Estriol	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0
Estrone	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	1.00	0
Fluoxetine	0.50	0.50	8.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	8.00	0
Iohexol	1645.00	1981.25	8.00	1100.00	3680.00	1165.00	2565.00	ng/L	20.00	200.00	0.00	8
Iopromide	116.00	114.49	8.00	77.60	146.00	87.78	142.25	ng/L	10.00	10.00	0.00	8
Linuron	0.00	0.00	8.00	0.00	0.00	0.00	0.00	ug/L	0.01	0.01	8.00	0
Meprobamate	63.55	84.29	8.00	22.90	200.00	47.53	102.50	ng/L	5.00	10.00	0.00	8
Naproxen	6.25	10.80	8.00	0.50	41.70	0.50	15.08	ng/L	5.00	10.00	4.00	4
Neotame	1.00	1.00	8.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	8.00	0

Nonylphenol	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
PhenylPhenol	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
Progesterone	0.55	0.55	2.00	0.10	1.00	0.33	0.78	ng/L	1.00	10.00	2.00	0
Sucralose	20650.00	19896.25	8.00	8470.00	30800.00	13025.00	26525.00	ng/L	100.00	1000.00	0.00	8
Testosterone (trans-Testosterone)	0.55	0.55	2.00	0.10	1.00	0.33	0.78	ng/L	1.00	10.00	2.00	0
ORGANIC (cont'd)												
Tetrabromobisphenol A	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
Total Organic Halogen	72.50	73.83	6.00	44.00	110.00	53.00	91.25	ug/L	20.00	40.00	0.00	6
Trimethoprim	0.50	0.56	8.00	0.50	1.00	0.50	0.50	ng/L	5.00	10.00	8.00	0
Tris-2-chloroethyl phosphate	105.00	105.48	8.00	52.80	190.00	84.60	112.50	ng/L	5.00	10.00	0.00	8
para-Chlorobenzene sulfonic acid	20.00	20.00	8.00	20.00	20.00	20.00	20.00	ng/L	200.00	200.00	8.00	0
SEMI-ORGANIC												
Acetaminophen	5.00	21.04	8.00	0.50	65.40	3.88	38.83	ng/L	5.00	50.00	5.00	3
Atrazine	0.00	0.00	8.00	0.00	0.01	0.00	0.00	ug/L	0.00	0.00	1.00	7
Azithromycin	1.00	2.00	8.00	1.00	5.00	1.00	2.00	ng/L	10.00	50.00	8.00	0
Caffeine	130.00	179.51	8.00	72.70	380.00	98.35	242.50	ng/L	3.00	3.00	0.00	8
Carbamazepine	67.90	67.74	8.00	36.80	100.00	49.93	84.30	ng/L	1.00	1.00	0.00	8
Diuron	0.21	0.36	8.00	0.03	1.25	0.05	0.46	ug/L	0.01	0.01	0.00	8
Erythromycin	0.10	0.60	8.00	0.10	4.10	0.10	0.10	ng/L	1.00	1.00	7.00	1
Gemfibrozil	6.85	9.48	8.00	1.30	28.10	3.18	11.00	ng/L	1.00	1.00	0.00	8
Ibuprofen	14.70	17.44	8.00	1.00	35.70	5.95	30.40	ng/L	1.00	10.00	1.00	7
N,N-diethyl-m-toluamide	26.30	28.29	8.00	20.70	39.20	23.78	32.78	ng/L	1.00	1.00	0.00	8
Pentachlorophenol (PCP)	0.02	0.02	2.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	2.00	0
Primidone	38.30	41.50	8.00	5.00	79.20	24.03	64.13	ng/L	1.00	100.00	2.00	6
Simazine	0.02	0.02	8.00	0.01	0.05	0.01	0.04	ug/L	0.01	0.01	0.00	8
Sulfamethoxazole	44.50	53.50	8.00	17.50	130.00	36.05	57.08	ng/L	1.00	1.00	0.00	8
Triclosan	0.30	0.55	8.00	0.10	1.30	0.10	1.05	ng/L	1.00	5.00	5.00	3

PARAMETER NAME	MEDIAN	MEAN	N=	MINIMUM	MAXIMUM	25th PERCENTILE	75th PERCENTILE	UNITS	MIN RDL	MAX RDL	# of NDs	# of DETECTS
BIOLOGICAL												
E. Coli (Membrane Filtration - CFU/100ml)	1.00	3.29	8.00	0.10	17.00	0.10	2.75	CFU/100	1	1	3	5
Enterococcus (Membrane Filtration-CFU/100ml)	2.00	1.70	3.00	0.10	3.00	1.05	2.50	CFU/100	1	1	1	2
Fecal Coliform (Membrane Filtration-CFU/100ml)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	CFU/100	1	1	0	1
Total Coliform (Membrane Filtration-CFU/100ml)	36.00	80.63	8.00	1.00	300.00	14.50	92.50	CFU/100	1	1	0	8
FIELD MEASUREMENTS												
Field Dissolved Oxygen	5.34	5.70	8.00	3.78	7.59	4.70	6.97	mg/L	0	0.01	0	8
Field Electrical Conductivity	873.00	855.50	8.00	643.00	1180.00	716.00	907.25	uS/cm	0	1	0	8
Field Oxidation-Reduction Potential	169.50	159.25	8.00	24.00	251.00	124.75	203.75	mV	-1000	-1000	0	8
Field Temperature	16.45	16.59	8.00	13.00	20.80	13.55	19.45	C	0	1	0	8
Field pH	7.75	7.74	8.00	7.50	8.00	7.68	7.80	UNITS	0	1	0	8
INORGANIC												
Alkalinity-Phenolphthalein	0.10	0.10	8.00	0.10	0.10	0.10	0.10	mg/L	1	1	8	0
Aluminum (dissolved)	2.30	2.54	8.00	1.10	6.20	1.65	2.60	ug/L	1	1	0	8
Ammonia Nitrogen	0.01	0.01	8.00	0.01	0.01	0.01	0.01	mg/L	0.1	0.1	8	0
Antimony (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Arsenic (dissolved)	2.40	2.36	8.00	1.20	3.80	1.83	2.75	ug/L	1	1	0	8
Barium (dissolved)	37.30	37.68	8.00	24.70	53.00	32.03	43.20	ug/L	1	1	0	8
Beryllium (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Bicarbonate (as CaCO3)	182.50	182.75	8.00	142.00	238.00	149.75	203.50	mg/L	1	1	0	8
Bicarbonate (as HCO3)	222.45	222.78	8.00	173.10	290.10	182.58	248.10	mg/L	1.2	1.2	0	8
Boron (dissolved)	0.20	0.21	8.00	0.20	0.30	0.20	0.20	mg/L	0.1	0.1	0	8
Bromide	0.15	0.14	8.00	0.01	0.24	0.13	0.16	mg/L	0.1	0.1	1	7
Cadmium (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Calcium (dissolved)	67.50	66.46	8.00	46.20	91.40	57.65	72.68	mg/L	0.5	0.5	0	8

INORGANIC (cont'd)												
Carbonate (as CaCO3)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	mg/L	1	1	8	0
Cation-Anion meq balance	-4.37	-4.39	5.00	-10.26	-0.44	-6.32	-0.55	RATIO			0	5
Chloride	99.85	96.96	8.00	66.20	144.00	74.55	106.50	mg/L	0.5	2	0	8
Chromium (dissolved)	0.10	0.69	8.00	0.10	3.90	0.10	0.33	ug/L	1	1	6	2
Cobalt (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Copper (dissolved)	3.65	3.70	8.00	2.80	4.30	3.50	4.05	ug/L	1	1	0	8
Electrical Conductivity	871.50	858.13	8.00	622.00	1200.00	722.50	919.50	uS/cm	1	1	0	8
Fluoride	0.36	0.34	8.00	0.25	0.43	0.31	0.37	mg/L	0.1	0.1	0	8
Gadolinium (dissolved)	52.60	52.15	8.00	10.90	79.60	43.53	66.65	ng/L	10	10	0	8
Hydroxide (as CaCO3)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	mg/L	1	1	8	0
Iron (dissolved)	4.65	5.81	8.00	0.10	15.00	3.45	7.58	ug/L	1	5	1	7
Lead (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Magnesium (dissolved)	16.40	16.60	8.00	11.50	23.30	14.53	18.18	mg/L	0.5	0.5	0	8
Manganese (dissolved)	0.10	0.78	8.00	0.10	5.50	0.10	0.10	ug/L	1	1	7	1
Mercury (dissolved)	0.10	0.09	8.00	0.01	0.10	0.10	0.10	ug/L	0.1	1	8	0
Nickel (dissolved)	2.55	2.16	8.00	0.10	4.00	1.38	2.70	ug/L	1	1	1	7
Nitrate	8.80	9.83	8.00	5.80	17.00	7.55	10.50	mg/L	0.4	0.4	0	8
Nitrate + Nitrite Nitrogen	1.99	2.23	8.00	1.36	3.85	1.71	2.39	mg/L	0.1	0.1	0	8
Nitrate Nitrogen	1.99	2.22	8.00	1.31	3.85	1.70	2.38	mg/L	0.1	0.1	0	8
Nitrite	0.02	0.04	8.00	0.01	0.15	0.02	0.03	mg/L	0.007	0.007	0	8
Nitrite Nitrogen	0.01	0.01	8.00	0.00	0.05	0.01	0.01	mg/L	0.002	0.002	0	8
Organic Nitrogen	0.30	0.29	8.00	0.20	0.40	0.28	0.30	mg/L	0.1	0.1	0	8
Phosphate Phosphorus (orthophosphate)	0.69	0.67	8.00	0.55	0.78	0.59	0.72	mg/L	0.01	0.01	0	8
Potassium (dissolved)	10.60	10.36	8.00	8.00	12.80	9.18	11.15	mg/L	0.5	0.5	0	8
Selenium (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Silica	14.40	13.94	8.00	8.40	18.00	11.60	17.43	mg/L	1	1	0	8
Silver (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Sodium (dissolved)	78.95	78.74	8.00	54.40	111.00	65.43	86.38	mg/L	0.5	0.5	0	8

INORGANIC (cont'd)												
Sulfate	95.15	96.19	8.00	62.80	147.00	82.75	103.00	mg/L	0.5	2	0	8
Suspended Solids	0.25	0.21	4.00	0.10	0.25	0.21	0.25	mg/L	1	2.5	4	0
Temperature (Laboratory)	22.10	21.87	3.00	21.00	22.50	21.55	22.30	C	1	1	0	3
Thallium (dissolved)	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1	1	8	0
Title 22 Total Anions	8.53	8.57	8.00	6.17	12.14	6.97	9.37	meq/L			0	8
Total Alkalinity (as CaCO3)	182.50	182.75	8.00	142.00	238.00	149.75	203.50	mg/L	1	5	0	8
Total Anions	8.21	8.74	5.00	6.20	12.17	6.95	10.15	meq/L	0	0	0	5
Total Cations	8.17	8.34	5.00	5.82	11.65	6.91	9.16	meq/L	0	0	0	5
Total Dissolved Solids	480.00	500.75	8.00	368.00	734.00	417.00	539.00	mg/L	1	2.5	0	8
Total Hardness (as CaCO3) (dissolved)	236.00	234.25	8.00	163.00	324.00	203.75	256.00	mg/L	1	1	0	8
Total Kjeldahl Nitrogen	0.30	0.30	8.00	0.20	0.40	0.30	0.30	mg/L	0.2	0.2	0	8
Total Nitrogen	2.30	2.55	8.00	1.80	4.20	2.03	2.68	mg/L	0.2	0.2	0	8
Total Organic Carbon (Unfiltered)	3.52	3.45	8.00	2.77	3.93	3.34	3.58	mg/L	0.05	0.05	0	8
Turbidity	0.30	0.35	8.00	0.10	0.60	0.28	0.50	NTU	0.1	0.1	0	8
UV Absorbance/TOC (unfiltered) ratio	0.03	0.03	8.00	0.02	0.04	0.03	0.03	L/mg-cm	1E-04	1E-04	0	8
Ultraviolet (absorbance)	0.10	0.10	8.00	0.07	0.12	0.10	0.11	1/cm	0.005	0.005	0	8
Vanadium (dissolved)	4.85	5.01	8.00	3.50	7.60	4.43	5.25	ug/L	1	1	0	8
Zinc (dissolved)	8.75	8.53	8.00	1.70	19.10	4.50	10.88	ug/L	1	1	0	8
pH	7.90	7.89	8.00	7.60	8.00	7.88	8.00	UNITS	1	1	0	8
ORGANIC												
Aspartame	10.00	10.00	5.00	10.00	10.00	10.00	10.00	ng/L	100	100	5	0
Atenolol	0.50	0.50	5.00	0.50	0.50	0.50	0.50	ng/L	5	5	5	0
Diclofenac	0.50	0.50	5.00	0.50	0.50	0.50	0.50	ng/L	5	5	5	0
Dilantin	28.60	28.28	5.00	12.30	41.10	27.00	32.40	ng/L	10	10	0	5
Dissolved Organic Carbon	3.45	3.35	8.00	2.69	3.79	3.24	3.58	mg/L	0.05	0.05	0	8
Fluoxetine	0.50	0.50	5.00	0.50	0.50	0.50	0.50	ng/L	5	5	5	0
Iohexol	152.00	255.00	5.00	77.00	690.00	146.00	210.00	ng/L	20	20	0	5

ORGANIC (cont'd)												
Iopromide	12.60	11.36	5.00	1.00	27.30	1.00	14.90	ng/L	10	10	2	3
Linuron	0.00	0.00	5.00	0.00	0.00	0.00	0.00	ug/L	0.005	0.005	5	0
Meprobamate	19.70	21.30	5.00	5.60	41.40	16.60	23.20	ng/L	5	10	0	5
Naproxen	0.50	0.60	5.00	0.50	1.00	0.50	0.50	ng/L	5	10	5	0
Neotame	1.00	1.00	5.00	1.00	1.00	1.00	1.00	ng/L	10	10	5	0
Sucralose	16700.00	15980.00	5.00	10900.00	22600.00	12200.00	17500.00	ng/L	100	1000	0	5
Total Organic Halogen	50.00	46.33	3.00	38.00	51.00	44.00	50.50	ug/L	20	20	0	3
Trimethoprim	0.50	0.50	5.00	0.50	0.50	0.50	0.50	ng/L	5	5	5	0
Tris-2-chloroethyl phosphate	40.50	41.18	5.00	18.50	62.10	27.60	57.20	ng/L	5	5	0	5
para-Chlorobenzene sulfonic acid	20.00	20.00	5.00	20.00	20.00	20.00	20.00	ng/L	200	200	5	0
SEMI-ORGANIC												
Acetaminophen	0.50	0.50	5.00	0.50	0.50	0.50	0.50	ng/L	5	5	5	0
Atrazine	0.00	0.00	5.00	0.00	0.01	0.00	0.00	ug/L	0.001	0.001	0	5
Azithromycin	1.00	2.60	5.00	1.00	5.00	1.00	5.00	ng/L	10	50	5	0
Caffeine	6.90	6.70	5.00	3.70	8.80	5.50	8.60	ng/L	3	3	0	5
Carbamazepine	60.50	65.20	5.00	39.70	87.70	59.50	78.60	ng/L	1	1	0	5
Diuron	0.03	0.05	5.00	0.01	0.09	0.02	0.09	ug/L	0.005	0.01	0	5
Erythromycin	0.10	0.10	5.00	0.10	0.10	0.10	0.10	ng/L	1	1	5	0
Gemfibrozil	0.10	0.10	5.00	0.10	0.10	0.10	0.10	ng/L	1	1	5	0
Ibuprofen	0.10	0.18	5.00	0.10	0.50	0.10	0.10	ng/L	1	5	5	0
N,N-diethyl-m-toluamide	8.70	8.28	5.00	3.40	11.70	7.30	10.30	ng/L	1	1	0	5
Primidone	43.30	36.44	5.00	5.00	65.20	10.00	58.70	ng/L	1	100	2	3
Simazine	0.02	0.03	5.00	0.01	0.05	0.02	0.03	ug/L	0.005	0.005	0	5
Sulfamethoxazole	50.20	58.06	5.00	25.60	110.00	38.40	66.10	ng/L	1	1	0	5
Triclosan	0.10	0.18	5.00	0.10	0.50	0.10	0.10	ng/L	1	5	5	0

Olive Basin Water Quality Summary Data (2014-2019)

PARAMETER NAME	MEDIAN	MEAN	N=	MINIMUM	MAXIMUM	25th PERCENTILE	75th PERCENTILE	UNITS	MIN RDL	MAX RDL	# of NDs	# of DETECTS
BIOLOGICAL												
E. Coli (Membrane Filtration - CFU/100ml)	0.10	0.10	10.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	10.00
Enterococcus (Membrane Filtration-CFU/100ml)	0.10	0.10	10.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	10.00
Fecal Coliform (Membrane Filtration-CFU/100ml)	0.10	0.10	2.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	2.00
Heterotrophic Plate Count (pour plate-CFU/1ml)	37.00	56.29	7.00	31.00	104.00	34.00	77.00	CFU/1 ml	1.00	1.00	0.00	7.00
Total Coliform (Membrane Filtration-CFU/100ml)	0.10	1.28	10.00	0.10	11.00	0.10	0.10	CFU/100	1.00	1.00	0.00	10.00
FIELD MEASUREMENTS												
Field Electrical Conductivity	1080.00	1047.47	30.00	609.00	1260.00	988.75	1165.00	uS/cm	0.00	1.00	0.00	30.00
Field Oxidation-Reduction Potential	84.00	66.73	30.00	-189.00	221.00	35.25	121.50	mV	-1000.00	-1000.00	0.00	30.00
Field Temperature	20.55	20.49	30.00	15.70	27.20	18.65	21.68	C	0.00	1.00	0.00	30.00
Field pH	7.40	7.41	30.00	6.30	7.90	7.30	7.50	UNITS	0.00	1.00	0.00	30.00
INORGANIC												
Aggressive Index	12.49	12.46	6.00	12.14	12.76	12.36	12.55	A.I.			0.00	6.00
Alkalinity-Phenolphthalein	0.10	0.10	28.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	0.00	28.00
Aluminum (dissolved)	1.50	1.84	22.00	0.10	8.40	1.15	2.00	ug/L	1.00	1.00	0.00	22.00
Ammonia Nitrogen	0.01	0.01	22.00	0.01	0.01	0.01	0.01	mg/L	0.10	0.10	0.00	22.00
Antimony (dissolved)	0.10	0.10	22.00	0.05	0.50	0.06	0.10	ug/L	0.50	1.00	0.00	22.00
Arsenic (dissolved)	4.65	4.60	22.00	3.20	5.80	4.15	5.00	ug/L	1.00	1.00	0.00	22.00
Barium (dissolved)	73.30	68.45	22.00	36.30	91.90	52.48	81.35	ug/L	1.00	1.00	0.00	22.00
Beryllium (dissolved)	0.10	0.08	22.00	0.05	0.10	0.05	0.10	ug/L	0.50	1.00	0.00	22.00
Bicarbonate (as CaCO3)	218.00	209.93	28.00	145.00	246.00	207.50	225.75	mg/L	1.00	1.00	0.00	28.00
Bicarbonate (as HCO3)	265.70	255.91	28.00	176.80	299.90	252.98	275.20	mg/L	1.20	1.20	0.00	28.00

Boron	0.29	0.28	6.00	0.23	0.31	0.27	0.31	mg/L	0.10	0.10	0.00	6.00
Boron (dissolved)	0.30	0.26	22.00	0.20	0.30	0.20	0.30	mg/L	0.10	0.10	0.00	22.00
Bromate	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	0.00	1.00
INORGANIC (cont'd)												
Bromide	0.20	0.18	28.00	0.01	0.30	0.16	0.21	mg/L	0.01	0.10	0.00	28.00
Cadmium (dissolved)	0.10	0.10	22.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Calcium	86.20	87.25	6.00	80.40	95.50	84.95	89.55	mg/L	0.50	0.50	0.00	6.00
Calcium (dissolved)	85.40	80.60	22.00	42.30	102.00	68.83	93.70	mg/L	0.50	0.50	0.00	22.00
Carbonate (as CaCO3)	0.10	0.10	28.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	0.00	28.00
Cation-Anion meq balance	-1.23	-1.01	19.00	-5.86	3.89	-3.31	1.27	RATIO			0.00	19.00
Chlorate	10.80	10.80	1.00	10.80	10.80	10.80	10.80	ug/L	10.00	10.00	0.00	1.00
Chloride	132.00	123.08	28.00	61.70	150.00	115.00	140.25	mg/L	0.50	2.00	0.00	28.00
Chromium (dissolved)	0.10	0.24	22.00	0.10	1.30	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Cobalt (dissolved)	0.10	0.19	22.00	0.10	1.10	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Copper (dissolved)	2.85	3.00	22.00	1.80	4.20	2.53	3.58	ug/L	1.00	1.00	0.00	22.00
Cyanide	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	0.00	1.00
Electrical Conductivity	1075.00	1029.46	28.00	633.00	1240.00	985.25	1150.00	uS/cm	1.00	1.00	0.00	28.00
Fluoride	0.34	0.36	22.00	0.29	0.45	0.32	0.39	mg/L	0.10	0.10	0.00	22.00
Gadolinium (dissolved)	26.60	29.91	22.00	10.80	63.70	22.90	31.85	ng/L	10.00	10.00	0.00	22.00
Hexavalent Chromium	0.30	0.30	1.00	0.30	0.30	0.30	0.30	ug/L	0.20	0.20	0.00	1.00
Hydroxide (as CaCO3)	0.10	0.14	28.00	0.10	0.50	0.10	0.10	mg/L	1.00	5.00	6.00	22.00
Iron (dissolved)	0.50	1.13	22.00	0.10	8.20	0.10	1.75	ug/L	1.00	5.00	0.00	22.00
Lead (dissolved)	0.10	0.10	22.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Magnesium	22.55	22.60	6.00	20.80	24.40	22.03	23.23	mg/L	0.50	0.50	0.00	6.00
Magnesium (dissolved)	22.00	21.09	22.00	11.10	27.00	18.30	24.63	mg/L	0.50	0.50	0.00	22.00
Manganese (dissolved)	0.10	2.32	22.00	0.10	16.70	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Mercury (dissolved)	0.06	0.06	22.00	0.01	0.10	0.01	0.10	ug/L	0.10	1.00	0.00	22.00
Nickel (dissolved)	2.35	2.59	22.00	1.10	4.30	2.00	3.25	ug/L	1.00	1.00	0.00	22.00
Nitrate	7.15	7.28	28.00	0.80	13.60	5.13	9.23	mg/L	0.40	0.40	0.00	28.00

Nitrate + Nitrite Nitrogen	1.66	1.69	23.00	0.70	3.08	1.23	2.16	mg/L	0.10	0.10	0.00	23.00
Nitrate Nitrogen	1.63	1.65	28.00	0.18	3.08	1.16	2.09	mg/L	0.10	0.10	0.00	28.00
Nitrite	0.00	0.00	23.00	0.00	0.01	0.00	0.00	mg/L	0.00	0.01	17.00	6.00
Nitrite Nitrogen	0.00	0.00	23.00	0.00	0.00	0.00	0.00	mg/L	0.00	0.00	0.00	23.00
INORGANIC (cont'd)												
Organic Nitrogen	0.01	0.10	22.00	0.01	0.30	0.01	0.20	mg/L	0.10	0.10	0.00	22.00
Perchlorate	0.25	0.24	20.00	0.20	0.25	0.25	0.25	ug/L	2.00	2.50	0.00	20.00
Phosphate Phosphorus (orthophosphate)	0.60	0.61	22.00	0.55	0.74	0.57	0.64	mg/L	0.01	0.01	0.00	22.00
Potassium	12.40	12.40	6.00	10.80	14.00	11.15	13.65	mg/L	0.50	0.50	0.00	6.00
Potassium (dissolved)	10.75	10.60	22.00	7.40	14.10	9.13	11.88	mg/L	0.50	0.50	0.00	22.00
Selenium (dissolved)	0.10	0.31	22.00	0.10	1.10	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Silica	17.50	17.38	22.00	13.70	21.80	15.85	18.83	mg/L	1.00	1.00	0.00	22.00
Silver (dissolved)	0.10	0.10	22.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	22.00
Sodium	103.50	101.60	6.00	88.60	110.00	100.75	104.00	mg/L	0.50	0.50	0.00	6.00
Sodium (dissolved)	99.55	96.40	22.00	67.50	115.00	84.65	110.50	mg/L	0.50	0.50	0.00	22.00
Sulfate	128.00	126.23	28.00	66.50	182.00	104.00	150.75	mg/L	0.50	2.00	0.00	28.00
Surfactants	0.00	0.00	1.00	0.00	0.00	0.00	0.00	mg/L	0.02	0.02	0.00	1.00
Suspended Solids	0.10	0.13	14.00	0.10	0.25	0.10	0.10	mg/L	1.00	2.50	0.00	14.00
Temperature (Laboratory)	21.30	21.36	7.00	20.20	22.20	20.85	22.05	C	1.00	1.00	0.00	7.00
Thallium (dissolved)	0.10	0.08	22.00	0.05	0.10	0.05	0.10	ug/L	0.50	1.00	0.00	22.00
Title 22 Total Anions	10.84	10.26	22.00	6.16	12.55	8.85	11.74	meq/L			0.00	22.00
Title 22 Total Cations	11.09	10.95	6.00	10.25	11.61	10.50	11.30	meq/L			0.00	6.00
Total Alkalinity (as CaCO3)	218.00	209.96	28.00	145.00	246.00	207.50	225.75	mg/L	1.00	5.00	0.00	28.00
Total Anions	10.99	10.60	19.00	6.85	12.58	9.89	12.04	meq/L	0.00	0.00	0.00	19.00
Total Cations	10.86	10.51	19.00	6.55	12.60	9.42	12.01	meq/L	0.00	0.00	0.00	19.00
Total Dissolved Solids	648.00	616.09	22.00	338.00	778.00	513.00	723.00	mg/L	1.00	2.50	0.00	22.00
Total Hardness (as CaCO3) (dissolved)	304.00	288.14	22.00	151.00	365.00	247.75	335.25	mg/L	1.00	1.00	0.00	22.00
Total Kjeldahl Nitrogen	0.02	0.07	22.00	0.02	0.30	0.02	0.02	mg/L	0.20	0.20	0.00	22.00

Total Nitrogen	1.63	1.72	22.00	0.79	3.10	1.20	2.15	mg/L	0.10	0.20	0.00	22.00
Total Organic Carbon (Unfiltered)	1.63	1.70	28.00	0.98	2.41	1.44	1.99	mg/L	0.05	0.05	0.00	28.00
Turbidity	0.15	0.21	22.00	0.01	1.10	0.01	0.28	NTU	0.10	0.10	0.00	22.00
UV Absorbance/TOC (unfiltered) ratio	0.02	0.03	22.00	0.02	0.04	0.02	0.03	L/mg-cm	0.00	0.00	0.00	22.00
INORGANIC (cont'd)												
Ultraviolet (absorbance)	0.04	0.04	22.00	0.02	0.06	0.03	0.05	1/cm	0.01	0.01	0.00	22.00
Vanadium (dissolved)	7.35	7.23	22.00	5.00	10.90	6.53	8.00	ug/L	1.00	1.00	0.00	22.00
Zinc (dissolved)	1.50	6.73	22.00	0.10	115.00	0.10	2.53	ug/L	1.00	1.00	0.00	22.00
pH	7.80	7.82	28.00	7.50	8.10	7.80	7.90	UNITS	1.00	1.00	0.00	28.00
ORGANIC												
1,1,1,2-Tetrachloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1,1-Trichloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1,2,2-Tetrachloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1,2-Trichloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1-Dichloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1-Dichloroethene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,1-Dichloropropene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2,3-Trichlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2,3-Trichloropropane	0.05	0.03	34.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	34.00	0.00
1,2,4-Trichlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2,4-Trimethylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2-Dibromo-3-chloropropane	0.05	0.03	34.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	34.00	0.00
1,2-Dibromoethane	0.05	0.03	34.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	34.00	0.00
1,2-Dichlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2-Dichloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,2-Dichloropropane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,3,5-Trimethylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,3-Dichlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,3-Dichloropropane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00

1,4-Dichlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
1,4-Dioxane	0.10	0.09	20.00	0.05	0.10	0.10	0.10	ug/L	0.50	1.00	20.00	0.00
11-chloroeicosafluoro-3-oxaundecane-1sulfonic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
17a-Estradiol	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	9.00	0.00
ORGANIC (cont'd)												
17a-Ethynylestradiol	0.20	0.29	9.00	0.20	1.00	0.20	0.20	ng/L	2.00	10.00	9.00	0.00
17b-Estradiol	0.20	0.20	9.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	9.00	0.00
2,2-Dichloropropane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
2,4-Dinitrotoluene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,6-Dinitrotoluene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2-Chloroethylvinyl ether	0.10	0.10	13.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	13.00	0.00
2-Chlorotoluene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
2-Hexanone	1.00	1.00	13.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	13.00	0.00
4,8-dioxa-3H-perfluorononanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
4-Androstene-3,17-dione	0.20	0.20	7.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	7.00	0.00
4-Chlorotoluene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
4-Isopropyltoluene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
4-n-Octylphenol	0.02	0.02	10.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	10.00	0.00
4-tert-Octylphenol	0.02	0.02	10.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	10.00	0.00
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Acetone	1.00	1.00	20.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	20.00	0.00
Acrolein	1.00	0.93	15.00	0.50	1.00	1.00	1.00	ug/L	5.00	10.00	15.00	0.00
Acrylonitrile	1.00	0.89	15.00	0.20	1.00	1.00	1.00	ug/L	2.00	10.00	15.00	0.00
Aspartame	10.00	10.00	18.00	10.00	10.00	10.00	10.00	ng/L	100.00	100.00	18.00	0.00
Atenolol	0.50	0.50	18.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	18.00	0.00
Benzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Bisphenol A	0.02	0.02	10.00	0.02	0.05	0.02	0.02	ug/L	0.20	0.50	10.00	0.00
Bromobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00

Bromochloromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Bromodichloromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Bromoform	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Bromomethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Carbon Disulfide	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
ORGANIC (cont'd)												
Carbon tetrachloride	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Chlorobenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Chlorodifluoromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Chloroethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Chloroform	0.05	0.15	20.00	0.05	0.80	0.05	0.25	ug/L	0.50	0.50	13.00	7.00
Chloromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Chlorotrifluoroethene	0.50	0.50	4.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	4.00	0.00
Dacthal Acid Metabolites	0.03	0.03	1.00	0.03	0.03	0.03	0.03	ug/L	0.25	0.25	1.00	0.00
Dibromochloromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Dibromomethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Dichlorodifluoromethane	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Diclofenac	0.50	0.50	18.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	18.00	0.00
Diethylstilbestrol	0.20	0.20	9.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	9.00	0.00
Diflubenzuron	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Diisopropyl ether	0.10	0.10	20.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	20.00	0.00
Dilantin	19.60	21.34	18.00	1.00	47.20	17.35	28.20	ng/L	10.00	10.00	2.00	16.00
Dissolved Organic Carbon	1.75	1.75	22.00	1.28	2.42	1.40	2.07	mg/L	0.05	0.05	0.00	22.00
Endosulfan II	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
Epitestosterone (cis-Testosterone)	0.10	0.10	10.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	10.00	0.00
Equilin	0.50	0.50	6.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	6.00	0.00
Estriol	0.20	0.20	9.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	9.00	0.00
Estrone	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	9.00	0.00
Ethyl tert-butyl ether	0.10	0.10	20.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	20.00	0.00

Ethylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Fluometuron	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Fluoxetine	0.50	0.50	18.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	18.00	0.00
Freon 123a	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
HCH-alpha (Alpha-BHC)	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.02	0.10	2.00	0.00
ORGANIC (cont'd)												
HCH-beta (Beta-BHC)	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.02	0.10	2.00	0.00
HCH-delta (Delta-BHC)	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.02	0.10	2.00	0.00
Hexachlorobutadiene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Hexafluoropropylene oxide dimer acid (GenX)	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Iohexol	2.00	12.49	18.00	2.00	66.80	2.00	2.00	ng/L	20.00	20.00	14.00	4.00
Iopromide	1.00	1.00	18.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	18.00	0.00
Isophorone	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Isopropylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Linuron	0.00	0.01	19.00	0.00	0.10	0.00	0.00	ug/L	0.01	1.00	19.00	0.00
Meprobamate	0.50	1.49	18.00	0.50	10.20	0.50	0.50	ng/L	5.00	10.00	16.00	2.00
Methyl Ethyl Ketone (MEK)	0.50	0.46	20.00	0.25	0.50	0.50	0.50	ug/L	2.50	5.00	20.00	0.00
Methyl Isobutyl Ketone (MIBK)	0.50	0.46	20.00	0.25	0.50	0.50	0.50	ug/L	2.50	5.00	20.00	0.00
Methyl tert-butyl ether	0.02	0.02	20.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	20.00	0.00
Methylene Chloride	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Methylisothiocyanate	0.00	0.00	13.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	13.00	0.00
Metolachlor	0.05	0.05	2.00	0.01	0.08	0.03	0.06	ug/L	0.10	0.80	2.00	0.00
N-Nitrosomorpholine	1.00	1.00	1.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	1.00	0.00
N-ethyl perfluorooctanesulfonamidoacetic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
N-methyl perfluorooctanesulfonamidoacetic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Naphthalene	0.05	0.05	21.00	0.01	0.05	0.05	0.05	ug/L	0.10	0.50	21.00	0.00

Naproxen	0.50	0.81	18.00	0.50	5.00	0.50	0.50	ng/L	5.00	50.00	18.00	0.00
Neotame	1.00	1.00	18.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	18.00	0.00
Nitrobenzene	0.50	0.50	13.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	13.00	0.00
Nonylphenol	0.02	0.02	10.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	10.00	0.00
PCB-1016	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PCB-1221	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
ORGANIC (cont'd)												
PCB-1232	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PCB-1242	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PCB-1248	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PCB-1254	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PCB-1260	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
PFOA + PFOS	21.00	21.00	2.00	14.30	27.70	17.65	24.35	ng/L	2.00	4.00	0.00	2.00
Perfluoro butane sulfonic acid	13.25	13.25	2.00	13.10	13.40	13.18	13.33	ng/L	2.00	4.00	0.00	2.00
Perfluoro heptanoic acid	1.95	1.95	2.00	0.40	3.50	1.18	2.73	ng/L	2.00	4.00	1.00	1.00
Perfluoro hexane sulfonic acid	8.65	8.65	2.00	6.30	11.00	7.48	9.83	ng/L	2.00	4.00	0.00	2.00
Perfluoro nonanoic acid	1.40	1.40	2.00	0.40	2.40	0.90	1.90	ng/L	2.00	4.00	1.00	1.00
Perfluoro octane sulfonic acid	13.05	13.05	2.00	9.30	16.80	11.18	14.93	ng/L	2.00	4.00	0.00	2.00
Perfluoro octanoic acid	7.95	7.95	2.00	5.00	10.90	6.48	9.43	ng/L	2.00	4.00	0.00	2.00
Perfluorodecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorododecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorohexanoic acid	8.90	8.90	1.00	8.90	8.90	8.90	8.90	ng/L	2.00	2.00	0.00	1.00
Perfluorotetradecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorotridecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluoroundecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
PhenylPhenol	0.02	0.02	10.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	10.00	0.00
Progesterone	0.10	0.10	10.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	10.00	0.00
Propanil	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Propylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00

Siduron	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Styrene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Sucralose	11750.00	11988.89	18.00	4830.00	20300.00	7825.00	16225.00	ng/L	100.00	1000.00	0.00	18.00
Terbufos Sulfone	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Tert-amyl methyl ether	0.10	0.10	20.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	20.00	0.00
Testosterone (trans-Testosterone)	0.10	0.10	10.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	10.00	0.00
ORGANIC (cont'd)												
Tetrabromobisphenol A	0.02	0.02	10.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	10.00	0.00
Tetrachloroethene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Thidiazuron	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Toluene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Total 1,3-Dichloropropene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Total Organic Halogen	28.50	29.50	18.00	2.00	57.00	22.50	34.75	ug/L	20.00	20.00	1.00	17.00
Total Trihalomethanes	0.05	0.15	20.00	0.05	0.80	0.05	0.25	ug/L	0.50	0.50	13.00	7.00
Total Xylenes (m,p,&o)	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Trichloroethene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Trichlorofluoromethane (Freon 11)	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Trichlorotrifluoroethane (Freon 113)	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
Trimethoprim	0.50	0.50	18.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	18.00	0.00
Tris-2-chloroethyl phosphate	0.50	9.21	18.00	0.50	67.50	0.50	1.00	ng/L	5.00	10.00	14.00	4.00
Vinyl Acetate	1.00	1.00	13.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	13.00	0.00
Vinyl chloride	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
bis (2-chloroethyl) ether	0.50	0.46	20.00	0.25	0.50	0.50	0.50	ug/L	2.50	5.00	20.00	0.00
cis-1,2-Dichloroethene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
cis-1,3-Dichloropropene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
m,p-Xylene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
n-Butylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
n-Nitrosodimethylamine	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00

o-Xylene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
para-Chlorobenzene sulfonic acid	20.00	20.00	18.00	20.00	20.00	20.00	20.00	ng/L	200.00	200.00	18.00	0.00
sec-Butylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
tert-Butylbenzene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
tert-butyl alcohol	0.20	0.20	20.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	20.00	0.00
trans-1,2 Dichloroethene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
trans-1,3-Dichloropropene	0.05	0.05	20.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	20.00	0.00
SEMI-ORGANIC												
1-Naphthol	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	1.00	0.00
2,2',3',4,6-Pentachlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,2',3,3',4,4',6-Heptachlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,2',4,4',5,6'-Hexachlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,2',4,4'-Tetrachlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,3-Dichlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,4,5-TP (Silvex)	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
2,4,5-Trichlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
2,4-Dichlorophenoxyacetic Acid	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
2-Chlorobiphenyl	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
3-Hydroxycarbofuran	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
4,4'-DDD	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
4,4'-DDE	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
4,4'-DDT	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
Acenaphthene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Acenaphthylene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Acetaminophen	0.50	0.75	18.00	0.50	5.00	0.50	0.50	ng/L	5.00	50.00	18.00	0.00
Acetochlor	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Acifluorfen	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00

Alachlor	0.01	0.02	3.00	0.01	0.05	0.01	0.03	ug/L	0.10	0.50	3.00	0.00
Aldicarb	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Aldicarb sulfone	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Aldicarb sulfoxide	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Aldrin	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.03	0.10	2.00	0.00
Ametryn	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Anthracene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Atrazine	0.00	0.00	20.00	0.00	0.01	0.00	0.00	ug/L	0.00	0.10	8.00	12.00
SEMI-ORGANIC (cont'd)												
Azithromycin	1.00	1.50	18.00	1.00	5.00	1.00	1.00	ng/L	10.00	50.00	18.00	0.00
Baygon	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Bentazon	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Benzo(a)anthracene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Benzo(a)pyrene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Benzo(b)fluoranthene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Benzo(g,h,i)perylene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Benzo[k]fluoranthene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Bromacil	0.03	0.03	2.00	0.01	0.05	0.02	0.04	ug/L	0.10	0.50	2.00	0.00
Butachlor	0.02	0.02	2.00	0.01	0.04	0.02	0.03	ug/L	0.10	0.38	2.00	0.00
Butylate	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Butylbenzyl phthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Caffeine	0.30	2.61	20.00	0.30	30.00	0.30	0.60	ng/L	3.00	300.00	19.00	1.00
Captan	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Carbamazepine	75.85	68.06	18.00	36.80	92.10	52.60	84.75	ng/L	1.00	5.00	0.00	18.00
Carbaryl	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Carbofuran	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Chlordane	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Chlordane-alpha	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
Chlordane-gamma	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00

Chlorobenzilate	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Chloroneb	0.03	0.03	2.00	0.01	0.04	0.02	0.03	ug/L	0.10	0.40	2.00	0.00
Chlorothalonil	0.26	0.26	2.00	0.01	0.50	0.13	0.38	ug/L	0.10	5.00	2.00	0.00
Chlorpropham	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Chlorpyrifos	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Chrysene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Cycloate	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
DCPA-Dacthal	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Dalapon	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
SEMI-ORGANIC (cont'd)												
Di-n-butylphthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Di-n-octyl phthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Diazinon	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Dibenzo(a,h)anthracene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Dicamba	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.08	0.08	1.00	0.00
Dichlorvos	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Dieldrin	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.02	0.10	2.00	0.00
Diethyl phthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Dimethoate	0.26	0.26	2.00	0.01	0.50	0.13	0.38	ug/L	0.10	5.00	2.00	0.00
Dimethyl phthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Dinoseb	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
Diphenamid	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Diquat	0.40	0.40	1.00	0.40	0.40	0.40	0.40	ug/L	4.00	4.00	1.00	0.00
Diuron	0.00	0.04	19.00	0.00	0.41	0.00	0.04	ug/L	0.01	1.00	12.00	7.00
EPTC	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Endosulfan I	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Endosulfan sulfate	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Endothall	4.50	4.50	1.00	4.50	4.50	4.50	4.50	ug/L	45.00	45.00	1.00	0.00
Endrin	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.03	0.10	2.00	0.00

Endrin Aldehyde	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Endrin Ketone	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Erythromycin	0.10	0.12	18.00	0.10	0.50	0.10	0.10	ng/L	1.00	5.00	18.00	0.00
Ethion	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Ethoprop	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Etridiazole	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Fenarimol	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Fluoranthene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Fluorene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Fluoridone	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
SEMI-ORGANIC (cont'd)												
Gemfibrozil	0.10	0.10	18.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	18.00	0.00
Glyphosate	2.50	2.50	1.00	2.50	2.50	2.50	2.50	ug/L	25.00	25.00	1.00	0.00
HCH-gamma (Lindane)	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Heptachlor	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
Heptachlor epoxide	0.01	0.01	2.00	0.00	0.01	0.00	0.01	ug/L	0.01	0.10	2.00	0.00
Hexachlorobenzene	0.03	0.03	2.00	0.01	0.05	0.02	0.04	ug/L	0.10	0.50	2.00	0.00
Hexachlorocyclopentadiene	0.03	0.03	2.00	0.01	0.05	0.02	0.04	ug/L	0.10	0.50	2.00	0.00
Hexazinone	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Ibuprofen	0.10	0.24	18.00	0.10	1.00	0.10	0.10	ng/L	1.00	10.00	18.00	0.00
Indeno(1,2,3-cd)pyrene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
MGK 264	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Malathion	0.60	0.60	1.00	0.60	0.60	0.60	0.60	ug/L	6.00	6.00	1.00	0.00
Methiocarb	0.40	0.40	1.00	0.40	0.40	0.40	0.40	ug/L	4.00	4.00	1.00	0.00
Methomyl	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Methoxychlor	0.06	0.06	2.00	0.01	0.10	0.03	0.08	ug/L	0.10	1.00	2.00	0.00
Methyl paraoxon	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Metribuzin	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
Mevinphos	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00

Molinate	0.03	0.03	2.00	0.01	0.05	0.02	0.04	ug/L	0.10	0.50	2.00	0.00
N,N-diethyl-m-toluamide	0.10	0.89	18.00	0.10	7.40	0.10	0.50	ng/L	1.00	5.00	14.00	4.00
Napropamide	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Norflurazon	0.08	0.08	2.00	0.05	0.10	0.06	0.09	ug/L	0.50	1.00	2.00	0.00
Oxamyl	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Paraquat	0.40	0.40	1.00	0.40	0.40	0.40	0.40	ug/L	4.00	4.00	1.00	0.00
Parathion	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
Pebulate	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Pentachlorophenol (PCP)	0.02	0.03	12.00	0.01	0.10	0.02	0.02	ug/L	0.10	1.00	12.00	0.00
Permethrin-(total of cis/trans)	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Phenanthrene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
SEMI-ORGANIC (cont'd)												
Picloram	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
Primidone	41.00	41.74	18.00	5.00	71.00	35.55	48.65	ng/L	1.00	100.00	2.00	16.00
Prometon	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Prometryn	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Pronamide	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Propachlor	0.05	0.04	3.00	0.01	0.05	0.03	0.05	ug/L	0.10	0.50	3.00	0.00
Propazine	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Pyrene	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Simazine	0.02	0.02	19.00	0.01	0.04	0.01	0.02	ug/L	0.01	0.10	2.00	17.00
Simetryn	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Stirofos	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Sulfamethoxazole	44.60	51.42	18.00	14.90	120.00	35.70	55.13	ng/L	1.00	5.00	0.00	18.00
Tebuthiuron	0.15	0.15	2.00	0.10	0.20	0.13	0.18	ug/L	1.00	2.00	2.00	0.00
Terbacil	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	2.00	0.00
Terbutryn	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Thiobencarb	0.03	0.03	2.00	0.01	0.05	0.02	0.04	ug/L	0.10	0.50	2.00	0.00
Toxaphene Mixture	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00

Triadimefon	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	1.00	0.00
Triclosan	0.10	0.19	18.00	0.10	1.00	0.10	0.10	ng/L	1.00	10.00	18.00	0.00
Tricyclazole	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
Trifluralin	0.01	0.01	2.00	0.01	0.01	0.01	0.01	ug/L	0.05	0.10	2.00	0.00
Trithion	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
Vernolate	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00
bis (2-ethylhexyl) adipate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
bis (2-ethylhexyl) phthalate	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	1.00	0.00
methyl-Parathion	0.05	0.05	1.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	1.00	0.00
trans-nonachlor	0.01	0.01	1.00	0.01	0.01	0.01	0.01	ug/L	0.10	0.10	1.00	0.00

TABLE: AM-51 Well Water Quality Summary Data (2013-2023)

PARAMETER NAME	MEDIAN	MEAN	N=	MINIMUM	MAXIMUM	25th PERCENTILE	75th PERCENTILE	UNITS	MIN RDL	MAX RDL	# of NDs	# of DETECTS
BIOLOGICAL												
E. Coli (Membrane Filtration - CFU/100ml)	0.10	0.10	2.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	2.00
Enterococcus (Membrane Filtration-CFU/100ml)	0.10	0.10	2.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	2.00
Total Coliform (Membrane Filtration-CFU/100ml)	0.10	0.10	2.00	0.10	0.10	0.10	0.10	CFU/100	1.00	1.00	0.00	2.00
FIELD MEASUREMENTS												
Field Dissolved Oxygen	5.59	5.02	15.00	0.52	8.03	3.87	6.64	mg/L	0.00	0.01	0.00	15.00
Field Electrical Conductivity	998.00	958.75	16.00	605.00	1270.00	823.25	1065.00	uS/cm	0.00	1.00	0.00	16.00
Field Oxidation-Reduction Potential	123.00	116.13	15.00	-40.00	256.00	65.00	160.00	mV	-1000.00	-1000.00	0.00	15.00
Field Temperature	19.90	20.43	16.00	14.70	25.60	19.28	21.48	C	0.00	1.00	0.00	16.00
Field pH	7.55	7.51	16.00	7.20	7.70	7.38	7.63	UNITS	0.00	1.00	0.00	16.00
INORGANIC												
Aggressive Index	12.43	12.49	7.00	12.28	12.66	12.42	12.61	A.I.			0.00	7.00
Alkalinity-Phenolphthalein	0.10	0.10	16.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	0.00	16.00
Aluminum (dissolved)	2.30	2.86	9.00	1.20	5.50	1.70	4.00	ug/L	1.00	1.00	0.00	9.00
Ammonia Nitrogen	0.01	0.01	10.00	0.01	0.01	0.01	0.01	mg/L	0.10	0.10	0.00	10.00
Antimony (dissolved)	0.10	0.20	9.00	0.10	0.60	0.10	0.10	ug/L	0.50	1.00	0.00	9.00
Arsenic (dissolved)	2.90	2.78	9.00	1.90	4.30	2.20	3.00	ug/L	1.00	1.00	0.00	9.00
Barium (dissolved)	50.30	50.07	9.00	35.90	71.30	42.80	55.10	ug/L	1.00	1.00	0.00	9.00
Beryllium (dissolved)	0.10	0.09	9.00	0.05	0.10	0.10	0.10	ug/L	0.50	1.00	0.00	9.00
Bicarbonate (as CaCO3)	190.50	195.19	16.00	140.00	255.00	166.75	223.50	mg/L	1.00	1.00	0.00	16.00
Bicarbonate (as HCO3)	232.25	237.94	16.00	170.70	310.80	203.30	272.43	mg/L	1.20	1.20	0.00	16.00
Boron	0.30	0.30	7.00	0.23	0.34	0.30	0.32	mg/L	0.10	0.10	0.00	7.00
Boron (dissolved)	0.20	0.19	9.00	0.10	0.20	0.20	0.20	mg/L	0.10	0.10	0.00	9.00

Bromide	0.17	0.16	16.00	0.01	0.23	0.13	0.18	mg/L	0.01	0.10	0.00	16.00
Cadmium (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Calcium	88.40	86.21	7.00	59.00	103.00	83.20	93.35	mg/L	0.50	0.50	0.00	7.00
INORGANIC (cont'd)												
Calcium (dissolved)	68.10	65.97	9.00	44.90	84.10	58.10	78.60	mg/L	0.50	0.50	0.00	9.00
Carbonate (as CaCO3)	0.10	0.10	16.00	0.10	0.10	0.10	0.10	mg/L	1.00	1.00	0.00	16.00
Cation-Anion meq balance	1.14	0.04	6.00	-3.96	3.61	-2.57	1.86	RATIO			0.00	6.00
Chloride	118.00	114.18	16.00	61.00	158.00	92.40	144.25	mg/L	0.50	2.00	0.00	16.00
Chromium (dissolved)	0.10	0.37	9.00	0.10	1.40	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Cobalt (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Copper (dissolved)	3.70	3.80	9.00	2.80	4.70	3.40	4.30	ug/L	1.00	1.00	0.00	9.00
Electrical Conductivity	989.50	960.81	16.00	632.00	1230.00	854.75	1087.50	uS/cm	1.00	1.00	0.00	16.00
Fluoride	0.31	0.32	9.00	0.29	0.37	0.30	0.35	mg/L	0.10	0.10	0.00	9.00
Gadolinium (dissolved)	35.70	42.86	9.00	27.30	80.60	32.20	50.20	ng/L	10.00	10.00	0.00	9.00
Hydroxide (as CaCO3)	0.10	0.18	16.00	0.10	0.50	0.10	0.10	mg/L	1.00	5.00	6.00	10.00
Iron (dissolved)	2.80	2.73	9.00	0.50	6.00	0.50	4.20	ug/L	1.00	5.00	0.00	9.00
Lead (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Magnesium	22.30	21.99	7.00	15.40	26.10	20.90	24.15	mg/L	0.50	0.50	0.00	7.00
Magnesium (dissolved)	17.90	17.07	9.00	11.90	21.10	15.10	20.30	mg/L	0.50	0.50	0.00	9.00
Manganese (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Mercury (dissolved)	0.10	0.07	9.00	0.01	0.10	0.01	0.10	ug/L	0.10	1.00	0.00	9.00
Nickel (dissolved)	2.40	2.39	9.00	1.00	4.40	1.70	2.50	ug/L	1.00	1.00	0.00	9.00
Nitrate	8.45	8.71	16.00	1.00	27.60	4.30	11.15	mg/L	0.40	0.40	0.00	16.00
Nitrate + Nitrite Nitrogen	1.98	2.32	11.00	0.74	6.23	1.30	2.76	mg/L	0.10	0.10	0.00	11.00
Nitrate Nitrogen	1.90	1.97	16.00	0.22	6.23	0.98	2.51	mg/L	0.10	0.10	0.00	16.00
Nitrite	0.00	0.00	11.00	0.00	0.02	0.00	0.00	mg/L	0.00	0.01	7.00	4.00
Nitrite Nitrogen	0.00	0.00	11.00	0.00	0.01	0.00	0.00	mg/L	0.00	0.00	0.00	11.00
Organic Nitrogen	0.20	0.19	10.00	0.01	0.30	0.13	0.30	mg/L	0.10	0.10	0.00	10.00
Perchlorate	0.23	0.23	8.00	0.20	0.25	0.20	0.25	ug/L	2.00	2.50	0.00	8.00

Phosphate Phosphorus (orthophosphate)	0.58	0.59	10.00	0.54	0.72	0.57	0.59	mg/L	0.01	0.01	0.00	10.00
Potassium	13.40	12.70	7.00	8.80	14.80	11.75	14.20	mg/L	0.50	0.50	0.00	7.00
Potassium (dissolved)	9.90	9.94	9.00	7.10	12.60	8.50	11.40	mg/L	0.50	0.50	0.00	9.00
INORGANIC (cont'd)												
Selenium (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Silica	12.90	13.68	9.00	10.50	17.60	12.40	15.20	mg/L	1.00	1.00	0.00	9.00
Silver (dissolved)	0.10	0.10	9.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	0.00	9.00
Sodium	113.00	107.57	7.00	81.00	115.00	107.50	114.50	mg/L	0.50	0.50	0.00	7.00
Sodium (dissolved)	79.20	79.22	9.00	59.30	95.40	69.00	89.30	mg/L	0.50	0.50	0.00	9.00
Sulfate	105.50	109.28	16.00	72.10	176.00	93.05	119.50	mg/L	0.50	2.00	0.00	16.00
Suspended Solids	1.68	4.78	6.00	0.25	19.00	0.25	5.13	mg/L	1.00	2.50	0.00	6.00
Temperature (Laboratory)	21.70	21.47	7.00	20.50	22.10	21.05	21.95	C	1.00	1.00	0.00	7.00
Thallium (dissolved)	0.10	0.09	9.00	0.05	0.10	0.10	0.10	ug/L	0.50	1.00	0.00	9.00
Title 22 Total Anions	8.25	8.34	9.00	6.18	10.24	7.51	9.63	meq/L			0.00	9.00
Title 22 Total Cations	11.53	11.12	7.00	7.96	12.67	10.86	11.97	meq/L			0.00	7.00
Total Alkalinity (as CaCO3)	190.50	195.19	16.00	140.00	255.00	166.75	223.50	mg/L	1.00	5.00	0.00	16.00
Total Anions	8.22	8.36	6.00	6.66	9.89	7.69	9.29	meq/L	0.00	0.00	0.00	6.00
Total Cations	8.40	8.39	6.00	6.40	10.09	7.50	9.47	meq/L	0.00	0.00	0.00	6.00
Total Dissolved Solids	492.00	501.80	10.00	350.00	676.00	460.50	554.00	mg/L	1.00	2.50	0.00	10.00
Total Hardness (as CaCO3)	211.00	211.00	1.00	211.00	211.00	211.00	211.00	mg/L	1.00	1.00	0.00	1.00
Total Hardness (as CaCO3) (dissolved)	244.00	234.89	9.00	161.00	296.00	207.00	280.00	mg/L	1.00	1.00	0.00	9.00
Total Kjeldahl Nitrogen	0.20	0.19	10.00	0.02	0.30	0.07	0.30	mg/L	0.20	0.20	0.00	10.00
Total Nitrogen	2.05	2.40	10.00	0.90	6.20	1.51	2.74	mg/L	0.10	0.20	0.00	10.00
Total Organic Carbon (Unfiltered)	2.37	2.47	16.00	1.39	3.59	2.14	2.78	mg/L	0.05	0.05	0.00	16.00
Turbidity	0.60	1.93	9.00	0.20	8.00	0.30	2.80	NTU	0.10	0.10	0.00	9.00
UV Absorbance/TOC (unfiltered) ratio	0.03	0.03	9.00	0.02	0.03	0.02	0.03	L/mg-cm	0.00	0.00	0.00	9.00
Ultraviolet (absorbance)	0.07	0.07	9.00	0.05	0.10	0.06	0.08	1/cm	0.01	0.01	0.00	9.00
Vanadium (dissolved)	5.60	5.66	9.00	4.20	7.00	5.30	6.20	ug/L	1.00	1.00	0.00	9.00
Zinc (dissolved)	2.10	4.10	9.00	0.10	18.90	1.30	4.50	ug/L	1.00	1.00	0.00	9.00

pH	7.90	7.84	16.00	7.60	8.00	7.78	7.90	UNITS	1.00	1.00	0.00	16.00
ORGANIC												
1,1,1,2-Tetrachloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
ORGANIC (cont'd)												
1,1,1-Trichloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,1,2,2-Tetrachloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,1,2-Trichloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,1-Dichloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,1-Dichloroethene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,1-Dichloropropene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2,3-Trichlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2,3-Trichloropropane	0.05	0.03	13.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	13.00	0.00
1,2,4-Trichlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2,4-Trimethylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2-Dibromo-3-chloropropane	0.05	0.03	13.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	13.00	0.00
1,2-Dibromoethane	0.05	0.03	13.00	0.00	0.05	0.00	0.05	ug/L	0.01	0.50	13.00	0.00
1,2-Dichlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2-Dichloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,2-Dichloropropane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,3,5-Trimethylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,3-Dichlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,3-Dichloropropane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,4-Dichlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
1,4-Dioxane	0.08	0.08	8.00	0.05	0.10	0.05	0.10	ug/L	0.50	1.00	8.00	0.00
11-chloroeicosafluoro-3-oxaundecane-1sulfonic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
2,2-Dichloropropane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
2-Chloroethylvinyl ether	0.10	0.10	5.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	5.00	0.00
2-Chlorotoluene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
2-Hexanone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	1.00	0.00

4,8-dioxa-3H-perfluorononanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
4-Androstene-3,17-dione	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
4-Chlorotoluene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
ORGANIC (cont'd)												
4-Isopropyltoluene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
4-n-Octylphenol	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
4-tert-Octylphenol	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Acetone	1.00	1.00	8.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	8.00	0.00
Acrolein	0.50	0.67	3.00	0.50	1.00	0.50	0.75	ug/L	5.00	10.00	3.00	0.00
Acrylonitrile	0.20	0.47	3.00	0.20	1.00	0.20	0.60	ug/L	2.00	10.00	3.00	0.00
Aspartame	10.00	10.00	6.00	10.00	10.00	10.00	10.00	ng/L	100.00	100.00	6.00	0.00
Atenolol	0.50	0.50	6.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	6.00	0.00
Benzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Bisphenol A	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
Bromobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Bromochloromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Bromodichloromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Bromoform	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Bromomethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Carbon Disulfide	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Carbon tetrachloride	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Chlorobenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Chlorodifluoromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Chloroethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Chloroform	0.25	0.21	8.00	0.05	0.50	0.05	0.25	ug/L	0.50	0.50	3.00	5.00
Chloromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Chlorotrifluoroethene	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	1.00	0.00
Dibromochloromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00

Dibromomethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Dichlorodifluoromethane	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Diclofenac	0.50	0.50	6.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	6.00	0.00
ORGANIC (cont'd)												
Diisopropyl ether	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	8.00	0.00
Dilantin	22.95	21.50	6.00	1.00	38.00	14.45	30.10	ng/L	10.00	10.00	1.00	5.00
Dissolved Organic Carbon	2.59	2.63	9.00	1.83	3.56	2.21	2.96	mg/L	0.05	0.05	0.00	9.00
Epitestosterone (cis-Testosterone)	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	1.00	0.00
Ethyl tert-butyl ether	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	8.00	0.00
Ethylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Fluoxetine	0.50	0.50	6.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	6.00	0.00
Freon 123a	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Hexachlorobutadiene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Hexafluoropropylene oxide dimer acid (GenX)	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Iohexol	26.65	48.90	6.00	2.00	195.00	7.63	38.03	ng/L	20.00	20.00	2.00	4.00
Iopromide	1.00	2.52	6.00	1.00	10.10	1.00	1.00	ng/L	10.00	10.00	5.00	1.00
Isopropylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Linuron	0.00	0.00	6.00	0.00	0.00	0.00	0.00	ug/L	0.01	0.01	6.00	0.00
Meprobamate	0.50	7.37	6.00	0.50	41.20	0.50	0.88	ng/L	5.00	10.00	5.00	1.00
Methyl Ethyl Ketone (MEK)	0.50	0.41	8.00	0.25	0.50	0.25	0.50	ug/L	2.50	5.00	8.00	0.00
Methyl Isobutyl Ketone (MIBK)	0.50	0.41	8.00	0.25	0.50	0.25	0.50	ug/L	2.50	5.00	8.00	0.00
Methyl tert-butyl ether	0.02	0.02	8.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	8.00	0.00
Methylene Chloride	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Methylisothiocyanate	0.01	0.01	5.00	0.00	0.01	0.01	0.01	ug/L	0.01	0.10	5.00	0.00
N-ethyl perfluorooctanesulfonamidoacetic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
N-methyl perfluorooctanesulfonamidoacetic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Naphthalene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00

Naproxen	0.50	0.58	6.00	0.50	1.00	0.50	0.50	ng/L	5.00	10.00	6.00	0.00
Neotame	1.00	1.00	6.00	1.00	1.00	1.00	1.00	ng/L	10.00	10.00	6.00	0.00
Nitrobenzene	0.50	0.50	1.00	0.50	0.50	0.50	0.50	ug/L	5.00	5.00	1.00	0.00
ORGANIC (cont'd)												
Nonylphenol	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
PFOA + PFOS	20.10	20.10	1.00	20.10	20.10	20.10	20.10	ng/L	2.00	2.00	0.00	1.00
Perfluoro butane sulfonic acid	12.40	12.40	1.00	12.40	12.40	12.40	12.40	ng/L	2.00	2.00	0.00	1.00
Perfluoro heptanoic acid	6.90	6.90	1.00	6.90	6.90	6.90	6.90	ng/L	2.00	2.00	0.00	1.00
Perfluoro hexane sulfonic acid	7.90	7.90	1.00	7.90	7.90	7.90	7.90	ng/L	2.00	2.00	0.00	1.00
Perfluoro nonanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluoro octane sulfonic acid	9.90	9.90	1.00	9.90	9.90	9.90	9.90	ng/L	2.00	2.00	0.00	1.00
Perfluoro octanoic acid	10.20	10.20	1.00	10.20	10.20	10.20	10.20	ng/L	2.00	2.00	0.00	1.00
Perfluorodecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorododecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorohexanoic acid	14.00	14.00	1.00	14.00	14.00	14.00	14.00	ng/L	2.00	2.00	0.00	1.00
Perfluorotetradecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluorotridecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
Perfluoroundecanoic acid	0.20	0.20	1.00	0.20	0.20	0.20	0.20	ng/L	2.00	2.00	1.00	0.00
PhenylPhenol	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
Progesterone	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	1.00	0.00
Propylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Styrene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Sucralose	15200.00	13428.33	6.00	6780.00	18900.00	9442.50	16525.00	ng/L	100.00	1000.00	0.00	6.00
Tert-amyl methyl ether	0.10	0.10	8.00	0.10	0.10	0.10	0.10	ug/L	1.00	1.00	8.00	0.00
Testosterone (trans-Testosterone)	0.10	0.10	1.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	1.00	0.00
Tetrabromobisphenol A	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
Tetrachloroethene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Toluene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Total 1,3-Dichloropropene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00

Total Organic Halogen	38.00	39.00	4.00	36.00	44.00	36.75	40.25	ug/L	20.00	20.00	0.00	4.00
Total Trihalomethanes	0.25	0.21	8.00	0.05	0.50	0.05	0.25	ug/L	0.50	0.50	3.00	5.00
Total Xylenes (m,p,&o)	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
ORGANIC (cont'd)												
Trichloroethene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Trichlorofluoromethane (Freon 11)	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Trichlorotrifluoroethane (Freon 113)	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
Trimethoprim	0.50	0.50	6.00	0.50	0.50	0.50	0.50	ng/L	5.00	5.00	6.00	0.00
Tris-2-chloroethyl phosphate	26.45	34.73	6.00	0.50	100.00	1.88	52.60	ng/L	5.00	10.00	2.00	4.00
Vinyl Acetate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	ug/L	10.00	10.00	1.00	0.00
Vinyl chloride	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
bis (2-chloroethyl) ether	0.50	0.66	8.00	0.25	2.50	0.25	0.50	ug/L	2.50	25.00	8.00	0.00
cis-1,2-Dichloroethene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
cis-1,3-Dichloropropene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
m,p-Xylene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
n-Butylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
o-Xylene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
para-Chlorobenzene sulfonic acid	20.00	20.00	6.00	20.00	20.00	20.00	20.00	ng/L	200.00	200.00	6.00	0.00
sec-Butylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
tert-Butylbenzene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
tert-butyl alcohol	0.20	0.20	8.00	0.20	0.20	0.20	0.20	ug/L	2.00	2.00	8.00	0.00
trans-1,2 Dichloroethene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
trans-1,3-Dichloropropene	0.05	0.05	8.00	0.05	0.05	0.05	0.05	ug/L	0.50	0.50	8.00	0.00
SEMI-ORGANIC												
Acetaminophen	0.50	1.25	6.00	0.50	5.00	0.50	0.50	ng/L	5.00	50.00	6.00	0.00
Atrazine	0.00	0.00	6.00	0.00	0.01	0.00	0.00	ug/L	0.00	0.00	1.00	5.00
Azithromycin	1.00	2.33	6.00	1.00	5.00	1.00	4.00	ng/L	10.00	50.00	6.00	0.00
Caffeine	0.90	3.63	6.00	0.30	15.00	0.30	3.68	ng/L	3.00	15.00	4.00	2.00
Carbamazepine	68.95	61.97	6.00	35.60	74.00	57.28	70.43	ng/L	1.00	1.00	0.00	6.00

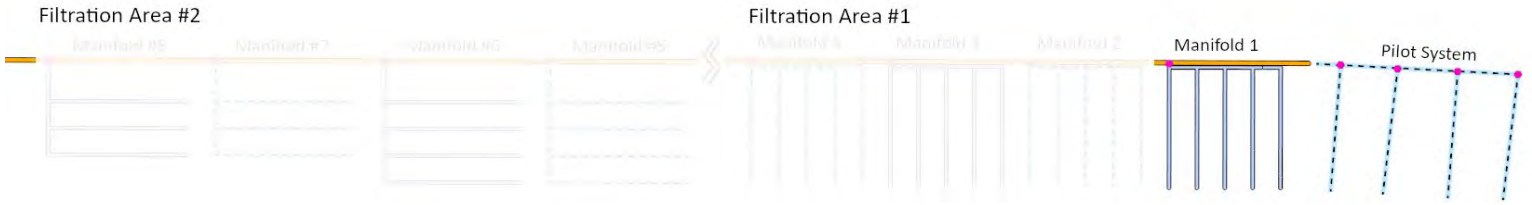
Diuron	0.03	0.08	6.00	0.00	0.33	0.01	0.05	ug/L	0.01	0.01	1.00	5.00
Erythromycin	0.10	0.10	6.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	6.00	0.00
Gemfibrozil	0.10	0.10	6.00	0.10	0.10	0.10	0.10	ng/L	1.00	1.00	6.00	0.00
SEMI-ORGANIC (cont'd)												
Ibuprofen	0.10	0.32	6.00	0.10	1.00	0.10	0.40	ng/L	1.00	10.00	6.00	0.00
N,N-diethyl-m-toluamide	1.60	3.62	6.00	0.10	12.20	0.10	5.35	ng/L	1.00	1.00	3.00	3.00
Pentachlorophenol (PCP)	0.02	0.02	1.00	0.02	0.02	0.02	0.02	ug/L	0.20	0.20	1.00	0.00
Primidone	47.30	35.32	6.00	5.00	51.30	19.13	50.28	ng/L	1.00	100.00	2.00	4.00
Simazine	0.02	0.02	6.00	0.01	0.04	0.01	0.03	ug/L	0.01	0.01	0.00	6.00
Sulfamethoxazole	54.35	61.57	6.00	16.50	110.00	34.38	93.45	ng/L	1.00	1.00	0.00	6.00
Triclosan	0.10	0.17	6.00	0.10	0.50	0.10	0.10	ng/L	1.00	5.00	6.00	0.00

Appendix C

RBF System Collector Testing

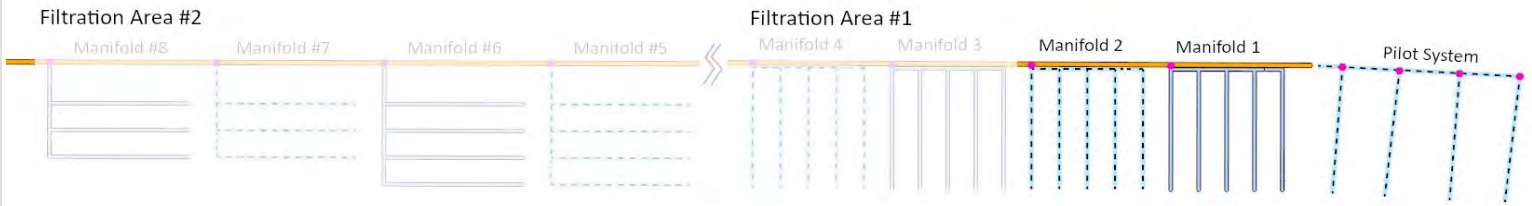
RBF system collector schematics showing results of variations in lateral configuration testing. Nineteen tests were conducted between December 2015- October 2017.

Collector Testing #1



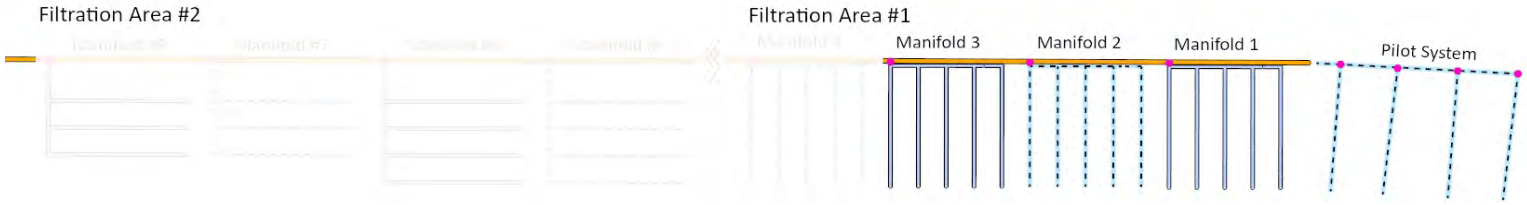
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
12/2015 to 1/2016	2	2	3.50	1.75	1,440	2.43

Collector Testing #2



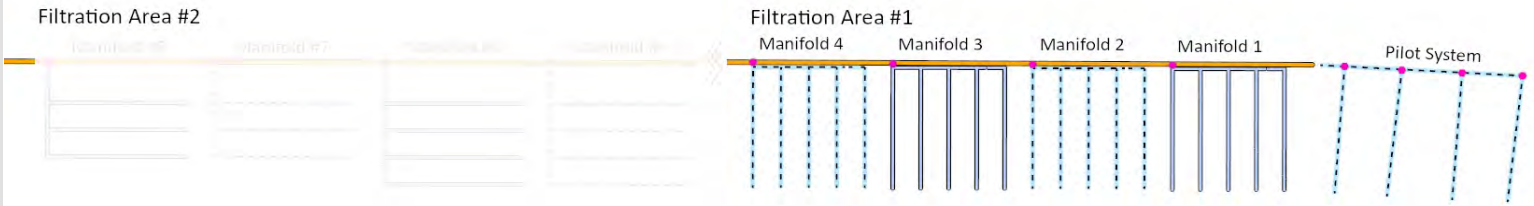
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
12/2015 to 1/2016	3	2	6.90	2.30	2,160	3.19

Collector Testing #3



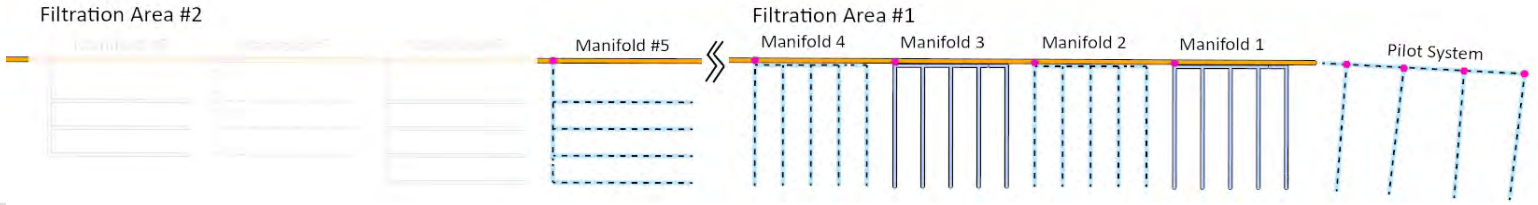
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
12/2015 to 1/2016	4	2	10.10	2.53	2,880	3.51

Collector Testing #4



Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
12/2015 to 1/2016	5	2	12.60	2.52	3,600	3.50

Collector Testing #5

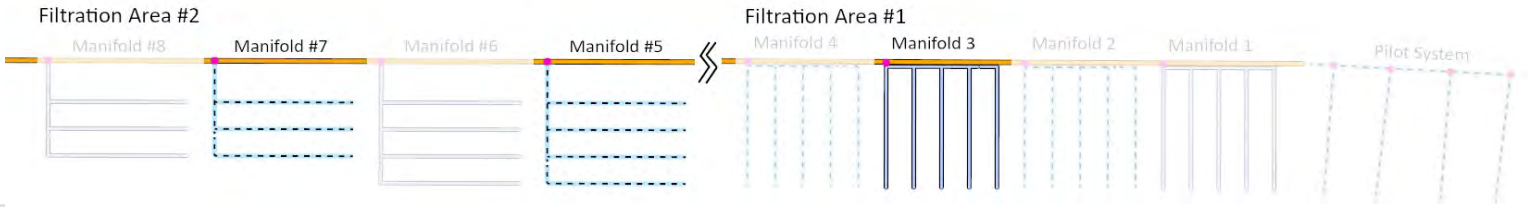


Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
12/2015 to 1/2016	6	3	14.90	2.48	4,320	3.45

Collector Testing #6

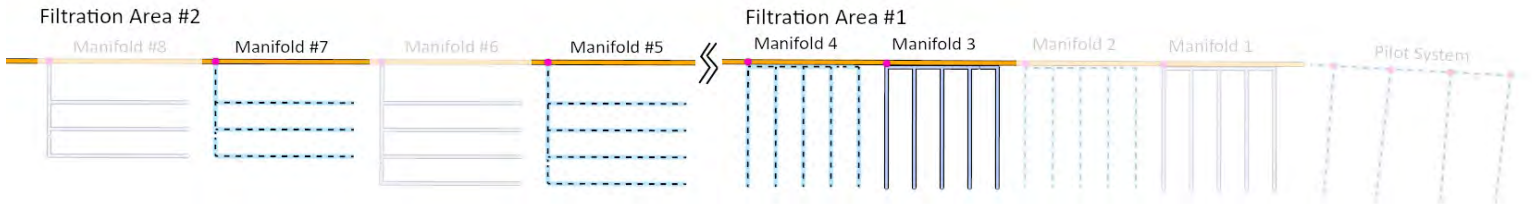
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
6/2016 to 8/2016	1	1	3.00	3.00	720	4.17

Collector Testing #7



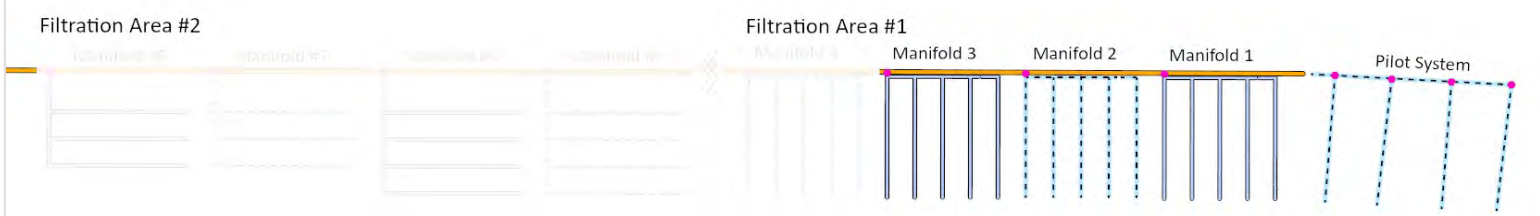
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
6/2016 to 8/2016	3	2	9.50	3.17	1,980	4.80

Collector Testing #8



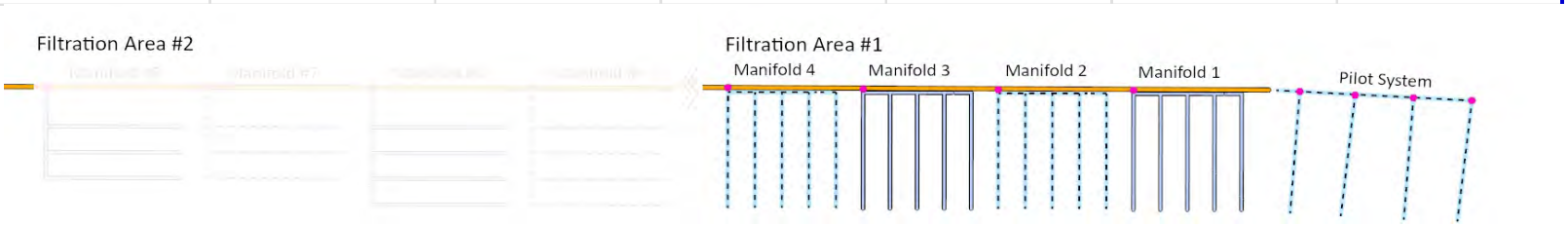
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
6/2016 to 8/2016	4	3	11.00	2.75	2,700	4.07

Collector Testing #9



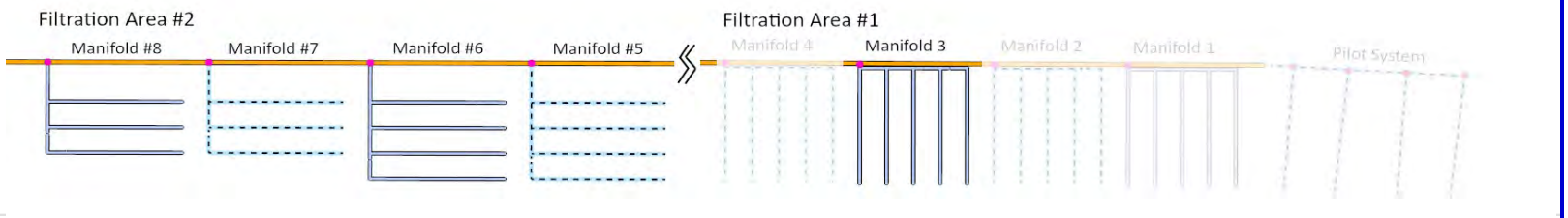
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
6/2016 to 8/2016	4	2	9.00	2.25	2,880	3.13

Collector Testing #10



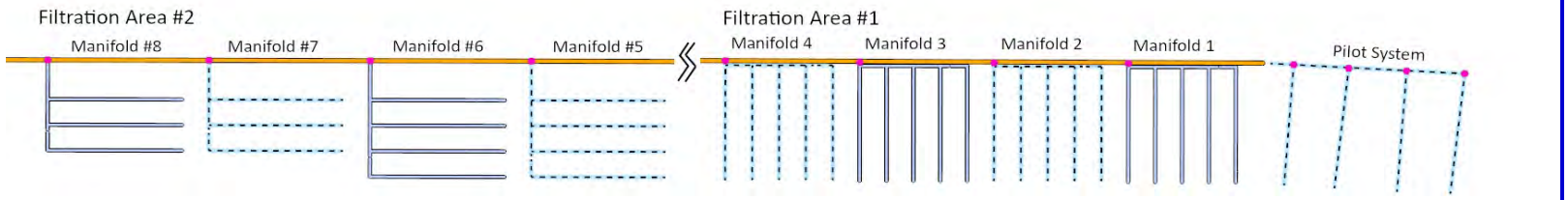
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
6/2016 to 8/2016	5	2	13.00	2.60	3,600	3.61

Collector Testing #11



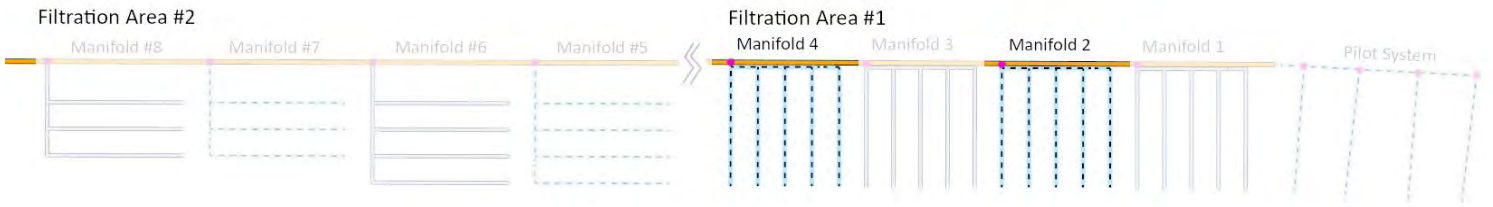
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
6/2016 to 8/2016	5	3	11.20	2.24	3,240	3.46

Collector Testing #12



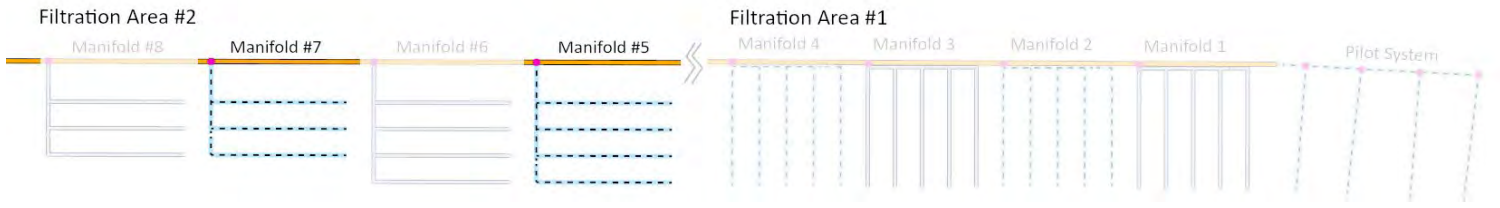
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
6/2016 to 8/2016	9	4	17.50	1.94	6,120	2.86

Collector Testing #13



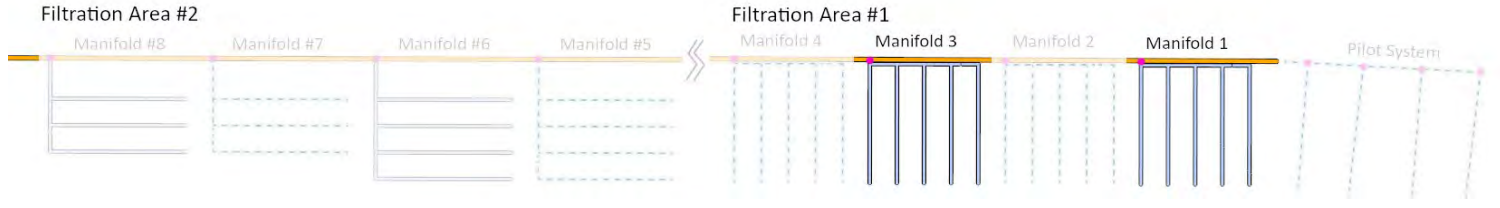
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
8/2017	2	1	7.00	3.50	1,440	4.86

Collector Testing #14



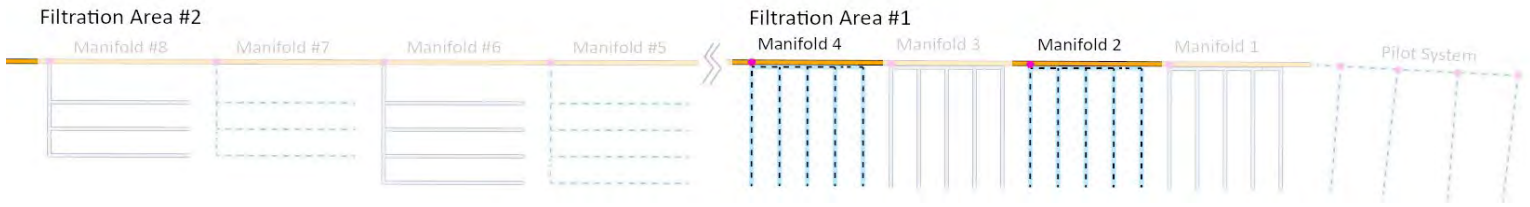
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
8/2017	2	1	5.00	2.50	1,260	3.97

Collector Testing #15



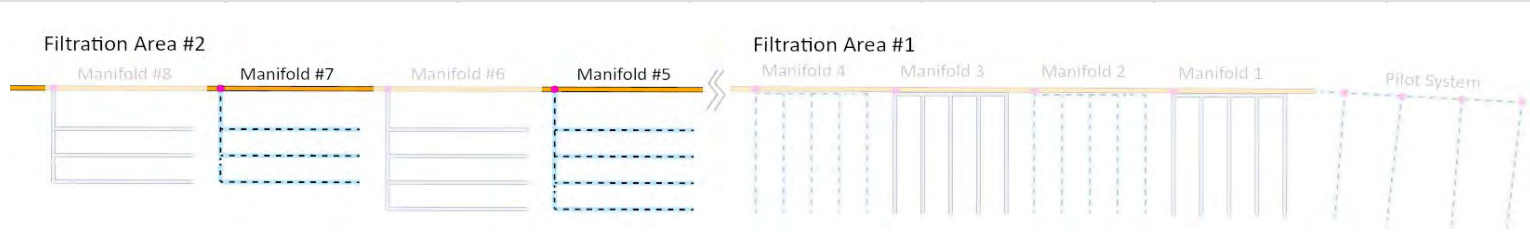
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow /Section (cfs)	Feet of Open Section	Avg flow /1000 ft
8/2017	2	1	5.90	2.95	1,440	4.10

Collector Testing #16



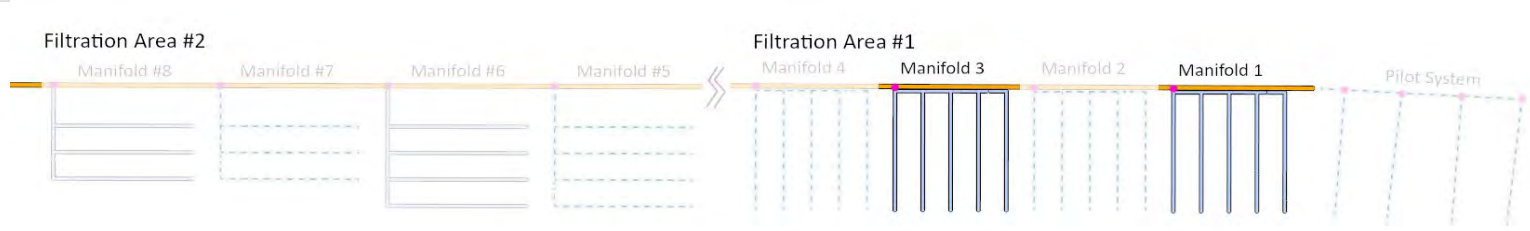
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
10/2017	2	1	5.10	2.55	1,440	3.54

Collector Testing #17



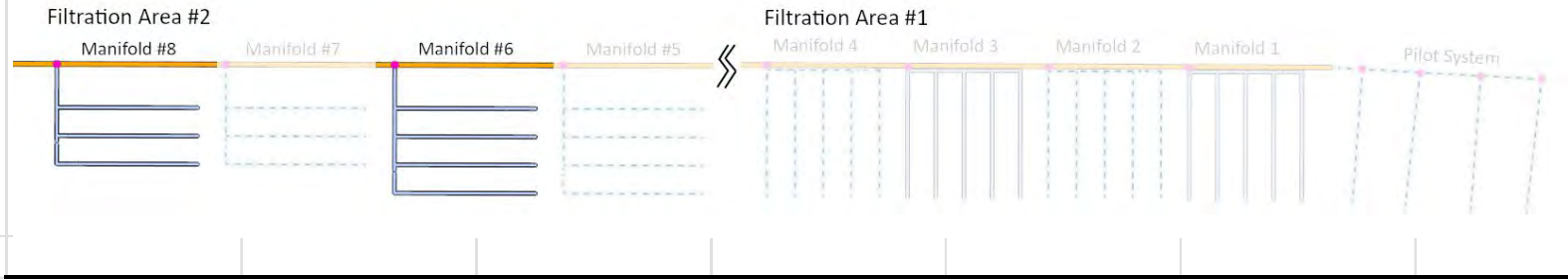
Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
10/2017	2	1	3.94	1.97	1,260	3.13

Collector Testing #18



Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
10/2017	2	1	5.60	2.80	1,260	4.44

Collector Testing #19



Date	# Open Sections	# of Combinations	Avg. Total Flow (cfs)	Avg Flow/Section (cfs)	Feet of Open Section	Avg flow/1000 ft
10/2017	2	1	4.86	2.43	1,260	3.86

RBF system collector schematic showing results of variations in lateral configuration testing; nineteen tests were conducted between December 2015- October 2017.

Appendix D

Recharge Facilities Model Update and RFS Simulations (Jacobs, 2023)

OCWD Recharge Facilities 2023 Model Update Technical Memo (Final)

Date:	August 29, 2023
Attention:	Adam Hutchinson/OCWD
Client:	Orange County Water District
Prepared By:	Marcelo Reginato, Jacobs
Reviewed By:	Adam Hutchinson/OCWD
Document no:	*[Document number]*
Revision No:	3

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1. Introduction

In 2009, CH2M Hill developed a recharge facilities model (RFM) for the Orange County Water District (OCWD) managed aquifer recharge system (CH2M Hill 2009). Subsequently, OCWD has used the model to understand recharge benefits related to potential projects or changes in operations. The user interacts with the model via dashboards and model results can be retrieved also from dashboards or loaded into spreadsheet tools for further analysis.

This TM describes the model activities and changes implemented between May and September 2023. The activities focused on updating model inputs, reviewing logic, adding new logic, and updating dashboards for model control. The activities include a few model scenarios runs to understand benefits related to implemented changes. The model activities included:

- Update of historical Prado Dam releases time series.
- Update riverbed filtration system (RFS) logic.
- Update of model logic to pause infiltration decay when RFS is active.
- Model simulations to understand the benefits of a RFS under different operational scenarios.

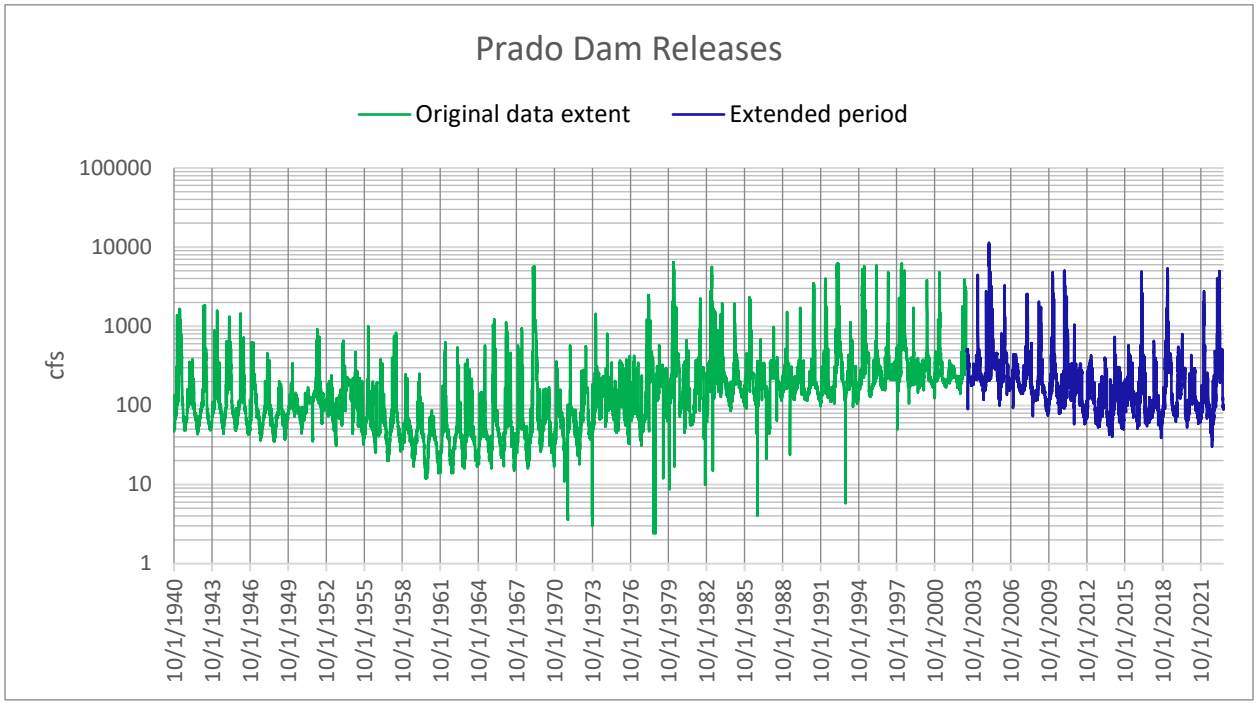
Attachment 1 includes the latest updated OCWD RFM model files that were used in this study. The files in attachment 1 were delivered electronically.

2. Model Updates

The Historical Prado Dam time series of water releases included in the original RFM extended from 10/1/1940 to 4/15/2013. During this current model update the time series were extended from 4/15/2013 to 7/18/2023. The flow data was downloaded from the United States Geological Survey (USGS) website (USGS 2023) for station USGS 11074000 SANTA ANA R BL PRADO DAM CA. The additional time series of Prado Dam releases allows model simulations to utilize historical Prado Dam releases up to 7/18/2023. shows the historical Prado Dam outflow data that can be used in the model as input to recharge basins. Historical Prado Dam releases is only one of many model options for inflow to the recharge system, other options include flows upstream Prado Dam with dynamic rules that operate the reservoir releases considering OCWD recharge basing status.

Prado Dam releases are a function of OCWD's recharge basins percolation status, therefore, simulations that have as main goal estimates of actual percolation volume should use a dynamic rule for Prado releases. The current model update is mainly concerned with the efficiency of a RFS; therefore, the historical record of Prado Dam releases is sufficient for this analysis. Future model runs may consider using historical or projected inflow rates and use the dynamic Prado Dam operations feature.

Figure 1. USGS 11074000 SANTA ANA R BL PRADO DAM CA historical flow data



The RFSis a concept that would divert flows from the Santa Ana River (SAR) using a collection gallery constructed under the bed of the SAR. This system, if implemented, is supposed to havea few advantages over the current rubber dam diversion system:

- Filtration of SAR water that would otherwise flow into the OCWD recharge basins and eventually clog recharge basins.
- Ability to divert flows even when rubber dam is deflated due to high flow conditions in the SAR.
- Ability to divert flows even when sediment concentration in the SAR is elevated and would be otherwise avoided since it would rapidly clog recharge basins.

To estimate the benefits of a RFS, a few model changes were necessary. Additional dashboard options were added so that the model user can select the following options for model scenarios:

- Current rubber dam diversion only
- RFS diversion only
- Rubber dam diversion and RFS only if rubber dam is down.
- Rubber dam diversion and RFS with rubber dam diverting only when RFS is at maximum capacity and diverting only to off-river system (Olive Basin and downstream basins).

The RFS capacity is a user input and estimated at 450 cfs for the current model simulations. This capacity is above the maximum pipe capacities in the Warner and Anaheim systems.

An additional model logic was implemented that pauses the infiltration decay of the percolation basins in the Warner and Anaheim systems if flows are being diverted from the RFS. The original model percolation decay is a feature with many options that was built into the first model version (CH2M Hill 2009).

A number of model simulations scenarios were created to understand the benefit of a RFS in creating additional recharge for the system. The model scenarios are described in the following section.

3. Modeling Simulations

The total eight model scenarios run in this study was to understand the benefits of a RFS. The simulation run for a total of 18 years, from Fiscal year 2003 to 2020 in a daily time step.

During the simulation period the model assumed historical Prado Dam releases. This is not the closest to reality since Prado Dam releases can be a function of OCWD recharge basin conditions, however this assumption allows a more consistent comparison of benefits across scenarios. This simplification was applied to all scenarios and that would show, conservatively, how much more recharge the system would be able to achieve given a consistent set of inflows (same for all scenarios). Future simulations using the dynamic Prado Dam operations will provide a more realistic estimate of benefits.

The baseline scenario selected (from where all other scenarios originated) was the calibration scenario from year 2010. This scenario was replicating similar historical recharge basin operations however this scenario does not include the recent expanded Groundwater Replenishment System (GWRS) flows, except for a short period between January and July of 2008, and recent added basins (Miraloma and La Palma). Figure 2 shows the percolation model results for the baseline model run in comparison with historical measured percolation. The historical data is available up to year 2008.

Figure 2. Baseline percolation comparison against available historical percolation up to year 2008

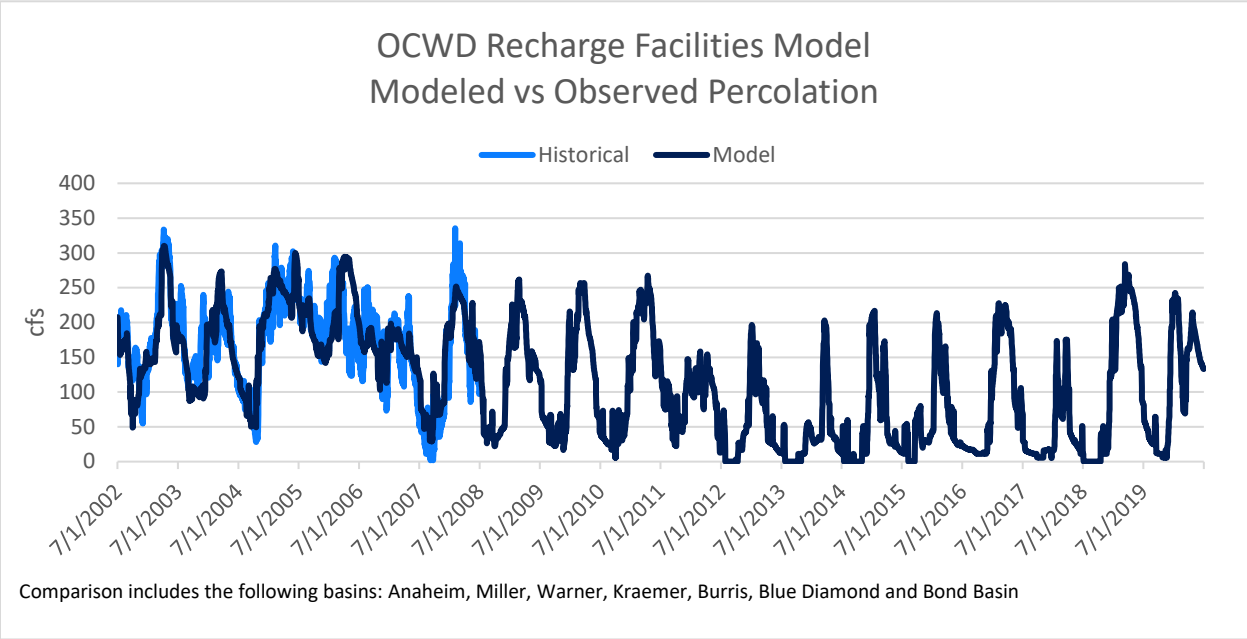
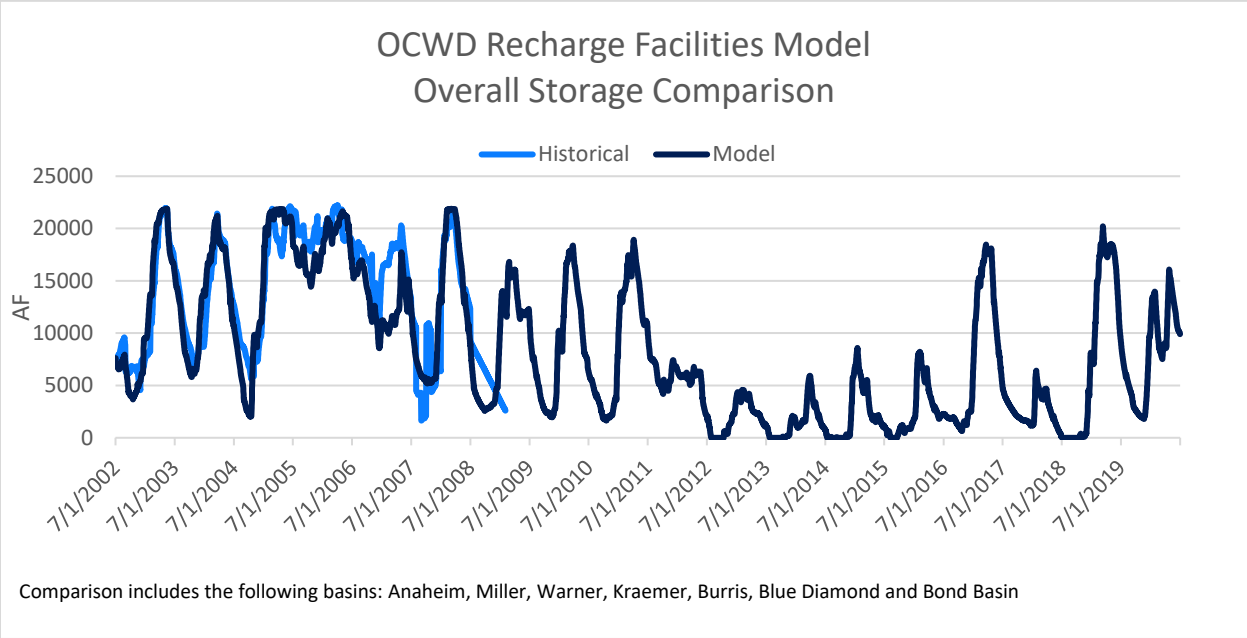


Figure 3 shows the system storage for a selection of basins The figure compares model results for the baseline model against historical measured storage. The historical data is available up to year 2008.

Figure 3. Baseline storage comparison against available historical storage up to year 2008



A total of seven additional model scenarios were created in addition to the Baseline. The seven model scenarios were created to evaluate the recharge benefits of a RFS. Following is a brief description of the model scenarios:

Base Calibration (Olive Basin ON) - the Baseline calibration scenario uses the same assumptions of the calibration model scenario except that the Olive Basin is turned on with percolation capacity of 20 cfs.

Alt1a - RB - This scenario includes the RFS as a replacement for the Rubber dam system. The difference in yield is due to the fact the RFS can divert water when the rubber dam is deflated.

Alt1b - RB Holding decay - Same assumptions of Alt1b, however this scenario stops the percolation decay of the Warner and Anaheim system basins.

Alt2a - RB OR RD - This scenario allows the use of the RFS or the rubber dam but not both systems at the same time. The RFS is activated only if the rubber dam is deflated due to high flows in the river.

Alt2b - RB OR RD Holding decay - Same assumptions of Alt2b, however the percolation decay of the basins that fed by the RFS (Anaheim and Warner basins) is paused when being fed water from the RFS.

Alt3a - RB AND RD - This scenario allows the use of both the RFS and rubber dam diversions at the same time, however, the rubber dam system will only divert after the RFS is maxed out and will divert only to off river system (Olive Basin and downstream basins). This scenario stops the percolation decay for Anaheim and Warner basins since it assumes that only water from the RFS supplies these basins.

Alt3b - RB AND RD incr. WTP capacity - Same assumptions of scenario Alt3a but with increase of the Warner Transmission Pipeline (WTP) from 170 cfs to unlimited and removing capacity constraints between WTP and the RFS. The unlimited value would show the maximum flows needed to supply basins downstream of the WTP.

A summary of the model variables that changed across all the scenarios are represented in Table 1.

Table 1. Demand Assumptions for the Different Model Alternatives

Scenarios	Model Variables			
	Rubber Dam diversions	Riverbed diversions	Hold Percolation Decay	Pipe capacity increased
Calibration (2010)	✓	x	x	x
Base Calibration (Olive Basin ON)	□	x	x	x
Alt1a-RB	x	□	x	x
Alt1b-RB Holding decay	x	x	□	x
Alt2a-RB OR RD	□	□	x	x
Alt2b-RB OR RD Holding decay	□	□	□	x
Alt3a-RB AND RD	□	□	□	x
Alt3b-RB AND RD incr. pipe capacity	□	□	□	□

The model results are summarized in Tables 2 and 3. Table 2 shows annual average percolation, average annual losses to the ocean, and average cleaning events over the simulation time. The table also shows the difference from Baseline scenario. Most of the scenario runs achieve higher percolation, reduced losses to the ocean and fewer basin cleaning events. The increased percolation ranges from approximately 650 AFY to a little over 10,000 AFY and there could be reductions in number of cleanings of up to 8 events per year.

Table 3 is focused on individual basins in the system and shows the average recharged in these basins in comparison with some historical averages. The implementation of a RFS would increase percolation in basins receiving this water.

For scenario Alt3b, where the WTP capacity was left unlimited, the maximum flow observed was 368 cfs.

Table 2. Summary of model results presented as average over an 18-year simulation period.

	18 years Annual Average Results			Difference From Calibration (2010)			Percentage Difference From Calibration (2010)		
Scenario	Average Percolation	Average Losses to Ocean	Average Cleaning Events	Average Percolation	Average Losses to Ocean	Average Cleaning Events	Average Percolation	Average Losses to Ocean	Average Cleaning Events
	AFY	AFY	Events/yr	AFY	AFY	Events/yr	%	%	%
Calibration (2010)	170,423	55,013	17	0	0	0	0.0%	0.0%	0.0%
Base Calibration (Olive Basin ON)	170,996	54,441	17	573	-572	0	0.3%	-1.0%	-0.3%
Alt1a-RB	172,427	52,994	17	2,004	-2,019	-1	1.2%	-3.7%	-3.2%
Alt1b-RB Holding decay	178,372	47,253	10	7,949	-7,760	-8	4.7%	-14.1%	-43.6%
Alt2a-RB OR RD	172,212	53,222	17	1,789	-1,791	-1	1.0%	-3.3%	-3.2%
Alt2b-RB OR RD Holding decay	172,378	53,069	17	1,955	-1,945	0	1.1%	-3.5%	-2.6%
Alt3a-RB AND RD	178,376	47,248	10	7,953	-7,765	-8	4.7%	-14.1%	-43.6%
Alt3b-RB AND RD incr. pipe capacity	180,519	45,144	10	10,097	-9,869	-7	5.9%	-17.9%	-42.9%

Table 3: Historical versus model results for average annual system percolation

	Historical Data			Model Results							
System	Time Period	Max Annual Recharge (afy)	Avg Annual Recharge (afy)	Calibration (2010)	Base Calibration (Olive Basin ON)	Alt1a-RB	Alt1b-RB Holding decay	Alt2a-RB OR RD	Alt2b-RB OR RD Holding decay	Alt3a-RB AND RD	Alt3b-RB AND RD incr. pipe capacity
		AFY	AFY	AFY	AFY	AFY	AFY	AFY	AFY	AFY	AFY
Desilting System	FY92/93 -FY12/13	3441	1,239	2,651	2,651	2,680	2,680	2,651	2,652	2,680	2,680
SAR Channel	FY95/96-FY12/13**	76961	62,600	68,438	68,438	68,398	68,398	68,438	68,441	68,398	68,398
Upper Off River Channel				340	348	416	204	417	395	204	144
Lower Off River Channel				1,046	990	1,139	584	1,118	1,062	584	410
Warner Basin System	FY88/89-FY12/13	33534	16,470	21,446	21,437	21,277	38,743	21,448	21,919	38,743	37,876
Anaheim Lake*	FY88/89-FY12/13	42555	30,950	24,069	24,134	24,890	35,621	24,442	24,869	35,621	36,309
Mini-Anaheim Lake*	FY97/98-FY12/13	5207	3,295	3,895	3,877	3,883	2,611	3,863	3,688	2,611	2,582
Kraemer Basin*	FY88/89-FY12/13	45502	25,637	14,614	14,348	14,660	10,396	14,468	14,505	10,396	13,202
Miller Basin*	FY88/89-FY12/13	27345	12,177	2,295	2,051	2,257	269	2,019	2,033	269	3,623
La Jolla Basin*	FY08/09-FY12/13	8505	5,621	808	674	729	-	762	711	-	270
Placentia Basin	FY88/89-FY12/13	3609	738	713	697	772	-	793	681	-	206
Raymond Basin	FY88/89-FY12/13	3517	1,148	843	848	850	11	889	725	11	213
Off-River Channel											
Olive Basin	FY08/09-FY12/13	3364	2,380	-	1,023	1,215	617	1,209	1,115	617	499
Five Coves Basins	FY89/90-FY12/13	5316	2,153	2,305	2,371	2,291	1,586	2,350	2,350	1,586	1,316
Lincoln Basin***	N/A		362	8	8	8	8	8	8	8	8
Burris Basin	FY89/90-FY12/13	15916	10,390	5,980	6,074	6,081	3,985	6,214	6,238	3,990	3,080
River View Basin	FY04/05-FY12/13	3152	1,930	1	1	1	1	1	1	1	1
Santiago Basins	FY95/96-FY12/13**	62250	38,800	18,830	18,895	18,778	11,237	18,994	18,766	11,237	8,606
Santiago Creek Channel	FY98/99-FY12/13	5149	3,152	2,185	2,173	2,143	1,465	2,171	2,263	1,465	1,143
Total		345323	219,042	**170,467**	**171,040**	**172,470**	**178,417**	**172,256**	**172,422**	**178,421**	**180,564**
			Change from Calibration (2010)		572	2,003	7,950	1,788	1,954	7,954	10,097

*Max recharge for these basins elevated due to recharge with imported and/or GWRS water.

**Early years excluded because different assumptions regarding storm flow and peak recharge were used.

***Assumed 0.5 cfs of recharge capacity.

**** average of 18 years

4. Conclusions

A RFS could significantly increase recharge in receiving basins by reducing the total suspended solids (TSS) in the diverted flows from SAR. The different model scenarios estimate the magnitude of the recharge benefit based on different possible operations, mainly by increasing diversion at times the current rubber dam system would be unable to divert and holding the percolation decay when receiving water from the RFS.

This first analysis of RFS benefits does not assume any decay on basin percolation. Although a much lower clogging effect is expected from water produced by the RFS the no decay condition is likely over optimistic. Further work is needed to assign a reasonable clogging rate to bound the potential benefits of the RFS.

The simulations indicate a potential additional annual yield of up to 6 percent using historical Prado Dam outflow. The improvements in recharge represent reduced losses to the ocean and are highest during the wet years when losses to the ocean are greatest.

A significant reduction in basin cleaning events is also expected since filtered water from the RFS will result in less clogging. Model results indicates a reduction between 1 and 8 total cleaning operations per year considering all basins that receive water from the RFS.

Future model scenarios can be run with projected Prado inflows and using the dynamic Prado Dam operations with target water conservation elevations. Another improvement is applying a more realistic basin percolation decay. Both of these changes will offer a better estimate on the future potential recharge that the RFS would be able to achieve.

5. References

CH2M Hill. 2009. Orange County Water District Recharge Facilities Model - Development and Calibration of the Orange County Water District Recharge Facilities Model (OCWD RFM). October 2009.

USGS.2023.USGS 11074000 SANTA ANA R BL PRADO DAM CA flow time series. Automated-retrieval info: https://help.waterdata.usgs.gov/faq/automated-retrievals. retrieved: 2023-07-19 14:17:13 EDT

Attachment 1
OCWD Recharge Facilities Model

OCWD_OPT_v1.63_v14_player.zip