NOTICE OF MEETING

Thursday, September 18, 2025

9:00 a.m. – Advisory Committee Meeting

CHINO BASIN WATERMASTER
ADVISORY COMMITTEE MEETING
9:00 a.m. – September 18, 2025
Mr. Eduardo Espinoza, Chair
Mr. Brian Geye, Vice-Chair
Mr. Jeff Pierson, Second Vice-Chair
At The Offices Of
Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

(Meeting can also be taken remotely via Zoom at this link)

AGENDA

CALL TO ORDER

ROLL CALL

AGENDA – ADDITIONS/REORDER

SAFETY MINUTE

I. CONSENT CALENDAR

All matters listed under the Consent Calendar are considered to be routine and non-controversial and will be acted upon by one motion in the form listed below. There will be no separate discussion on these items prior to voting unless any members, staff, or the public requests specific items be discussed and/or removed from the Consent Calendar for separate action.

A. MINUTES
Approve as presented:
Minutes of the Advisory Committee Meeting held on August 21, 2025 *(Page 1)*

B. FINANCIAL REPORTS
Monthly Financial Reports for the Period Ended July 31, 2025
(July 2025 financials are being deferred to the October 2025 meetings.)

C. APPLICATION: WATER TRANSACTION – 788 AF JURUPA COMMUNITY SERVICES DISTRICT TO FONTANA WATER COMPANY
Provide advice and assistance to the Watermaster Board on the proposed transaction *(Page 6)*.

D. APPLICATION: WATER TRANSACTION – 2,000 AF CITY OF CHINO TO NIAGARA BOTTLING, LLC
Provide advice and assistance to the Watermaster Board on the proposed transaction *(Page 13).*

E. OBMP SEMI-ANNUAL STATUS REPORT 2025-1
Recommend to the Watermaster Board to adopt the OBMP Semi-Annual Status Report 2025-1, and direct staff to file a copy with the Court, subject to any necessary non-substantive changes *(Page 20).*

II. BUSINESS ITEMS

A. OPTIMUM BASIN MANAGEMENT PROGRAM – ECONOMIC ANALYSIS (UPDATE) (INFORMATION ONLY) *(Page 43)*

B. PEER REVIEW OF THE DRAFT 2025 SAFE YIELD REEVALUATION FINAL REPORT (CONSULTANT PRESENTATION – INFORMATION ONLY) *(Page 48)*

III. REPORTS/UPDATES

A. WATERMASTER LEGAL COUNSEL

1. September 12, 2025, Court Hearing (Watermaster Motion for Receipt and Filing of Semi-Annual OBMP Status Report 2024-2; IEUA Motion for Costs and Fees; Watermaster Motion for Extension of Time to Complete Safe Yield Evaluation)
2. October 3, 2025, Status Conference re Court of Appeal Remittitur in Consolidated Cases No. E080457 and E082127; Court Hearing (Appropriative Pool Motion for Costs and Fees)
3. October 31, 2025, Court Hearing (Ontario Motion for Attorney's Fees and Costs)
4. Court of Appeal Consolidated Cases No. E080457 and E082127 (City of Ontario appeal re: Fiscal Year 2021-22 and 2022-23 Assessment Packages)
5. Inland Empire Utilities Agency, et al. v. LS-Fontana LLC (C.D. Cal Cases Nos.: 5:25-cv-00809, 5:25 cv-01159)

B. ENGINEER

1. 2024 State of the Basin Report (Update)
2. Ground-Level Monitoring Program

C. GENERAL MANAGER

1. Update on Implementation of Dry Year Yield Appellate Court Ruling – Workshops
2. Assessment Package for Fiscal Year ended June 30, 2025 – Water Activity Reports Due 9/15/25
3. AB1413 Update
4. Other

D. INLAND EMPIRE UTILITIES AGENCY *(Page 128)*

1. Metropolitan Water District Activities Report (Written)
2. Water Supply Conditions (Written)
3. State and Federal Legislative Reports (Written)
4. Ground Water Recharge update (Written)

E. OTHER METROPOLITAN MEMBER AGENCY REPORTS

IV. INFORMATION

A. RECHARGE INVESTIGATION AND PROJECTS COMMITTEE (PROJECT 23a STATUS) *(Page 153)*

V. COMMITTEE MEMBER COMMENTS

VI. OTHER BUSINESS

VII. CONFIDENTIAL SESSION - POSSIBLE ACTION

A Confidential Session may be held during the Advisory Committee meeting for the purpose of discussion and possible action.

VIII. FUTURE MEETINGS AT WATERMASTER

09/25/25	Thu	9:30 a.m.	Watermaster Orientation (in person only)
09/25/25	Thu	11:00 a.m.	Watermaster Board
10/02/25	Thu	10:00 a.m.	Ground-Level Monitoring Committee
10/02/25	Thu	1:30 p.m.	Groundwater Recharge Brainstorming Session
10/09/25	Thu	9:00 a.m.	Appropriative Pool Committee
10/09/25	Thu	11:00 a.m.	Non-Agricultural Pool Committee
10/09/25	Thu	1:30 p.m.	Agricultural Pool Committee
10/16/25	Thu	9:00 a.m.	Advisory Committee
10/21/25	Tue	10:00 a.m.	Fiscal Year 2025/26 Assessment Package Workshop #1
10/23/25	Thu	9:30 a.m.	Watermaster Orientation (in person only)
10/23/25	Thu	11:00 a.m.	Watermaster Board
10/28/25	Tue	10:00 a.m.	Fiscal Year 2025/26 Assessment Package Workshop #2

ADJOURNMENT

DRAFT MINUTES
CHINO BASIN WATERMASTER
ADVISORY COMMITTEE MEETING
August 21, 2025

The Advisory Committee meeting was held at the Chino Basin Watermaster offices located at 9641 San Bernardino Road, Rancho Cucamonga, CA, and via Zoom (conference call and web meeting) on August 21, 2025.

ADVISORY COMMITTEE MEMBERS PRESENT

- **APPROPRIATIVE POOL COMMITTEE MEMBERS PRESENT AT WATERMASTER**

Eduardo Espinoza, **Chair** (for John Bosler)	Cucamonga Valley Water District
Hye Jin Lee	City of Chino
Chris Diggs	City of Pomona
Cris Fealy	Fontana Water Company
Justin Castruita (for Josh Swift)	Fontana Union Water Company
Jesse Pompa (for Chris Berch)	Jurupa Community Services District
Justin Scott-Coe	Monte Vista Water District

- **APPROPRIATIVE POOL COMMITTEE MEMBERS PRESENT ON ZOOM**

Chad Nishida (for Courtney Jones)	City of Ontario
Nicole deMoet	City of Upland
Brian Lee	San Antonio Water Company

- **NON-AGRICULTURAL POOL COMMITTEE MEMBERS PRESENT AT WATERMASTER**

Brian Geye, **Vice-Chair**	California Speedway Corporation
Bob Bowcock	CalMat Co.

- **NON-AGRICULTURAL POOL COMMITTEE MEMBERS PRESENT ON ZOOM**

Alexis Mascarinas	City of Ontario (Non-Ag)

- **AGRICULTURAL POOL COMMITTEE MEMBERS PRESENT ON ZOOM**

Jeff Pierson, **Second Vice-Chair**	Crops
Gino Filippi	Crops
Carol Boyd	State of California
Michael Maeda	State of California
Imelda Cadigal	State of California
Lewis Callahan	State of California
Jimmy Medrano	State of California

- **MUNICIPAL REPRESENTATIVES PRESENT ON ZOOM**

Matt Litchfield	Three Valleys Municipal Water District
Laura Roughton	Western Municipal Water District

WATERMASTER BOARD MEMBERS PRESENT AT WATERMASTER

Marty Zvirbulis	Fontana Water Company

WATERMASTER BOARD MEMBERS PRESENT ON ZOOM

Bill Velto	City of Upland
Mike Gardner	Western Municipal Water District

WATERMASTER STAFF PRESENT

Todd Corbin	General Manager
Edgar Tellez Foster	Water Resources Mgmt. & Planning Director
Anna Nelson	Director of Administration
Justin Nakano	Water Resources Technical Manager
Frank Yoo	Data Services and Judgment Reporting Manager
Daniela Uriarte	Senior Accountant
Ruby Favela Quintero	Executive Assistant
Alonso Jurado	Senior Field Operations Specialist
Kirk Richard Dolar	Administrative Analyst
Jordan Garcia	Senior Field Operations Specialist
Erik Vides	Field Operations Specialist

WATERMASTER CONSULTANTS PRESENT ON ZOOM

Brad Herrema	Brownstein Hyatt Farber Schreck, LLP
Carolina Sanchez	West Yost

OTHERS PRESENT AT WATERMASTER

Melissa Cansino	City of Pomona
Amanda Coker	Cucamonga Valley Water District
Jiwon Seung	Cucamonga Valley Water District
Bryan Smith	Jurupa Community Services District
Sylvie Lee	Three Valleys Municipal Water District

OTHERS PRESENT ON ZOOM

Ben Orosco	City of Chino
Derek Hoffman	Fennemore Law
Ben Lewis	Golden State Water Company
Eddie Lin	Inland Empire Utilities Agency
Aimee Zhao	Inland Empire Utilities Agency
Justin Scott-Coe	Monte Vista Irrigation Company
Manny Martinez	Monte Vista Water District
Kevin O'Toole	Orange County Water District
David De Jesus	Three Valleys Municipal Water District
Jorge Marquez	Three Valleys Municipal Water District
Joshua Aguilar	Three Valleys Municipal Water District
Ryan Shaw	Western Municipal Water District
Nicole deMoet	West End Consolidated Water Company
Rick Rees	WSP USA

CALL TO ORDER

Chair Espinoza called the Advisory Committee meeting to order at 9:01 a.m.

ROLL CALL

(00:00:14) Ms. Nelson conducted the roll call and announced that a quorum was present.

AGENDA – ADDITIONS/REORDER

None

SAFETY MINUTE

(00:02:48) Mr. Corbin emphasized the importance of skin protection and reminded everyone to use sunscreen, wear protective clothing, and hats when outdoors, especially during the summer season.

I. CONSENT CALENDAR

All matters listed under the Consent Calendar are considered to be routine and non-controversial and will be acted upon by one motion in the form listed below. There will be no separate discussion on these items prior to voting unless any members, staff, or the public requests specific items be discussed and/or removed from the Consent Calendar for separate action.

A. MINUTES

Approve as presented:
Minutes of the Advisory Committee Meeting held on July 17, 2025

B. FINANCIAL REPORTS

Receive and file as presented:
Monthly Financial Report for the Period Ended June 30, 2025

C. APPLICATION: WATER TRANSACTION – 708.3 AF WEST END CONSOLIDATED WATER COMPANY TO CITY OF UPLAND

Provide advice and assistance to the Watermaster Board on the proposed transaction.

D. APPLICATION: WATER TRANSACTION – 66.4 AF WEST END CONSOLIDATED WATER COMPANY TO GOLDEN STATE WATER COMPANY

Provide advice and assistance to the Watermaster Board on the proposed transaction.

E. APPLICATION: WATER TRANSACTION – 400 AF CITY OF UPLAND TO GOLDEN STATE WATER COMPANY

Provide advice and assistance to the Watermaster Board on the proposed transaction.

(00:03:55)
Motion by Mr. Cris Fealy, seconded by Vice-Chair Brian Geye, there being no dissent, the motion was deemed passed unanimously among those present.

Moved to approve the Consent Calendar as presented.

II. BUSINESS ITEMS

A. CONSIDERATION OF THE FISCAL YEAR 2025/26 CARRYOVER BUDGET

Recommend Watermaster Board to approve budget amendment as presented.

(00:04:23) Mr. Corbin gave a presentation. A discussion ensued.

(00:08:03)
Motion by Mr. Chris Diggs, seconded by Mr. Jesse Pompa, the motion was deemed passed by majority vote of those present with one abstention by Monte Vista Water District,.

Moved to approve Business Item II.A. as presented.

B. OPTIMUM BASIN MANAGEMENT PROGRAM – ECONOMIC ANALYSIS UPDATE (INFORMATION ONLY)

(00:09:00) Mr. Corbin prefaced the item and asked Mr. Tellez Foster to give a report. A discussion ensued.

C. PEER REVIEW OF THE DRAFT 2025 SAFE YIELD REEVALUATION FINAL REPORT UPDATE (INFORMATION ONLY)

(00:15:10) Mr. Tellez Foster gave a report. A discussion ensued.

III. REPORTS/UPDATES

A. WATERMASTER LEGAL COUNSEL

1. September 12, 2025, Court Hearing (Watermaster Motion for Receipt and Filing of Semi-Annual OBMP Status Report 2024-2; IEUA Motion for Costs and Fees; Watermaster Motion for Extension of Time to Complete Safe Yield Evaluation)
2. October 3, 2025, Court Hearing (Appropriative Pool Motion for Costs and Fees)
3. October 31, 2025, Court Hearing (Ontario Motion for Attorney's Fees and Costs)
4. Court of Appeal Consolidated Cases No. E080457 and E082127 (City of Ontario appeal re: Fiscal Year 2021-22 and 2022-23 Assessment Packages)
5. Inland Empire Utilities Agency, et al. v. LS-Fontana LLC (C.D. Cal Cases Nos.: 5:25-cv-00809, 5:25-cv-01159)
6. Motion For OSC In RE Deadline To Exercise Peace Agreement Section 8.4 Extension Right

(00:21:44) Mr. Herrema gave a report.

B. ENGINEER

1. Update 2024 State of the Basin Report

(00:24:30) Ms. Sanchez gave a report.

C. GENERAL MANAGER

1. Update on Implementation of Dry Year Yield Appellate Court Ruling – Workshops
2. Frontier Communications Contract
3. Other

(00:25:05) Mr. Corbin reported that for Item 1, Watermaster held workshop #2 on August 20, 2025, at 10:00 a.m. to further the discussions for the implementation of the Appellate Court's ruling regarding the Dry Year Yield program and thanked everyone who attended. For Item 2, he reported that a contract with Frontier Communications for direct internet access will be submitted to the Board for approval.

D. INLAND EMPIRE UTILITIES AGENCY

1. Metropolitan Water District Activities Report (Written)
2. Water Supply Conditions (Written)
3. State and Federal Legislative Reports (Written)

No oral report was given.

E. OTHER METROPOLITAN MEMBER AGENCY REPORTS

(00:26:33) Ms. Roughton wished everyone a happy Labor Day weekend.

IV. INFORMATION

A. RECHARGE INVESTIGATION AND PROJECTS COMMITTEE (PROJECT 23a STATUS)

This was an informational item, and no oral report was given.

V. COMMITTEE MEMBER COMMENTS

None

VI. OTHER BUSINESS

None

VII. CONFIDENTIAL SESSION - POSSIBLE ACTION

A Confidential Session may be held during the Advisory Committee meeting for the purpose of discussion and possible action.

None

ADJOURNMENT

Chair Espinoza adjourned the Advisory Committee meeting at 9:28 a.m.

Secretary: _____

Approved: _____

CHINO BASIN WATERMASTER

9641 San Bernardino Road, Rancho Cucamonga, CA 91730
909.484.3888 www.cbwm.org

STAFF REPORT

DATE: September 18, 2025

TO: Advisory Committee Members

SUBJECT: Application: Water Transaction – 788 AF from Jurupa Community Services District to Fontana Water Company (Consent Calendar Item I.C.)

Issue: The Purchase of 788 acre-feet of water from Jurupa Community Services District by Fontana Water Company. This purchase is made from Jurupa Community Services District's Local Storage Account. [Within WM Duties and Powers]

Recommendation: Provide advice and assistance to the Watermaster Board on the proposed transaction.

Financial Impact: None.

ACTIONS:
Appropriative Pool – August 14, 2025 [Final]: Provided advice and assistance.
Non-Agricultural Pool – August 14, 2025 [Final]: Provided advice and assistance.
Agricultural Pool – August 14, 2025 [Final]: Provided advice and assistance.
Advisory Committee – September 18, 2025 [Recommended]: Advice and assistance.
Watermaster Board – September 25, 2025 [Recommended]: Approval.

BACKGROUND

On July 13, 2000, the Court approved the Peace Agreement, the Implementation Plan, and the goals and objectives identified in the OBMP Phase I Report and ordered Watermaster to proceed in a manner consistent with the Peace Agreement. Under the Peace Agreement, Watermaster approval is required for applications to store, recapture, recharge, or transfer water, as well as for applications for credits or reimbursements, and storage and recovery programs.

Where there is no Material Physical Injury, Watermaster must approve the transaction. Where the request for Watermaster approval is submitted by a Party to the Judgment, there is a rebuttable presumption, under the Peace Agreement, that most of the transactions do not result in Material Physical Injury to a Party to the Judgment or the Basin (Storage and Recovery Programs do not have this presumption).

The date of this application is June 30, 2025. Notice of the transaction along with the materials submitted by the requestors was transmitted to stakeholders electronically on August 8, 2025.

DISCUSSION

Beyond confirmation of the source of the water to be transferred (Annual Production Right, Supplemental Water, or Excess Carryover), Watermaster will evaluate the eventual disposition of the transferred water (e.g. production, storage, etc.) at the end of the production year and account for the same consistent with the Watermaster Guidance Documents.

Water transactions occur each year and are included as production by the respective entity (if produced) in any relevant analysis conducted by West Yost pursuant to the Peace Agreement and the Rules & Regulations. There is no indication that additional analysis regarding this transaction is necessary at this time. As part of the OBMP Implementation Plan, measurement of groundwater levels and ground level changes are ongoing, and based on current data, there is no indication that the proposed water transaction will cause Material Physical Injury to a Party to the Judgment, or to the Basin.

Pursuant to the Rules & Regulations, “The Application shall not be considered by the Advisory Committee until at least twenty-one (21) days after the last of the three Pool Committee meetings to consider the matter.” Therefore, this application will be presented to the Advisory Committee and Watermaster Board in the month of September 2025.

At the Pool Committee meetings held on August 14, 2025, the Appropriative and Overlying (Agricultural) Pools unanimously recommended Advisory Committee to recommend to the Watermaster Board to approve the proposed transaction; the Overlying (Non-Agricultural) pool unanimously recommended its representatives to support at the Advisory Committee and Watermaster Board meetings subject to changes they deem appropriate.

ATTACHMENTS
1. Consolidated Forms 3, 4, & 5
2. Notice Forms

ATTACHMENT 1

Consolidated Forms 3, 4 & 5

CONSOLIDATED WATER TRANSFER FORMS:
FORM 3: APPLICATION FOR SALE OR TRANSFER OF RIGHT TO PRODUCE WATER FROM STORAGE
FORM 4: APPLICATION OR AMENDMENT TO APPLICATION TO RECAPTURE WATER IN STORAGE
FORM 5: APPLICATION TO TRANSFER ANNUAL PRODUCTION RIGHT OR SAFE YIELD

FISCAL YEAR 2024 - 2025

DATE REQUESTED: 6/30/2025 **AMOUNT REQUESTED:** 788 Acre-Feet

TRANSFER FROM (SELLER / TRANSFEROR):	**TRANSFER TO (BUYER / TRANSFEREE):**
Jurupa Community Services District Name of Party	Fontana Water Company Name of Party
11201 Harrel St Street Address	15966 Arrow Route Street Address
Mira Loma / CA / 91737 City / State / Zip Code	Fontana / CA. / 92335 City / State / Zip Code
951-685-7434 Telephone	(909) 822-2201 Telephone
951-727-3503 Facsimile	(909) 823-5046 Facsimile

Have any other transfers been approved by Watermaster between these parties covering the same fiscal year? Yes ☐ No ☒

PURPOSE OF TRANSFER:

- ☐ Pump when other sources of supply are curtailed
- ☒ Pump to meet current or future demand over and above production right
- ☐ Pump as necessary to stabilize future assessment amounts
- ☐ Other, explain _____

WATER IS TO BE TRANSFERRED FROM:

- ☐ Annual Production Right (Appropriative Pool) or Operating Safe Yield (Non-Agricultural Pool)
- ☒ Storage
- ☐ Annual Production Right / Operating Safe Yield first, then any additional from Storage
- ☐ Other, explain _____

WATER IS TO BE TRANSFERRED TO:

- ☒ Annual Production Right / Operating Safe Yield (common)
- ☐ Storage (rare)
- ☐ Other, explain _____

IS THE 85/15 RULE EXPECTED TO APPLY? (If yes, all answers below must be "yes.")	**Yes ☐**	**No ☒**
Is the Buyer an 85/15 Party?	Yes ☐	No ☐
Is the purpose of the transfer to meet a current demand over and above production right?	Yes ☐	No ☐
Is the water being placed into the Buyer's Annual Account?	Yes ☐	No ☐

IF WATER IS TO BE TRANSFERRED FROM STORAGE:

Varies
Projected Rate of Recapture

2024-2025
Projected Duration of Recapture

METHOD OF RECAPTURE (e.g. pumping, exchange, etc.):

Pumping

PLACE OF USE OF WATER TO BE RECAPTURED:

Chino Basin Management Zone 3

LOCATION OF RECAPTURE FACILITIES (IF DIFFERENT FROM REGULAR PRODUCTION FACILITIES):

N/A

WATER QUALITY AND WATER LEVELS

Are the Parties aware of any water quality issues that exist in the area? Yes ☒ No ☐

If yes, please explain:

In 2025, perchlorate and nitrate levels ranged as high as 6.9 ppb and 9.3 ppm respectively.

What are the existing water levels in the areas that are likely to be affected?

Static Water Levels ranging from 317 feet (bgs) to 677 feet (bgs) as of May 2025.

MATERIAL PHYSICAL INJURY

Are any of the recapture wells located within Management Zone 1? Yes ☐ No ☒

Is the Applicant aware of any potential Material Physical Injury to a party to the Judgment or the Basin that may be caused by the action covered by the application? Yes ☐ No ☒

If yes, what are the proposed mitigation measures, if any, that might reasonably be imposed to ensure that the action does not result in Material Physical Injury to a party to the Judgment or the Basin?

SAID TRANSFER SHALL BE CONDITIONED UPON:

(1) Transferee shall exercise said right on behalf of Transferor under the terms of the Judgment, the Peace Agreement, the Peace II Agreement, and the Management Zone 1 Subsidence Management Plan for the period described above. The first water produced in any year shall be that produced pursuant to carry-over rights defined in the Judgment. After production of its carry-over rights, if any, the next (or first if no carry-over rights) water produced by Transferee from the Chino Basin shall be that produced hereunder.

(2) Transferee shall put all waters utilized pursuant to said Transfer to reasonable beneficial use.

(3) Transferee shall pay all Watermaster assessments on account of the water production hereby Transferred.

(4) Any Transferee not already a party must Intervene and become a party to the Judgment.

ADDITIONAL INFORMATION ATTACHED Yes ☐ No ☒

Signed by:
AC0B75A3CB1E49D...
7/11/2025 | 7:05 AM PDT

Seller / Transferor Representative Signature

Buyer / Transferee Representative Signature

Chris Berch - General Manager
Seller / Transferor Representative Name (Printed)

Martin Zvirbulis, Vice President - Water Resources
Buyer / Transferee Representative Name (Printed)

TO BE COMPLETED BY WATERMASTER STAFF:

DATE OF WATERMASTER NOTICE: August 8, 2025

DATE OF APPROVAL FROM APPROPRIATIVE POOL: August 14, 2025

DATE OF APPROVAL FROM NON-AGRICULTURAL POOL: August 14, 2025

DATE OF APPROVAL FROM AGRICULTURAL POOL: August 14, 2025

HEARING DATE, IF ANY: _____

DATE OF ADVISORY COMMITTEE APPROVAL: _____

DATE OF BOARD APPROVAL: _____

CHINO BASIN WATERMASTER

NOTICE

OF

APPLICATION(S)

RECEIVED FOR

TRANSFER OF WATER

Date of Notice:

August 8, 2025

This notice is to advise interested persons that the attached application(s) will come before the Watermaster Board on or after 30 days from the date of this notice.

APPLICATION FOR TRANSFER OF WATER

The attached staff report will be included in the meeting package at the time the transfer begins the Watermaster process.

NOTICE OF APPLICATION(S) RECEIVED

Date of Application: **June 30, 2025** Date of this notice: **August 08, 2025**

Please take notice that the following Application has been received by Watermaster:

- Notice of Sale or Transfer – The purchase of 788 acre-feet of water from Jurupa Community Services District by Fontana Water Company. This purchase is made from Jurupa Community Services District's Local Storage Account.

This ***Application*** will first be considered by each of the respective pool committees on the following dates:

Appropriative Pool:	August 14, 2025
Non-Agricultural Pool:	August 14, 2025
Agricultural Pool:	August 14, 2025

This ***Application*** will be scheduled for consideration by the Advisory Committee ***no earlier than thirty days from the date of this notice and a minimum of twenty-one calendar days*** after the last pool committee reviews it***.***

After consideration by the Advisory Committee, the ***Application*** will be considered by the Board.

Unless the ***Application*** is amended, as ***Contests*** must be submitted a minimum of fourteen (14) days prior to the Advisory Committee's consideration of an ***Application,*** parties to the Judgment may file ***Contests*** to the ***Application*** with Watermaster ***within seven calendar days*** of when the last pool committee considers it. Any ***Contest*** must be in writing and state the basis of the ***Contest***.

Watermaster address:

Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

Tel: (909) 484-3888
Web: www.cbwm.org
watertransactions@cbwm.org

CHINO BASIN WATERMASTER

9641 San Bernardino Road, Rancho Cucamonga, CA 91730
909.484.3888 www.cbwm.org

STAFF REPORT

DATE: September 18, 2025

TO: Advisory Committee Members

SUBJECT: Application: Water Transaction – 2,000 AF from City of Chino to Niagara Bottling, LLC (Consent Calendar Item I.D.)

Issue: The Purchase of 2,000 acre-feet of water from City of Chino by Niagara Bottling, LLC. This purchase is made from City of Chino's Local Excess Carry Over Storage Account. [Within WM Duties and Powers]

Recommendation: Provide advice and assistance to the Watermaster Board on the proposed transaction.

Financial Impact: None.

ACTIONS:
Appropriative Pool – August 14, 2025 [Final]: Provided advice and assistance.
Non-Agricultural Pool – August 14, 2025 [Final]: Provided advice and assistance.
Agricultural Pool – August 14, 2025 [Final]: Provided advice and assistance.
Advisory Committee – September 18, 2025 [Recommended]: Advice and assistance.
Watermaster Board – September 25, 2025 [Recommended]: Approval.

BACKGROUND

On July 13, 2000, the Court approved the Peace Agreement, the Implementation Plan, and the goals and objectives identified in the OBMP Phase I Report and ordered Watermaster to proceed in a manner consistent with the Peace Agreement. Under the Peace Agreement, Watermaster approval is required for applications to store, recapture, recharge, or transfer water, as well as for applications for credits or reimbursements, and storage and recovery programs.

Where there is no Material Physical Injury, Watermaster must approve the transaction. Where the request for Watermaster approval is submitted by a Party to the Judgment, there is a rebuttable presumption, under the Peace Agreement, that most of the transactions do not result in Material Physical Injury to a Party to the Judgment or the Basin (Storage and Recovery Programs do not have this presumption).

The date of this application is June 17, 2025. Notice of the transaction along with the materials submitted by the requestors was transmitted to stakeholders electronically on August 8, 2025. Although the date of this application falls within the 2024/25 fiscal year, this transaction will apply to the 2025/26 fiscal year as indicated on the application.

DISCUSSION

Beyond confirmation of the source of the water to be transferred (Annual Production Right, Supplemental Water, or Excess Carryover), Watermaster will evaluate the eventual disposition of the transferred water (e.g. production, storage, etc.) at the end of the production year and account for the same consistent with the Watermaster Guidance Documents.

Water transactions occur each year and are included as production by the respective entity (if produced) in any relevant analysis conducted by West Yost pursuant to the Peace Agreement and the Rules & Regulations. There is no indication that additional analysis regarding this transaction is necessary at this time. As part of the OBMP Implementation Plan, measurement of groundwater levels and ground level changes are ongoing, and based on current data, there is no indication that the proposed water transaction will cause Material Physical Injury to a Party to the Judgment, or to the Basin.

Pursuant to the Rules & Regulations, “The Application shall not be considered by the Advisory Committee until at least twenty-one (21) days after the last of the three Pool Committee meetings to consider the matter.” Therefore, this application will be presented to the Advisory Committee and Watermaster Board in the month of September 2025.

At the Pool Committee meetings held on August 14, 2025, the Appropriative and Overlying (Agricultural) Pools unanimously recommended Advisory Committee to recommend to the Watermaster Board to approve the proposed transaction; the Overlying (Non-Agricultural) Pool unanimously recommended its representatives to support at the Advisory Committee and Watermaster Board meetings subject to changes they deem appropriate.

ATTACHMENTS
1. Consolidated Forms 3, 4, & 5
2. Notice Forms

ATTACHMENT 1

Consolidated Forms 3, 4 & 5

CONSOLIDATED WATER TRANSFER FORMS:
FORM 3: APPLICATION FOR SALE OR TRANSFER OF RIGHT TO PRODUCE WATER FROM STORAGE
FORM 4: APPLICATION OR AMENDMENT TO APPLICATION TO RECAPTURE WATER IN STORAGE
FORM 5: APPLICATION TO TRANSFER ANNUAL PRODUCTION RIGHT OR SAFE YIELD

FISCAL YEAR 2025 - 2026

DATE REQUESTED: 6/17/2025 **AMOUNT REQUESTED:** 2,000 Acre-Feet

TRANSFER FROM (SELLER / TRANSFEROR):	**TRANSFER TO (BUYER / TRANSFEREE):**
City of Chino Name of Party	Niagara Bottling, LLC Name of Party
13220 Central Ave Street Address	1440 Bridgegate Dr. Street Address
Chino (City) CA (State) 91710 (Zip Code)	Diamond Bar (City) CA (State) 91765 (Zip Code)
(909) 334-3250 Telephone	(909) 230-5000 Telephone
Facsimile	Facsimile

Have any other transfers been approved by Watermaster between these parties covering the same fiscal year? Yes ☐ No ☒

PURPOSE OF TRANSFER:

- ☐ Pump when other sources of supply are curtailed
- ☒ Pump to meet current or future demand over and above production right
- ☐ Pump as necessary to stabilize future assessment amounts
- ☐ Other, explain _____

WATER IS TO BE TRANSFERRED FROM:

- ☐ Annual Production Right (Appropriative Pool) or Operating Safe Yield (Non-Agricultural Pool)
- ☐ Storage
- ☐ Annual Production Right / Operating Safe Yield first, then any additional from Storage
- ☒ Other, explain Storage - Excess carry over

WATER IS TO BE TRANSFERRED TO:

- ☒ Annual Production Right / Operating Safe Yield (common)
- ☐ Storage (rare)
- ☐ Other, explain _____

IS THE 85/15 RULE EXPECTED TO APPLY? (If yes, all answers below must be "yes.")	**Yes** ☐	**No** ☒
Is the Buyer an 85/15 Party?	Yes ☐	No ☐
Is the purpose of the transfer to meet a current demand over and above production right?	Yes ☐	No ☐
Is the water being placed into the Buyer's Annual Account?	Yes ☐	No ☐

IF WATER IS TO BE TRANSFERRED FROM STORAGE:

1500 AFY
Projected Rate of Recapture

January to December
Projected Duration of Recapture

METHOD OF RECAPTURE (e.g. pumping, exchange, etc.):

Pumping

PLACE OF USE OF WATER TO BE RECAPTURED:

Ontario Facility

LOCATION OF RECAPTURE FACILITIES (IF DIFFERENT FROM REGULAR PRODUCTION FACILITIES):

N/A

WATER QUALITY AND WATER LEVELS

Are the Parties aware of any water quality issues that exist in the area? Yes ☐ No ☒

If yes, please explain:

What are the existing water levels in the areas that are likely to be affected?

MATERIAL PHYSICAL INJURY

Are any of the recapture wells located within Management Zone 1? Yes ☐ No ☒

Is the Applicant aware of any potential Material Physical Injury to a party to the Judgment or the Basin that may be caused by the action covered by the application? Yes ☐ No ☒

If yes, what are the proposed mitigation measures, if any, that might reasonably be imposed to ensure that the action does not result in Material Physical Injury to a party to the Judgment or the Basin?

SAID TRANSFER SHALL BE CONDITIONED UPON:

(1) Transferee shall exercise said right on behalf of Transferor under the terms of the Judgment, the Peace Agreement, the Peace II Agreement, and the Management Zone 1 Subsidence Management Plan for the period described above. The first water produced in any year shall be that produced pursuant to carry-over rights defined in the Judgment. After production of its carry-over rights, if any, the next (or first if no carry-over rights) water produced by Transferee from the Chino Basin shall be that produced hereunder.

(2) Transferee shall put all waters utilized pursuant to said Transfer to reasonable beneficial use.

(3) Transferee shall pay all Watermaster assessments on account of the water production hereby Transferred.

(4) Any Transferee not already a party must Intervene and become a party to the Judgment.

ADDITIONAL INFORMATION ATTACHED Yes ☐ No ☒

Seller / Transferor Representative Signature

Hye Jin Lee Director of Public Works
Seller / Transferor Representative Name (Printed)

DocuSigned by:
Geoff Kamansky
BE0F0CAAACA043E...
Buyer / Transferee Representative Signature

Geoffrey Kamansky
Buyer / Transferee Representative Name (Printed)

TO BE COMPLETED BY WATERMASTER STAFF:

DATE OF WATERMASTER NOTICE: August 8, 2025

DATE OF APPROVAL FROM APPROPRIATIVE POOL: August 14, 2025

DATE OF APPROVAL FROM NON-AGRICULTURAL POOL: August 14, 2025

DATE OF APPROVAL FROM AGRICULTURAL POOL: August 14, 2025

HEARING DATE, IF ANY: _____

DATE OF ADVISORY COMMITTEE APPROVAL: _____

DATE OF BOARD APPROVAL: _____

CHINO BASIN WATERMASTER

NOTICE

OF

APPLICATION(S)

RECEIVED FOR

TRANSFER OF WATER

Date of Notice:

August 8, 2025

This notice is to advise interested persons that the attached application(s) will come before the Watermaster Board on or after 30 days from the date of this notice.

APPLICATION FOR TRANSFER OF WATER

The attached staff report will be included in the meeting package at the time the transfer begins the Watermaster process.

NOTICE OF APPLICATION(S) RECEIVED

Date of Application: **June 17, 2025** Date of this notice: **August 08, 2025**

Please take notice that the following Application has been received by Watermaster:

- Notice of Sale or Transfer – The purchase of 2,000 acre-feet of water from City of Chino by Niagara Bottling, LLC. This purchase is made from City of Chino's Local Excess Carry Over Storage Account.

This ***Application*** will first be considered by each of the respective pool committees on the following dates:

Appropriative Pool:	August 14, 2025
Non-Agricultural Pool:	August 14, 2025
Agricultural Pool:	August 14, 2025

This ***Application*** will be scheduled for consideration by the Advisory Committee ***no earlier than thirty days from the date of this notice and a minimum of twenty-one calendar days*** after the last pool committee reviews it***.***

After consideration by the Advisory Committee, the ***Application*** will be considered by the Board.

Unless the ***Application*** is amended, as ***Contests*** must be submitted a minimum of fourteen (14) days prior to the Advisory Committee's consideration of an ***Application,*** parties to the Judgment may file ***Contests*** to the ***Application*** with Watermaster ***within seven calendar days*** of when the last pool committee considers it. Any ***Contest*** must be in writing and state the basis of the ***Contest***.

Watermaster address:

Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

Tel: (909) 484-3888
Web: www.cbwm.org
watertransactions@cbwm.org

CHINO BASIN WATERMASTER

9641 San Bernardino Road, Rancho Cucamonga, CA 91730
909.484.3888 www.cbwm.org

STAFF REPORT

DATE: September 18, 2025

TO: Advisory Committee Members

SUBJECT: OBMP Semi-Annual Status Report 2025-1 (Consent Calendar Item I.E.)

Issue: Pursuant to the September 28, 2000 Court Order under Periodic Reporting Requirements, Watermaster is required to produce the Semi-Annual Optimum Basin Management Program (OBMP) Status Reports. The draft report for the period January to June 2025 is presented for comments, recommendations and adoption. [Discretionary Function]

Recommendation: Recommend to the Watermaster Board to adopt the OBMP Semi-Annual Status Report 2025-1, and direct staff to file a copy with the Court, subject to any necessary non-substantive changes.

Financial Impact: None.

ACTIONS:
Appropriative Pool – September 11, 2025 [Final]: Provided advice and assistance.
Non-Agricultural Pool – September 11, 2025 [Final]: Provided advice and assistance.
Agricultural Pool – September 11, 2025 [Final]: Provided advice and assistance.
Advisory Committee – September 18, 2025 [Recommended]: Advice and assistance.
Watermaster Board – September 25, 2025 [Recommended]: Adopt and direct staff to file with the Court.

BACKGROUND

The OBMP Semi-Annual Status Report 2025-1 covers the period from January to June 2025. The report describes work conducted, and the status of the nine Program Elements of the Optimum Basin Management Program during the six-month period.

DISCUSSION

The OBMP Semi-Annual Status Report 2025-1 (Attachment 1) has been drafted. Once adopted by the Watermaster Board, a copy of the report will be filed with the Court.

At the Pool Committee meetings held on September 11, 2025, the Appropriative Pool unanimously recommended the Advisory Committee to recommend to the Watermaster Board to adopt the Report; the Overlying (Non-Agricultural) Pool unanimously recommended its representatives to support at the Advisory Committee and Watermaster Board meetings subject to changes they deem appropriate; and the Overlying (Agricultural) Pool unanimously recommended the Advisory Committee to recommend to the Watermaster Board to adopt the Report with a correction made to the name of the California Institution for Men on page 13 (Attachment 2).

ATTACHMENT
1. OBMP Semi-Annual Status Report 2025-1
2. OBMP Semi-Annual Status Report 2025-1 (redlined)

Optimum Basin Management Program

Staff Status Report 2025-1: January to June 2025

CHINO BASIN WATERMASTER

Highlighted Activities

- About 300 manual water level measurements from 38 private and 12 municipal supply wells were taken; two quarterly data downloads were conducted from 140 pressure transducers installed at various well sites; two quarterly surface water quality samples from two sites (SAR at River Road and SAR at Etiwanda) and groundwater quality samples from three nearby wells (Archibald 1, Archibald 2, and SARWC 9) were taken; and two well sites (SARWC 10 and Archibald) were rehabilitated.
- Pursuant to the requirement of the Peace II Subsequent Environmental Impact Report (SEIR), Watermaster and the Inland Empire Utilities Agency (IEUA) continued to implement the Prado Basin Habitat Sustainability Program (PBHSP). Watermaster conducted two quarterly downloads of pressure transducers at the 18 PBHSP monitoring wells, collected quarterly water quality parameters at four surface water sites, prepared the annual report for water year 2024, developed the PBHSP scope and budget for the fiscal year 2025/26, and conducted two Prado Basin Habitat Sustainability Committee (PBHSC) meetings.
- Watermaster continued to implement the Ground-Level Monitoring Program (GLMP) for the MZ-1 and Northwest MZ-1 areas. Watermaster has: collected, processed, and checked groundwater level and aquifer-system deformation data from the Ayala Park, Chino Creek, and Pomona extensometer facilities, and groundwater production data from wells in Northwest MZ-1; continued high-resolution water-level monitoring at about 30 wells within the MZ-1 Managed Area and the Areas of Subsidence Concern; conducted Spring-2025 ground-elevation surveys at established benchmarks across the Northwest MZ-1 Area; performed InSAR analyses of vertical ground motion across all Areas of Subsidence Concern for the periods 2023-24 and 2024-25; begun troubleshooting and scoping activities at the Pomona extensometer facility in preparation for the refurbishment; conducted one Ground-Level Monitoring Committee (GLMC) meeting; prepared the draft and final technical memoranda on the Recommended Scope and Budget for the GLMP for FY 2025/26; and prepared figures and text for the draft *2024-25 Annual Report for the Ground-Level Monitoring Program*.
- Watermaster and the IEUA continued to implement the 2013 Amendment to the 2010 Recharge Master Plan Update (2013 RMPU). The Wineville/Jurupa/RP3 Basins project continued with a new completion date of Spring 2026. IEUA submitted a grant application for the Montclair Basins project and was notified that $1.3 million in grant funding is anticipated to be awarded; the project's updated completion date is set for December 2026. Watermaster and the IEUA recharged a total of 13,866 acre-feet of water: 6,409 acre-feet of stormwater, 7,388 acre-feet of recycled water, and 69 acre-feet of imported water.
- Watermaster and the IEUA continued to implement the Maximum Benefit Salt and Nutrient Management Plan and provide support to the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) staff on the Basin Plan amendment to update the plan's commitments and requirements.
- Watermaster and the IEUA completed the first year's monthly sampling for the surface water monitoring program in Chino Creek and will perform the first annual data review during the next reporting period.
- Watermaster continued its technical efforts to evaluate the Safe Yield of the Chino Basin for the period of fiscal year 2021 through 2030 (2025 Safe Yield Reevaluation). In alignment with the Watermaster Board's direction to engage an independent consultant for peer review of the technical work, Watermaster submitted a motion to the Court requesting an extension of the deadline to complete the 2025 Safe Yield Reevaluation to fall 2025.
- In January 2025, the Court approved Watermaster's motion to increase the Safe Storage Capacity of the Chino Basin to 900,000 acre-feet through June 30, 2040.
- Watermaster prepared its twelfth State of the Basin report in June 2025. A draft *2024 OBMP State of the Basin* report is a web-based report featuring interactive maps and exhibits that characterize current Basin conditions and illustrate how conditions have changed since the implementation of the Optimum Basin Management Program (OBMP) in 2000.

Important Court Hearings and Orders

- **JANUARY 10, 2025:**
  HEARING AND ORDERS GRANTING WATERMASTER'S MOTION: 1) TO RECEIVE AND FILE THE 2023/2024 ANNUAL REPORT FOR THE GROUND-LEVEL MONITORING PROGRAM; 2) TO INCREASE THE SAFE STORAGE CAPACITY OF THE CHINO BASIN; AND 3) FOR AUTHORIZATION TO FILE SUIT
- **APRIL 4, 2025:**
  HEARING AND ORDER GRANTING WATERMASTER'S MOTION FOR COURT TO RECEIVE AND FILE 47TH ANNUAL REPORT

Program Element 1: Develop and Implement a Comprehensive Monitoring Program

Fundamental to the implementation of the OBMP Program Elements are the monitoring and data collection efforts performed in accordance with Program Element 1, including monitoring basin hydrology, production, recharge, groundwater levels, groundwater quality, and ground-level movement. Various monitoring programs have and will continue to be refined over time to satisfy the evolving needs of Watermaster and the IEUA, such as new regulatory requirements and improved data coverage. Monitoring is performed by basin pumpers, Watermaster staff, and other cooperating entities as follows.

Groundwater Level Monitoring

Watermaster's basin-wide groundwater-level monitoring program supports the periodic reassessment of Safe Yield, the monitoring and management of ground-level movement, the impact analysis of desalter pumping, the impact analysis of the implementation of the Peace II Agreement on groundwater levels and riparian vegetation in the Prado Basin, the triennial recomputation of ambient water quality mandated by the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan), and the assessment of Hydraulic Control—a maximum-benefit commitment in the Basin Plan. The data are also used to update and recalibrate Watermaster's computer-simulated groundwater flow model in order to assess groundwater flow directions, to compute storage changes, to support interpretations of water quality data, recompute the safe yield, and to identify areas of the basin where recharge and discharge are not in balance.

The current groundwater-level monitoring program is comprised of approximately 1,150 wells. At about 960 of these wells, groundwater levels are measured by well owners, which include municipal water agencies, the California Department of Toxic Substances Control (DTSC), the Counties, and various private consulting firms. Watermaster collects these groundwater level data semi-annually from the well owners. At the remaining 190 wells, groundwater levels are measured monthly by Watermaster staff using manual methods or by pressure transducers that record data on a 15-minute interval. These wells are mainly Agricultural Pool wells or dedicated monitoring wells located south of the 60 freeway.

Watermaster Staff Taking Groundwater Level Measurement

All groundwater-level data are checked and uploaded to a centralized database management system that can be accessed online through HydroDaVE℠. During this reporting period, Watermaster measured approximately 300 groundwater levels at about 38 private wells and 12 municipal supply wells and conducted two quarterly downloads of about 140 pressure transducers installed in private, municipal, and monitoring wells throughout the Chino Basin. Additionally, Watermaster compiled all available groundwater level data from well owners in the basin for the October 2024 to March 2025 period.

Groundwater Quality Monitoring

Watermaster initiated a comprehensive groundwater-quality monitoring program in which the obtained data may be used for: the biennial *Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report), the triennial re-computation of ambient water quality, the demonstration of Hydraulic Control—a maximum-benefit commitment in the Basin Plan, monitoring of nonpoint-source groundwater contamination and plumes associated with point-source contamination (see Program Element 6 section of this report), and assessing the overall health of the groundwater basin. Groundwater-quality data are also used in conjunction with numerical models to assist Watermaster and other parties in evaluating proposed salinity management and groundwater remediation strategies. The details of the groundwater-quality monitoring programs as of fiscal year 2024/25 are described below.

Chino Basin Data Collection (CBDC). Watermaster routinely and proactively collects groundwater-quality data from well owners including municipal and governmental agencies. Groundwater quality data are also obtained from special studies and monitoring required by orders of the Santa Ana Water Board—such as for landfills and other groundwater quality investigations, the DTSC, the US Geological Survey (USGS), and others. These data are collected semi-annually from well owners and monitoring entities. Data are collected for approximately 860 wells as part of the CBDC program. During this reporting period, Watermaster compiled data for the CBDC program for the July to December 2024 period. All groundwater quality data are checked and uploaded to a centralized database management system that can be accessed online through HydroDaVE℠.

Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

Watermaster Field Groundwater Quality Monitoring Programs. Watermaster monitors groundwater quality at privately owned wells and dedicated monitoring wells on a routine basis as follows:

1. *Private Wells*. About 62 private wells, located predominantly in the southern portion of the basin, are sampled at various frequencies based on their proximity to known point-source contamination plumes. Seven wells near contaminant plumes are sampled annually, and the remaining 55 wells are sampled triennially.
2. *Watermaster Monitoring Wells*. Watermaster collects groundwater-quality samples from a total of 49 multi-nested monitoring wells at 21 well sites located throughout the Chino Basin. These monitoring well sites include: nine HCMP sites constructed to support the demonstration of Hydraulic Control in the southern Chino Basin, nine sites constructed to support the PBHSP in the Prado Basin region, and three sites that fill spatial data gaps near contamination plumes in MZ-3. Each nested well site contains up to four wells in the borehole. Additionally, Watermaster samples one single-casing well in MZ-3. Currently, the HCMP MZ-3, and Kaiser monitoring wells are sampled annually, and the PBHSP wells are sampled triennially.
3. *Other Wells*. Watermaster collects quarterly samples from four near-river wells to characterize the interaction of the Santa Ana River and groundwater. These shallow wells along the Santa Ana River consist of two former USGS National Water Quality Assessment Program wells (Archibald 1 and Archibald 2) and two Santa Ana River Water Company (SARWC) wells (active well SARWC 9 and inactive well SARWC 10).

During this reporting period, Watermaster collected quarterly groundwater quality samples from three of the near river wells (Archibald 1, Archibald 2, and SARWC 9). The samples were sent to Clinical Laboratories for analysis. In May 2025, Watermaster conducted a comprehensive rehabilitation of the near river well SARWC 10 that had been unsampleable since 2023 due to structural deterioration and sediment accumulation. SARWC 10 will be sampled next reporting period. In June 2025, the near-river wells Archibald 1 and Archibald 2 were rehabbed to remove sediment from the bottom of the wells and prohibit sediment build up in the future. All groundwater quality data are checked by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE℠.

Testing Agricultural Meter for Accuracy

Groundwater Production Monitoring

As of the end of this reporting period, there were a total of 406 producing wells, 213 of which were for agricultural uses. The number of agricultural wells has been decreasing in recent years due to urbanization and development. Many of the remaining active agricultural production wells are metered, and Watermaster reads the meters on a quarterly basis. Meter reads and production data are then entered into Watermaster's relational database, which can be accessed online through HydroDaVE℠. In February 2024, Watermaster entered into a contract to test and maintain meters on agricultural wells. To date, they have tested/calibrated 48 meters, and replaced/installed 40. During this period, there were eight tests/calibrations, and 24 replacements/installations.

Surface Water Monitoring

CBDC of Surface Water Data. Watermaster routinely and proactively collects surface water flow and quality data from the tributary area to Chino Basin and Prado Dam terminus of the Santa Ana River. Data is collected from IEUA and publicly available data sets including California Integrated Water Quality System Project (CIWQS) and the USGS. Data are collected for approximately 30 surface water locations as part of the CBDC program. These data are collected semi-annually. During this reporting period, Watermaster collected surface water data for the July to December 2024 period. All surface water quality and flow data are checked and uploaded to a centralized database management system that can be accessed online through HydroDaVE℠.

Watermaster Field Surface Water Monitoring Programs. Watermaster monitors surface water quality on a routine basis as follows:

Watermaster collects grab water quality samples at two sites along the Santa Ana River (SAR at River Road and SAR at Etiwanda) on a quarterly basis. Sample data from these surface water sites and from four near-river wells are used to characterize the interaction between the Santa Ana River and nearby groundwater. During this reporting period, Watermaster collected four quarterly surface water-quality samples from the two surface water sites. The samples were sent to Clinical Laboratories for analysis.

Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

Watermaster collects grab water quality samples at 8 sites along Chino Creek on a monthly basis. This is part of new monitoring program that was initiated in July 2024. Watermaster with the IEUA developed this monitoring program to conduct monitoring of Chino Creek to have sufficient data to support the next round of the state-wide assessment of impaired water bodies subject to listing pursuant to Clean Water Act 303(d) Category 3 by the State Board and Regional Water Boards (see Program Element 7 Development of a Surface Water Monitoring Program in Chino Creek). During this reporting period, Watermaster and IEUA collected 48 quarterly surface water-quality samples from the eight surface water sites. The samples were sent to the Laboratory at IEUA for analysis.

Prado Basin Habitat Sustainability Program (PBHSP)

Mitigation Measure 4.4-3 from the Peace II SEIR requires that Watermaster and the IEUA, in collaboration with the Orange County Water District (OCWD), form a committee, the PBHSC, to develop and implement an Adaptive Management Plan for the PBHSP. The PBHSC is open to all interested participants, including the Watermaster Parties, IEUA member agencies, the OCWD, and other interested stakeholders. The objective of the PBHSP is to ensure that riparian habitat in the Prado Basin is not adversely impacted by the implementation of Peace II activities. Currently, the PBHSP consists of a monitoring program and the annual reporting on its results. The monitoring program includes an assessment of the riparian habitat and factors that could potentially impact the riparian habitat, including those factors affected by Peace II activities such as changes in groundwater levels. Sixteen monitoring wells at nine sites were constructed in 2015 to support the PBHSP. Two existing wells are also monitored as part of the PBHSP. The PBHSC developed the Adaptive Management Plan of the PBHSP to describe an initial monitoring program and a process to modify the monitoring program and/or implement mitigation strategies, as necessary.

During this reporting period, Watermaster performed the following tasks:

- Conducted the groundwater monitoring program, which included quarterly downloads in April and June 2025 of transducers that measure groundwater levels and temperature at eight PBHSP monitoring wells, and transducers that measure electrical conductivity (EC), temperature, and groundwater levels at ten PBHSP monitoring wells.
- Conducted the surface-water monitoring program, which included quarterly collection of field parameters for EC and temperature at four surface water sites in Chino Creek and Mill Creek in April and June 2025.
- Prepared a memorandum titled: "*Recommended Scope and Budget of the Prado Basin Habitat Sustainability Program for Fiscal Year 2025/26*". This memorandum was used by Watermaster and the IEUA to develop and approve their respective fiscal year 2025/26 budgets.
- Prepared the ninth annual report: *Annual Report of the Prado Basin Habitat Sustainability Program for Water Year 2024*. The main conclusion of the annual report was that the quality of the riparian habitat remained stable or slightly decreased across most of the Prado Basin from 2023-2024 and at the same time there was above average precipitation and stream discharge conditions, but less than the previous year. The air photo does show some notable declines in the vegetation along Mill Creek which will be confirmed and further investigated during the field vegetation surveys in summer of 2025. Groundwater levels have changed throughout most of the study area by up to +/- 5 feet, and there were notable declines of about nine feet near the top of Mill Creek in 2022, which have come back up since by four feet. No mitigation measures are proposed at this time.
- Conducted two meetings of the PBHSC:
    - On March 19, 2025 to present the Recommended Scope and Budget of the PBHSP for fiscal year 2025/26.
    - On May 14, 2025 to present the draft Annual Report of the PBHSP for water year 2024.

Chino Basin Groundwater Recharge Monitoring Program

Watermaster, the IEUA, the Chino Basin Water Conservation District, and the San Bernardino County Flood Control District jointly sponsor the Chino Basin Groundwater Recharge Program. This is a comprehensive water supply program to enhance water supply reliability and improve groundwater quality in local drinking water wells by increasing the recharge of storm, imported, and recycled waters. The recharge program is regulated under the IEUA and Watermaster's recycled water recharge permit— Santa Ana Water Board Order No. R8-2007-0039 and Monitoring and Reporting Program No. R8-2007-0039.

Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

Watermaster and the IEUA measure the quantity of storm, imported, and recycled water that enters recharge basins using pressure transducers or staff gauges. The IEUA also conducts water-quality monitoring for all required parameters in Order No. R8-2007-0039 for recycled water, diluent water (storm water, dry-weather flow, and imported water), and groundwater. The IEUA staff samples for recycled water quality data: daily and weekly for the RP-1 and RP-4 effluent; quarterly and annually at two recycled water locations representative of recharge quality; and monthly from lysimeters at recharge basins. Most of the recycled water recharge basins have alternative compliance plans for total organic carbon (TOC) and total nitrogen (TN) using the results from the recycled water samples and the application of a correction factor for soil aquifer treatment. The IEUA also collects samples at about 15 surface water locations for stormwater and dry-weather flows. Imported water quality data for State Water Project water are obtained from the Metropolitan Water District of Southern California (MWDSC). The flow and quality data is used to calculate: 120-month blended water quality for total dissolved solids (TDS) and nitrate of all recharge sources in each recharge basin to assess adequate dilution of recycled water as required by the recycled water recharge permits held with the Division of Drinking Water (DDW); and 5-year blended water quality for TDS and nitrate for all recharge sources in all recharge basins in the Chino Basin as required by the Maximum Benefit Salinity Management Plan (see the Program Element 7 update in this status report).

The IEUA also collects quarterly and annual groundwater quality samples at a network of about 41 dedicated monitoring wells and production wells that are downgradient of the recharge basins.

Monitoring Activities. During this reporting period, the IEUA performed its ongoing monitoring program to measure and record recharge volumes and to collect water quality samples for recycled water, diluent water, and groundwater pursuant to IEUA and Watermaster's permit requirements. This included collecting approximately 110 recycled water quality samples, 2 lysimeter samples, 7 diluent water quality samples, and 71 groundwater quality samples for analytical analyses. Daily composite water quality data was also collected at the RP-1 and RP-4 effluent.

Reporting. Watermaster and the IEUA completed the following compliance reports concerning the recharge program during this reporting period:

- 4Q-2024 Quarterly Report, which was submitted to the Santa Ana Water Board on February 15, 2025
- 1Q-2025 Quarterly Report, which was submitted to the Santa Ana Water Board on May 15, 2025
- The Annual Report, which was submitted to the Santa Ana Water Board on May 1, 2025

Ground Level Monitoring

To address the historical occurrence of land subsidence and ground fissuring in the Chino Basin, Watermaster prepared and submitted a subsidence management plan (known as the MZ-1 Plan) to the Court for approval and in November 2007, the Court ordered its implementation (see Program Element 4 in this report for more on MZ-1 Plan implementation). The MZ-1 Plan required several monitoring and mitigation measures to minimize or abate the future occurrence of land subsidence and ground fissuring. These measures and activities included:

- Continuing the scope and frequency of monitoring within the so-called Managed Area that was conducted during the period when the MZ-1 Plan was being developed.
- Expanding the monitoring of the aquifer system and ground-level movement into other areas of MZ-1 and the Chino Basin where data indicate concern for future subsidence and ground fissuring (Areas of Subsidence Concern).
- Monitoring of horizontal strain across the historical zone of ground fissuring.
- Conducting additional testing and monitoring to refine the MZ-1 Guidance Criteria for subsidence management (e.g., the Long-Term- Pumping Test).
- Developing alternative pumping plans for the MZ-1 producers impacted by the MZ-1 Plan.
- Constructing and testing a lower-cost cable extensometer facility at Ayala Park.
- Evaluating and comparing ground-level surveying and Interferometric Synthetic Aperture Radar (InSAR) and recommending future monitoring protocols for both techniques.
- Conducting an aquifer storage recovery (ASR) feasibility study at a City of Chino Hills production well (Well 16) within the MZ-1 Managed Area.

Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

Since the initial MZ-1 Plan was adopted in 2007, Watermaster has conducted the Ground-Level Monitoring Program. The main results from the GLMP show that very little permanent land subsidence has occurred in the MZ-1 Managed Area, indicating that subsidence is being successfully managed in this area, but land subsidence has been occurring in Northwest MZ-1. One concern is that land subsidence in Northwest MZ-1 has occurred differentially across the San Jose Fault, following the same pattern of differential subsidence that occurred in the MZ-1 Managed Area during the time of ground fissuring.

Based on these observations, Watermaster determined that the subsidence management plan needed to be updated to include a Subsidence Management Plan for Northwest MZ-1, with the long-term objective of minimizing or abating the occurrence of the differential land subsidence. Thus, Watermaster expanded the GLMP into Northwest MZ-1 and prepared an updated Chino Basin Subsidence Management Plan, which included the Work Plan to Develop a Subsidence Management Plan for Northwest MZ-1 (Work Plan) as an appendix.

During this reporting period, Watermaster undertook the following Chino Basin Subsidence Management Plan activities:

- Continued high-resolution water-level monitoring at approximately 30 wells within the MZ-1 Managed Area and within the Areas of Subsidence Concern. All monitoring equipment was inspected at least quarterly and was repaired and/or replaced as necessary. The data collected were checked and analyzed to assess the functionality of the monitoring equipment and for compliance with the Chino Basin Subsidence Management Plan.
- Performed monthly maintenance, data collection, and verification at the Ayala Park, Chino Creek, and Pomona extensometer facilities. This included two special efforts at the Pomona extensometer facility: (i) developing plans and cost estimates to refurbish the Pomona extensometer facility in FY 2025/26 and; (ii) troubleshooting the data from this facility by calibrating linear potentiometers and updating datalogger code.
- Conducted Spring-2025 ground-elevation surveys at established benchmarks across the Northwest MZ-1 Area.
- Performed InSAR analyses of vertical ground motion across all Areas of Subsidence Concern for the periods 2011-25 and 2024-25.
- Continued monitoring of Northwest MZ-1 pursuant to the Work Plan:
    - Collected, processed, and checked groundwater level and production data from wells in Northwest MZ-1 on a monthly basis.

Program Element 2: Develop and Implement a Comprehensive Recharge Program

The objectives of the comprehensive recharge program include: enhancing the yield of the Chino Basin through the development and implementation of a Recharge Master Plan to improve, expand, and construct recharge facilities that enable the recharge of storm, recycled, and imported waters; ensuring a balance of recharge and discharge in the Chino Basin management zones; and ensuring that sufficient storm and imported waters are recharged to comply with the recycled water dilution requirements in Watermaster and the IEUA's recycled water recharge permits.

Pursuant to Program Element 2 of the OBMP, Watermaster and the IEUA partnered with the San Bernardino County Flood Control District and the Chino Basin Water Conservation District to construct and/or improve 18 recharge sites. This project is known as the Chino Basin Facilities Improvement Project (CBFIP). The average annual stormwater recharge of the CBFIP facilities is approximately 10,000 acre-feet per year, the supplemental "wet"[1] water recharge capacity is about 56,600 acre-feet per year, and the in-lieu supplemental water recharge capacity ranges from 26,600 to 45,200 acre-feet per year. In addition to the CBFIP facilities, the Monte Vista Water District (MVWD) has four ASR wells with a well injection capacity of about 5,500 acre-feet per year. The current total supplemental water recharge capacity ranges from 99,000 to 123,000 acre-feet per year, which is greater than the projected supplemental water recharge capacity required by Watermaster.

In 2008, Watermaster began preparing the *2010 Recharge Master Plan Update* (2010 RMPU) pursuant to the December 21, 2007 Court Order (the Peace II Agreement) to complete a Recharge Master Plan Update by July 1, 2010. In October 2010, the Court accepted the 2010 RMPU as satisfying the condition and ordered that certain recommendations of the 2010 RMPU be implemented. In November 2011, Watermaster reported its progress to the Court pursuant to the October 2010 Court Order, and in

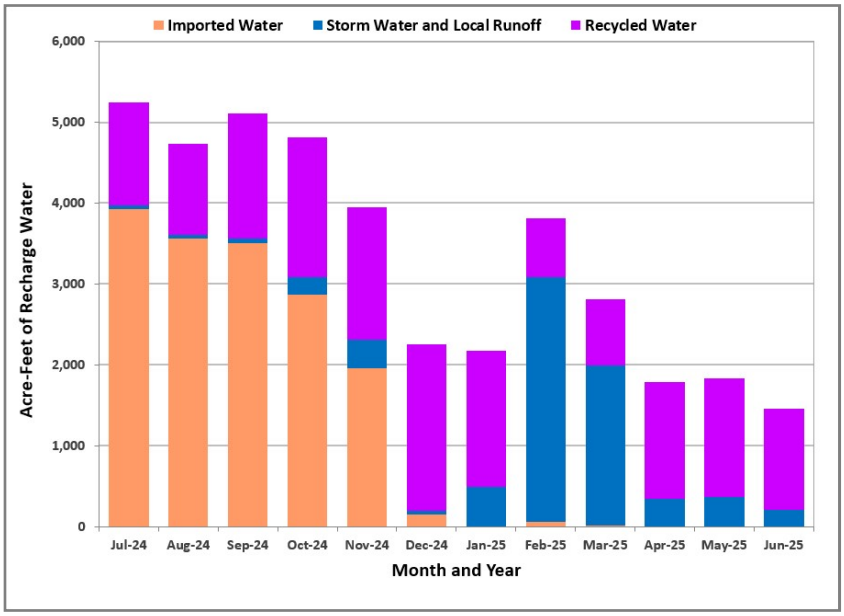
[1] The modifier "wet" means actual physical water is being recharged in spreading basins as opposed to the dedication of water from storage or in-lieu recharge.

Program Element 2: Develop and Implement a Comprehensive Recharge Program (Continued)

December 2011, the Court issued an order directing Watermaster to continue with its implementation of the 2010 RMPU per its October 2010 order but with a revised schedule. On December 15, 2011, the Watermaster Board moved to:

> "approve that within the next year there will be the completion of [a] Recharge Master Plan Update, there will be the development of an Implementation Plan to address balance issues within the Chino Basin subzones, and the development of a Funding Plan, as presented."

This motion led to the development of an update to the 2010 RMPU and in 2012, Watermaster staff sent out a "call for projects" to the Watermaster Parties, seeking their recommendations for recharge improvement projects that should be considered in the update. The *2013 Amendment to the 2010 Recharge Master Plan Update* (2013 RMPU) outlines the recommended projects to be implemented by Watermaster and the IEUA and lays out the implementation and financing plans. The 2013 RMPU report was approved by the Watermaster Board in September 2013 and filed with the Court in October 2013. In December 2013, the Court approved the 2013 RMPU except for Section 5, which dealt with the accounting for new recharge from Municipal Separate Stormwater Sewer Systems; Section 5 was later approved by the Court in April 2014.



In September 2018, Watermaster completed the 2018 Recharge Master Plan Update (2018 RMPU) and submitted it to the Court in October 2018. The Court approved the 2018 RMPU on December 28, 2018.

In September 2023, Watermaster completed the 2023 Recharge Master Plan Update (2023 RMPU) and submitted it to the Court in October 2023. The Court approved the 2023 RMPU on December 6, 2023.

2013 RMPU Implementation. Watermaster and the IEUA are continuing to carry out the October 2013 Court Order, which authorizes them to implement the 2013 RMPU. Construction of the San Sevaine Basin improvements was completed in September 2018, the construction of the Victoria Basin improvements was completed in December 2018, and the construction of the Lower Day project was completed in August 2024. During this reporting period, the construction work for Wineville/Jurupa/RP3 continued and the updated project completion date is in spring 2026. In June 2025, the US Bureau of Reclamation notified IEUA that $1.3 million in grant funding is anticipated to be awarded to the Montclair Basins project. The updated project completion date for Montclair Basins is December 2026, which was delayed due to the permitting process with the Department of Fish and Wildlife and basin operations for Dry-Year-Yield deliveries.

Additionally, Watermaster and the IEUA continue to collaborate in the development of projects outside of the 2013 RMPU effort that will increase and/or facilitate stormwater and supplemental water recharge and have jointly funded these projects, including monitoring upgrades and habitat conservation. During this reporting period, no projects were completed.

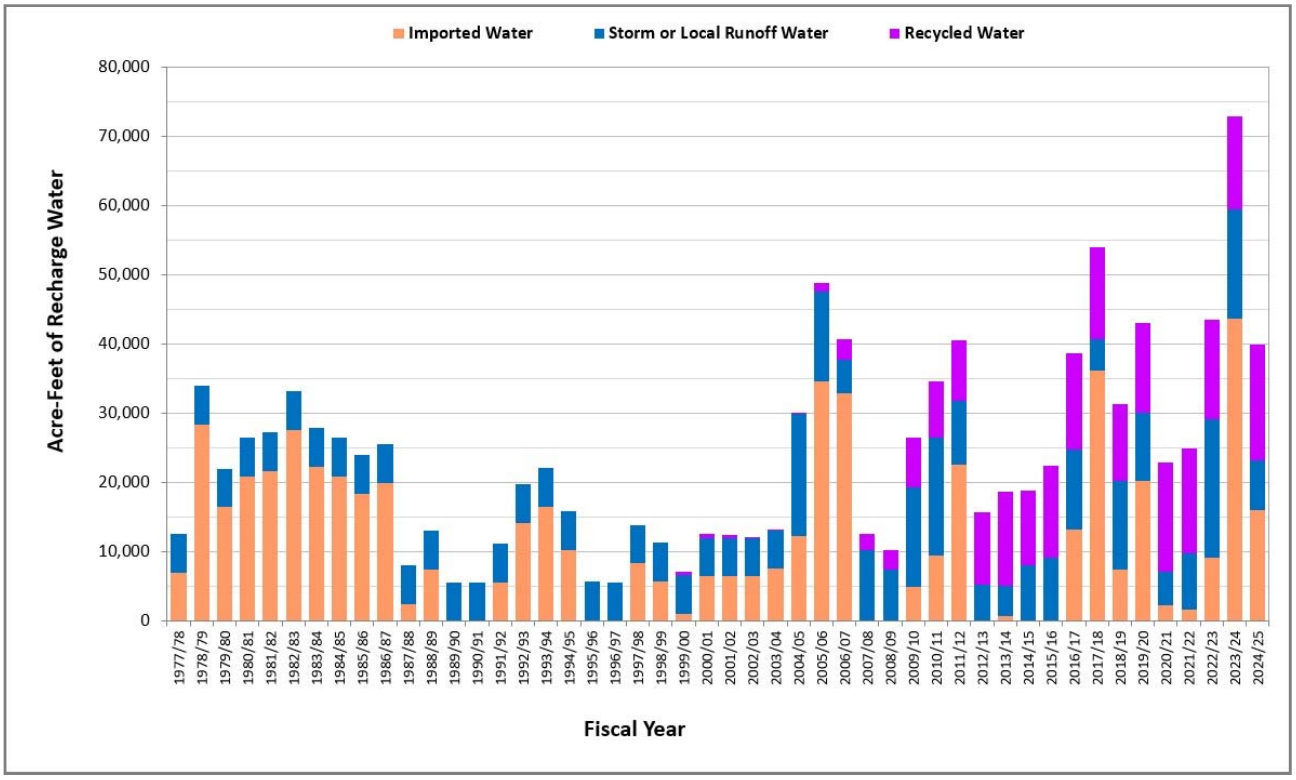
The Recharge Investigation and Projects Committee met two times during this reporting period on the progress of implementing the 2013 RMPU Projects and other recharge-related projects.

Recharge for Dilution of Recycled Water. In fiscal year 2009/10, Watermaster and the IEUA's recycled water recharge permit was amended to allow for existing underflow dilution and extended the period for calculating dilution from a running 60-month to a running 120-month period. Additionally, the IEUA has worked with the DDW to obtain approval to increase the allowable recycled water contribution (RWC) at wells to 50 percent. These permit amendments allow for increased recycled water recharge without having to increase the amount of imported and storm waters required for dilution. The IEUA projects its dilution requirements as part of its annual reporting to the Santa Ana Water Board. Based on the latest Annual Report (May 2025)[2], the IEUA projects that dilution requirements will be met through 2033 even if no imported water is available for dilution.

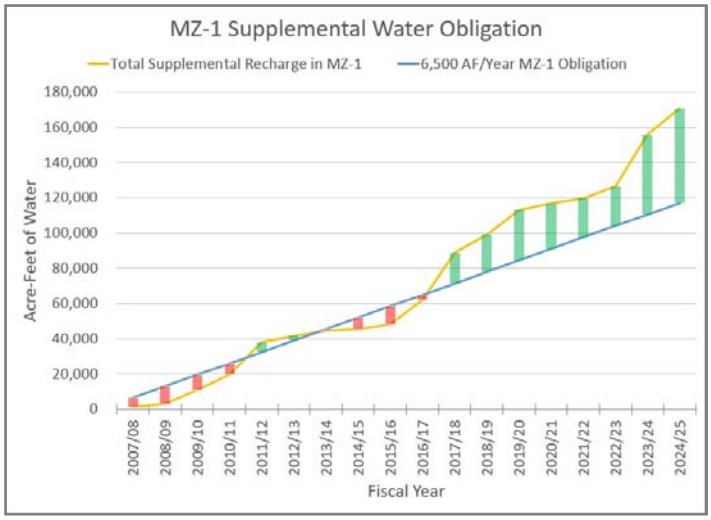
[2] https://www.ieua.org/read-our-reports/groundwater-recharge-reports/

Program Element 2: Develop and Implement a Comprehensive Recharge Program (Continued)

Recharge Activities. During this reporting period, ongoing recycled water recharge occurred in the Brooks, 8th Street, Ely, Turner, Victoria, San Sevaine, Hickory, Banana, RP-3, and Declez Basins; stormwater was recharged at 18 recharge basins across all Chino Basin management zones; and imported water was recharged at the Intex property, Montclair, and Lower Day Basins. From January 1 through June 30, 2025, Watermaster and the IEUA recharged a total of 13,866 acre-feet of water: 6,409 acre-feet of stormwater, 7,388 acre-feet of recycled water, and 69 acre-feet of imported water.



Balance of Recharge and Discharge in MZ-1. The total amount of supplemental water recharged in MZ-1 since the Peace II Agreement through June 30, 2025 was approximately 170,717 acre-feet, which is about 53,717 acre-feet more than the 117,000 acre-feet required by June 30, 2025 (annual requirement of 6,500 acre-feet). The amount of supplemental water recharged into MZ-1 during the reporting period was approximately 1,977 acre-feet.



Program Element 3: Develop and Implement Water Supply Plan for the Impaired Areas of the Basin; and Program Element 5: Develop and Implement Regional Supplemental Water Program

As stated in the OBMP, "the goal of Program Elements 3 and 5 is to develop a regional, long range, cost effective, equitable, water supply plan for producers in the Chino Basin that incorporates sound basin management." One element of the water supply plan is to replace the decline in agricultural groundwater production in the south part of the Basin to prevent significant amounts of degraded groundwater from discharging to the Santa Ana River and achieve Hydraulic Control—a maximum-benefit commitment in the Basin Plan. Replacing the decline in agricultural groundwater production will also mitigate the reduction of the Safe Yield of the basin and allow for more flexibility in the basin's supplemental water supplies if the produced groundwater is treated. This is achieved through the operation of the Chino Basin Desalter facilities, which comprise a series of wells and treatment facilities in the southern Chino Basin designed to replace the decline of the agricultural groundwater producers and treat and serve this groundwater to various Appropriative Pool members.

The Chino I Desalter expansion and the Chino II Desalter facilities were completed in February 2006, bringing the total Chino Basin Desalter capacity to about 32,500 acre-feet per year (29 million gallons per day [MGD]). Development and planning continued between the Chino Basin Desalter Authority (CDA) and Watermaster to expand the groundwater production and treatment capacity of the Chino Basin Desalters by another 10 MGD for a total groundwater production to 40,000 acre-feet per year. More than $77 million in grant funds were secured toward this expansion. As currently configured, the Chino I Desalter treats about 14,500 acre-feet of groundwater per year (12.9 MGD) pumped from 14 wells (I-1 through I-11, I-13 through I-18, I-20, and I-21). This water is treated through ion exchange (nitrate removal), and/or reverse osmosis (for nitrate and TDS removal), and granulated activated carbon ([GAC] for volatile organic compound [VOC] removal). The VOC removal at Chino I Desalter is part of the remedial solution for the Chino Airport Plume (see Chino Airport Plumes section under Program Element 6 in this report). The Chino II Desalter treats about 25,500 acre-feet of groundwater per year (22.7 MGD) from pumping at eleven wells (II-1 through II-4 and II-6 through II-12). This water is treated through ion exchange and/or reverse osmosis, and air strippers (for VOC removal). The VOC removal at Chino II Desalter is part of the remedial action plan to clean up the South Archibald Plume (see the Program Element 6 update in this status report).

The most recently completed expansion of the Chino Basin Desalters was completed in 2021and included three wells (Wells II-10, II-11, and II-12) and facilities for the Chino II Desalter. These wells helped achieve the total of 40,000 acre-feet per year of total Chino Basin Desalter groundwater pumping to maintain Hydraulic Control. These three wells are also being utilized as part of the remedial solution to clean up the South Archibald Plume (see the Program Element 6 update in this status report). The Chino Bain Desalters reached the 40,000 acre-feet per year of pumping capacity in June 2020, prior to the full commencement of pumping at these new wells. During the reporting period, the Chino Basin Desalters maintained the pumping rate of 40,000 acre-feet per year.

Program Element 4: Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1

Because of the historical occurrence of pumping induced land subsidence and ground fissuring in southwestern Chino Basin (Managed Area), the OBMP required the development and implementation of an Interim Management Plan (IMP) for MZ-1 that would:

- Minimize subsidence and fissuring in the short-term.
- Collect the information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring.
- Formulate a management plan to reduce to tolerable levels or abate future subsidence and fissuring.

From 2001-2005, Watermaster developed, coordinated, and conducted an IMP under the guidance of the MZ-1 Technical Committee (referred to now as the Ground-Level Monitoring Committee or GLMC). The investigation provided enough information for Watermaster to develop Guidance Criteria for the MZ-1 producers in the investigation area that, if followed, would minimize the potential for subsidence and fissuring during the completion of the MZ-1 Plan. The Guidance Criteria included a list of Managed Wells and their owners subject to the criteria, a map of the so-called Managed Area, and an initial threshold water level (Guidance Level) of 245 feet below the top of the PA-7 well casing. The MZ-1 Summary Report and the Guidance Criteria were adopted by the Watermaster Board in May 2006. The Guidance Criteria formed the basis for the MZ-1 Plan, which was approved by Watermaster in October 2007. The Court approved the MZ-1 Plan in November 2007 and ordered its implementation. Watermaster has implemented the MZ-1 Plan since that time, including the ongoing Ground-Level- Monitoring Program called for by the MZ-1 Plan (refer to in Program Element 1).

Program Element 4: Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1 (Continued)

The MZ-1 Plan states that if data from existing monitoring efforts in the so-called Areas of Subsidence Concern indicate the potential for adverse impacts due to subsidence, Watermaster will revise the MZ-1 Plan pursuant to the process outlined in Section 3 of the MZ-1 Plan. In early 2015, Watermaster prepared an update to the MZ-1 Plan, which included a name change to the *"Chino Basin Subsidence Management Plan"*, and a *Work Plan to Develop the Subsidence Management Plan for Northwest MZ-1* (Work Plan) as an appendix. The Chino Basin Subsidence Management Plan and the Work Plan were adopted through the Watermaster Pool process in July 2015.

The data, analysis, and reports generated through the implementation of the MZ-1 Plan, Chino Basin Subsidence Management Plan, and Work Plan are reviewed and discussed by the GLMC, which meets on a periodic basis throughout the year. The GLMC is open to all interested participants, including the Watermaster Parties and their consultants. During this reporting period, Watermaster undertook the following data analysis and reporting tasks:

- Began preparing figures and tables for the draft *2024-25 Annual Report for the Ground-Level Monitoring Program*.
- Prepared draft and final technical memoranda on the *Recommended Scope and Budget for the GLMP for FY 2025/26*. This memorandum was prepared with input from the GLMC and was used to inform the Watermaster's budgeting process for FY 2025/26.

A GLMC meeting was conducted during the reporting period on March 6, 2025. The meeting presentation and agenda packet were posted to the Watermaster's website. The meeting agenda included the Draft Technical Memorandum: Recommended Scope of Work and Budget for the Ground Level Monitoring Program for Fiscal Year 2025/26.

Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management

Program Elements 6 and 7 are necessary to address the water quality management problems in the Chino Basin. During the development of the OBMP, it was identified that Watermaster did not have sufficient information to determine whether point and non-point sources of groundwater contamination were being adequately addressed, including the various Chino Basin contaminant plumes. With the Santa Ana Water Board and other agencies, Watermaster has worked to address the major point source contaminant plumes in the Chino Basin as described below:

South Archibald Plume

In July 2005, the Santa Ana Water Board prepared draft Cleanup and Abatement Orders (CAOs) for six parties who were tenants on the Ontario Airport regarding the South Archibald Trichloroethene (TCE) Plume in the southern portion of the Chino Basin. The draft CAOs required the parties to "submit a work plan and time schedule to further define the lateral and vertical extent of the TCE and related VOCs that are discharging, have been discharged, or threaten to be discharged from the site" and to "submit a detailed remedial action plan, including an implementation schedule, to cleanup or abate the effects of the TCE and related VOCs." Four of the six parties (Aerojet-General Corporation, The Boeing Company, General Electric, and Lockheed Martin) voluntarily formed a group known as ABGL to work jointly on a remedial investigation. Northrop Grumman declined to participate in the group. The US Air Force, in cooperation with the US Army Corps of Engineers, funded the installation of one of the four clusters of monitoring wells installed by the ABGL Parties.

In 2008, Santa Ana Water Board staff continued to conduct research pertaining to the likely source of the TCE contamination and identified discharges of wastewater that may have contained TCE to the RP-1 treatment plant and associated disposal areas as a potential source. The Santa Ana Water Board identified several industries, including some previously identified tenants of the Ontario Airport property, that likely used TCE solvents before and during the early-1970s, and discharged wastes to the Cities of Ontario and Upland's sewage systems and subsequently to the RP-1 treatment plant and disposal areas. In 2012, an additional Draft CAO was issued by the Santa Ana Water Board jointly to the City of Ontario, City of Upland, and IEUA as the previous and current operators of the RP-1 treatment plant and disposal area (collectively, the RP-1 Parties). In part, the draft CAOs required that RP-1 Parties "supply uninterrupted replacement water service […] to all residences south of Riverside Drive that are served by private domestic wells at which TCE has been detected at concentrations at or exceeding 5 µg/L […]" and to report this information to the Santa Ana Water Board. In addition, the RP-1 Parties are to "prepare and submit [a] […] feasibility study" and "prepare, submit and implement the Remedial Action Plan" to mitigate the "effects of the TCE groundwater plume."

Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

Under the Santa Ana Water Board's oversight, the ABGL Parties and/or the RP-1 Parties conducted four sampling events at private residential wells and taps between 2007 and 2014 in the region where groundwater is potentially contaminated with TCE. By 2014, all private wells and/or taps in the region of the plume had been sampled at least once. Alternative water systems (tanks) have been installed at residences in the area where well or tap water contains TCE at or above 80 percent of the maximum contaminant level (MCL) of 5 µg/L. Watermaster has also been sampling at the private wells.

In July 2015, the RP-1 Parties completed the Draft Feasibility Study Report for the South Archibald Plume. The Feasibility Study established cleanup objectives for both domestic water supply and plume remediation and evaluated alternatives to accomplish these objectives. In November 2015, a revised Draft Feasibility Study, Remedial Action Plan, and Responses to Comments were completed to address input from the public, the ABGL, and others. In September 2016, the Santa Ana Water Board issued the Final CAO R8-2016-0016 collectively to the RP-1 Parties and the ABGL Parties. The Final CAO was adopted by all parties in November 2016, thus approving the preferred plume remediation and domestic water supply alternatives identified in the Remedial Action Plan. The parties also reached a settlement agreement that aligns with the Final CAO and authorizes funding to initiate implementation of the plume remediation alternative.

The plume remediation alternative involves the use of CDA production wells and facilities. The RP-1 Parties reached a Joint Facility Development Agreement with the CDA for the implementation of a project designed in part to remediate the South Archibald Plume. The project, termed the Chino Basin Improvement and Groundwater Clean-up Project, includes the operation of three newly constructed CDA wells (II-10, II-11, and II-12) and a dedicated pipeline connecting the three wells and the existing CDA well I-11 to the Desalter II treatment facility. It also includes the addition of an air stripping system at the treatment facility to remove TCE and other VOCs. Construction of two of the three wells (II-10 and II-11) were completed and became operational in 2018 and construction of an onsite monitoring well near the proposed location of CDA well II-12 (II-MW-3) was completed in 2019. The construction of well II-12 was completed in November 2020. In the first half of 2021, the RP-1 Parties and the CDA submitted the final *Monitoring and Reporting Plan for the Chino Basin Improvement and Groundwater Clean-up Project* to the Santa Ana Water Board and completed the construction of five multi-depth monitoring wells at two locations in the South Archibald Plume (II-MW-4 and II-MW-5). In 2021, the CDA completed the equipping of well II-12, the modification to the decarbonator, and the construction of the raw water pipeline, and the project became operational in August of 2021. The Monitoring and Reporting plan stipulates ongoing quarterly sampling at the CDA production and monitoring wells within and near the plume and at nearby agency-owned wells.

The domestic water supply alternative for the private residences affected by TCE groundwater contamination is a hybrid between the installation of tank systems for some residences, where water is delivered from the City of Ontario potable supply via truck deliveries, and the connection of some residences to the City of Ontario potable water system. Residences without a tank system or pipeline connection receive bottled water. The Cities of Ontario and Upland have assumed responsibility for implementing the domestic water supply alternative. In February 2017, the Cities of Ontario and Upland submitted the Domestic Water Supply Work Plan to the Santa Ana Water Board to outline the approach to monitoring and supplying alternative water supplies for affected residences. The City of Ontario will continue to monitor for potentially affected residences to ensure that an alternative water supply is offered and provided to any residences with TCE concentrations greater than 80% of the MCL for TCE. During the last reporting period the City of Ontario completed the annual water supply sampling event at private residences pursuant to the Domestic Water Supply Plan and prepared and submitted an annual monitoring report of the results to the Santa Ana Water Board in December 2024. As of the end of 2024, there are 22 affected residences that are being supplied water by tank systems, and five affected residences that remain on bottled water. There was no sampling for the domestic water supply alternative during this reporting period and the next sampling event is scheduled for fall 2025.

Watermaster delineates the spatial extent of the plume using data collected from their own sampling at private wells in the area and data collected as part of their data collection program. Watermaster completed its most recent characterization of the plume in June 2025 for the *2024 Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report). In April of this reporting period, Watermaster prepared a semi-annual status report on the South Archibald Plume for Watermaster Parties.

Chino Airport Plume

In 1990, the Santa Ana Water Board issued CAO No. 90-134 to the County of San Bernardino, Department of Airports (County) to address groundwater contamination originating from Chino Airport. During 1991 to 1992, ten underground storage tanks and 310 containers of hazardous waste were removed, and 81 soil borings were drilled and sampled on the airport property. From 2003 to 2005, nine onsite monitoring wells were installed and used to collect groundwater quality samples. In 2007, the County conducted its

Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

first offsite monitoring effort, and in 2008, the Santa Ana Water Board issued CAO No. R8-2008-0064, requiring the County to define the lateral and vertical extent of the plume and prepare a remedial action plan. From 2009 to 2015, Tetra Tech, consultant to the County, constructed 66 monitoring wells and conducted several off-site and on-site plume characterization studies to delineate the areal and vertical extent of the plume and determined that there were both east and west TCE and 1,2,3-trichloropropane (1,2,3-TCP) plumes. In January 2017, the Santa Ana Water Board issued CAO R8-2017-0011, which requires the County to prepare a Final Feasibility Study that incorporates comments from the Santa Ana Water Board and to prepare, submit, and implement a Remedial Action Plan. The County submitted a Final Feasibility Study on June 6, 2017, and it was approved by the Santa Ana Water Board on June 7, 2017. On December 18, 2017, the County submitted the *Draft Interim Remedial Action Plan* with the remediation alternative of a groundwater pump-and-treat system to provide hydraulic containment and treatment of the Chino Airport plumes. The system consists of 22 County extraction wells at ten extraction well sites located on and off airport property that will produce approximately 1,700 gallons per minute (gpm) along with CDA wellsI-16 through I-18, which will produce an additional 500 gpm. CDA's I-20 and I-21wells will be added to the system as needed. The groundwater extracted will be conveyed to a new GAC system constructed by the CDA and funded by the County (South GAC System). In April 2023, CDA wells I-17 (offline for 5 years) and I-18 (never been online) began pumping and conveyed groundwater to the South GAC System.

Treated groundwater from the South GAC system, is then conveyed to the existing Chino I Desalter that uses reverse osmosis and ion exchange to treat for nitrate and TDS; then discharged for use as potable municipal water supply.

An additional treatment system (North GAC System), which also began operation in April 2023 was constructed by CDA and treats water from four CDA wells (I-I through I-4) that produce from the lower aquifer in the plume; however, this system is not associated with the County's remedial solution.

Watermaster has commitments to this area within the vicinity of the Chino Airport to maintain Hydraulic Control and to avoid impacts to the groundwater dependent riparian habitat in the Prado Basin, and in 2018 Watermaster used the Chino Basin groundwater flow model to analyze how increased groundwater production for the remedial solution will affect groundwater levels in this area. Watermaster completed the modeling and prepared a technical memorandum to describe the results, which concluded that operation of the remedial solution would improve Hydraulic Control in this area. In January 2022, the County completed construction of six piezometers near the riparian habitat along Chino Creek and initiated monitoring of groundwater levels for potential impacts from pumping at the new extraction wells.

Between 2018 and 2022, the County constructed five extraction wells, an additional 12 piezometers and 14 monitoring wells to assist with the design for the remedial solution and delineation of the plumes. In 2022, the County completed the final *Remedial Action Work Plan* which divides the construction of the pump-and-treat system into two phases. The first Phase (1) which is underway, includes the 5 onsite extraction well locations and conveyance piping to the South GAC system. Phase 1construction was completed in July 2024 and as of April of this reporting period, there were still a few electrical and engineering tasks that needed to be completed prior to well startup which is anticipated to commence during the next reporting period the second half of 2025. Phase 2 includes construction of the 5 offsite extraction well locations and conveyance piping and is expected to commence in 2026 following the completion of an addendum to the *Remedial Action Work Plan* at the end of 2025.

In August 2024, the County installed six new monitoring wells (CAMW 71-76) on the Airport property where high concentrations of contaminants of concern were detected in recent vapor sampling. Sampling at the new wells commenced during the Fall 2024 monitoring event and several wells had the highest concentrations of contaminants of concern measured at any monitoring well over the last five years indicating that there could be a newly identified potential source area beneath the northwestern portion of the airport property.

The County conducts quarterly, biennial, and annual monitoring events at 96 site-related monitoring wells and four onsite agricultural wells. The conclusions from this monitoring program can be found in reports posted on the State Water Board's GeoTracker website. The most recent monitoring report submitted during this reporting period is the *Semiannual Groundwater Monitoring Report Summer and Fall 2024 Chino Airport, San Bernardino County, California*, which presents the results from the August and November 2024 sampling events. Watermaster also samples for water quality at private and monitoring wells in the area and uses this and other data obtained from its data collection programs to independently delineate the spatial extent of the plumes. Watermaster completed its most recent characterization of the plumes in June 2025 for the *2024 Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report). In April of this reporting period, Watermaster prepared a semi-annual status report on the Chino Airport Plumes for Watermaster Parties.

Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

Other Plumes

Watermaster continues to track the monitoring programs and mitigation measures associated with other point sources of contamination in the Chino Basin, including: Alumax Aluminum Recycling, Alger Manufacturing Facility, General Electric Test Cell and Flatiron facilities, the Former Kaiser Steel Mill, Milliken Landfill, Mid-Valley Landfill, Upland Landfill, California Institution for Men, and the Stringfellow National Priorities List sites. In October 2024 Watermaster prepared the most recent annual status reports for the GE Test Cell, GE Flatiron, Milliken Landfill, California Institution for Men, Stringfellow Plumes, and the former Kaiser Steel Mill site. During this reporting period, the most current Watermaster delineations of the extent of these plumes were completed in June 2025 for the 2024 *Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report).

Water Quality Management Program

Through the collaborative stakeholder process to update the OBMP in 2020 (see 2020 OBMP Update section of this report), the parties identified a new management action under Program Element 6 to develop a Water Quality Management Program that addresses contaminants of emerging regulations of concern to better prepare the parties for addressing compliance with new State and Federal drinking water regulations, and provide for the long-term maximum beneficial use of the basin. It was identified that reconvening the Water Quality Committee (WQC) that met historically from 2003 to 2010 to implement Program Element 6 of the 2000 OBMP would be the ideal approach to guide the development and implementation of the Water Quality Management Plan (WQMP). Watermaster held a kick-off meeting in October 2023 to reconvene the WQC. Two additional WQC meetings were conducted during the first half of 2024 to develop an initial Emerging Contaminants Monitoring Plan (ECMP), and a framework and scope for a WQMP. From July to December 2024, Watermaster collected samples for the parameters that are part of the ECMP during the routine groundwater sampling that is part of Program Element 1. During this reporting period, there was no activities for the WQMP.

Program Element 7: Develop and Implement a Salt Management Program

Maximum Benefit Salt and Nutrient Management Plan

In January 2004, the Santa Ana Water Board amended the Basin Plan to incorporate an updated TDS and nitrogen (N) management plan. The Basin Plan amendment includes both "antidegradation" and "maximum-benefit" objectives for TDS and nitrate for the Chino-North and Cucamonga groundwater management zones (GMZs). The maximum-benefit objectives allow for recycled water reuse and recharge of recycled and imported waters, which is an integral part of the OBMP, without the immediate need for mitigation. The application of the maximum-benefit objectives is contingent on the implementation of specific projects and requirements termed the maximum-benefit commitments by Watermaster and IEUA. The status of compliance with each commitment is reported to the Santa Ana Water Board annually in April. The nine maximum-benefit commitments include:

1. The development and implementation of a surface water monitoring program.
2. The development and implementation of a groundwater monitoring program.
3. The expansion of the Chino I Desalter to a capacity of 10 MGD and the construction of the Chino II Desalter with a design capacity of 10 MGD.
4. The additional expansion of desalter capacity (to 40 MGD) pursuant to the OBMP and the Peace Agreement (tied to the IEUA's agency-wide effluent TDS concentration).
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program.
6. The management of recycled water quality to ensure that the IEUA agency-wide, 12-month volume-weighted running average TDS and TIN concentrations do not exceed 550 mgl and 8 mgl, respectively.
7. The management of water quality in artificial recharge to ensure that the five-year volume-weighted running average TDS and nitrate concentrations in artificial recharge of recycled, imported, and storm waters are less than or equal to the maximum-benefit objectives of 420 mgl and 5 mgl, respectively.

Program Element 7: Develop and Implement a Salt Management Program (Continued)

8. The achievement and maintenance of the "Hydraulic Control" of groundwater outflow from the Chino-North GMZ to protect Santa Ana River water quality and downstream beneficial uses.

9. The determination of ambient TDS and nitrate concentrations of Chino Basin groundwater every five years[3].

Monitoring Programs. Pursuant to maximum-benefit commitment numbers 1 and 2, Watermaster and the IEUA submitted a surface water and groundwater monitoring program work plan to the Santa Ana Water Board in May 2004. On April 15, 2005, the Santa Ana Water Board adopted resolution R8-2005-0064, approving Watermaster and the IEUA's surface and groundwater monitoring programs (2005 Work Plan). These monitoring programs were implemented pursuant to the 2005 Work Plan from 2004 to 2012. On February 12, 2012, the Santa Ana Water Board adopted an amendment to the Basin Plan to remove all references to the specific monitoring locations and sampling frequencies required for groundwater and surface water monitoring. The Basin Plan amendment allows the monitoring programs to be modified over time, subject to the approval of the Executive Officer of the Santa Ana Water Board. On December 6, 2012, the State Office of Administrative Law finalized the approval of the Basin Plan amendment. In place of specific monitoring requirements, the Basin Plan amendment required that Watermaster and the IEUA submit (i) a new surface water monitoring program work plan by February 25, 2012, and (ii) a new groundwater monitoring program work plan by December 31, 2013 to the Santa Ana Water Board for approval. Pursuant to (i), Watermaster and the IEUA submitted the *2012 Hydraulic Control Monitoring Program Work Plan*, which was approved by the Santa Ana Water Board in March 2012. Pursuant to (ii), Watermaster and the IEUA submitted the *2014 Maximum-Benefit Monitoring Program Work Plan* (2014 Work Plan), which was approved by the Santa Ana Water Board in April 2014. The 2014 Work Plan describes the questions to be answered by the monitoring program, the methods that will be employed to address each question, the monitoring and data collection that will be performed to implement the methods, and a reporting schedule. The monitoring pursuant to the 2014 Work Plan is incorporated as part of the groundwater level, groundwater quality, and surface water monitoring programs described in Program Element 1. During this reporting period, Watermaster continued to implement the monitoring programs (see Program Element 1 for details). Also during this reporting period, Watermaster began efforts to update the 2014 Work Plan which is a requirement Basin Plan amendment that is underway (see description of the Basin Plan amendment under the Recycled Water Quality subsection below).

Hydraulic Control and Chino Basin Desalters. Pursuant to maximum-benefit commitment number 8, to achieve and maintain Hydraulic Control, the Chino Basin Desalters were expanded (maximum-benefit commitment numbers 3 and 4) to increase production in the southern portion of the Chino Basin. The Chino Basin Desalters are designed to replace the decreased agricultural production that previously prevented the outflow of high TDS and nitrate groundwater to the Santa Ana River and the Prado Basin (surface) water management zone (PBMZ). Hydraulic Control is defined in the Basin Plan as the elimination of groundwater discharge from the Chino-North GMZ to the Santa Ana River to *de minimis* levels. In October 2011, the Santa Ana Water Board defined the *de minimis* discharge of groundwater from the Chino-North GMZ to the PBMZ as 1,000 acre-feet per year or less. Pursuant to commitment number 8, Watermaster and the IEUA submitted a mitigation plan (2005 Mitigation Plan) to the Santa Ana Water Board in March 2005. This plan demonstrated how Watermaster and the IEUA would address the mitigation for any temporary loss of Hydraulic Control.

Filtration System at the Chino Desalter Authority I Facility

The Watermaster and IEUA use groundwater level measurements to prepare groundwater-elevation contours of the southern Chino Basin to demonstrate Hydraulic Control. Since 2006, the groundwater elevation data demonstrate complete capture of groundwater from the Chino-North at the Chino Basin Desalter well field (Hydraulic Control) at and east of Chino-I Desalter Well I-5; and since 2016 extended to the area at and east of Chino-I Desalter Well I-20.

The construction and operation of the Chino Basin Desalter Chino Creek Well Field (CCWF) in the west (wells I-16, I-17, I-18, I-20, and I-21) is intended to achieve Hydraulic Control, per the *de minimis* definition <1,000 acre-feet per year, at the area west of Well I-5. The CCWF began full operation in 2016 with wells I-16, I-17, I-20, and I-21; no pumping at well I-18 commenced at this time. From 2017 to 2023 there was less pumping at the CCWF due to well I-17 being offline due to the presence of 1,2,3-TCP and the new MCL, in addition to no pumping at well I-18. In April 2023, well I-18 (for the first time) and well I-17 (since 2017) both began pumping groundwater which was conveyed for treatment as part of the Chino Airport Plume remediation to the South GAC System (see Program Element 6 Chino Airport Plume of this report). Watermaster and the IEUA recalibrate the Chino Basin groundwater-flow model every five years, which in turn is used to estimate the annual groundwater discharge from the Chino-North GMZ to the PBMZ

[3] The Santa Ana Water Board amended the Basin Plan (R8-2021-0025) to modify the ambient water quality determination to every five years following the ambient water quality determination on October 1, 2023.

Program Element 7: Develop and Implement a Salt Management Program (Continued)

(i.e., annual underflow past the CCWF) to determine whether Hydraulic Control is achieved in the west. The model results indicate that that both the estimated historical and projected discharge past the CCWF are below the *de minimis* level threshold of 1,000 acre-feet per year.

The Chino Basin Desalter pumping is necessary to replace lost agricultural groundwater production in the southern part of the Chino Basin to sustain Hydraulic Control. In a letter dated January 23, 2014, the Santa Ana Water Board required that Watermaster and the IEUA submit a plan detailing how Hydraulic Control will be sustained in the future as agricultural production in the southern region of Chino-North continues to decrease—specifically, how the Chino Basin Desalters will achieve the required total groundwater production level of 40,000 acre-feet per year. On June 30, 2015, Watermaster and the IEUA submitted a final plan and schedule for the construction and operation of three new desalter wells (II-10, II-11, and II-12). Well II-10 and II-11 were constructed and began operation in mid-2018, and Well II-12 was constructed in 2020 and began operation in mid-2021. The Chino Basin Desalters officially reached the pumping capacity necessary to meet the 40,000 acre-feet per year required for Hydraulic Control in June 2020. This pumping capacity was achieved without the inclusion of Well II-12, which was operational in August 2021 and was the last part of the final expansion designed to meet the 40,000 acre-feet per year. A full status report on the desalter expansion facilities is described in Program Element 3.

Following the completion of the desalter expansion, Watermaster prepared an update to the 2005 Mitigation Plan to: (i) remove a definition of the minimum pumping requirement at the CCWF to maintain Hydraulic Control, (ii) provide definition of operational flexibility for desalter production fluctuations on the order of plus or minus 2,100 acre-feet a year that maintain a five-year average pumping of about 40,000 acre-feet a year, and (iii) updated protocol for mitigation of temporary loss of Hydraulic Control. The updated mitigation plan was prepared with inputs from the Santa Ana Water Board staff. Watermaster finalized and submitted the updated mitigation plan to the Santa Ana Water Board on December 11, 2023.

Recycled Water Quality. Pursuant to the maximum-benefit commitment number 6, Watermaster and the IEUA manage the recycled water quality to ensure that the 12-month volume-weighted running average IEUA agency-wide, effluent quality does not exceed the permit limits of 550 mgl and 8 mgl for TDS and TIN, respectively. Additionally, Watermaster and the IEUA must submit a plan and schedule to the Santa Ana Water Board for the implementation of measures to ensure long-term compliance with these permit limits when either the 12-month volume-weighted running average IEUA agency-wide effluent TDS concentration exceeds 545 mgl for three consecutive months or the TIN concentration exceeds 8 mgl in any one month (action limits). The IEUA calculates and reports the 12-month volume-weighted running average agency-wide effluent TDS and TIN concentrations in the *Groundwater Recharge Program Quarterly Monitoring Reports*.

Since the initiation of recycled water recharge in July 2005, the 12-month running average TDS and TIN concentrations have ranged between 456 and 534 mgl and 3.8 and 7.6 mgl, respectively, and have never exceeded the permit limits. During the statewide drought in mid-2015, a historical high 12-month running average IEUA agency-wide effluent TDS concentration of 534 mgl was calculated for three consecutive months: June, July, and August. This 12-month running average IEUA agency-wide effluent TDS concentration of 534 mgl was only 11 mgl below the action limit. The 12-month running average agency-wide TDS concentration has decreased since mid-2015. As of June 2025, the 12-month running average IEUA agency-wide effluent TDS concentration was 475mgl.

Through analysis of water supply and wastewater data, Watermaster and the IEUA concluded that drought conditions have a meaningful impact on the short-term TDS concentration of the water supplies available to IEUA agencies and that future droughts similar to the 2012-2016 period could lead to short-term exceedances of the 12-month running average IEUA agency-wide effluent TDS concentration. For this reason, in October 2016, Watermaster and the IEUA petitioned the Santa Ana Water Board to consider modifying the TDS compliance metric for recycled water to a longer-term averaging period. The Santa Ana Water Board agreed that an evaluation of the compliance metric was warranted and directed Watermaster and the IEUA to develop a technical scope of work to support the adoption of a longer-term averaging period for incorporation into the Basin Plan. The proposed technical scope of work to support a Basin Plan amendment to revise the recycled water compliance metric was submitted to the Santa Ana Water Board in May 2017. The proposed scope of work which was approved by the Santa Ana Water Board includes the following tasks:

- Develop numerical modeling tools (R4, Hydrus 2D, MODFLOW, MT3D) to evaluate the projected TDS and nitrate concentrations of the Chino Basin.
- Define a baseline (status-quo) scenario and evaluate it with the new modeling tools.
- Define salinity management planning scenarios and evaluate them with the new modeling tools to compare the projected TDS and nitrate concentrations against the baseline scenario.

Program Element 7: Develop and Implement a Salt Management Program (Continued)

- Use the results to develop a draft regulatory compliance strategy that includes a longer-term average period for recycled water TDS concentrations.
- Collaborate with the Santa Ana Water Board to review and finalize the regulatory strategy.
- Support the Santa Ana Water Board in the preparation of a Basin Plan amendment upon approval of the regulatory strategy.

Watermaster and the IEUA began implementing the scope of work in July 2017 and worked collaboratively with the Santa Ana Water Board staff to review interim work products. In December 2021, Watermaster and the IEUA completed and submitted the documentation of the technical work, *Total Dissolved Solids and Nitrate Concentrations Projections for the Chino Basin*, to the Santa Ana Water Board. Watermaster and the IEUA presented the technical work and received approval from the Santa Ana Water Board staff in July 2022 to proceed with the work to amend the Basin Plan. Specifically, the amendment to the Basin Plan will, in part, modify the TDS compliance metrics and action limit for IEUA's recycled water supply under maximum-benefit commitment number 6 to a 10-year volume-weighted running average of the agency-wide supply.

During this reporting period, Watermaster and the IEUA provided support to the Santa Ana Water Board staff on the Basin Plan amendment, including preparing: a draft Substitute Environmental Document (SED) to comply with the California Environmental Quality Act (CEQA), a Staff Report, a Resolution, and peer review package to support the Santa Ana Water Board staff with the Basin Plan amendment.

Recycled Water Recharge. Pursuant to the maximum-benefit commitment number 5, Watermaster and the IEUA completed the construction of the recharge facilities and began artificial recharge of stormwater and recycled water in the Chino Basin in 2005. Additionally, pursuant to maximum-benefit commitment number 7, Watermaster and the IEUA limit recycled water for artificial recharge to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve five-year running average concentrations of less than or equal the maximum-benefit objectives (420 and 5 mgl for TDS and nitrate, respectively). This data is analyzed and reported to the Santa Ana Water Board annually in April. During this reporting period, Watermaster and the IEUA continued their monitoring programs to collect the data required for analysis and reporting to the Santa Ana Water Board. Since recycled water recharge began in July 2005, the five-year volume-weighted running average TDS and nitrate concentrations have ranged from 203 to 354 mgl and from 1.1 to 3.0 mgl, respectively, and have never exceeded the maximum-benefit objectives. As of December 2024, the five-year volume-weighted- running average TDS and nitrate concentrations of these three recharge sources were 264 and 1.5 mgl, respectively. As part of the Basin Plan amendment, the TDS and nitrate compliance metrics for the artificial recharge under maximum-benefit commitment number 5 are proposed to be modified to 10-year volume-weighted running average. During this reporting period, Watermaster and the IEUA continued to provide support to the Santa Ana Water Board staff for the Basin Plan amendment (see description of the Basin Plan amendment in Recycled Water Quality subsection above).

Ambient Groundwater Quality. Pursuant to the maximum-benefit commitment number 9, Watermaster and the IEUA are required to recompute the current ambient TDS and nitrate concentrations for the Chino Basin and Cucamonga GMZs periodically. The re-computation of ambient water quality is performed for the entire Santa Ana River Watershed, and the technical work is contracted, managed, and directed by the Santa Ana Watershed Project Authority's (SAWPA's) Basin Monitoring Program Task Force (Task Force). Watermaster and the IEUA have participated in each watershed-wide ambient water quality computation as members of the Task Force.

The most recent ambient water quality, which covers the 20-year period of 2002 to 2021 (2021 ambient water quality), was completed by the Task Force in October 2023. As part of this computation, Watermaster and the IEUA provided requested groundwater quality data, inputs on interim findings, and reviewed draft documentation to support the computation of the 2021 ambient water quality. Pursuant to the 2021 Basin Plan Amendment (R8-2021-0025), the Task Force is required to recompute the current ambient water quality every five years after October 1, 2023.

The next ambient water quality is due to the Santa Ana Water Board on October 1, 2028 for the 20-year period of 2007 to 2026.

Development of a Surface Water Monitoring Program in Chino Creek. Pursuant to the Clean Water Act sections 303(d) and 305(b), the State Board is required to assess surface water quality conditions relative to the established water quality objectives and prepare a list of impaired water bodies based on the results of the assessment. The State Board collaborates with the Regional Boards to periodically perform this assessment. The assessment and the list of impaired water bodies are included in the California Integrated Report. In 2024, the State Board collaborated with the Santa Ana Water Board to assess surface water quality conditions in the Santa Ana River Watershed (2024 Integrated Report). The 2024 Integrated Report initially identified that Chino Creek 1B was an

Program Element 7: Develop and Implement a Salt Management Program (Continued)

impaired water body subject to listing pursuant to Clean Water Act 303(d). Such a listing would require an extensive effort to develop and implement a Total Maximum Daily Load (TMDL) program and could impact the Watermaster and IEUA recycled water permit and uses in the Chino Basin. During a subsequent review of surface water quality data of Chino Creek 1B, the Santa Ana Water Board concluded that there was insufficient data to make a final determination of water quality conditions for Chino Creek 1B; however, the limited data indicated that there may be impairment. Additionally, the Santa Ana Water Board expressed that more data is needed in order to support future assessment for the Integrated Reports. Watermaster and IEUA acknowledged the importance of additional data for proper assessment and initiated the effort to collaborate with the Santa Ana Water Board staff to develop and implement a surface water monitoring program for Chino Creek. The objectives of the monitoring program are to collect the requisite water quality data for use in future Integrated Reports, and to characterize the sources of salt loading into Chino Creek should a TMDL or a TMDL-equivalent program be required. The Santa Ana Water Board approved the monitoring program including the Quality Assurance Program Plan (QAPP) in June 2024. The monitoring program includes monthly surface water quality sampling, data processing and management, and annual data review to characterize water quality and trends. Watermaster and IEUA plan to implement the monitoring program for three fiscal years. At the end of the three-year period in 2027, Watermaster and IEUA will perform a detailed analysis of the monitoring data to assess long-term trends in water quality conditions across Chino Creek and characterize salt loadings into Chino Creek 1B. Watermaster and IEUA initiated the implementation of the monitoring program in August 2024.

During this reporting period, Watermaster and IEUA completed the first fiscal year of monthly surface water sampling. Watermaster and IEUA will perform the first annual data review during the next reporting period.

Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program

Groundwater storage is critical to the Chino Basin stakeholders. The OBMP outlines Watermaster's commitments to investigate the technical and management implications of Local Storage Agreements, improve related policies and procedures, and then revisit all pending Local Storage Agreement applications.

The existing Watermaster/IEUA/MWDSC/Three Valleys Municipal Water District Dry-Year Yield (DYY) program was initiated in the early 2000's and is the only Storage and Recovery Program that is being implemented in the Chino Basin. By April 30, 2011, all DYY program construction projects and a full "put" and "take" cycle had been completed, leaving the DYY storage account with a zero balance. Another DYY cycle began in June 2017 and was completed in June 2022. In response to the heavy precipitation in early 2023, MWDSC began recharging imported water in the Chino Basin in spring 2023. During the reporting period, MWDSC recharged about 49 acre-feet of imported water in the Chino Basin through the DYY program.

Safe Yield Recalculation

The Basin's Safe Yield was initially set by the Judgment at 140,000 acre-feet per year based on hydrology for the period of 1965 through 1974. Pursuant to the OBMP Implementation Plan and Watermaster's Rules and Regulations, in fiscal year 2010/11 and every ten years thereafter, Watermaster is to recalculate the Safe Yield. The 2011 Safe Yield recalculation began in 2011 and after significant technical and legal process, on April 28, 2017, the Court issued a final order (2017 Court Order), resetting the Safe Yield to 135,000 acre-feet per year effective July 1, 2010.

In July 2018, Watermaster's Engineer began the technical work necessary for the Safe Yield recalculation for 2020 pursuant to the OBMP Implementation Plan using the approved methodology in the 2017 Court Order. After substantial technical process and stakeholder engagement, the Watermaster Board adopted recommendations to the Court to update the Safe Yield for the period 2021 through 2030 to 131,000 acre-feet per year. In July 2020, the Court approved Watermaster's recommendation and reset the Safe Yield to 131,000 acre-feet per year for the period commencing on July 1, 2020 and ending on June 30, 2030.

The 2017 Court Order i) requires that the current Safe Yield be evaluated no later than June 30, 2025, ii) allows for supplementation of the current Safe Yield Reset methodology, and iii) requires annual collection and evaluation of data regarding cultural conditions of the Chino Basin. In 2022, Watermaster's Engineer completed a process to supplement the current Safe Yield Reset methodology to address comments received during the peer review process of the 2020 Safe Yield recalculation regarding uncertainty in the groundwater model and the data used in future projections. As a result of this process, which was supported by extensive peer review, Watermaster submitted an updated Safe Yield Reset methodology (2022 Safe Yield Reset methodology) to the Court. The Court approved the 2022 Safe Yield Reset methodology in December 2022.

Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program (Continued)

During this reporting period, Watermaster's Engineer continued the process to evaluate the Safe Yield of the Chino Basin for the period of fiscal year 2021 through 2030 (the 2025 Safe Yield Reevaluation). The 2025 Safe Yield Reevaluation process includes updating Watermaster's groundwater-flow model and implementing the 2022 Safe Yield Reset methodology. During this reporting period, Watermaster hosted a workshop in March 2025 on the preliminary results of the 2025 Safe Yield Reevaluation. The Watermaster Board directed Watermaster staff in March 2025 to procure an outside consultant to review Watermaster's groundwater-flow model and implementation of the 2022 Safe Yield Reset methodology. Watermaster staff solicited bids and contracted a consultant to provide peer review starting in June 2025. Since the added peer review process would prevent Watermaster from meeting the original deadline to complete the 2025 Safe Yield Reevaluation by June 30, 2025, Watermaster submitted a motion to the Court to grant an extension to the deadline to fiscal year 2025/26.

Groundwater Storage Management

Addendum to PEIR. The original OBMP storage management program consists of managing groundwater production, replenishment, recharge, and storage such that the total storage within the basin lies within the range known as the Safe Storage Capacity (SSC), which is the difference between the Safe Storage[4] and the Operational Storage Requirement[5]. The allocation and use of storage space in excess of the SSC will preemptively require mitigation: mitigation must be defined, and resources must be committed to mitigation prior to allocation and use.

Water occupying the SSC includes Local Storage Account Water, Carryover Water, and water anticipated to be stored in future groundwater Storage and Recovery programs. This storage management program was evaluated in the OBMP programmatic environmental impact report (PEIR) in 2000.

After the OBMP PEIR, Watermaster and the Watermaster Parties revised the OBMP based on new monitoring and borehole data collected since 1998, an improved hydrogeologic conceptualization of the basin, new numerical models that have improved the understanding of basin hydrology since 2000, and the need to expand the Chino Basin Desalters (desalters) to the 40,000 acre-feet per year of groundwater production required in the OBMP Implementation Plan. These investigations included a recalculation of the total water in storage in the basin, based on the improved hydrogeologic understanding. The total storage in the Chino Basin for 2000 was estimated to be about 5.9 million acre-feet[6], about 100,000 acre-feet greater than the estimated Safe Storage at the time.

The Watermaster Parties negotiated the Peace II Agreement to implement, among other things, the expansion of the desalters, the dedication of 400,000 acre-feet of groundwater in storage to desalter replenishment (i.e., approved overdraft), and changes in the Judgment to implement the Peace II Agreement. However, the storage management plan was not changed in light of the approved overdraft and the fact that the estimated storage in the basin exceeded the SSC. The IEUA completed and subsequently adopted a supplemental environmental impact report for the Peace II Agreement in 2010.

Following the implementation of desalters and the Peace II Agreement, basin storage continued to grow, prompting Watermaster and the IEUA to propose a temporary increase in SSC. This was analyzed through an addendum to the 2000 PEIR, and on March 15, 2017, the IEUA adopted an increase from 500,000 acre-feet to 600,000 acre-feet, effective from July 1, 2017, to June 30, 2021. The temporary increase did not cause material physical injury or loss of Hydraulic Control, giving Watermaster and its partners time to develop a new storage management plan.

2020 Storage Management Plan. In 2019, Watermaster began developing the 2020 Storage Management Plan (2020 SMP) with input from the Watermaster Parties and Board. A white paper outlining the need and requirements for the SMP was presented to stakeholders in June 2019. This effort built on the 2018 Storage Framework Investigation, which explored potential storage space between 700,000 and 1,000,000 acre-feet. A final SMP report was published in December 2019 and included in the 2020 OBMP Update Report, which the Watermaster Board adopted in October 2020.

Local Storage Limitation Solution. The temporary increase in Safe Storage Capacity was set to expire on June 30, 2021, reverting to 500,000 acre-feet unless a new Court-approved storage agreement was made. By the end of Production Year 2020, Managed Storage had reached 588,000 acre-feet. To address the expiration, Watermaster Parties recommended expanding environmental analysis to cover storage use above 500,000 acre-feet. This work, called the Local Storage Limitation Solution (LSLS), was supported by an updated groundwater-flow model that found no unmitigable significant adverse impacts. The LSLS allowed Safe Storage

[4] Safe Storage is an estimate of the maximum storage in the basin that will not cause significant water quality and high groundwater related problems. Safe Storage was estimated in the development of the OBMP to be about 5.8 million acre-feet based on the then-current understanding of the basin.

[5] The Operational Storage Requirement is the storage or volume in the Chino Basin that is necessary to maintain the Safe Yield. This is an average value with the storage oscillating around this value due to dry and wet periods in precipitation. The Operational Storage Requirement was estimated in the development of the OBMP to be about 5.3 million acre-feet. This storage value was set at the estimated storage in the basin in 1997.

[6] The most recent modeling of the Chino Basin estimates the total water in storage to be about 12 million acre-feet.

Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program (Continued)

Capacity to increase to 700,000 acre-feet through June 30, 2030, and to 620,000 acre-feet from July 1, 2030, through June 30, 2035. The CEQA documentation was adopted as Addendum No. 2 to the OBMP PEIR on March 17, 2021. The Court granted Watermaster's motion, and the LSLS became effective on July 1, 2021.

Increase of Safe Storage Capacity to 900,000 Acre-Feet. Following two consecutive wetter-than-average years resulting in low groundwater demands and increased recharge through the DYY Program, the total managed storage at the end of fiscal year 2023/24 was about 709,000 acre-feet, exceeding the SSC authorized by the approval of the LSLS. To address this, the Watermaster Board adopted Resolution 2024-04 to recommend that the Court authorize the increase of the SSC to a maximum of 900,000 acre-feet through June 30, 2040, consistent with the project evaluated as part of the 2020 OBMP Update (see 2020 OBMP Update description below). During this reporting period in January 2025, the Court approved the motion to increase the SSC to a maximum of 900,000 acre-feet through June 30, 2040.

2020 OBMP Update

OBMP implementation began in 2000. By 2019, many of the projects and management programs envisioned in the 2000 OBMP have been implemented. The understanding of the hydrology and hydrogeology of the Chino Basin has improved since 2000, and new water-management issues have been identified that necessitate that the OBMP be adapted to protect the collective interests of the Watermaster Parties and their water supply reliability. For these reasons, the Watermaster, with input from the Parties, prepared a 2020 OBMP Update to set the framework for the next 20 years of basin-management activities.

During 2019, Watermaster convened a collaborative stakeholder process to prepare the 2020 OBMP Update similar to the process employed for the development of the 2000 OBMP. The final 2020 OBMP Scoping Report (Scoping Report) was published in November 2019 to document the results of the first four Listening Sessions that Watermaster conducted with the stakeholders. The Scoping Report summarized (i) the need to update the OBMP, (ii) the issues, needs, and wants of the stakeholders, (iii) the goals for the 2020 OBMP Update, and (iv) the recommended scope of work to implement seven stakeholder-defined- basin-management activities that could be included in the 2020 OBMP Update.

Through the listening session process, it became apparent that the 2000 OBMP goals remain unchanged, and the nine Program Elements (PEs) defined in the 2000 OBMP are still relevant today as the overarching program elements of a basin management program. Each of the seven activities in the Scoping Report had objectives and tasks that were directly related to one or more of the 2000 OBMP PEs. Based on this finding, the nine PEs defined in the 2000 OBMP were retained for the 2020 OBMP Update. Each of the seven activities were mapped to one of the existing PEs.

In January 2020, the Watermaster published the 2020 OBMP Update Report, which described: (i) the 2020 OBMP Update process; (ii) the OBMP goals and new activities for the 2020 OBMP Update; (iii) the status of the OBMP PEs and ongoing activities within them; and (iv) the recommended 2020 OBMP management plan – inclusive of ongoing and new activities. The management plan will form the foundation for the Watermaster Parties to develop a 2020 OBMP Implementation Plan and the agreements necessary to implement it. After several workshops and comprehensive review and comments by Watermaster Parties, the final 2020 OBMP Update Report was adopted by the Watermaster Board on October 22, 2020.

In January 2020, Watermaster and the IEUA (as the lead agency) began preparing a SEIR to support the 2020 OBMP Update. This SEIR was designed to inform decision-making, investments, and grant applications for both ongoing and new management actions under the OBMP. However, following feedback from the Parties, the certification of the SEIR was postponed. In 2022, Watermaster and IEUA resumed the process, holding three workshops to gather input from the Watermaster Parties on the 2020 OBMP Update's project description and potential updates. This included the proposed use of managed storage of up to 900,000 acre-feet. In May 2023, Watermaster published the 2023 Storage Framework Investigation to evaluate the impacts of this storage level. IEUA then released the draft SEIR for public review in September 2023, with the comment period concluding on November 9, 2023. The final SEIR was certified by IEUA in February 2024. This SEIR supported Watermaster's motion to the Court to increase the SSC in fiscal year 2024/25.

Two new management activities in the 2020 OBMP Update began in fiscal year 2023/24:

- Development of a Storage and Recovery Master Plan (SRMP). The SRMP Committee (SRMPC) initially convened in November 2023 to define the objectives of the SRMP and refine the scope of work for its development, including defining desired benefits of Storage and Recovery Programs in the Chino Basin. The SRMPC did not meet during this reporting period.

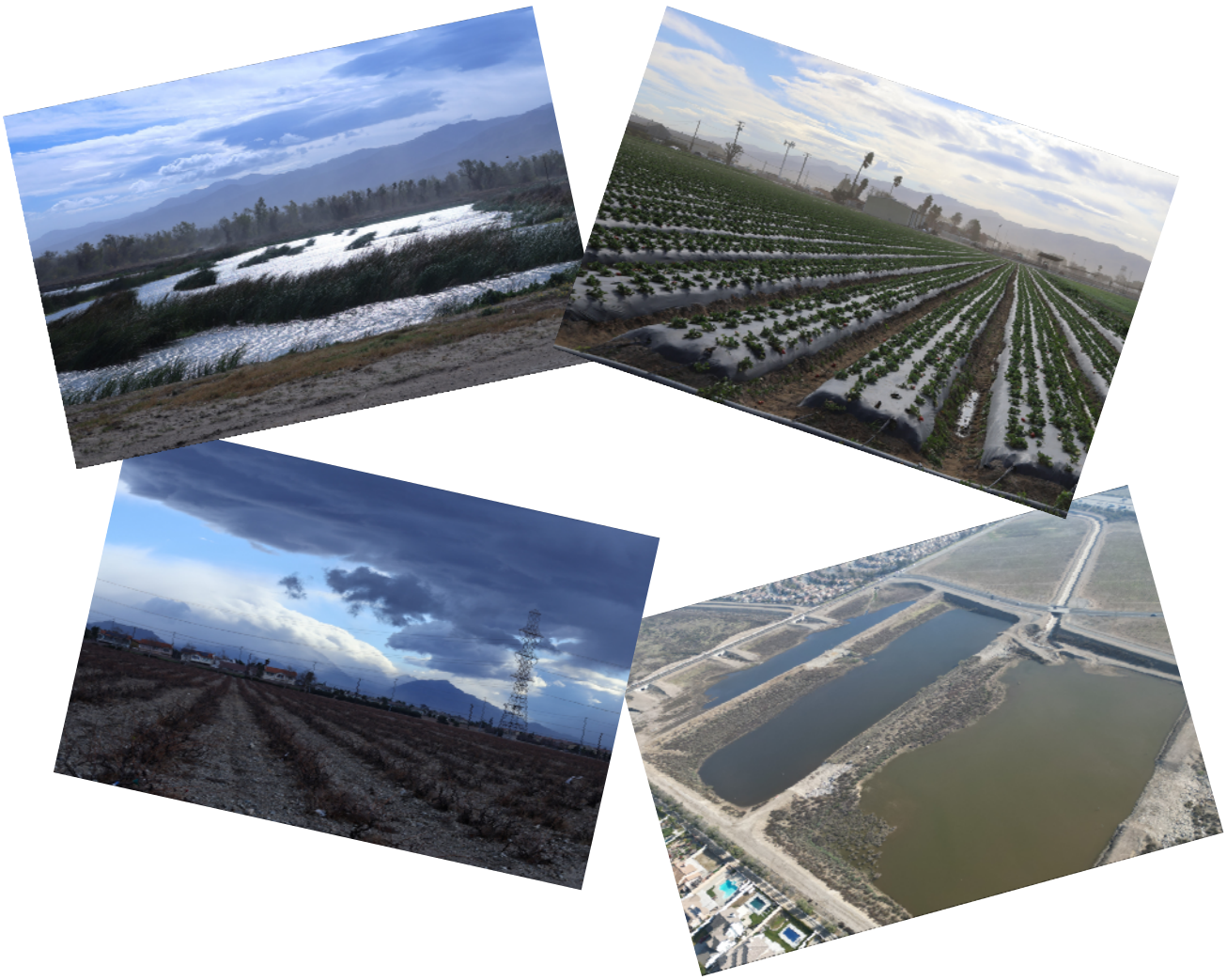
2020 OBMP Update (Continued)

- Preparation of a WQMP. Watermaster and its stakeholders began convening the WQC in fiscal year 2023/24 to define the objectives and refine the scope of work for the WQMP, and develop a monitoring plan for emerging contaminants in the Chino Basin (see Groundwater Quality Management Program section under Program Element 6 in this report). The WQC did not meet during this reporting period.

2024 State of the Basin Report

As a reporting mechanism and pursuant to the *OBMP Implementation Plan and* the November 15, 2001 Court Order, Watermaster prepares a State of the Basin report every two years that demonstrates the current state of the Basin and the progress made since OBMP implementation began on July 1, 2000. The State of the Basin reports on activities, related to OBMP Program Elements such as: well meter installation, desalter planning and engineering, recharge assessments, recharge master planning, hydraulic control, expansion of monitoring programs for groundwater levels and quality, and the monitoring and management of land subsidence.

In June of this reporting period, Watermaster prepared the draft *2024 Chino Basin OBMP State of the Basin* report which is the twelfth report since OBMP implementation. The *2024 Chino Basin OBMP State of the Basin* report is in a new format which is web-based using ArcGIS StoryMaps that features interactive maps and exhibits that characterize Basin conditions including hydrology, pumping, recharge, groundwater levels, groundwater quality, and ground motion. The final report will be completed and made publicly available on Watermaster's website during the second half of 2025.



Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

Other Plumes

Watermaster continues to track the monitoring programs and mitigation measures associated with other point sources of contamination in the Chino Basin, including: Alumax Aluminum Recycling, Alger Manufacturing Facility, General Electric Test Cell and Flatiron facilities, the Former Kaiser Steel Mill, Milliken Landfill, Mid-Valley Landfill, Upland Landfill, ~~Chino~~ California Institution for Men, and the Stringfellow National Priorities List sites. In October 2024 Watermaster prepared the most recent annual status reports for the GE Test Cell, GE Flatiron, Milliken Landfill, California Institution for Men, Stringfellow Plumes, and the former Kaiser Steel Mill site. During this reporting period, the most current Watermaster delineations of the extent of these plumes were completed in June 2025 for the 2024 *Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report).

Water Quality Management Program

Through the collaborative stakeholder process to update the OBMP in 2020 (see 2020 OBMP Update section of this report), the parties identified a new management action under Program Element 6 to develop a Water Quality Management Program that addresses contaminants of emerging regulations of concern to better prepare the parties for addressing compliance with new State and Federal drinking water regulations, and provide for the long-term maximum beneficial use of the basin. It was identified that reconvening the Water Quality Committee (WQC) that met historically from 2003 to 2010 to implement Program Element 6 of the 2000 OBMP would be the ideal approach to guide the development and implementation of the Water Quality Management Plan (WQMP). Watermaster held a kick-off meeting in October 2023 to reconvene the WQC. Two additional WQC meetings were conducted during the first half of 2024 to develop an initial Emerging Contaminants Monitoring Plan (ECMP), and a framework and scope for a WQMP. From July to December 2024, Watermaster collected samples for the parameters that are part of the ECMP during the routine groundwater sampling that is part of Program Element 1. During this reporting period, there was no activities for the WQMP.

Program Element 7: Develop and Implement a Salt Management Program

Maximum Benefit Salt and Nutrient Management Plan

In January 2004, the Santa Ana Water Board amended the Basin Plan to incorporate an updated TDS and nitrogen (N) management plan. The Basin Plan amendment includes both "antidegradation" and "maximum-benefit" objectives for TDS and nitrate for the Chino-North and Cucamonga groundwater management zones (GMZs). The maximum-benefit objectives allow for recycled water reuse and recharge of recycled and imported waters, which is an integral part of the OBMP, without the immediate need for mitigation. The application of the maximum-benefit objectives is contingent on the implementation of specific projects and requirements termed the maximum-benefit commitments by Watermaster and IEUA. The status of compliance with each commitment is reported to the Santa Ana Water Board annually in April. The nine maximum-benefit commitments include:

1. The development and implementation of a surface water monitoring program.
2. The development and implementation of a groundwater monitoring program.
3. The expansion of the Chino I Desalter to a capacity of 10 MGD and the construction of the Chino II Desalter with a design capacity of 10 MGD.
4. The additional expansion of desalter capacity (to 40 MGD) pursuant to the OBMP and the Peace Agreement (tied to the IEUA's agency-wide effluent TDS concentration).
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program.
6. The management of recycled water quality to ensure that the IEUA agency-wide, 12-month volume-weighted running average TDS and TIN concentrations do not exceed 550 mgl and 8 mgl, respectively.
7. The management of water quality in artificial recharge to ensure that the five-year volume-weighted running average TDS and nitrate concentrations in artificial recharge of recycled, imported, and storm waters are less than or equal to the maximum-benefit objectives of 420 mgl and 5 mgl, respectively.

Update to the Chino Basin Socioeconomic Studies from 2006-2007

SEPTEMBER 18, 2025

ADVISORY COMMITTEE

Purpose and Objectives

Purpose:

Update 2006–2007 economic studies of the Chino Basin to reflect current legal, hydrologic, and institutional realities.

Objectives:

- Integrate updated data on groundwater rights, recycled water, infrastructure, and energy costs.
- Revise Net Present Value models with Monte Carlo simulations.
- Assess equity and efficiency of benefit distribution.

Status

- Concluded Stakeholder interviews
- Data gathering in process
- Review of 15+ hrs. of recorded material

Timeline

August 4 – September 30, 2025

- Weeks 1–2: Data collection & stakeholder interviews
- Weeks 3–4: Model updates & legal/institutional integration
- Weeks 5–6: Scenario modeling & benefit distribution analysis
- Weeks 7–8: Sensitivity testing & report drafting
- Final Days: Outreach materials

QUESTIONS?

CHINO BASIN WATERMASTER

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STAFF REPORT

DATE: September 18, 2025

TO: Advisory Committee Members

SUBJECT: Peer Review of the 2025 Safe Yield Reevaluation Final Draft Report (Business Item II.B)

Issue: To receive and discuss a presentation by Watermaster consultant, S.S. Papadopulos and Associates, conducting a peer review analysis of the 2025 Safe Yield Evaluation process. [Normal Course of Business]

Recommendation: This presentation is for information only. No action is required by the Advisory Committee.

Financial Impact: None

ACTIONS:
Watermaster Board – September 25, 2025 [Recommended]: Receive and file presentation

BACKGROUND

The court-ordered update to the Chino Basin groundwater model is now complete and the technical analysis for the 2025 Safe Yield Reevaluation is completed. The process began with a workshop on March 25, 2025 to discuss the preliminary results. Prior to the release of the Final Administrative Draft of the technical analysis report, the Watermaster Board (Board) directed, at its March 27, 2025 meeting, an independent peer review of the groundwater model results, methodologies, and final 2025 Safe Yield Reevaluation Report be conducted. The Board requested the peer review be conducted prior to finalizing the final report for the Board's consideration.

Watermaster staff developed a scope of work and solicitation process which was reviewed, amended and approved through the Watermaster process in April and May, 2025. Watermaster received three proposals from a prequalified list of bidders. After the proposals were scored and bidder interviews were conducted, the consulting firm of S.S. Papadopulos and Associates (SSPA) was selected (Attachment 1). Upon completion of negotiating a professional services agreement with the firm, the Board approved the agreement with SSPA on June 26, 2025. A kickoff meeting was held on July 2, 2025 to begin the project.

DISCUSSION

The comprehensive Scope of Work includes evaluating Watermaster's implementation of the court-approved 2022 Safe Yield Reset Methodology, reviewing assumptions and calculations used to estimate Net Recharge for the 10-year period 2021-2030, assessing the calibration and storage level determinations of the Chino Valley Model (CVM), and identifying any additional issues relevant to the calculation of Net Recharge. SSPA is tasked with presenting findings for discussion at the regular meetings of the Advisory Committee and Watermaster Board in September 2025.

The Superior Court granted, on September 12, 2025, Watermaster's motion for extension of time to complete the evaluation of the Safe Yield through October 31, 2025. The moving papers indicated that this extension would allow the Watermaster Board to address the results of the 2025 evaluation during a December 2025 Board meeting. A tentative timeline consistent with this schedule has been developed and shared with the Watermaster Pool Committees on September 11, 2025 (Attachment 2).

The evaluation and determination of Safe Yield is a significant element of sustainable basin management and local water supplies. Because of its importance and complexities, parties are encouraged to ask questions and provide comments on the technical materials being presented. The Advisory Committee will review this issue again at its October 16, 2025 meeting.

ATTACHMENTS
1. S.S. Papadopulos & Associates, Inc. (SSPA) Proposal
2. Tentative Timeline
3. Presentation (to be distributed upon completion)

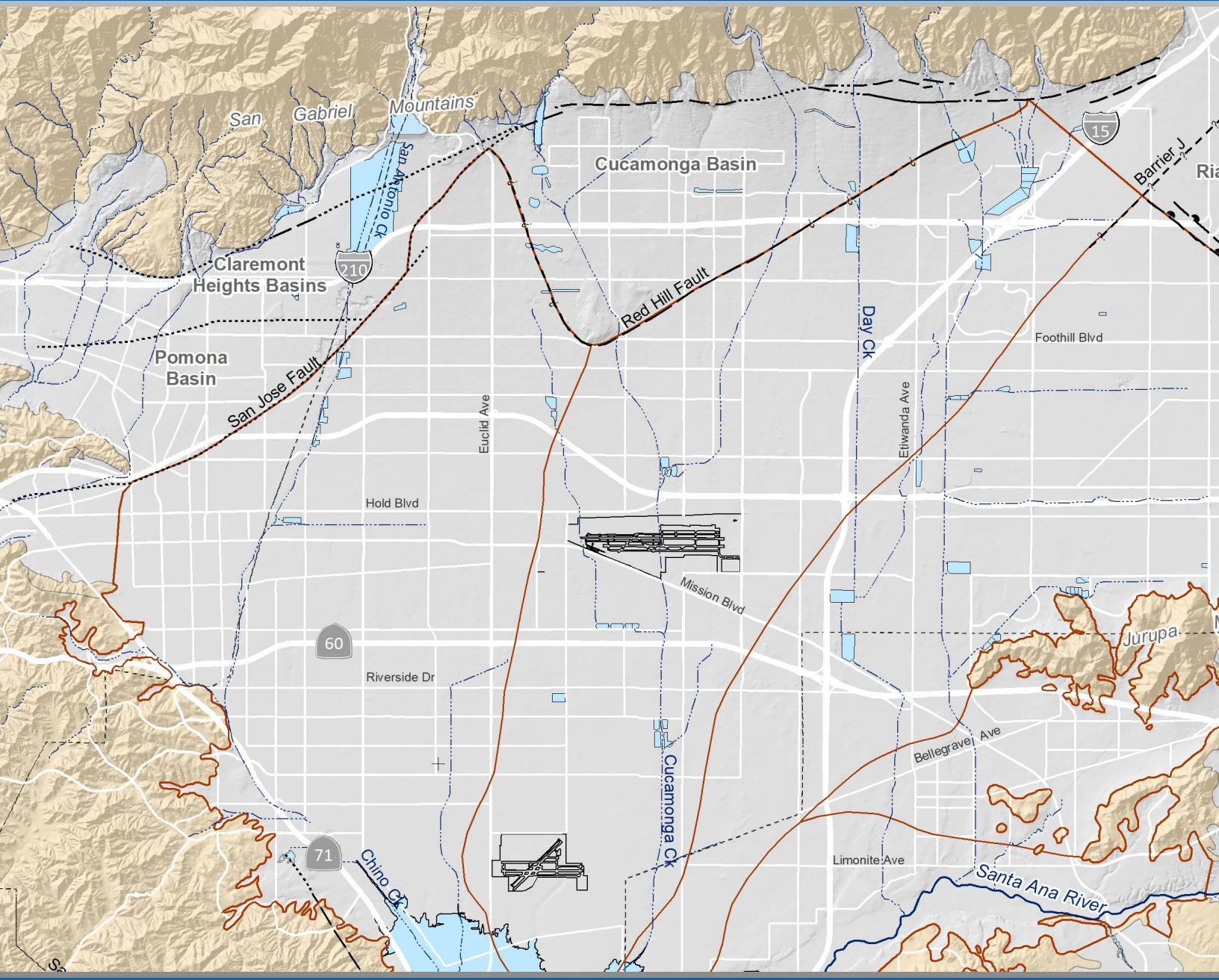


Image source: Figure from Chino Basin Watermaster 2020 State of the Basin Report by West Yost.

PROPOSAL

Peer Review of 2025 Safe Yield Evaluation Process and Results

Submitted to the Chino Basin Watermaster June 9, 2025

June 9, 2025 SUBMITTED ELECTRONICALLY

Todd Corbin
General Manager
Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730
tcorbin@cbwm.org

SUBJECT: **Proposal – Peer Review of 2025 Safe Yield Evaluation Process and Results**

Dear Mr. Corbin,

S.S. Papadopulos and Associates, Inc. (SSP&A) is hereby expressing strong interest in the Chino Basin Watermaster's (Watermaster's) Peer Review of the 2025 Safe Yield Evaluation Process and Results (SYEPR) project. We appreciate the invitation to support this important evaluation effort and thank you for the opportunity to submit our proposal.

This complex project requires a team of specialized experts to provide a rigorous and independent peer review that provides the Watermaster with an accurate final report that empowers you to move forward with confidence. SSP&A has assembled that team specifically for this engagement. We bring critical technical experience with the modeling tools central to this evaluation, including MODFLOW, PEST-IES, Hydrus, and HSPF, as well as deep understanding of issues such as safe yield determination, boundary condition estimation, model calibration, associated uncertainties, and local geological understanding.

To supplement our in-house capabilities, we have added specialists from our long-term teaming partners Paradigm Environmental (an Ulteig Company) for their expertise in surface water modeling with Hydrological Simulation Program–Fortran (HSPF) and development of Loading Simulation Program C++ (LSPC), and from Wood Rodgers for local hydrogeologic expertise in reviewing aquifer properties as well as in-person engagement with CBW staff and consultants. To support the review process and maintain strong communication with Watermaster staff and stakeholders, our team will meet for biweekly calls and has already reserved time for the scheduled meetings. We are fully available for the in-person Watermaster Board presentation on September 25, the Pool Committees on October 9, the Advisory Committee on October 16, and the Watermaster Board meeting on October 23, 2025.

We look forward to the opportunity to work with the Watermaster and to contribute meaningfully to the 2025 Safe Yield Evaluation through independent and constructive peer-review services. Please contact Vivek Bedekar with questions or to discuss our proposed approach, schedule, and fees.

Sincerely,

Matthew J. Tonkin, PhD
President and Principal-in-Charge
matt@sspa.com

Vivek Bedekar, PhD, PE
Project Manager
vivekb@sspa.com

Section 1.
Experience and Qualifications

Introduction

S.S. Papadopulos & Associates Inc. (SSP&A) is a groundwater and environmental consulting firm providing specialty services in water resources, groundwater modeling, contaminant fate-and-transport, geochemistry, and environmental remediation. SSP&A's reputation is built upon pioneering achievements from the development of analytical methods for determining aquifer properties, to the origination of the precursors to today's standard numerical groundwater modeling tools. We continue our industry leadership by creating numerical simulators that are used worldwide for flow and transport modeling, authoring and publishing software for hydrologic analyses, providing technical and professional training, leading research and development (R&D), and completing complex and challenging projects for public and private entities worldwide.

SSP&A critically evaluates available data, guides focused data acquisition efforts, and develops quantitative analyses to deliver practical solutions to complex problems. SSP&A tailors project-specific combinations of the following disciplines and skills – often in collaboration with other consultants and contractors – to address the needs of each client:

- Environmental Modeling and Hydrogeology
- Geochemistry
- Engineering and Remediation
- Software Development
- Geophysical Investigations and Analysis
- Data Management and Analysis
- Field Services
- Expert Witness and Litigation Support

To meet the Chino Basin Watermaster's goals for the peer review, **S.S. Papadopulos & Associates, Inc. (SSP&A)** has assembled a highly qualified and collaborative team comprising **Paradigm Environmental, an Ulteig Company (Paradigm)** and **Wood Rodgers**. This team combines deep technical expertise in groundwater and watershed modeling, regulatory and planning experience, and local knowledge essential for effective stakeholder engagement. This team also includes nationally-recognized experts in hydrologic and groundwater modeling to support the peer review effort. We have a strong track record of collaborative work and relevant project experience, particularly in the California context, with expertise in groundwater modeling, model calibration, and uncertainty analysis to deliver the right combination of senior professionals with decades of experience in applying and reviewing complex hydrologic models used for water resources management, basin planning, and regulatory compliance.

SSP&A is currently engaged in evaluating the safe yield estimates for two confidential groundwater basins in California, neither of which conflicts with the Chino basin.

Relevant Experience

S.S. Papadopulos & Associates, Inc.

SSP&A staff proposed for this project are currently supporting two active legal matters in California that center on safe yield estimation. We recognize the inherent challenges in estimating groundwater flow budgets and the importance of integrated modeling to characterize aquifer storage and inter-basin flow dynamics. Several key components of the groundwater budgets, such as inter-basin flows, vadose zone storage, and aquifer storage, cannot be measured directly and must therefore be estimated using a calibrated model. This underscores the critical importance of robust model calibration.

SSP&A has a long-standing reputation for developing and applying groundwater models to support practical resource management and policy needs. In our current projects, we are providing independent technical peer review of safe yield estimates presented in approved Groundwater Sustainability Plans. Our team is responsible for refining and recalibrating existing groundwater models to improve the accuracy of these estimates. This work includes recalculating and verifying individual groundwater budget terms, particularly those related to recharge and inter-basin flow, and updating the numerical flow models accordingly.

As with any modeling effort, and especially those involving safe yield estimation, ongoing stakeholder engagement is essential. We are currently supporting mediation proceedings by providing technical input and expert interpretation of model results to help build consensus and guide decision-making.

Paradigm Environmental, an Ulteig Company

Paradigm Environmental, an Ulteig Company, brings specialized expertise in surface water modeling, particularly in applying the Hydrological Simulation Program – FORTRAN (HSPF) model, its successor code Loading Simulation Module, in C++ (LSPC) that includes streamlined HSPF algorithms, and in developing and applying spreadsheet-based tools for estimating sustainable yields and evaluating water availability. Paradigm's role in the State Board contract complements SSP&A's groundwater modeling expertise, enabling a comprehensive and integrated evaluation of hydrologic systems.

In collaboration with Paradigm, SSP&A is currently engaged under a contract with the California State Water Resources Control Board (SWRCB) to develop and apply integrated surface water – groundwater models that assess supply and demand in multiple watersheds across the state. This collaborative effort leverages complementary expertise and demonstrates our ability to deliver technically robust, policy-relevant modeling analyses.

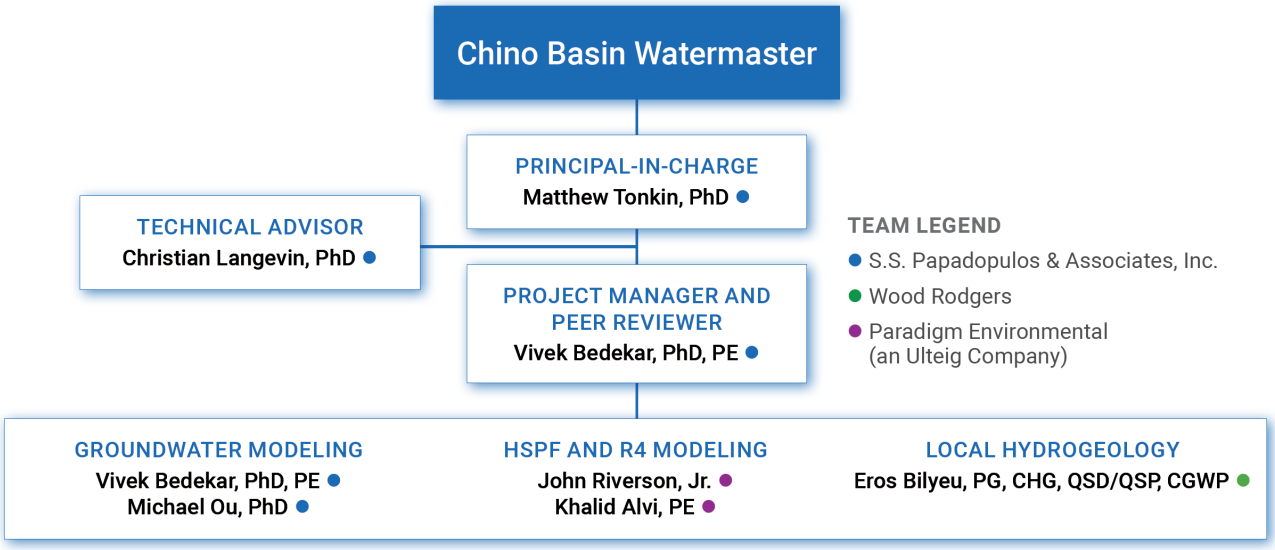
Wood Rodgers

Wood Rodgers contributes essential regional insight and stakeholder engagement experience, with a long-standing presence in the region and direct involvement in local groundwater sustainability planning. Their knowledge of basin-specific conditions, regulatory frameworks, and agency needs strengthens the team's ability to provide relevant and actionable peer review support.

With Wood Rodgers, SSP&A is currently involved in groundwater modeling for the San Bernardino Basin. While this project is still underway and results are not expected before the peer review work is completed, our involvement provides us with a strong understanding and knowledge of local hydrogeologic conditions and basin management challenges that will inform our approach.

Team Roles and Qualifications

SSP&A's streamlined team will perform an efficient, effective review of the draft 2025 Safe Yield Evaluation Process and Results (SYEPR). Brief introductions of our team members and their roles are provided below. Resumes for each team member are included in Appendix B.



Matthew Tonkin, PhD

Principal-in-Charge

EDUCATION: PhD, Civil Engineering; MSc, Hydrogeology; BSc, Applied Geology; YEARS OF EXPERIENCE: 30

Dr. Tonkin is Principal Hydrogeologist and President of SSP&A. He will provide principal oversight and confirm appropriate company resources are dedicated to this project. His areas of expertise include water resource evaluations, environmental data analysis and interpretation, and modeling to guide groundwater, surface water, and soil and contamination studies for public, private, and legal clients. He has more than 30 years of experience planning sampling and monitoring programs; developing and applying models of hydrologic and hydrogeologic systems; presenting to stakeholders; and collaborating with other experts. For this project, Dr. Tonkin will serve as Principal-in-Charge to review project deliverables and work products.

Christian Langevin, PhD

Technical Advisor

EDUCATION: PhD, Geology; MS, Geology; BS, Geology; YEARS OF EXPERIENCE: 25+

Dr. Langevin is an internationally recognized authority in the field of hydrologic modeling, Dr. Langevin specializes in the development and application of advanced simulation software for complex groundwater resource evaluations and contaminant transport analyses. Prior to joining SSP&A, Dr. Langevin served as the lead developer and primary caretaker of the U.S. Geological Survey (USGS) MODFLOW program, the world's most widely used groundwater simulator. In this pivotal role, he helped shape modern groundwater simulation tools. He has developed and codeveloped key hydrologic modeling software, including MODFLOW 6, MODFLOW-USG, MT3D-USGS, SEAWAT, and FloPy, and authored or coauthored numerous peer-reviewed publications and technical reports on hydrologic modeling. His expertise in translating physical hydrologic systems into numerical representations comes from over two decades of practical application together with teaching and advising on the application of numerical models in diverse hydrologic settings.

Vivek Bedekar, PhD, PE

Project Manager and Peer Reviewer

EDUCATION: PhD, Civil Engineering; MS, Environmental Engineering; BS, Civil Engineering; REGISTRATION: Professional Civil Engineer, DC #PE904565; YEARS OF EXPERIENCE: 25+

Dr. Bedekar has more than 25 years of experience working on a variety of modeling and software development projects. He has developed numerous local and regional models, surface-water/groundwater interaction models, flow-and-transport models, and variable density models. Dr. Bedekar's experience includes development of various modeling codes, serving as the lead author of MT3D-USGS, and co-developer of Texture2Par, and has contributed to MODFLOW and the Integrated Water Flow Model (IWFM) for California Department of Water Resources. For this project, Dr. Bedekar will serve as the primary point-of-contact for the Watermaster, manage the SSP&A team in reviewing the Safe Yield report and methodology, assist with the modeling efforts, attend the October 9, 16, and 23, 2025 meetings, and present the final peer-review report in September 2025 in person.

Gengxin (Michael) Ou, PhD

Modeling and Tool Development

EDUCATION: PhD, Civil Engineering (minor in Natural Resource Sciences); MS, Hydrology and Water Resources; BE, Hydrology and Water Resources Engineering; YEARS OF EXPERIENCE: 10+

Dr. Ou is a hydrologic and groundwater modeler with extensive experience in model implementation and development, water resources planning and assessments, development of graphical user interfaces, and statistical and spatial analysis. He brings strong computational and advanced mathematics skills and experience programming with Python, Fortran, R, and VBA. He has developed many software applications including several MODFLOW packages to enhance model capability. Dr. Ou analyzes and customizes modeling software architecture, performs model simulations, and provides data analysis and data integration. For this project, Dr. Ou will provide support for modeling tasks and develop tools for pre- and post-processing modeling results.

John Riverson, Jr.

HSPF Modeling Lead (Paradigm Environmental, an Ulteig Company)

EDUCATION: MS, Civil & Environmental Engineering; BS, Civil & Environmental Engineering; YEARS OF EXPERIENCE: 20

Mr. Riverson specializes in developing and applying hydrologic models and conducting supporting data analyses services, with a focus on public-domain models typically used to support water resources management and regulations and subject to peer review (e.g., HSPF, LSPC, SWMM, SWAT, TR-55, CE-QUAL-W2, QUAL2E/2K, SUSTAIN). He has an in-depth understanding of meteorological and hydrological processes and interactions, climate change assessment, watershed and stormwater management, water quality, and pollutant source characterization. John led the development of USEPA's LSPC from 2003 and was responsible for designing system architecture and developing algorithms for most of the core LSPC modules including: (1) high-resolution meteorological data (2) crop-associated irrigation, (3) hydraulic withdrawals and diversions, and (4) the time-variable land use module. John is regularly sought by different agencies to provide third-party review and QA/QC of modeling applications. For this project, Mr. Riverson will provide peer review for the HSPF model.

Khalid Alvi, PE

LSPC Lead Developer (Paradigm Environmental, an Ulteig Company)

EDUCATION: MS, Civil & Environmental Engineering; BS, Civil Engineering; REGISTRATION: Professional Engineer, VA #0402046509; YEARS OF EXPERIENCE: 24+

Mr. Alvi is a professional engineer and an experienced stormwater, watershed, water quality modeler, and data and GIS application developer with more than 24 years of experience in the development of watershed and BMP modeling systems. Mr. Alvi served as project manager and technical lead for the development of Opti-Tool, a spreadsheet-based stormwater best management practices optimization tool designed for use by municipal SW managers and their consultants to assist in developing technically sound and optimized cost-effective SW management plans. He co-led the development of EPA's Loading Simulation Program C++ (LSPC) to modernize the watershed model HSPF and EPA's SUSTAIN - a decision support system for the EPA's Office of Research and Development to develop, evaluate, optimize, select, and place BMPs based on cost and effectiveness. For this project, he will provide peer review for the R4 model.

Eros Bilyeu, PG, CHG, QSD/QSP, CGWP

Local Engagement, Yield and Storage Data, (Wood Rodgers)

EDUCATION: BS, Geology; REGISTRATION: Professional Geologist, CA #9351; Certified Hydrogeologist, CA #1061; Qualified Stormwater Pollution Prevention Plan Developer and Practitioner #27447; YEARS OF EXPERIENCE: 17+

Mr. Bilyeu is a California Certified Hydrogeologist with experience in high-resolution hydrogeologic characterization and 3D conceptual and numerical modeling of groundwater basins, karst terrains, and fractured bedrock aquifer systems. Mr. Bilyeu has extensive experience in groundwater management and planning, including implementation of key components of Groundwater Sustainability Plans (GSPs) under California's Sustainable Groundwater Management Act (SGMA) in high-priority basins. He has managed and executed a wide range of groundwater and well-related projects, including managed aquifer recharge (MAR), recharge basins, well siting, well design, and construction management for municipal supply wells. His technical expertise also includes the design and installation of multi-level and nested monitoring wells,

remedial extraction wells, and Aquifer Storage and Recovery (ASR) wells, as well as horizontal wells. For this project, Mr. Bilyeu will provide his local hydrogeologic expertise when reviewing aquifer properties.

Relevant Project Descriptions

Detailed summaries of relevant projects completed by SSP&A, Paradigm, and Wood Rodgers are included in Appendix A.

Section 2.
Technical Approach

Project Understanding

Chino Basin Watermaster (Watermaster) is undertaking a critical reassessment of the Safe Yield of the Chino Basin through the 2025 Safe Yield Evaluation Process and Results (SYEPR). Preliminary findings based on the recalibrated Chino Valley Model (CVM) indicate a potential reduction in Safe Yield on the order of 14,000 acre-feet per year (AFY), which is about 10% less than prior estimates made in 2020. Given the significance of this outcome, Watermaster has requested an independent, technical peer review to evaluate the underlying methodology, assumptions, and results.

SSP&A has conducted a preliminary review of the available technical memoranda and presentations to develop a comprehensive, objective approach to this peer review. Our methodology is grounded in technical rigor, transparency, and collaboration. We believe that effective peer review is not only about verification, but also about enhancing trust and clarity in decision-making through constructive, data-driven engagement with Watermaster staff, their consultants, and the stakeholders.

Our proposed approach addresses each element of the Scope of Work outlined in the RFP. The following sections describe our planned technical review activities, organized by Task, and highlight how we will bring our groundwater modeling and evaluation expertise to ensure a robust and credible outcome for the 2025 SYEPR.

Scope of Work

Task 1 – Evaluate Watermaster's implementation of the court-approved 2022 Safe Yield Reset Methodology

SSP&A will conduct a thorough review of the Court Order approving the 2022 Safe Yield Reset Methodology and assess the consistency of Watermaster's implementation with the Court's directives. This evaluation will specifically focus on the estimation of Net Recharge and the broader methodology, including:

- **Assessment of future water demands and cultural conditions:** We will review whether these assumptions align with the Court Order and accepted practices for predictive simulations.
- **Evaluation of Ensemble Modeling and Uncertainty Analysis:** Our team will examine the selection process for the multiple calibrated realizations used in the uncertainty analysis, focusing on:
  - Whether uncertainty analysis was required and its value to model calibration and decision-making.
  - The use of an ensemble modeling approach, specifically, the Iterative Ensemble Smoother (IES), and whether realization #157 (or the final selection) is appropriately representative of the ensemble. Review whether the use of a 'base model' is more appropriate for predictive purposes rather than one specific realization from the ensemble.

  - » Opportunities for further calibration using traditional gradient-based techniques, and whether parameter values and boundary conditions are within reasonable and plausible ranges.

- **Review of estimated Net Recharge ranges:** We will assess the assumptions and compare estimated Net Recharge to historical precipitation (P), applied water (AW) data, and review Net Recharge as a percentage of P and AW, and compare that against other relevant studies. Special attention will be paid to whether multipliers were used in changing the recharge generated by models like HSPF and R4, and if such use may compromise the integration of surface water and groundwater systems by under/over-estimating other water balance components such as evapotranspiration (ET).

The findings from Task 1 will be included in the peer-review report (final deliverable) outlining the methodology's fidelity to the Court Order, technical soundness, and transparency.

Task 2 – Review Assumptions and Calculations Used to Estimate Net Recharge

Our team recognizes the advantages and potential challenges associated with using a suite of integrated models – HSPF, R4, HYDRUS-2D, and MODFLOW-NWT. We will:

- **Review model assumptions and calibration changes**, particularly parameters and boundary conditions that were adjusted during history matching, to ensure consistency and physical plausibility.
- **Develop a comprehensive water budget** across all tools and physical domains and ensure all components are accounted for without duplication or omission, recognizing the risk of disconnects when linking models. With a complex assemblage of models, it is critical to evaluate the combined water budget to ensure that inconsistencies in linkage terms do not go undetected. For example, surface water model outputs used as recharge inputs to the groundwater model must align precisely, particularly during model calibration, to avoid discrepancies in groundwater recharge estimates.
- **Evaluate flow components holistically**, including deep infiltration of precipitation and applied water (DIPAW), managed aquifer recharge, mountain-front recharge, streambed infiltration, basin boundary flows, and ET. We will correlate the changes in groundwater storage with precipitation, applied water, and groundwater pumping to understand the system. Change in vadose zone storage will be similarly assessed to understand lag times associated with flow through vadose zone. Aquifer properties (horizontal and vertical conductivity, and storage) will also be reviewed.
- **Compare 2025 model outputs with prior evaluations,** and investigate reasons for the ~14,000 AFY decrease in Safe Yield estimates, assessing their technical defensibility. Spatial and temporal patterns of changes will be evaluated including, but not limited to, DIPAW, vadose and groundwater storage changes, stream-aquifer interactions, basin boundary inflows/outflows, and ET.

We assume access to all model files and documentation, including R4, and will request developer support for the R4 model where necessary. To meet the project schedule, our team members will coordinate to perform Task 2 in parallel.

Task 3 – Review elements relating to the CVM model calibration and determination of storage levels in the basin

We will evaluate the model calibration methodology to determine whether a range of calibration targets was appropriately considered during history matching. Specifically, we will assess model performance in simulating groundwater heads and streamflows and how the calibration process was used to constrain the water budgets. The vadose zone may not have observed values to constrain water budgets and therefore a qualitative assessment will be performed for changes in saturation with depth and through time. Equally important is to assess whether aquifer properties and vadose zone parameters remained within physically meaningful ranges throughout the calibration process. Ensuring that model parameters reflect actual hydrogeologic conditions, not simply numerical artifacts to accommodate model error, is essential to support reliable predictive use.

A key part of this task will involve reviewing the calibrated model's ability to simulate changes in groundwater levels, which in turn indicates whether storage properties have been appropriately parameterized. Special emphasis will be placed on storage-related parameters, as one of the stated purposes of the model is to confirm the total storage capacity of the Chino Basin.

We will evaluate whether model calibration minimizes the risk of compensating for structural or data limitations through overfitting. Overfitted parameters may improve history matching but lack physical meaning and can result in misleading predictions. Our review will emphasize the importance of multiple lines of evidence during calibration, ensuring that the model can produce credible water budget estimates and serve as a reliable tool for future decision-making.

We will analyze the spatial and temporal distribution of groundwater head residuals to determine whether there is any bias in the model. Special attention will be given to model performance near the basin boundaries, where boundary conditions often exert disproportionate influence and may introduce error. A series of reality checks will be conducted to evaluate how well the model performs in these edge regions.

Our team will also assess the use of the Iterative Ensemble Smoother (IES) in the uncertainty analysis. We will review how uncertainty analysis was incorporated into the calibration framework; whether the selected realization (e.g., one close to the ensemble mean) exhibits both strong calibration and reasonable parameter and boundary condition values; and, whether traditional gradient-based calibration techniques could further improve model performance.

Given the connected nature of the Chino Basin, careful model calibration is critical for reasonably estimating Safe Yield. This task will ensure that the CVM has been calibrated in a scientifically sound and defensible manner that supports both current evaluation needs and future planning.

Task 4 – Other Issues Relevant to the Calculation of Net Recharge

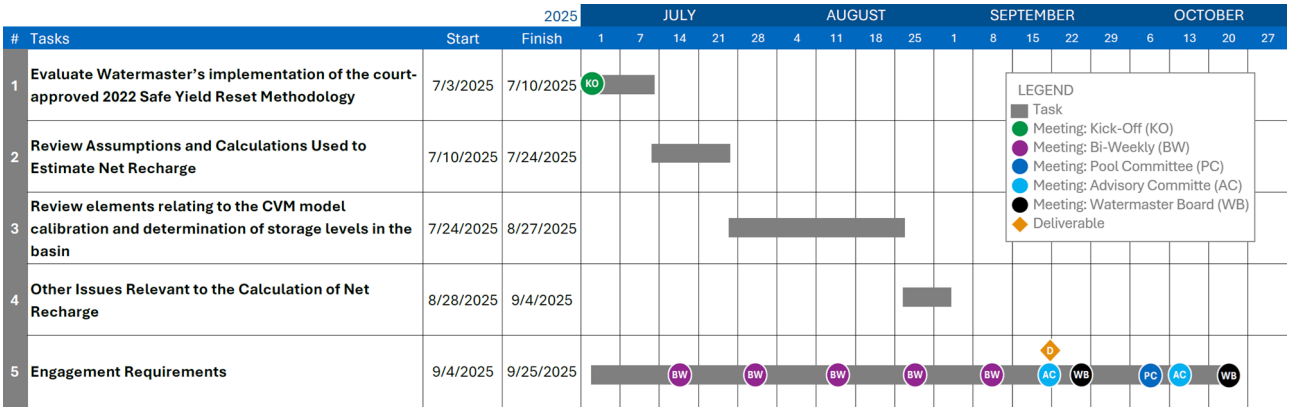
We recognize that relevant technical issues may fall outside the predefined tasks. As we review model assumptions, methodologies, and calibration outputs, we will identify and document any additional factors with potential to impact Net Recharge estimates, such as limitations or assumptions in coupling model components, use of model multipliers that may compromise internal consistency, and opportunities to strengthen the predictive use of CVM by refining how uncertainty is applied.

We aim to collaborate with Watermaster staff and their consultants throughout the review, potentially integrating improvements as they are identified to ensure an efficient and iterative process.

The deliverable for Tasks 1- 4 will be a comprehensive report summarizing findings, limitations, and recommendations.

Task 5 – Engagement Requirements

The schedule below reflects the anticipated project schedule by task, including meetings and deliverables.



SSP&A will maintain an active and transparent line of communication with Watermaster staff and other consultants:

- We will participate in **biweekly meetings** to provide progress updates and discuss technical issues.
- A **presentation of findings** will be delivered to the Advisory Committee on September 18, 2025.
- The **final Peer Review report** will be submitted and presented to the Watermaster Board on September 25, 2025.
- We will also participate in all October Pool Committee, Advisory Committee, and Board meetings, either in person or virtually.

Our team is committed to making this engagement collaborative, data-driven, and solution-oriented. The peer review process will be framed by professional rigor and built on our experience with similar large-scale groundwater model evaluations across the country.

Section 3.
Cost Estimate

The total cost estimate for the project, including materials, labor, software, and travel is $95,628. Details of the cost breakdown are provided below.

		Billing Classification	Principal Hydrogeologist		Principal Hydrologist		Associate Engineer		Senior Project Scientist		Principal Engineer		Senior Project Engineer		Senior Hydrogeologist		
		Hourly Rate	$376		$376		$269		$216		$345		$325		$270		
Task	Description		Matthew Tonkin		Christian Langevin		Vivek Bedekar		Michael Ou		John Riverson, Jr.		Khalid Alvi		Eros Bilyeu		Total Cost
			Hours	Total	Hours	Total	Hours	Total	Hours	Total	Hours	Total	Hours	Total	Hours	Total	
1	Evaluate Watermaster's implementation of the court-approved 2022 Safe Yield Reset Methodology		0	$0	8	$3,008	24	$6,456	0	$0	0	$0	0	$0	0	$0	**$9,464**
2	Review Assumptions and Calculations Used to Estimate Net Recharge		8	$3,008	16	$6,016	24	$6,456	16	$3,456	16	$5,520	16	$5,200	0	$0	**$29,656**
3	Review elements relating to the CVM model calibration and determination of storage levels in the basin		8	$3,008	24	$9,024	56	$15,064	40	$8,640	0	$0	0	$0	16	$4,320	**$40,056**
4	Other Issues Relevant to the Calculation of Net Recharge		0	$0	8	$3,008	16	$4,304	0	$0	0	$0	0	$0	0	$0	**$7,312**
5	Engagement Requirements		0	$0	10	$3,760	20	$5,380	0	$0	0	$0	0	$0	0	$0	**$9,140**
			16	$6,016	66	$24,816	140	$37,660	56	$12,096	16	$5,520	16	$5,200	16	$4,320	**$95,628**

Appendix A.
Relevant Project Descriptions

Third-party Review of GULF and GMA 14 Models

Lone Star Groundwater Conservation District, Conroe, Texas

REFERENCE: Sarah Kouba, General Manager, Lone Star Groundwater Conservation District, (936) 494-3436, skouba@lonestargcd.org; TEAM: Vivek Bedekar, Michael Ou (SSP&A)

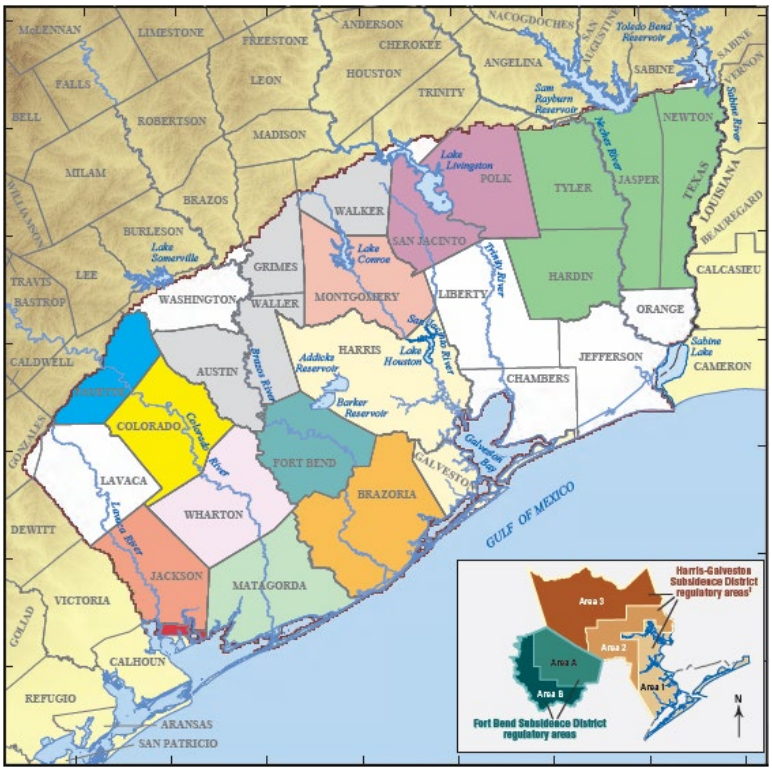


Figure shows land subsidence and groundwater conservation districts within the Gulf Coast aquifer system study area in southeast Texas. SOURCE: Ellis et al, 2023

SSP&A was selected by the Lone Star Groundwater Conservation District (GCD) of Texas to provide a third-party review of a groundwater model that is being developed for the Groundwater Management Area (GMA) 14 for joint planning purposes. GMA 14 partially or fully includes five GCDs and two subsidence districts.

A groundwater model (GULF Model) was developed by the U.S. Geological Survey (USGS) to simulate groundwater conditions and subsidence in the Gulf Coast Aquifer System. Subsidence has been recorded due to increased groundwater pumping, predominantly in Montgomery, Harris, Fort Bend, and other neighboring counties. The USGS model is being revised by a consultant team comprised of Advanced Groundwater Solutions, LLC (AGS) and KT Groundwater (GMA14 Model), who were retained by the Lone Star GCD.

SSP&A's role is to review the GULF Model and subsequently review the GMA14 Model to evaluate the changes made in the GMA 14 Model, and identify limitations in both models, if any. SSP&A staff have summarized their findings related to the groundwater model calibration, and particularly the compaction and subsidence aspects of the model in a report. The report was submitted to Lone Star GCD and to the Texas Water Development Board (TWBD) at the end of March 2025.

Goleta Groundwater Basin – Water Resources Modeling and Expert Testimony

Confidential Client, Goleta, California

REFERENCE: Carl L. Blumenstein, Attorney at Law, NOSSAMAN LLP, (415) 438-7219; TEAM: Matthew Tonkin, Vivek Bedekar, Michael Ou (SSP&A)

SSP&A was retained to provide subject matter expert services for the second phase of a bifurcated case to evaluate and revise a previously-developed conceptual flow model (CSM). Initially, Dr. Matthew Tonkin acted as a Phase 2 responsive expert to review, execute, modify, and opine on Defendant's models.

Documents received, reviewed, and opined upon included groundwater models constructed using MODFLOW-2000/SURFACT; integrated hydrologic models constructed using ParFlow-CLM; and land surface models constructed using DPWM. Dr. Tonkin reviewed, executed, and re-calibrated various versions of these models and provided opinion on the CSM and hydrogeologic structure, including the coastal alluvial basin and underlying / surrounding consolidated tertiary sedimentary rocks subject to vertical and lateral fault displacement. He reviewed groundwater level and streamflow data and undertook streamflow separation to understand groundwater/surface-water interaction.

As the project progressed, Dr. Tonkin reviewed and responded to new groundwater level, streamflow, pumping, climate, aquifer test, and rock core data; and reviewed, executed, and re-calibrated new versions of the MODFLOW-SURFACT, ParFlow-CLM, and DPWM models in addition to other LSMs constructed using the USDA HYDRUS code, USGS SWB code, USGS INFIL3.0 simulation code, and USGS PRMS code.

Subsequently, all Phase 1 work (which Dr. Tonkin had not previously been engaged in) and Phase 2 work was revisited to prepare for a new judge and new Phase 1 and Phase 2 deposition and trial testimony.

Dr. Tonkin was retained as an affirmative and responsive expert, along with Dr. Vivek Bedekar to as a responsive expert to complete assessments that included: (a) re-calibration and application of the various groundwater and LSMs; (b) independent evaluation of the sources and rates of recharge via aerial infiltration and also from three primary mountain-front recharge processes – stream leakage, alluvial canyon flows, and bedrock underflow; and (c) use of these assessments to evaluate the resiliency of the alluvial basin to changes in recharge.

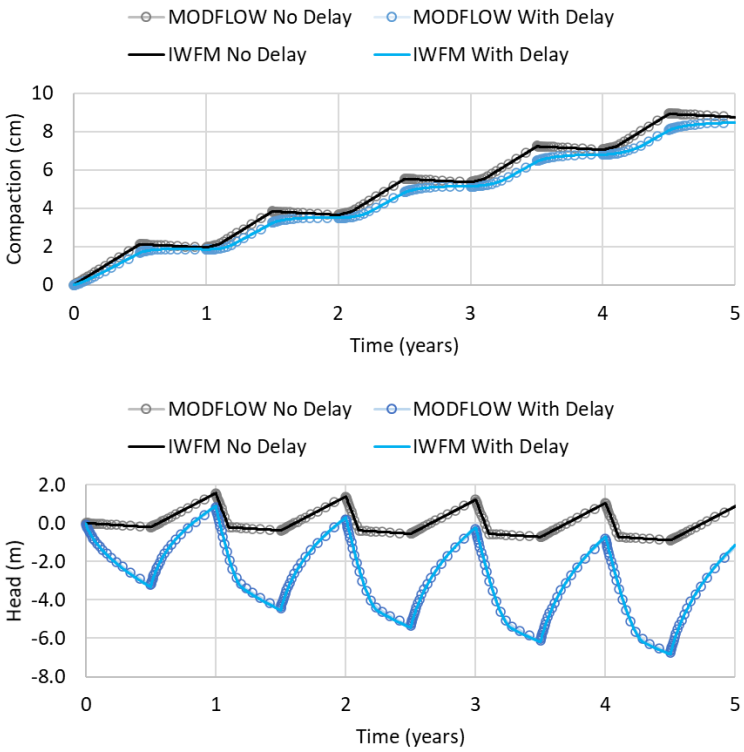
At the completion of the Phase 2 work, Dr. Tonkin authored a comprehensive affirmative Phase 1 expert report that detailed the regional and local hydrogeology, sources and rates of recharge, and long-term sustainability of groundwater resources with particular emphasis on the consolidated bedrock units. Estimation of transient net groundwater recharge in response to climate conditions was a major component of this work, which included:

- Evaluation and revisions to CSM and multiple models built on that CSM.
- Evaluation of multiple data types critical to estimation of groundwater recharge.
- Preparation of detailed expert reports.
- Testimony at deposition and preparation for trial testimony.

Central Valley Integrated Water Flow Model Modification, Calibration, and Finite Element Modeling Services

California Department of Water Resources, Sacramento

REFERENCE: Christopher Bonds, PG, CHg, Senior Engineering Geologist (Specialist), SVSim Project Manager, California Department of Water Resources, (916) 586-5428, chris.bonds@water.ca.gov; TEAM: Vivek Bedekar, Matthew Tonkin (SSP&A)



MODFLOW and IWFM models simulated using with-delay formulation. Compaction is not impacted as much as head change, and head change is much pronounced with delayed subsidence.

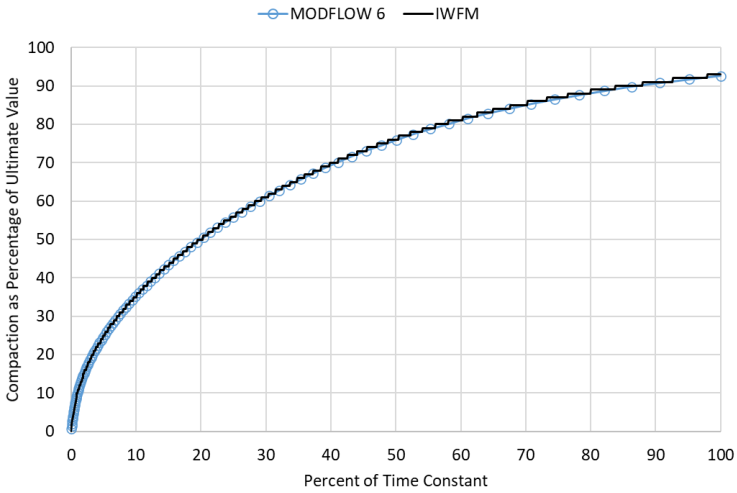
SSP&A has worked on several Central Valley modeling projects for more than 12 years using coarse- and fine-gridded Central Valley models, and the Sacramento Valley Model.

SSP&A has completed several projects in collaboration with the California Department of Water Resources (DWR) simulating groundwater conditions within the Central Valley. Initially, SSP&A acted as a technical consultant to the Sacramento Office of the DWR from 2005 to 2008 implementing the modification, calibration and development of a finite-element model of the Central Valley, that was developed using the Integrated Groundwater and Surface-water Model (IGSM2) simulation platform. The work was completed together with CH2M Hill, Oakland Office. In this role, SSP&A completed a range of tasks including the development of calibration tools to calibrate the Central Valley IGSM2 (CVGSM2) and later with the finite element Integrated Water Flow Model (IWFM - formerly IGSM/IGSM2) codes, review of USGS and DWR models and reports, tool development for PEST support, and co-production of a report to the DWR outlining a stepwise calibration strategy for the CVGSM2 application.

This project laid an initial foundation for the linkage of PEST with the IWFM simulator for calibration, sensitivity, and uncertainty analysis purposes. SSP&A subsequently teamed with Woodard and Curran under contract to DWR to continue the calibration of the coarse-grid (CG) version of the updated CVGSM2 application referred to as the C2VSIM model; calibration of the fine-grid (C2VSim-FG) version of the model; and the development and calibration of the Sacramento Valley Simulation Model (SVSim).

SVSim was developed and calibrated to simulate the surface water – groundwater conditions and interaction within the Sacramento Valley in California. The calibration used a holistic approach, taking into account basin-wide integrated water budgets and then calibrating individual components of flow in the integrated system including root zone, groundwater, and streamflow. SVSim was developed using DWR's IWFM flow simulator with the primary objective of estimating stream depletion associated with groundwater pumping.

In addition to traditional calibration methods evaluating model-wide and subregional water budgets, groundwater levels, and streamflow, SSP&A developed and implemented several innovative methods. Groundwater data were synthesized identifying temporal trends in groundwater head data using cluster analysis. The identified long-term and seasonal water level trends were utilized to effectively calibrate the central valley models. Sediment texture-based groundwater parameters were calculated by developing a textural analysis code called Texture2Par. SSP&A leveraged their PEST.cloud computing platform by adopting it for use with DWR's cloud computing infrastructure. This enabled the use for DWR's computing resources together with a version of PEST, PESTPP, and PEST_HP, optimized for use in highly parallelized environments.



IWFM matches MODFLOW results. The analytical solution is not calculated but MODFLOW documentation shows the same results.

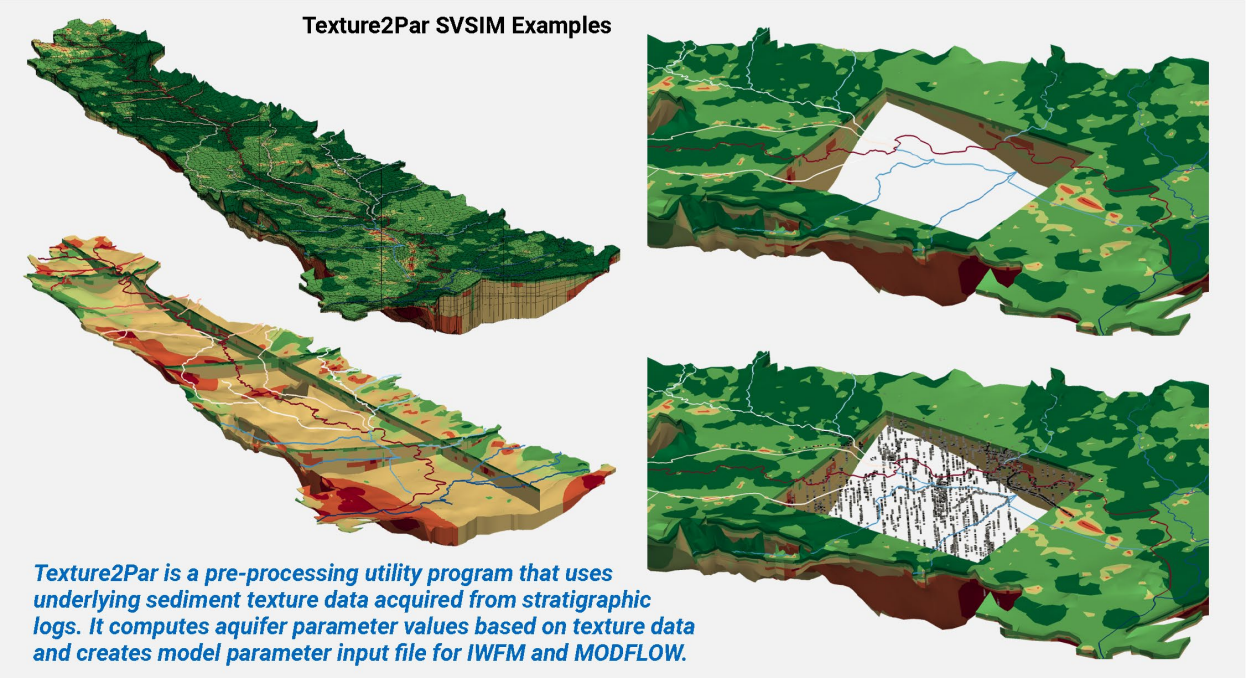
DWR's Bay Delta Office also retained SSP&A to develop numerical code to incorporate delayed subsidence effects within DWR's IWFM flow simulator. The code changes account for delayed effect of pumping on storage change within clay interbeds that results in land subsidence, an improvement from the previous version that assumed an instantaneous change in storage. Other contributions to the IWFM code by SSP&A include the incorporation of variable wetted perimeter and dynamic connection to groundwater (GW) over wide stream reaches such as flow bypasses that are wide section of streams connected to multiple groundwater nodes. These changes were released as part of the IWFM code.

To facilitate detailed review, post-processing and visualization of three-dimensional models developed in a range of simulation codes, SSP&A has developed and released GroundWater Desktop (GWD), a fully 3D interface to visualize groundwater models and their results. GWD can be used to visualize multiple models, and currently supports MODFLOW, MODPATH, MT3D, and the unstructured grid versions MODFLOW-USG and MODFLOW 6. GWD was also expanded to incorporate models developed using the finite-element IWFM simulation code, enabling IWFM-based models to be examined using cross-sectional, cut-away and layer "exploded" views.

Aquifer Parameter Tool (Texture2Par) Development

California Department of Water Resources, Central Valley

REFERENCE: Katherine Dlubac, Senior Engineering Geologist, (916) 902-7289, Katherine.Dlubac@water.ca.gov; TEAM: Matthew Tonkin, Vivek Bedekar, Michael Ou (SSP&A)



SSP&A collaborated with Woodard and Curran to develop the aquifer parameter tool, Texture2Par, for use with Integrated Water Flow Model (IWFM) and MODFLOW models in support of California Department of Water Resources' (DWR's) Central Valley and statewide modeling efforts.

Texture2Par facilitates the assignment of aquifer parameter values directly to IWFM and MODFLOW model input files on the basis of sediment texture data acquired from stratigraphic logs. Aquifer properties that can be ascribed using Texture2Par are:

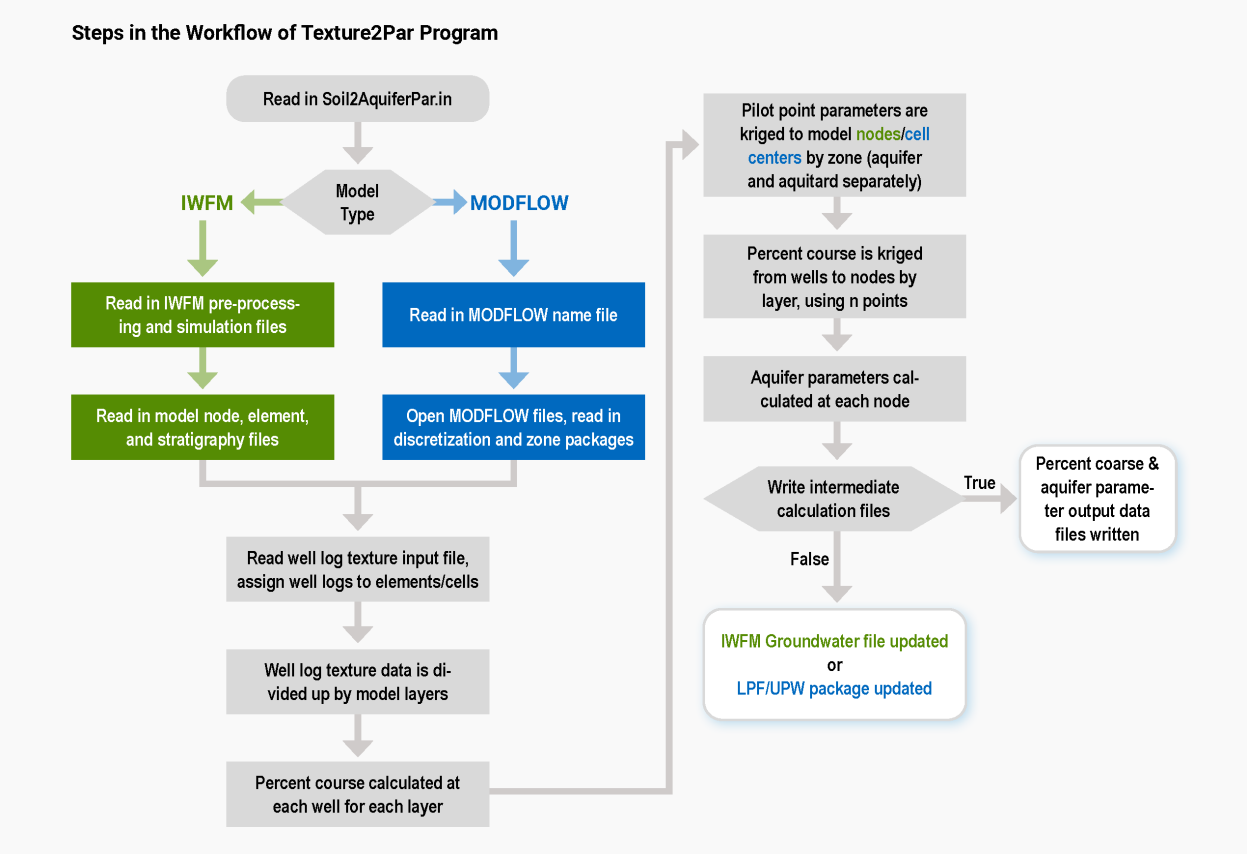
- Horizonal hydraulic conductivity
- Vertical hydraulic conductivity
- Specific yield
- Specific storage

Interbed clay thicknesses are also calculated for subsidence simulations.

Texture2Par uses estimates of soil coarseness derived from stratigraphic logs to infer values for aquifer properties using power-law averaging techniques. Decreases in hydraulic conductivity with increasing depth resulting from compaction can also be accommodated with Texture2Par.

In the first release of Texture2Par, spatially distributed aquifer properties are computed based on the model discretization; values for each aquifer property corresponding to end-member coarse and fine material types; and values for the percentage of coarse material at boring locations.

Only a small number of inputs is required to generate spatially distributed, potentially heterogeneous, parameterization of the model based on texture data, enabling Texture2Par to be integrated into a parsimonious calibration (parameter estimation) workflow that uses sediment texture data. To accommodate areas of differing cementation, compaction, or sorting that leads to varying texture properties, Texture2Par incorporates pilot points enabling the values for aquifer parameters associated with purely coarse or fine textures (and fractions between) to vary in space.



Pilot points can be grouped with specific model nodes or cells to form distinct geological zones that exhibit different relationships between texture and aquifer properties. Example applications of Texture2Par include SVSim, C2VSim-FG developed using IWFM, and Arizona DWR's Phoenix AMA Model developed using MODFLOW-NWT.

Texture2Par Highlights

Texture2Par

SSP&A and Woodard and Curran are currently working with DWR to develop methods, tools, documentation, and case studies for formally integrating Airborne Electro-Magnetic (AEM) data into both (a) development of hydrogeologic conceptual models (HCMs) and (b) parameterization and calibration of groundwater models.

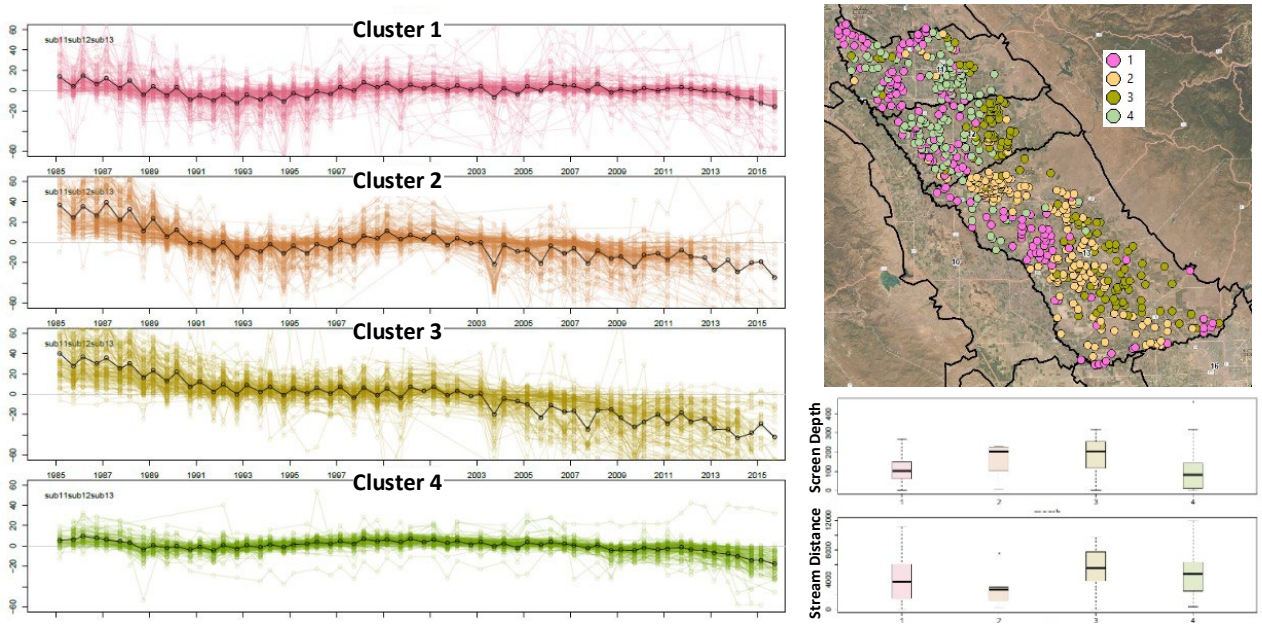
The development of HCMs and aquifer parameterization is instrumental in understanding the hydrogeologic systems that are being evaluated.

The first two phases of the project – literature review and method testing and development – were completed in December 2022. The project is anticipated to enhance the capabilities of Texture2Par and companion tools for HCM analysis by incorporating state-wide AEM data collected through recent geophysical surveys, thereby improving understanding of the geological and hydrogeologic structure of priority basins which are focus areas for water-resource modeling efforts.

Central Valley Hydrograph Cluster Analysis

California Department of Water Resources, Central Valley

LOCATION: Central Valley, California; REFERENCE: Chris Bonds, Senior Engineering Geologist, California Department of Water Resources, 916-376-9657, Chris.Bonds@water.ca.gov; TEAM: Matt O'Connell, Vivek Bedekar, Matthew Tonkin (SSP&A)



Cluster analysis of water level data to identify 'type-hydrographs' across a large basin. The figure shows four hydrograph clusters and the associated type-hydrographs. Physical characteristics of the wells were not used to calculate clusters, but statistical analysis shows that wells within clusters display similar spatial locations, well depth, and proximity to streams.

Large-scale regional groundwater models, such as the Sacramento Valley and the Central Valley Models in California (SVSim and C2VSimFG) encompass extensive datasets with thousands of hydrographs. Each hydrograph reflects both regional stresses and localized hydrological processes, making it challenging to discern dominant trends essential for accurate model calibration. Traditional calibration methods often struggle to isolate these trends due to the "noise" introduced by local variations and short-term perturbations.

SSP&A have developed a hydrograph pattern identification procedure utilizing fuzzy cluster analysis to address these challenges. This approach involves (1) Correlation Analysis to compute correlation coefficients between hydrographs to construct a comprehensive correlation matrix, (2) Clustering to apply unsupervised fuzzy c-means clustering (FCM) to group observation wells with similar functional responses into clusters

based on similar temporal trends, (3) Type-Hydrograph Development to create representative 'type-hydrographs' for each cluster, which encapsulate the dominant observed temporal patterns, and (4) Calibration to use these type-hydrographs as calibration targets, thereby focusing on dominant hydrologic processes rather than individual hydrographs.

In the California Central Valley, this methodology effectively condensed data from 12,204 well hydrographs into 45 representative type-hydrographs, streamlining the calibration process for aquifer storage parameters and boundary conditions that affect temporal trends.

Monterey Peninsula Water Supply Project

California Marine Sanctuary Foundation, Monterey, California

REFERENCE: Bill McIlvride, Senior Project Hydrogeologist, Weiss Associates, (510) 450-6000, WAM@weiss.com; TEAM: Vivek Bedekar, Matthew Tonkin (SSP&A)

SSP&A was selected by Weiss Associates to conduct an independent hydrogeologic review of data, studies, and models related to the California American Water's (Cal-Am) proposed Monterey Peninsula Water Supply Project (MPWSP). The MPWSP was expected to capture predominantly seawater from a planned well field near the Monterey Bay shoreline in the City of Marina, California.

The primary objective of the project was to calculate ocean water percentage (OWP) captured by the well field of the MPWSP. The effects of potential and actual hydraulic gradients on OWP and the possible project modifications to mitigate and reduce potential effects of pumping were assessed. The project involved the calculation of freshwater captured by slant wells proposed for a desalination plant. The desalination plant would incur penalties for any freshwater captured by the withdrawal wells.

An existing flow model was utilized, and boundary conditions and parameters were modified to perform sensitivity analysis and meet the project objectives. The conceptual site model was also reassessed to more accurately represent the aquifer formations and its impact on groundwater flow and the resulting OWP captured by the slant wells. The methodology used in the previous versions of the models included particle tracking to assess flow paths from the ocean boundary to calculate OWP, which was an approximate calculation. The methodology was improved by incorporating a solute transport code MT3D to identify the source of water and to quantify the amount of saltwater captured by the pumping wells.

Produced Water Analysis

Confidential Client, California

TEAM: Matthew Tonkin, Vivek Bedekar (SSP&A)

SSP&A was retained by a national drilling and energy development company to provide an expert-level assessment of the actual historical, and potential future, impacts from the disposal of produced water to both surface impoundments and to subsurface injection wells.

Initially, SSP&A developed detailed water budgets for the historical period of operation, and also documented the quality of the produced water from various well fields and following mixing in surface impoundments prior to disposal. Next, SSP&A developed a detailed 3D groundwater flow and constituent transport (F&T) model to

simulate the historic and future transport, extent, mixing, and fate of produced water in the subsurface. The analyses completed using this subregional-scale model – which was calibrated to 60 years of groundwater elevation and multi-constituent groundwater quality data – were supplemented by hydrogeologic conceptual model (HCM) development and documentation, evaluations of aquifer and gas producing horizons, review of available gas well information (including electric logs, mud logs, well completion reports, chemical analysis results, etc.), geochemical evaluation of laboratory results from multiple groundwater and gas phase sampling events, critical review of analytical laboratory methods and QA/QC procedures, and review of the field methods. In the modeling simulations, it was assumed that – consistent with available field data – any oil and gas present in the upper producing zones through to the unconfined upper aquifer were at residual levels and therefore need not be explicitly simulated.

As the project evolved it became clear that three important aspects of the analyses required particular attention – first, the role of long-screen cross-connecting wells on communication between different aquifer and producing zones, and the role of well integrity and compromise on this vertical connectivity; second, the role of the disposed water (brine) density and its changes over the development history of the producing zone; and third, the heterogeneity of the aquifer and producing zones as represented by sediment texture ("net-to-gross") data obtained at very high vertical frequency from hundreds of borings. To incorporate these characteristics, SSP&A (a) implanted the MODFLOW/MT3D Multi-Node-Well (MNW) and MODFLOW-6 Multi-Aquifer-Well (MAW) packages to represent wells as continuous connected sinks/sources; (b) explicitly modeled the density of the various fluids using SEAWAT and the Variable Density formulation of MODFLOW-6; and (c) incorporated use of the Texture-to-Parameter (Texture2Par or "T2P") program developed separately by SSP&A for the California Department of Water Resources (DWR). T2P provides the ability to incorporate fine-scale texture data in the definition of aquifer conductivity, storage, and compressibility parameters as part of the non-linear model calibration process.

To further analyze the combined relative effects of density, well design, and heterogeneity on pressure development, well integrity, and lateral versus vertical migration, SSP&A developed very detailed but computationally efficient radially-symmetric simulations for a number of high-priority wells. Deliverables from the project were used to understand the relative importance of a wide range of factors on historical migration patterns leading to the present-day extents; project potential future impacts; and, to evaluate the feasibility of a wide range of potential mitigating actions.

Software Development: Contributions to MODFLOW and IWFM

S.S. Papadopulos & Associates in collaboration with U.S. Geological Survey, California Department of Water Resources, and GSI Environmental

TEAM: Matthew Tonkin, Christian Langevin, Vivek Bedekar (SSP&A)

SSP&A has made important contributions to the MODFLOW family of simulators over the past 45 years. Our founders helped shape the precursor to MODFLOW, laying foundational concepts in groundwater modeling.

Before MODFLOW-NWT, SSP&A implemented Newton-Raphson capabilities in MODFLOW for solution stability. We collaborate with Dr. Sorab Panday by contributing to the development of MODFLOW-USG, and continue our leadership as part of the core development team for MODFLOW 6. SSP&A also collaborated with Dr. Can Dogrul (DWR) in the development of delayed subsidence in IWFM.

Calibration and Uncertainty Analysis

SSP&A performs model calibration and uncertainty analysis on models developed internally and by others, offering clients enhanced confidence in model predictions and decision-making.

We have collaborated with Dr. John Doherty (developer of PEST), the USGS, U.S. Nuclear Regulatory Commission (NRC), Pacific Northwest National Laboratory (PNNL), and others in the development of novel methods. These collaborations include development of course materials and co-instructing professional courses.

PEST.cloud

In collaboration with Dr. Doherty, SSP&A developed a web-based cloud tool for model calibration using PEST on Microsoft Azure to streamline compute node setup, file distribution, and run monitoring, with easy result packaging and downloads.

Contributions to PEST/PEST++ and Associated Capabilities

Under a USGS contract, SSP&A served as the prime contractor and co-developer of PEST++ and related tools for inverse modeling on distributed computer networks. SSP&A developed two key components: GENIE, a model-independent parallel run manager to manage model runs across networks using multithreaded message-passing; and PESTCommander, a graphical user interface (GUI) to simplify model file management across diverse computing environments including Cloud-based systems.

Linear Predictive Analysis of Models (OPR-PPR)

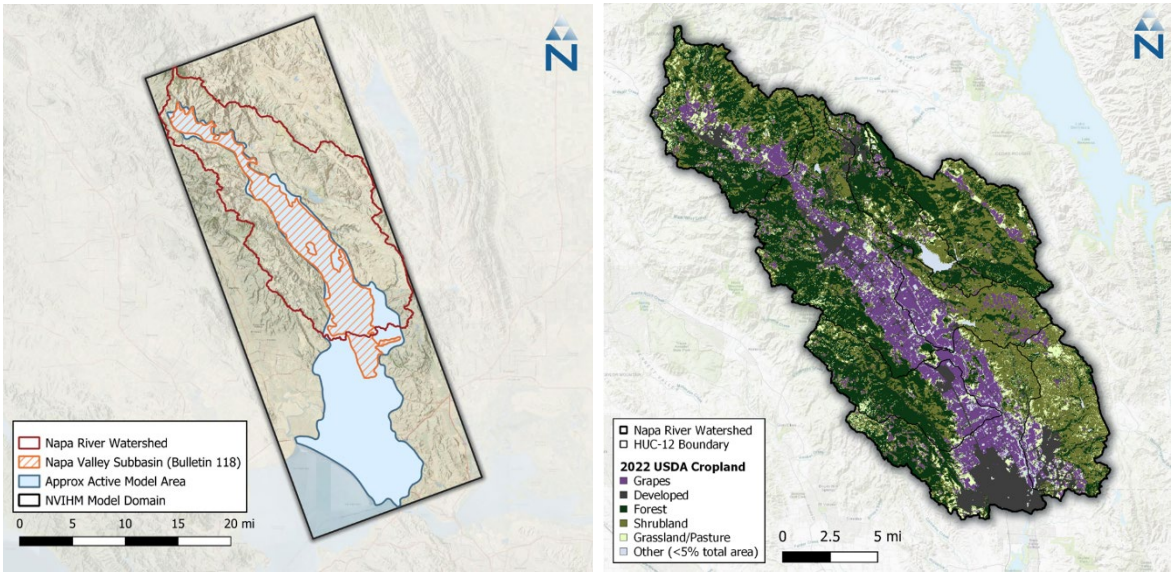
SSP&A developed the OPR-PPR program for the USGS to evaluate how different data types influence predictive uncertainty. OPR-PPR helps prioritize data collection by assessing the value of observations and other independent information. The program was published in a 2007 USGS report, and SSP&A has provided training on its use alongside Dr. Mary Hill.

Supply and Demand Assessment Hydrology Modeling,

State Water Resources Control Board

TEAM: Khalid Alvi, John Riverson, Jr. (Paradigm), Vivek Bedekar, Annette Hein, Jack Wang, Michael Ou (SSP&A)

In April 2021, Governor Gavin Newsom issued a state of emergency proclamation for specific watersheds across California in response to exceptionally dry conditions throughout the state. This proclamation, as well as subsequent proclamations, directed the Board to address these emergency conditions to ensure adequate, minimal water supplies for critical purposes. To support the Water Board's actions in addressing emergency conditions, hydrologic modeling and analysis tools are being developed to contribute to a comprehensive decision support system that assesses water supply and demand, as well as the flow needs for watersheds throughout California.



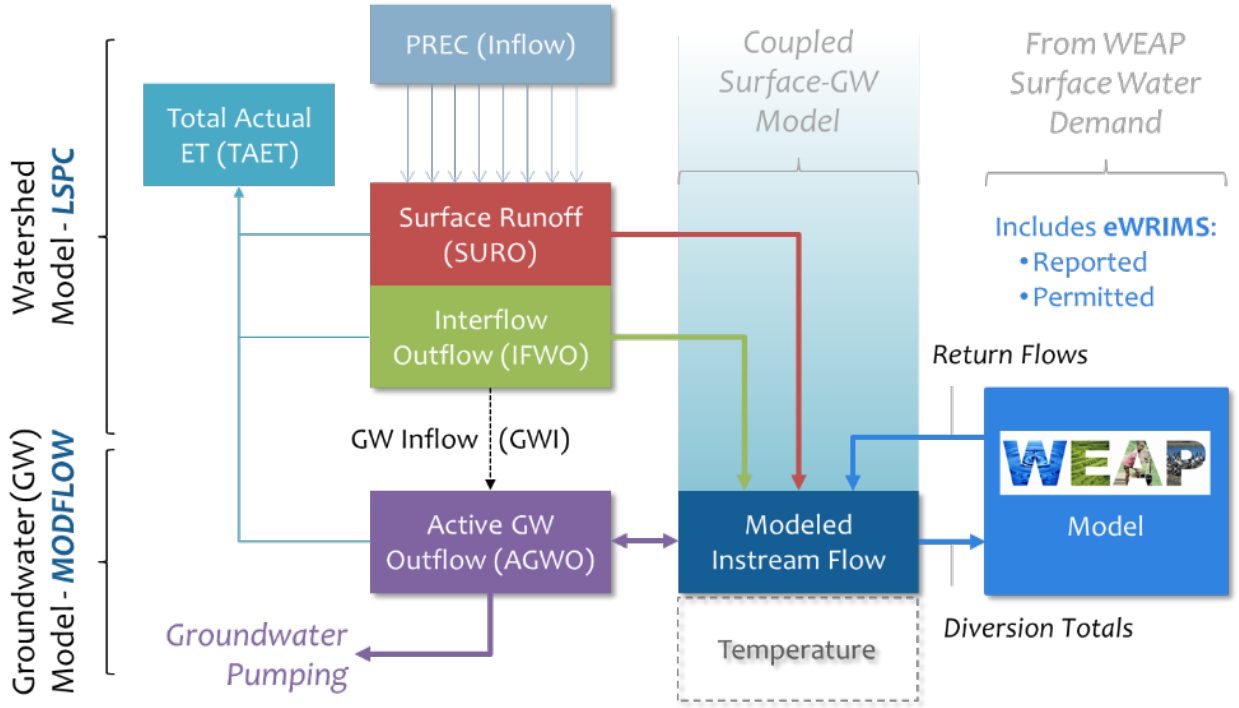
In conjunction with SSP&A, Paradigm is supporting the SWRCB with hydrologic modeling of multiple watersheds across the state, incorporating representation of surface water and groundwater withdrawals. The model development process is data-intensive, sourcing geospatial data sets from various local, state, and national sources. The team is currently developing work plans, calibrated models, and modeling reports for 18 different watersheds across the state using the Loading Simulation Program C++ (LSPC) watershed model, which is linked to MODFLOW models in specific watersheds when necessary to represent more complex groundwater interactions.

The watershed models leverage the foundation of the underlying Hydrologic Simulation Program FORTRAN model, combined with a modernized relational database framework within LSPC, which enables the construction of large-scale systems within a single model. The data frameworks are built using the latest national and local data sets to develop climate forcing inputs for precipitation and evapotranspiration. Hydrologic response units are constructed using the National Land Cover Database (NLCD), soil survey, and digital elevation models published by federal agencies. The United States Department of Agriculture's (USDA) Crop Data Layer (CDL) is used to override national land cover categories to represent crop types better. In some cases, locally available data is even used to represent crop distributions. This is especially important in heavily managed watersheds like the Napa River, where irrigation withdrawals can have a significant impact on low flows in both the mainstem and smaller tributaries. The LSPC processes for irrigation leverage the fundamental hydrology modules and inputs from HSPF but have been designed and coded by the Paradigm team to support the scale of the LSPC model applications and offer added flexibility to support future scenario development.

Hydrology Modeling Services for Instream Flow Assessment

State Water Resources Control Board

TEAM: Khalid Alvi, John Riverson, Jr. (Paradigm), Vivek Bedekar, Michael Ou, Kathy Mihm (SSP&A)



Paradigm is supporting the State Board, through collaboration with the California Department of Fish and Wildlife and the North Coast Regional Board, in developing hydrologic and temperature characterization models for the South Fork Eel River and Shasta River watersheds.

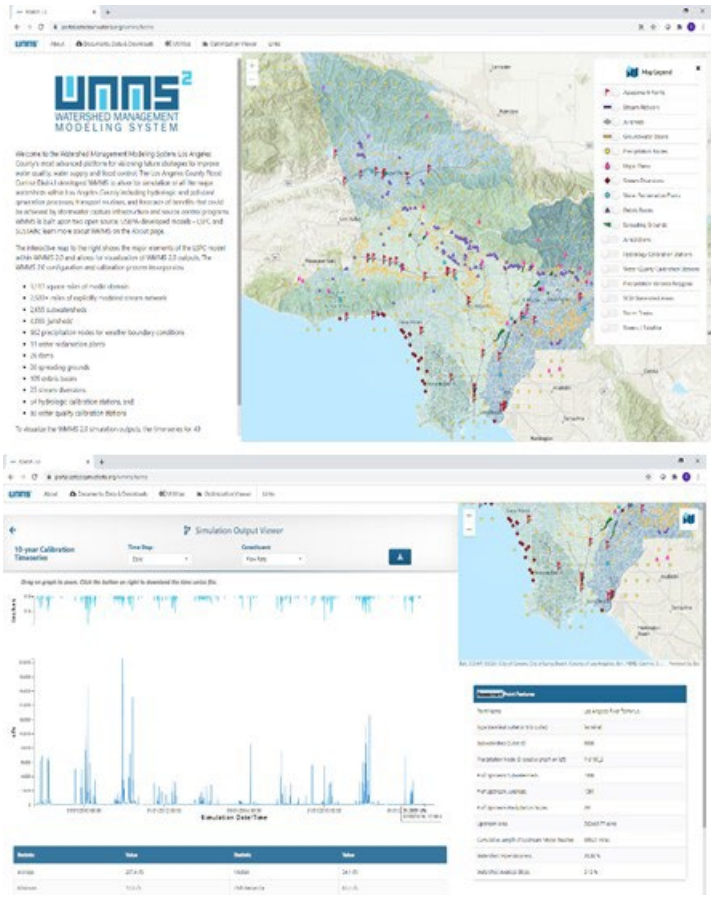
The purpose of these models is to support the implementation of the California Water Action Plan and perform hydrologic studies to fully understand the linkages of water use, surface and groundwater, and instream flows and temperatures that vary spatially and temporally throughout the watersheds. The hydrology models provide a basis for assessments of benefits and impacts of potential watershed management actions on fish habitat, existing water users, and other beneficial uses.

Working with SSP&A, Paradigm has developed integrated surface-groundwater interaction models, based on linked LSPC and MODFLOW models, for both the South Fork Eel River and Shasta River watersheds. The models incorporate several high-resolution spatial and temporal datasets and are being configured to facilitate evaluations of complex water management scenarios. The models are being calibrated against long-term USGS streamflow data and, when available, recently collected critical low-flow measurements from key small tributaries. The South Fork Eel LSPC model development effort has successfully coupled outputs from a MODFLOW model, more explicitly representing groundwater processes unique to the watershed, with boundary conditions developed through SEI's WEAP modeling efforts to define water use demands. Paradigm is currently planning for a similar linkage of the Shasta River LSPC model to a groundwater model under development by a key stakeholder, Siskiyou County. Paradigm is also developing techniques for utilizing flow

predictions from the hydrologic models to link to methods and models for estimating stream temperatures in each watershed.

Watershed Management Modeling System (WMMS) 2.0

Los Angeles County



WMMS 2.0 Web-Based Interface and Tools to View the Model and Output.

TEAM: Khalid Alvi, John Riverson, Jr. (Paradigm)

In 2009, the Los Angeles County Flood Control District (LACFCD) partnered with USEPA Region 9 to compile the various TMDL models (described above) into a countywide modeling system to support watershed planning and TMDL implementation.

Led by Steve Carter and John Riverson, this Watershed Management Modeling System (WMMS) converted all existing HSPF/LSPC models to a consistent version of LSPC, and included a wealth of new or improved methods for representing hydrologic controls (e.g., diversions), meteorological inputs, subwatershed delineations, land characteristics, and irrigation practices within each watershed. WMMS resulted in the modeling of all coastal watersheds in Los Angeles County, representing 12,000 km^2, 2,655 subwatersheds, and 941 streams/rivers. In 2012, LACFCD released WMMS to the public for use in watershed planning and hydrologic analyses for all of Los Angeles County.

In 2020, Paradigm supported the LACFCD in the update of WMMS 2.0 to provide a next-generation version of the modeling system that incorporates recent and best-available data, improves model performance, promotes transparency through comprehensive documentation and peer review, engages stakeholders, and provides a user-interface and tools that will allow agencies to more-readily access and leverage WMMS for hydrologic and water quality analyses and visualize model results. As the original developers of LSPC for the USEPA, Paradigm staff were able to leverage the latest version of LSPC and perform strategic code modifications and tailor the model to address the needs of WMMS 2.0 (this latest LSPC version is also being used to support State Board hydrologic modeling services)

Paradigm first performed an extensive review and analysis of spatial data representing various land characteristics within each watershed, and developed Hydrologic Responses Units (HRUs) that form the building blocks for hydrologic and water quality model parameterization. Paradigm also pioneered new

techniques for incorporating and processing meteorological data from multiple sources, including rainfall gages and other publicly available datasets (i.e., PRISM and NLDAS), to provide a comprehensive understanding of the spatial and temporal variation of historic rainfall and evapotranspiration that serve as model boundary conditions. The resulting LSPC model simulates hydrologic runoff, subsurface flows, and water quality for sediment, nutrients, and metals. Paradigm performed a comprehensive assessment of all available flow and water quality data, analysis of hydrologic and spatial trends, and processing of data for comparison with model-predicted flows and water quality to support model calibration. Paradigm provided all services for model documentation, engagement with stakeholders, and model training. Currently, Paradigm is supporting upgrades to WMMS 2.0 to provide simulation of future climate change scenarios, which includes hourly simulation of flows (present to 2100) for all watersheds using synthetic meteorological inputs based on downscaled global climate model projections.

To support WMMS 2.0 release, Paradigm developed a web-based viewer, model interface, and repository (https://portal.safecleanwaterla.org/wmms/home), which includes multiple tools to provide access to hydrologic model predictions, manage model workflow, and visualize model results. The viewer provides mapping tools that illustrate key features of the model and watersheds (e.g., streams, groundwater basins, diversions, dams), and allows users and non-modelers to click and access model-simulated hourly flows at numerous assessment points. The website also provides access to all model documentation, model files and data inputs, recordings of training sessions, and model user guides.

Agua Mansa Commerce Park (Former Riverside Cement Plant) Jurupa Valley, California Riverside Cement Plant

Varidian Partners

TEAM: Eros Bilyeu (Wood Rodgers)

Mr. Bilyeu served as Project Hydrogeologist for the redevelopment of the former Riverside Cement Plant property, a 277-acre site located at the boundary between the Chino Basin and Rialto-Colton Basin, an area known for complex hydrostratigraphy and significant modeling uncertainty in regional groundwater flow.

Under a California Land Reuse and Revitalization Act (CLRRA) agreement with DTSC, Mr. Bilyeu led hydrogeologic investigations and soil/groundwater characterization in support of grading design and remedial planning. He developed and implemented multiple site-wide sampling work plans, including detailed assessment of hexavalent chromium impacts in perched and semi-confined aquifers.

Fieldwork included trenching, deep borings, and a multi-depth well network across historically disturbed geologic units. Mr. Bilyeu characterized the Sky Blue and Chino Limestone formations, evaluated structural and stratigraphic controls on groundwater flow, and mapped the interface between cement kiln dust (CKD) deposits and native alluvium to support risk-based remedial design.

Findings informed grading and cut/fill operations exceeding 2 million cubic yards. Chromium exceedances in groundwater were evaluated in the context of aquifer recharge, oxidation conditions, and regional flow vectors. The project offered direct insight into boundary condition uncertainty, recharge underrepresentation, and lithologic heterogeneity, which are key issues relevant to the Chino Valley Groundwater Model.

Mr. Bilyeu also supported coordination with DTSC, SCAQMD, the EPA, and the Regional Water Quality Control Board, contributing to effective regulatory engagement and site closure strategy development.

Rialto Groundwater Investigation at the Kinder Morgan Facility

Kinder Morgan

TEAM: Eros Bilyeu (while with CH2M Hill, prior to joining Wood Rodgers)

This project is directly relevant to the Chino Basin Model Peer Review, particularly for tasks related to aquifer parameter assumptions, boundary condition sensitivity, and calibration challenges near the Chino-Rialto interface.

Mr. Bilyeu served as a field and project hydrogeologist for groundwater investigations at the Kinder Morgan Rialto Terminal, located along the Rialto-Colton fault boundary in the Upper Santa Ana Valley Groundwater Basin, adjacent to the Chino Basin. The project focused on evaluating aquifer behavior, vertical and lateral hydraulic gradients, and LNAPL presence in a historically industrial area with complex subsurface conditions.

Mr. Bilyeu supervised drilling, well construction, and hydrogeologic logging during the installation of multiple monitoring wells across perched, unconfined, and semi-confined alluvial aquifers. His work included detailed stratigraphic interpretation to distinguish between aquitards and water-bearing zones. He developed and applied qualitative lithologic mapping protocols based on USCS classifications and integrated them with geophysical resistivity logging to characterize lateral heterogeneity and porosity trends.

The project improved the conceptual understanding of subsurface conditions, specifically the shallow and regional groundwater aquifer interface, in a region where groundwater flow direction and aquifer connectivity have challenging to model. Mr. Bilyeu's work supported contaminant transport evaluation, plume stability assessment, and informed groundwater flow dynamics in the area.

Appendix B.
Resumes

- Matthew Tonkin, PhD
- Christian Langevin, PhD
- Vivek Bedekar, PhD, PE
- Michael Ou, PhD
- Eros Bilyeu, PG, CHG, QSD/QSP, CGWP (Wood Rodgers)
- John Riverson, Jr.
- Kalid Alvi, PE

Matthew J. Tonkin, Ph.D.

President and Principal Hydrogeologist

As President, Dr. Tonkin manages and provides technical review for many projects. He specializes in data synthesis and modeling to guide groundwater, surface water, soil and contamination studies, for public, private and legal clients. This includes planning sampling and monitoring programs; collaborating with other experts; developing and applying models; and presenting to stakeholders. He received his PhD on the topic of model calibration and uncertainty analysis under Dr. John Doherty and has instructed on these and other topics.

REPRESENTATIVE EXPERIENCE

S.S. Papadopulos & Associates, Inc.

WATER RESOURCE EVALUATIONS

California Department of Water Resources (CA-DWR): In collaboration with CH2M-Hill, created and modified programs to calibrate the IGSM2 code Central Valley application (CVGSM2) during its transition to the IWFM platform. Reviewed existing USGS and CA-DWR models and reports to support model re-structuring and re-parameterization. Re-defined aquifer parameters using pilot points; completed sensitivity analyses with the revised model to guide calibration; co-authored reports outlining a stepwise model development and calibration strategy.

California Department of Water Resources (CA-DWR): In collaboration with Woodward & Curran, developed conceptual and numerical modeling bases, calibration approach, and stream-depletion analysis methods, for three Central Valley models – the Sacramento Valley (SVSIM), and the coarse- and fine-grid full Central Valley applications (C2VSIM-CG and C2VSIM-FG). This included developing methods and tools to integrate sediment texture into model development and parameterization (Texture2Par); implementing time-series and correlative analysis for groundwater elevation and streamflow targets; leading calibration of the three models; and preparing methods of historical and predictive streamflow depletion analysis.

Confidential Client, California: Evaluated groundwater budgets, and the transport, extent, and mixing of produced water in the subsurface using a variety of time-series and geochemical analysis, geo-statistics, and deterministic modeling techniques.

Saline Incursion Management, Washington State: To evaluate the sustainability of a water resources that is subject to salinity incursion and upconing, participated in the development of a variable-density model, and led the design and implementation of a transient calibration strategy that included water levels and salinities. Used the calibrated model to estimate optimal pumping rates to meet drinking water criterion for chloride at existing and proposed production-well locations.

Spring-water Bottling Company Water Supply Study, Michigan: Evaluated possible impacts of groundwater pumping on surface water bodies including wetlands. Following calibration of a groundwater model to baseflow data, and steady state and transient water levels, designed a series of non-linear predictive error analyses to assess uncertainties in predicted depletions. Conducted similar analysis at several potential spring sources over several years.

YEARS OF EXPERIENCE

25+

EDUCATION

- **PhD**, Civil Engineering, University of Queensland, Australia, 2009
- **MSc**, Hydrogeology, University of Birmingham, UK, 1994
- **BSc**, Applied Geology, University of Birmingham, UK, 1993

EXAMPLE AREAS OF EXPERTISE

- Groundwater Remedy Design
- Groundwater Flow and Contaminant Transport Simulation
- Environmental Data Analysis and Interpretation
- Modeling Project Design and Management
- Water Resource Evaluations
- Model Calibration and Uncertainty Analysis

AWARDS AND HONORS

- Co-Inventor of U.S. Patent No. 10,371,860 (issued Aug. 6, 2019), entitled "*Simultaneous Multi-Event Universal Kriging Methods for Spatio-Temporal Data Analysis and Mapping*": 2019
- ITRC Industry Recognition Award (co-recipient) – MTBE and other Fuel Oxygenates Team: 2005
- NGWA Outstanding Groundwater Remediation Project Award (co-recipient): 2004
- ENTEC Award for MS Program and Thesis: 1994
- British National Environmental Research Council (NERC) MS scholarship: 1993

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Water Resource Assessment, Minnesota: Retained by MDNR to evaluate groundwater and surface water conditions, including modeling and statistical studies conducted by the USGS and others, and opine on the impact of groundwater extraction on surface water. Evaluated the relative impact of groundwater pumping and climate change on groundwater and surface water in the vicinity of White Bear Lake, MN, and other lakes. SSP&A developed a transient 3D modeling framework to guide mitigating strategies, which entailed calibration and predictive management scenario development. Modeling comprised linking the Soil Water Balance (SWB) Land Surface Model (LSM) with a MODFLOW-NWT groundwater model constructed. At the conclusion of the project, SSP&A transferred all pre- and post-processing tools, numerical modeling files, associated data, calibration files, and predictive modeling, to MN DNR and provided training to staff to execute the model, advance the calibration, and run predictive management scenarios. SSP&A presented findings at a public meeting. MN DWR staff continue to use the model and provide updates to the public (North & East Metro Groundwater Management Area | Minnesota DNR [state.mn.us]).

Republican River Basin Interstate Compact: Provided technical evaluation of the nature, magnitude and timing of streamflow accretions and depletions through the development of a calibrated model. Calibration data included transient water-level and stream-flow calibration targets. Implemented pilot points with regularization for aquifer parameters, and evaluated a mixed-model ANOVA applied to power conversion coefficients (PCCs) as a surrogate for metered pumping. Supported testimony before a River Master and in Supreme Court.

EXAMPLE DATA ANALYSIS PROJECTS

Confidential Client, San Francisco, California: To support soil removal actions, wrote programs to process numerous look-up tables, using varying assumptions for censored data, to calculate, summarize, and compare 95% UCLs for the mean for over 30 analytes.

Marion Thompson Site, Indiana: Completed Monte-Carlo analyses of contaminant transport in groundwater combining bootstrap re-sampling, published PDFs, and re-parameterization techniques to represent variables for this probabilistic evaluation of fate-and-transport.

PCB-Contaminated Site: For a confidential private client, reviewed 1,100 chromatographs to characterize source area, receptor stream and sediment signatures. Wrote programs to plot, scale, and align chromatographs based on curve area, height and lab spikes. Developed cumulative-area method to identify contributions at receptors as part of an allocation process.

Big South Fork National Park, Kentucky: Assessed contaminant load to a river from 80 mines. Coordinated field sampling tasks. Completed data QA/QC, analyses and interpretation. Simulated mine water mixing using Phreeqe. Prepared STORET database for the National Park Service.

REMEDIATION PROJECTS

Goleta Groundwater Basin, California: Retained to provide hydrogeological and modeling services in legal proceedings as an affirmative and responsive expert establishing quantities of water available for allocation / adjudication as via a Physical Solution. Developed a detailed understanding of the hydrogeology of the Goleta Groundwater Basin (GGWB) and surrounding and underlying consolidated bedrock units, and conducted simulations using groundwater flow, integrated hydrologic, and land-surface process models constructed with

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- Individual Structural Geological Mapping Award: 1993
- Royal Air Force Flight Training Scholarship: 1988

APPOINTMENTS AND COMMITTEES

- 2021–present: Groundwater Resources Association of California (GRAC) GRACast Subcommittee
- 2013–2024: MODFLOW-and-More Conference Organizing Committee: Colorado School of Mines, Princeton
- 2018, 2019: Groundwater Journal, Guest Editor
- 2005–2010: Interagency Steering Committee on Multimedia Environmental Models (ISCMEM)
- 2002–2006: Interstate Technology and Regulatory Council (ITRC) MTBE Team

PROFESSIONAL SOCIETIES

- National Ground Water Association (NGWA)
- Geological Society of America (GSA)
- Groundwater Resources Association of California (GRAC)
- American Geophysical Union (AGU)

PROFESSIONAL HISTORY

- S.S. Papadopulos & Associates, Inc.: 1995–present
- Birmingham University, UK, Geology Department: 1993–1994

EMAIL

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Modflow, Modflow-Surfact, ParFlow-CLM, Hydrus, the Soil Water Balance (SWB), INFIL, PRMS, and the Distributed Parameter Watershed Model (DPWM). A major component of the work comprised distinguishing and estimating potential and actual groundwater recharge.

Private Client, San Francisco, California: Led evaluation of risk posed to two high-capacity supply wells by fuel released from a storage facility. Simulated multi-component vadose- and saturated-zone transport of the BTEX compounds, MTBE, TBA, and less soluble components. Implemented kinetic transport capabilities developed by SSP&A under contract to USEPA as released in the MT3D-USGS transport simulation code.

Confidential Client, California: Assessed the fate and transport of several contaminants including chlorinated solvents, chromium, and 1,4-dioxane in groundwater from numerous sources, as part of a multi-party allocation at a large Superfund site within a mixed residential-/commercial-use area. Provided technical support to ultimately conclusive mediation proceedings.

U.S. Navy Red Hill Fuel Storage Facility, Hawaii: In accordance with an Administrative Order on Consent (AOC), assisted EPA and Hawaii DOH in evaluating the conceptual site model (CSM); interpreting soil, soil vapor, fuel product, and groundwater data; and the development by the Navy and its contractors of saturated and vadose zone flow and transport models for the complex fractured basalt aquifer overlain and intruded by volcanics. Led forensic evaluations of environmental data including analyses of gas chromatograms, and evaluations of PFAS/PFOA compounds associated with AFFF facilities. Undertook spatial and temporal statistical analyses. Developed model review criteria; presented at multiple in-person and remotely hosted stakeholder meetings; provided written technical comment on Navy deliverables. Provided additional technical support in response to documented releases to the environment that occurred in 2021, and more recently provided technical support in developing monitoring and response strategies for defueling of the facility.

Confidential Client, Maryland: Retained to evaluate the fate of Cr[VI] arising from historical plating at this RCRA corrective action facility, and interpret the effectiveness of various remedies. Delineation comprised vertical delineation borings (VDBs) and nested wells, and Cr[VI] remedies included enhanced fluid recovery (EFR) and in-situ chemical reduction (ISCR). SSP&A evaluated the EFR and ISCR using multi-variate trend analysis, data mapping, and reactive transport modeling. Provided guidance in the delineation and mobility-assessment of light non-aqueous phase liquid (LNAPL) and its soluble fractions; and evaluated the sources, transport and fate of chlorinated volatile organic compounds (cVOCs). Evaluated the potential for PFAS/PFOA compounds to be presented based on facility manufacturing and material use information. Participated in numerous remotely hosted and in-person meetings with the EPA, including application of the RCRA FIRST (Facilities Investigation Remedy Selection Track) toolbox for site evaluation and remedy selection, culminating in SSP&A leading the development of a long-term monitoring (LTM) plan to support a Statement of Basis. The LTM work guided data collection to support MNA as the final groundwater remedy with source removal, natural source zone depletion (NSZD), and a restrictive land use covenant.

U.S. EPA Region 5: Provided multi-year technical support to Region 5 EPA Superfund group evaluating remedy decisions and actions under CERCLA. Scope includes evaluating conceptual site models (CSMs); interpreting regulatory documents focused on remedy decisions; reviewing or developing analyses of groundwater flow, contaminant transport, and the sources, disposition, and remediation of primary and secondary sources; with the overarching objective of evaluating and improving the performance of remedies at >30 Superfund sites. Authored / co-authored reports to support Five-Year Reviews, with recommendations on remedy and monitoring optimization. Remedial technologies evaluated included pump-and-treat (P&T), monitored natural attenuation (MNA), slurry/barrier walls, in-situ reduction/oxidation, and soil vapor extraction (SVE), among others. Oversaw sampling and characterization activities for PFAS/PFOA compounds at two selected sites based on past manufacturing and reporting chemical use histories. Led a rigorous comparative monitoring network evaluation and optimization study using Summit Optimizer, MAROS, VSP, indicator cross-validation, and maximum likelihood methods.

U.S. DOE Hanford Site, Washington State: Over 15 years as part of a multi-firm team addressing radionuclide, organic and inorganic contamination under CERCLA, RCRA, and AEA programs. Developed fate-and-transport models for remedy design and optimization of Central Plateau and River Corridor OUs. Developed and documented methods and guidelines to assess remedy performance and conducted a “needs assessment” for model-based decision support. Developed methods to assess remedy performance and simulated Uranium, Iodine, Sr90, Tc-99, CrVI, TCE, NO3, CCl4 and other constituents, as part of CERCLA and RCRA actions. Developed and published multi-variate trend analyses for MNA remedies. Oversaw sitewide RCRA facility and monitoring network evaluations and the development of monitoring and data analysis strategies during the transition of dozens of RCRA facilities from interim to final monitoring status. Presented findings at numerous multi-stakeholder meetings.

New York Department of Environmental Conservation: Provided hydrogeologic oversight and groundwater flow and fuel-component transport and fate analyses

to design and optimize soil and groundwater remedies to protect sole-source municipal supplies from single and multiple UST releases at over 15 facilities. Designed and implemented sentinel monitoring network programs for municipal supplies. Presented results at public/civic meetings, ITRC events, and a remediation charette throughout New York State. Co-recipient of NGWA groundwater remediation award for work at the Hampton Bays site.

Delta Consultants (on behalf of BP), Deer Park, New York: Analyzed the distribution and transport of multiple contaminants arising from a fuel-spill migrating toward a large freshwater body to support investigation efforts and a comparative evaluation of remedial alternatives. Presented results to New York State Department of Environmental Conservation.

Otis Air Force Base, Massachusetts: Retained to design performance monitoring plans for several pump-and-treat systems under CERCLA including evaluation of the location, migration, and impacts of CVOCs and other constituents discharging to freshwater kettle ponds. Contributed to treatment plant design assessments, recommended O&M improvements, and co-authored quarterly and annual reports. Designed and oversaw data collection activities including impeller and heat-pulse flow profiling of long-screened extraction wells to identify contaminant inflow locations and estimate aquifer parameters. Developed novel data mapping techniques as a supplement to numerical groundwater flow and contaminant transport modeling. Presented technical findings to AFCEE and at multi-stakeholder meetings. To undertake this work efficiently, made primary residence in Barnstable County from 1999 through 2004.

West Lake Superfund Site, Missouri: Led an assessment of the lateral and vertical extent, disposition, and potential transport and fate of radionuclides within and from solid landfill water materials. Implemented 3D multiple-indicator geo-statistics using a variety of data types to assess radionuclide extent and partial excavation strategies, and managed a project team participating in field work, lab studies and geochemical fate and transport modeling.

PROGRAMMING & SOFTWARE DEVELOPMENT

Release of MT3D-USGS: Contributing developer to MT3D-USGS, incorporating multi-component transport capabilities developed for EPA plus other features (Documented in Bedekar *et al*, 2016).

Expansion of HSSM and MT3DMS to Simulate Multi-Species Reactive Transport: Contracted by USEPA-ORD to expand HSSM and MT3DMS to simulate kinetic reactive transport of multiple fuel constituents with application to fuels. Capability ultimately released in MT3D-USGS.

Linkage of HSSM with MT3DMS: Contracted by the USEPA-ORD, with Dr. Chunmiao Zheng, to link vadose simulation capabilities of HSSM to MT3DMS and provide calibration support with PEST. Developed software released in 2010 (Documented in Zheng *et al*., 2010).

Data Worth Evaluation Using Models: Contracted by the U.S. Geological Survey to program OPR-PPR, which uses FOSM methods and the JUPITER API to evaluate the relative importance of observations and information on model parameters to predictions (Detailed in Tonkin *et al*., 2007).

Predictive Analysis with MODFLOW: Contracted by the USGS to program MOD-PREDICT, which executes MODFLOW-2000 forward, performs sensitivity and calibration runs, and calculates summary statistics focused on predictive error analysis. (Documented in Tonkin *et al*., 2003).

Hydraulic Capture Analysis: Co-developer of KT3D_H2O programs that combine kriging, analytic elements and particle tracking to map groundwater levels and evaluate hydraulic capture. (Documented in Karanovic *et al*., 2009; Tonkin et al., 2009; Tonkin and Larson, 2002.)

TRAINING & SOFTWARE SUPPORT

MODFLOW and More Conferences: Member of organizing committee, Integrated Groundwater Modeling Center (IGWMC), Colorado School of Mines (2013, 2015, 2017, 2019, 2022).

The PEST Conference: Principal organizer and editor of electronic proceedings for model calibration and uncertainty analysis. Published on-line at LULU.com (November 2009).

Collection and Mapping of Water Levels to Assist in Remedy Performance Evaluation: Organizer, co-instructor. Presented to USDOE and contractors at the Hanford Site (August 2009).

PEST Software Support: Provided technical support for the software PEST through a list-serve hosted by S.S. Papadopulos & Associates, Inc. (2002–2012). Organizer and Instructor (with Dr. John Doherty) of model parameterization and uncertainty analysis courses using PEST in the USA and overseas (2002–present).

Instructor (with Dr. Mary Hill) of "UCODE_2005 and Pest: Universal Inversion Codes for Automated Calibration" (2006, 2007, 2009, 2011); "Programming with the JUPITER-API" (2008).

ITRC Workshop Instructor: "MTBE & TBA Comprehensive Site Assessment and Successful Groundwater Remediation". New York (2003), Denver (2004), San Francisco (2005).

Structural Mapping Supervisor: Birmingham University, United Kingdom. Assisted professors in developing mapping training for introduction to curriculum (1994).

Publications & Presentations

Scantlebury, L., Bedekar, V., Tonkin, M.J., Karanovic, M., and Harter, T., 2025. *Texture2Par: A Texture-Driven Tool for Estimating Subsurface Hydraulic Properties*. Environmental Modelling & Software. doi: 10.1016/j.envsoft.2025.106372

DiFilippo, E., M. Tonkin and W. Huber, 2023. *Use of Censored Multiple Regression to Interpret Temporal Environmental Data and Assess Remedy Progress*. Groundwater, vol 61, no. 6: 846-864. doi: 10.1111/gwat.13315

Wyatt, K., M. Beck, and M. Tonkin, 2022. *Advanced Geostatistics to Optimize the Sampling Approach for Contaminated Soil Investigations and Remediations*. Platform presentation at Battelle's Twelfth International Conference on Remediation of Chlorinated and Recalcitrant Compounds. May.

Muffels, C., S. Panday, C. Andrews, M.J. Tonkin, and A. Spiliotopoulos, 2022. *Simulating Groundwater Interaction within a Surface Water Network using Connected Linear Networks (CLNs)*. Ground Water. doi: 10.1111/gwat.13202. Online release April.

Tonkin, M.J., and M. Chowdhury, 2022. *Groundwater Modeling to Support Site Characterization and Remediation in Field Sampling Methods for Remedial Investigations*. 3rd Edition.

Tonkin, M.J., and Chowdhury, M., 2021. *Monitoring Network Analysis for Integrated Central Plateau Decision Making (at the DOE Hanford Site)*. Invited Presentation at REMPLEX, the 2021 Global Summit on Environmental Remediation, November.

Tonkin, M.J., M. Hill, R.M. Maxwell, and C. Zheng, 2020. *Groundwater Modeling and Beyond: MODFLOW-and-More*. 2019 Special Issue. Ground Water, v. 58, no. 3, pp. 325-326, doi: 10.1111/gwat.12999.

Spiliotopoulos A., E.L. DiFilippo, P. Khambhammettu, D. Hayes, M.J. Tonkin, M. Hartman, K. Ivarson, and J. Hulstrom, 2019. *Web-Assisted Methods and Tools for Efficient Remedy Design and System Performance Evaluation at Hanford*. Presentation at the Waste Management Conference, Phoenix, AZ, March 7, 2019. Received "Superior" paper and "WM2019 Papers of Note Winner" awards. OSTI #23003084

DiFilippo E.L., M.J. Tonkin, A. Spiliotopoulos, W. Huber, and V. Rohay, 2019. *Evaluating Environmental Remediation Performance at Radwaste Sites Using Multiple, Censored Regression Analysis*. Presentation at the Waste Management Conference, Phoenix, AZ, March 7, 2019. IAEA #52043413

Maxwell, R.M., A. Navarre – Sitchler, and M. Tonkin, 2018. *Forward: Modeling for Sustainability and Adaptation*. Ground Water, v. 56, no. 4, pp. 515-516, doi: 10.1111/gwat.12795.

Bedekar, V., E.D. Morway, C.D. Langevin, and M. Tonkin, 2016. *MT3D-USGS Version 1: A U.S. Geological Survey Release of MT3DMS Updated with New and Expanded Transport Capabilities for Use with MODFLOW*. U.S. Geological Survey Techniques and Methods Report #6-A53, Reston, VA. 69 p.

Tonkin, M.J., J. Kennel, W. Huber, and J. Lambie, 2015. *Multi-Event Universal Kriging (MEUK)*, Advances in Water Resources, v. 87, pp. 92–105, January. doi: 10.1016/j.advwatres.2015.11.001

Royer, P. D., M.J. Tonkin, and T. Hammond, 2014. *Conjunctive Water Use in Confined Basalt Aquifers: An Evaluation Using Geochemistry, a Numerical Model, and Historical Water Levels*. Journal of the American Water Resources Association (JAWRA), v. 50, No. 4, pp. 963–976, August. doi: 10.1111/jawr.12151

Tonkin, M.J., J. Kennel, W. Huber, and J.A. Lambie, 2013. *Hybrid Analytic Element Universal Kriging Interpolation Technique Built in the Open Source R Environment*. Presentation at the American Geophysical Union, Fall Meeting 2013, Abstract #H52E-03.

Tonkin, M. and Z. Tajani, 2012. *Piecewise-Continuous Boundaries Using the MODFLOW FHB and MT3DMS HSS Packages*. Ground Water, v. 50, no. 2, pp. 296-300. doi: 10.1111/j.1745-6584.2011.00811.x

Bedekar, V., C. Neville, and M. Tonkin, 2012. *Source Screening Module for Contaminant Transport Analysis Through Vadose and Saturated Zones*. Ground Water, v. 50, pp. 954–958. doi:10.1111/j.1745-6584.2012.00954.x

Ma, R., C. Zheng, J. Zachara, and M. Tonkin, 2012. *Utility of Bromide and Heat Tracers for Aquifer Characterization Affected by Highly Transient Flow Conditions*. Water Resources Research, v. 48, #8. doi: 10.1029/2011WR011281

Bedekar, V., R.G. Niswonger, K. Kipp, S. Panday, and M. Tonkin, 2011. *Approaches to the Simulation of Unconfined Flow and Perched Groundwater Flow in MODFLOW*. Ground Water, v. 50, no. 2, pp. 187-198. doi: 10.1111/j.1745-6584.2012.00811.x

Ma, R., C. Zheng, M. Tonkin, and J. Zachara, 2011. *Importance of Considering Intraborehole Flow in Solute Transport Modeling under Highly Dynamic Flow Conditions*.

Journal of Contaminant Hydrology, v. 123, Issues 1-2, April 1, 2011, pp. 11-19.

Hunt, R., J. Luchette, W. Schreuder, J. Rumbaugh, J. Doherty, M. Tonkin, and D. Rumbaugh, 2010. *Using a Cloud to Replenish Parched Groundwater Modeling Efforts*. Ground Water, v. 48, no. 3, pp. 360-365.

Shannon, R., M. Karanovic, and M. Tonkin, 2010. *Hydraulic Capture Estimated using Universal Kriging with Hydrologic Drift Terms*. Presentation at the19th Annual Maryland Groundwater Symposium, Baltimore, MD, 47.

Tonkin, M.J. (Editor), 2010. *PEST Conference Proceedings*. Potomac, MD, November 2009. Available at www.LULU.com.

Zheng, C., J. Weaver, and M. Tonkin, 2010. MT3DMS, *A Modular Three-dimensional Multispecies Transport Model: User Guide to the Hydrocarbon Spill Source (HSS) Package*. Prepared for U.S. Environmental Protection Agency, Athens, GA.

Tonkin, M., and J. Doherty, 2010. *Citation and Acceptance of the 2009 M. King Hubbert Award*. Ground Water (published online). January 2010.

Tonkin, M., S. Dadi, and R. Shannon, 2009. *Collection and Mapping of Water Levels to Assist in the Evaluation of Groundwater Pump-and-Treat Remedy Performance*. SGW-42305 (Rev. 0). Prepared for the US Department of Energy, Richland, WA, September 2009.

Karanovic, M., M. Tonkin, and D. Wilson, 2009. *KT3D_H20: A Program for Kriging Water-Level Data Using Hydrologic Drift Terms*. Ground Water, v. 45, no. 4, pp. 580-586, July/August. doi: 10.1111/j.1745-6584.2009.00565.x

Tonkin, M. J., 2009. *Efficient Calibration and Predictive Error Analysis for Highly-Parameterized Models Combining Tikhonov and Subspace Regularization Techniques*. Doctoral Thesis, University of Queensland, Australia.

Weaver, J., J. Zhang, M. Tonkin, and R.J. Charbeneau, 2009. *Modeling the Transport of Ethanol Fuel Blends with the Combined HSSM and MT3D Models*. Presentation at the 21st Annual National Tanks Conference and Expo, Sacramento, CA, March 30 – April 01, 2009.

Tonkin, M., and J. Doherty, 2009. *Calibration-Constrained Monte Carlo Analysis of Highly-Parameterized Models Using Subspace Techniques*. Water Resources Research, v. 45. W00B10. doi: 10.1029/2007WR006678

Tonkin, M., C. Arola, and D. Miller, 2007. *Decision-Level Modeling within a Feasibility-Study Process: An Application at the Hanford Site*. Presentation at the Association of Engineering and Environmental Geologists 50th Anniversary, Los Angeles, CA, September 26-28, 2007.

Tonkin, M., and J. Doherty, 2007. *An Efficient Calibration-Constrained Monte Carlo Technique for Evaluating Model Predictive Uncertainty*. in Proceedings of an International Conference on Calibration and Reliability in Groundwater Modeling: Credibility of Modeling (ModelCARE2007), Copenhagen, Denmark, September 2007. IAHS Publication 320.

Hunt, R., J. Doherty, and M. Tonkin, 2007. *Are Models Too Simple? Arguments for Increased Parameterization*. Ground Water, v. 45, no. 3, pp. 254-262.

Tonkin, M., J. Doherty, and C. Moore, 2007. *Efficient Non-Linear Predictive Error Variance for Highly Parameterized Models*: Water Resources Research, v. 43. W07429. doi: 10.1029/2006WR005348

Tonkin, M., C. Tiedeman, D. Ely, and M. Hill, 2007. *OPR-PPR, a Computer Program for Assessing Data Importance to Model Predictions Using Linear Statistics, Constructed Using the JUPITER API*. Prepared in Cooperation with the U.S. Department of Energy. Techniques and Methods 6-E2. U.S. Geological Survey.

Muffels, C., H. Zhang, J. Doherty, R. Hunt, M. Anderson, and M. Tonkin, 2006. *Incorporating PROPACK into PEST to Estimate the Model Resolution Matrix for Large Groundwater Flow Models*. Presentation at the American Geophysical Union (AGU) Fall Meeting, Moscone Center, San Francisco, CA, December 2006.

Muffels, C., J. Doherty, M. Anderson, R. Hunt, T. Clemo, and M. Tonkin, 2006. *LSQR and Tikhonov Regularization in the Calibration of a Complex MODFLOW Model*. Presentation at the Geological Society of America Annual Meeting, Philadelphia, PA, October 2006.

Muffels, C., M. Tonkin, H. Zhang, M. Anderson, and T. Clemo, 2006. *Application of LSQR to Calibration of a MODFLOW Model: A Synthetic Study*. in Proceedings of MODFLOW and More 2006, Managing Ground-Water Systems, International Ground Water Modeling Center, Colorado School of Mines Golden, CO, May 2006, v. 1, pp. 283-287.

Tonkin, M., M. Karanovic, A. Hughes, and C. Jackson, 2006. *New and Contrasting Approaches to Local Grid Refinement*. in Proceedings of MODFLOW and More 2006, Managing Ground-Water Systems, International Ground Water Modeling Center, Colorado School of Mines Golden, CO, May 2006, v. 2, pp. 601-605.

Tonkin, M., and J. Doherty, 2005. *A Hybrid Regularized Inversion Methodology for Highly Parameterized Environmental Models*. Water Resources Research, v. 41, no. 10, October. W10412. doi: 10.1029/2005WR003995

Tonkin, M., and M. Becker, 2005. Environmental Insite: *A Software Package for Ground Water Data Visualization*. Ground Water, v. 43, no. 4, pp. 466-470. Software Spotlight.

Tonkin, M.J., 2005. *Model Analysis Using the JUPITER API*. Presentation at the Annual Public Meeting of the Interagency Steering Committee on Multimedia Environmental Models (ISCMEM), American Geophysical Union (AGU), Washington, DC, August 2005.

Tonkin, M., J. Weaver, C. Zheng, C. Muffels, and J. Rumbaugh, 2005. *Coupled Free and Dissolved Phase Transport: New Simulation Capabilities and Parameter Inversion*. in Proceedings of the 2005 National Ground Water Association (NGWA) Conference on MTBE and Perchlorate, Assessment, Remediation, and Public Policy, San Francisco, CA, May 2005.

Muffels, C., M. Tonkin, J. Haas, and D. Trego, 2005. Predictive and Post-Audit Mass Flux Estimates. in Proceedings of the National Ground Water Association (NGWA) Ground Water Summit, San Antonio, TX, April 2005.

Tonkin, M. (as Contributing author to Interstate Technology & Regulatory Council (ITRC)). MTBE and Other Fuel Oxygenates Team, 2005. *Overview of Groundwater Remediation Technologies for MTBE and TBA*. February 2005.

Neville, C. and M. Tonkin, 2004. *Modeling Multi-Aquifer Wells with MODFLOW*. Ground Water, v. 42, no. 6, pp. 910-919.

Tonkin, M. and C. Muffels, 2004. *Assessing Hydraulic Capture through Combined Analytic Elements and Interpolation*. EPA Groundwater Forum, Sacramento, CA, October 2004.

Tonkin, M., S. Larson, and C. Muffels, 2004. *Assessment of Hydraulic Capture through Interpolation of Measured Water Level Data*. Presentation at the Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs through Optimization: Environmental Protection Agency, Federal Remediation Technology Roundtable, Dallas, TX, June 2004.

Tonkin, M., T. Clemo, and J. Doherty, 2003. *Computationally Efficient Regularized Inversion for Highly Parameterized MODFLOW Models*. in Proceedings of MODFLOW and More 2003: Understanding through Modeling, International Ground Water Modeling Center, Colorado School of Mines, Golden, CO, September 16, 2003, v. 2, pp. 595-599.

Tonkin, M., M. Hill, and J. Doherty, 2003. *Modflow-2000, The U.S. Geological Survey Modular Ground-Water Model – Documentation of Mod-Predict for Predictions, Prediction Sensitivity Analysis, and Enhanced Analysis of Model Fit*. Prepared in Cooperation with the U.S. Department of Energy. U.S. Geological Survey Open-File Report 03-385.

Lolcama, J., H. Cohen, and M. Tonkin, 2002. *Deep Karst Conduits, Flooding, and Sinkholes: Lessons for the Aggregates Industry*. Engineering Geology, v. 65, no. 2-3, pp.151-157.

Tonkin, M., and S. Larson, 2002. *Kriging Water Levels with a Regional-Linear and Point-Logarithmic Drift*. Ground Water, v. 40, no. 2, pp. 185-193.

Neville, C., and M. Tonkin, 2001. *Representation of Multi-Aquifer Wells in MODFLOW*. in Proceedings of MODFLOW 2001 and Other Modeling Odysseys, International Groundwater Modeling Center, Colorado School of Mines, Golden, CO, September 2001, v. 1, pp. 51-59.

Cohen, H., M. Tonkin, and C. Neville, 2000. *Determination of Hydraulic Conductivity Distribution in a Heterogeneous Glacial Sand Aquifer: Correlation between Estimates Based on Impeller Flow Meter Data and Grain Size Distributions*. Society for Sedimentary Geology/International Association of Sedimentologists Research Conference: Environmental Sedimentology: Hydrogeology of Sedimentary Aquifers, Santa Fe, NM, September 24-27, 2000.

Deposition & Testimony-at-Trial Experience

DEPOSITIONS

- 2023 – *Jed and Alisa Behar v. Northrop Grumman Corporation and Northrop Grumman Systems Corp.*, United States District Court for the District of California, Civil Action No. 21-cv-03946-HDV-SK. December 6.
- 2022 – *Goleta Water District v. Slippery Rock Ranch, LLC*. Superior Court of the State of California. No. 1487005. March 18.
- 2022 – *Goleta Water District v. Slippery Rock Ranch, LLC*. Superior Court of the State of California. No. 1487005. March 12.
- 2021 – *Goleta Water District v. Slippery Rock Ranch, LLC*. Superior Court of the State of California. No. 1487005. August 31 - September 1.
- 2021 – *Goleta Water District v. Slippery Rock Ranch, LLC*. Superior Court of the State of California. No. 1487005. April 28.
- 2019 – *Goleta Water District v. Slippery Rock Ranch, LLC*. Superior Court of the State of California. No. 1487005. September 16 - 17.
- 2018 – *State of New York v. United Gas Corp., et al*. December 11 - 12.
- 2016 – *Waverley View Investors, LLC. vs. United States of America*. United States Court of Federal Claims. No. 15-371L. December 15.

- 2016 – *Samantha Hall vs. Conoco, Inc. et al*. United States District Court for the Western District of Oklahoma. No. 14-CV-670-HE. March 3.
- 2014 – *Jerilyn K. Allen et al. vs. ExxonMobil Corporation*. Circuit Court of the State of Maryland, County of Baltimore No. C-11-8536. April 4.
- 2011 – *State of New York vs. 913 Portion Road Realty Corp, et al*. Supreme Court of the State of New York. No. 26495-M. July 29.
- 2008 – *Jeff Alban et al. vs. ExxonMobil Corporation et al*. Circuit Court of the State of Maryland, County of Baltimore. No. 03-C-06-010932. February 6.

TESTIMONY-AT-TRIAL

- 2017 – *Waverley View Investors, LLC. vs. United States of America*. United States Court of Federal Claims. Case No. 15-371L. May 15.
- 2017 – *White Bear Lake Restoration Association, ex rel, State of Minnesota vs. Minnesota Department of Natural Resources and Thomas J. Landwehr in his Capacity as Commissioner of the Minnesota Department of Natural Resources*. State of Minnesota Second Judicial District Court, County of Ramsey. Case No. 62-CV-13-2414. March 23.
- 2017 – *Waverley View Investors, LLC. vs. United States of America*. United States Court of Federal Claims. Case No. 15-371L. January 18.

Christian D. Langevin, Ph.D.

Principal Hydrologist

Dr. Langevin is an internationally recognized authority in the field of hydrologic modeling. He specializes in the development and application of advanced simulation software for complex groundwater resource evaluations and contaminant transport analyses. Prior to joining SSP&A, Dr. Langevin served as the lead developer and primary caretaker of the U.S. Geological Survey (USGS) MODFLOW program, the world's most widely used groundwater simulator. In this pivotal role, he helped shape modern groundwater simulation tools. He has developed and codeveloped key hydrologic modeling software, including MODFLOW 6, MODFLOW-USG, MT3D-USGS, SEAWAT, and FloPy, and authored or coauthored numerous peer-reviewed publications and technical reports on hydrologic modeling. His expertise in translating physical hydrologic systems into numerical representations comes from over two decades of practical application together with teaching and advising on the application of numerical models in diverse hydrologic settings. His specialized knowledge includes constant- and variable-density groundwater flow – emphasizing saltwater intrusion – solute and heat transport, efficient unstructured grid applications, and automated workflows for model construction, calibration, and predictive analysis. His project experience includes modeling integrated surface and groundwater systems, aquifer storage and recovery, deep-well injection, and coastal hydrology including seawater intrusion.

REPRESENTATIVE EXPERIENCE

S.S. Papadopulos & Associates, Inc. *– Saint Paul, Minnesota*

Dr. Langevin recently joined SSP&A and will be working on a variety of projects to be added here in the near future.

U.S. Geological Survey *– Mounds View, Minnesota*

MODFLOW Development and Support: Led development and support of the USGS hydrologic simulation program called MODFLOW. Provided leadership throughout the development of new capabilities through the initial needs identification, background work to understand what had previously been done, prototyping of multiple alternatives to examine the most promising avenues, implementation of methods within one or more programming languages, rigorous testing of the new capability against a suite of benchmark problems, publication of the new capability in the appropriate outlet, and supporting, teaching, and promoting the capability to existing and new users. Extensions to MODFLOW during this period included solute transport, heat transport, variable-density flow, particle tracking, an Application Programming Interface (API), and parallel simulation capabilities for laptops, desktops, and supercomputers. Promoted technology transfer of new simulation capabilities through USGS and customized workshops and training classes, conference presentations, and publications in peer-reviewed journals.

U.S. Geological Survey *– Reston, Virginia*

MODFLOW Development and Support: Led development of the next generation of MODFLOW, culminating in the release of MODFLOW 6. Collaborated on the development, publication, and USGS release of the MODFLOW-USG groundwater flow model. Developed the USGS Gridgen software for construction of quadtree unstructured grids. Contributed to development, publication, and release of the MT3D-USGS program.

YEARS OF EXPERIENCE

25+

EDUCATION

- **PhD**, Geology, University of South Florida, 1998
- **MS**, Geology, University of South Florida, 1993
- **BS**, Geology, University of Wisconsin-Madison, 1991

EXAMPLE AREAS OF EXPERTISE

- Quantitative Hydrogeology
- Numerical Modeling of Groundwater Flow
- Variable-Density Groundwater Flow
- Solute Transport
- Saltwater Intrusion
- Development of Customized Hydrologic Modeling Software
- Automated and Reproducible Modeling Workflows

AWARDS & HONORS

- Alumni Award, University of South Florida Geology Department: 2010
- John Hem Award for Excellence in Science & Engineering, National Ground Water Association: 2008

ACADEMIC APPOINTMENTS

- Courtesy faculty appointment, Florida International University, Department of Earth Sciences, Miami, FL: September 2007 – May 2010
- Courtesy faculty appointment, University of Alabama, Graduate School, Tuscaloosa, AL: October 2004 – May 2010

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Special Assignments: Participated in the Water Science Center Technical Reviews, conducted jointly by the Office of Groundwater and Office of Water Quality. As part of the review team, met with Water Science Center staff, reviewed data collection activities and interpretive projects, and prepared a written report of findings. Assignments included:

- Technical Reviewer, Ohio Water Science Center: Columbus, OH, May 24-28, 2010
- Technical Review Leader, Maryland-District of Columbia-Delaware Water Science Center: Baltimore, MD, April 4-8, 2011.
- Technical Reviewer, California Water Science Center: San Diego, CA, June 12-17, 2011.
- Technical Reviewer, South Carolina Water Science Center: Columbia, SC, January 8-13, 2012.
- Technical Review Leader, Louisiana Water Science Center: Baton Rouge, LA, May 21-25, 2012.
- Technical Reviewer, Caribbean Water Science Center: San Juan, PR, February 3-8, 2013.
- Technical Review Leader, North Carolina Water Science Center: Raleigh, NC, April 8-12, 2013.
- Technical Reviewer, Arizona Water Science Center: Tucson, AZ, February 10-14, 2014.
- Technical Review Leader, Pacific Islands Water Science Center: Honolulu, HI, May 4-8, 2015.
- Technical Reviewer, Colorado Water Science Center: Lakewood, CO, July 20-24, 2015.
- Technical Reviewer, Oregon Water Science Center: Portland, OR, April 25-29, 2016.
- Technical Review Leader, New Mexico Water Science Center: Albuquerque, NM, February 13-17, 2017.
- Technical Reviewer, New Jersey Water Science Center: Trenton, NJ, May 1-5, 2017.

U.S. Geological Survey – Fort Lauderdale, Florida

SEAWAT Development and Support: Led the development, publication, and USGS release of the popular SEAWAT code for simulation of variable-density groundwater flow coupled with solute and heat transport.

Effect of Sea Level Rise on Saltwater Intrusion Near a Coastal Wellfield: Quantified the effect of sea level rise, well field withdrawals, variations in precipitation, and surface water management practices on movement of the saltwater interface in the surficial aquifer system in Broward County, Florida. Applied highly parameterized calibration strategies for history matching of a variable-density numerical model. Predicted future movement of the saltwater interface in response to a range of anticipated stresses.

Integrated Surface and Groundwater Modeling for Everglades Restoration: To support Federal and state restoration efforts, developed and applied coupled numerical surface and groundwater models to the Everglades and coastal wetlands. Simulated alternative restoration scenarios to evaluate the response of surface and groundwater flows and salinities to a range of water management scenarios.

Continued from previous page

- Courtesy faculty appointment, University of Florida, Tropical Research and Education Center, Homestead, FL: August 2004 – 2010
- Visiting Professor, University of Puerto Rico-Rio Piedras, Department of Environmental Studies: 2003 Summer Semester
- Instructor, University of South Florida, Geology Department, Tampa, FL: 1994, 1995, 1996 Fall Semesters

COMMITTEES

- 2024-Present: Steering Group Member, Groundwater Network of the Global Energy and Water Exchanges (GEWEX) Program
- 2016: Team Leader and Lead Author, Office of Groundwater Technical Memorandum 2016.02— *Policy for documenting, archiving, and public release of numerical groundwater flow and transport models*
- 2015: International Committee Participant, Danish International Network Programme
- 2014: Team Member and Coauthor, Office of Groundwater Technical Memorandum 2015.02 – *Policy and guidelines for archival of surface-water, groundwater, and water-quality model applications*
- 2006 – Present: Associate Editor, Groundwater Journal
- 2000 – 2005: Technical Advisor, Aquifer Storage and Recovery Project Development Team of the Comprehensive Everglades Restoration Plan
- 2002: Expert Consultant, Bureau of Indian Affairs for SEAWAT modeling study, Lummi Indian Reservation, Washington
- 2002: International Expert Consultant, United Nations Food and Agricultural Organization, Rabat, Morocco

PROFESSIONAL SOCIETIES

- National Ground Water Association (NGWA)
- Geological Society of America (GSA)
- American Geophysical Union (AGU)

Effect of Turkey Point Hypersaline Cooling Canals on the Biscayne Aquifer: Quantified the effect of hypersaline cooling canals on groundwater flow patterns and salinity distributions in the Biscayne aquifer. Applied the heat and solute transport capabilities of the SEAWAT model to quantify the effect of hypersaline cooling canals on the Biscayne aquifer.

Estimation of Capture Zones and Drawdown at Two Public Supply Well Fields: Evaluated the effects of quarry lakes on simulated well field capture zones. Quantified the uncertainty in captures zones using a stochastic Monte Carlo analysis and particle tracking. Predicted the effects of proposed quarry lake expansion.

Deep-Well Injection at the South District Wastewater Treatment Plant: Evaluated the fate and transport of deep-well injectate. Simulated the buoyancy effects due to temperature and dissolved solid concentrations on movement of injectate.

Quantification of Submarine Groundwater to Biscayne Bay: Conducted field studies and numerical analyses to estimate the rate of fresh groundwater discharge into Biscayne Bay, Florida. Fresh groundwater discharge rates were used to inform and improve hydrodynamic simulations of salinity patterns in Biscayne Bay.

Environmental Resources Management, Inc. – *Tampa, Florida*

Nutrient Loading to Shallow Aquifers: Identified and mapped areas of increased risk for nutrient loading using novel geographic information scripting. Developed automated routines and graphical user interfaces for project managers.

Savannah River Site, Department of Energy – *Aiken, South Carolina*

Groundwater Model Database Development: Developed a geographic information system to store temporal and spatial data useful for constructing and calibrating groundwater flow and transport models.

Software Releases

MODFLOW 6

MODFLOW 6 releases are listed below and also available on GitHub at: https://github.com/MODFLOW-ORG/modflow6/releases

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M.J., Niswonger, R.G., Panday, Sorab, Merrick, Damian, Morway, E.D., Reno, M.J., Bonelli, W.P., Boyce, S.E., and Banta, E.R., 2025. *MODFLOW 6 Modular Hydrologic Model version 6.6.1*: U.S. Geological Survey Software Release, 10 February 2025. doi: 10.5066/P9FL1JCC

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M.J., Niswonger, R.G., Panday, Sorab, Merrick, Damian, Morway, E.D., Reno, M.J., Bonelli, W.P., Boyce, S.E., and Banta, E.R., 2024. *MODFLOW 6 Modular Hydrologic Model version 6.6.0*: U.S. Geological Survey Software Release, 19 December. doi: 10.5066/P1DXFBUR

Langevin, C.D., Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M.J., Morway, E.D., Reno, M.J., Bonelli, W.P., Panday, Sorab, Merrick, Damian, Niswonger, R.G., Boyce, S.E., and Banta, E.R., 2024. *MODFLOW 6 Modular Hydrologic Model version 6.5.0*: U.S. Geological Survey Software Release, 23 May. doi: 10.5066/P13COJJM

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ONLINE PROFILES

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» Google Scholar: https://scholar.google.com/citations?user=5oaktdAAAAAJ&hl=en

PROFESSIONAL HISTORY

» S.S. Papadopulos & Associates, Inc.: 2025–present

» USGS Water Mission Area, Integrated Modeling and Prediction Division, Chief Scientist for Groundwater Modeling: 2017–2025

» USGS Office of Groundwater, Chief Scientist for Groundwater Modeling: 2010-2017

» USGS Florida Water Science Center, Research Hydrologist: 1998–2010

EMAIL

langevin@sspa.com

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M.J., Niswonger, R.G., Panday, Sorab, Merrick, Damian, Banta, E.R., Morway, E.D., Reno, M.J., and Bonelli, W.P., 2022. *MODFLOW 6 Modular Hydrologic Model version 6.4.0*: U.S. Geological Survey Software Release, 30 November. doi: 10.5066/P9FL1JCC

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2021. *MODFLOW 6 Modular Hydrologic Model version 6.3.0 release candidate*: U.S. Geological Survey Software Release, 4 March. doi: 10.5066/F76Q1VQV

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2021. *MODFLOW 6 Modular Hydrologic Model version 6.2.2 release candidate*: U.S. Geological Survey Software Release, 6 August. doi: 10.5066/F76Q1VQV

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2021. *MODFLOW 6 Modular Hydrologic Model version 6.2.1*: U.S. Geological Survey Software Release, 17 February. doi: 10.5066/F76Q1VQV

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2020. *MODFLOW 6 Modular Hydrologic Model version 6.2.0*: U.S. Geological Survey Software Release, 22 October. doi: 10.5066/F76Q1VQV

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2020. *MODFLOW 6 Modular Hydrologic Model version 6.1.1*: U.S. Geological Survey Software Release, 12 June. doi: 10.5066/F76Q1VQV

Langevin, C.D., Hughes, J.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2018. *MODFLOW 6 Modular Hydrologic Model version 6.1.0*: U.S. Geological Survey Software Release. doi: 10.5066/F76Q1VQV

OTHER SOFTWARE RELEASES

Mccreight, James L., Langevin, C.D., Hughes, J. D., Bonelli, W. P., 2024. *pywatershed v2.0.0*, U.S. Geological Survey Software Release. doi: 10.5066/P13EWPEV

Fienen M.N., Hughes, J.D., Langevin, C.D., Larsen, J.D., and Leaf, A.T. 2024. *python-for-hydrology*, U.S. Geological Survey software release. Reston, VA. doi: 10.5066/P1QTRYJY

Mccreight, James L., Langevin, C.D., Hughes, J. D., Bonelli, W. P., 2023. *pywatershed v1.0.0*, U.S. Geological Survey Software Release, 1 December. doi: 10.5066/P9AVWA7Z

Bedekar, Vivek, Morway, E.D., Langevin, C.D., and Tonkin, Matt, 2016. *MT3D-USGS version 1: A U.S. Geological Survey release of MT3DMS updated with new and expanded transport capabilities for use with MODFLOW*: U.S. Geological Survey Techniques and Methods 6-A53, 69 p. doi: 10.3133/tm6A53

Lien, Jyh-Ming, Liu, Guilin, and Langevin, C.D., 2015. *GRIDGEN version 1.0—A computer program for generating unstructured finite-volume grids*: U.S. Geological Survey Open-File Report 2014–1109, 26 p. doi: 10.3133/ofr20141109

Panday, Sorab, Langevin, C.D., Niswonger, R.G., Ibaraki, Motomu, and Hughes, J.D., 2013. *MODFLOW-USG version 1: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation*: U.S. Geological Survey Techniques and Methods, book 6, chap. A45, 66 p. doi: 10.3133/tm6A45

Langevin, C.D., Thorne, D., Dausman, A.M., Sukop, M.C., and Guo, W., 2007. *SEAWAT Version 4: A computer program for simulation of multi-species solute and heat transport*. U.S. Geological Survey Techniques and Methods Book 6, Chapter A22, 39 p.

Publications & Presentations

PEER-REVIEWED PUBLICATIONS

Morway, E.D., Provost, A.M., Langevin, C.D., Hughes, J.D., Russcher, M.J., Chen, C.Y., Lin, Y.F.F., 2025. *A New Groundwater Energy Transport Model for the MODFLOW Hydrologic Simulator*. Groundwater. doi: 10.1111/gwat.13470

Provost, A.M., Bardot, K., Langevin, C.D., McCallum, J.L., 2025. *Accurate Simulation of Flow through Dipping Aquifers with MODFLOW 6 Using Enhanced Cell Connectivity*. Groundwater. doi: 10.1111/gwat.13459

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M.J. and Panday, S. 2024. *MODFLOW as a Configurable Multi-Model Hydrologic Simulator*. Groundwater, 62: 111-123. doi: 10.1111/gwat.13351

Larsen, J.D., Langevin, C.D., Hughes, J.D. and Niswonger, R.G., 2024. *An Agricultural Package for MODFLOW 6 Using the Application Programming Interface*. Groundwater, 62: 157-166. doi: 10.1111/gwat.13367

Hughes, J.D., Langevin, C.D., Paulinski, S.R., Larsen, J.D. and Brakenhoff, D., 2024. *FloPy Workflows for Creating Structured and Unstructured MODFLOW Models*. Groundwater, 62: 124-139. doi: 10.1111/gwat.13327

Mancewicz, L.K., Mayer, A., Langevin, C.D., and Gulley, J., 2023. *Improved Method for Simulating Groundwater Inundation Using the MODFLOW 6 Lake Transport Package*. Groundwater, 61: 421-430. doi: 10.1111/gwat.13254

Herrera, P.A., Langevin, C.D. and Hammond, G., 2023. *Estimation of the Water Table Position in Unconfined Aquifers with MODFLOW 6*. Groundwater, 61: 648-662. doi: 10.1111/gwat.13270

Hughes, J.D., Russcher, M.J., Langevin, C.D., Morway, E.D., and McDonald, R.R., 2022. *The MODFLOW Application Programming Interface for simulation control and software interoperability*: Environmental Modelling & Software, v. 148, 105257. doi: 10.1016/j.envsoft.2021.105257

Morway, E.D., Langevin, C.D., and Hughes, J.D., 2021. *Use of the MODFLOW 6 water mover package to represent natural and managed hydrologic connections*: Groundwater, v. 59, no. 6, p. 913-924. doi: 10.1111/gwat.13117

Langevin, C.D., Panday, S. and Provost, A.M. 2020. *Hydraulic-Head Formulation for Density-Dependent Flow and Transport*. Groundwater, 58: 349-362. doi: 10.1111/gwat.12967

Provost, A.M., Werner, A.D., Post, V.E.A., Michael, H.A., and Langevin, C.D., 2018. *Rebuttal to "The case of the Biscayne Bay and aquifer near Miami, Florida: density-driven flow of seawater or gravitationally driven discharge of deep saline groundwater?" by Weyer* (Environ Earth Sci 2018, 77:1–16). Environ Earth Sci 77, 710. doi: 10.1007/s12665-018-7832-5

Panday, Sorab, Bedekar, Vivek, and Langevin, C.D., 2018. *Impact of Local Groundwater Flow Model Errors on Transport and a Practical Solution for the Issue*. Groundwater, 56: 667-672. doi: 10.1111/gwat.12627

Bakker, M., Post, V., Langevin, C. D., Hughes, J. D., White, J. T., Starn, J. J. and Fienen, M. N., 2016. *Scripting MODFLOW model development using Python and FloPy*. Groundwater 54 p. 733-739. doi: 10.1111/gwat.12413

Feinstein, D.T., Fienen, M.N., Reeves, H.W., and Langevin, C.D., 2016. *A semi-structured MODFLOW-USG model to evaluate local water sources to wells for decision support*. Groundwater 54 p. 532-544. doi: 10.1111/gwat.12389

Hughes, J.D., Langevin, C.D., and White, J.T., 2014. *MODFLOW-based coupled surface water routing and groundwater-flow simulation*. Groundwater 53 p. 452-463. doi: 10.1111/gwat.12216

Konikow, L.F., Akhavan, M., Langevin, C.D., Michael, H.A., and Sawyer, A.H., 2013. *Seawater circulation in sediments driven by interactions between seabed topography and fluid density*. Water Resources Research, Volume 49, Issue 3 p. 1386-1399. doi: 10.1002/wrcr.20121

Morway, E.D., Niswonger, R.G., Langevin, C.D., Bailey, R.T., and Healy, R.W., 2013. *Modeling variably saturated subsurface solute transport with MODFLOW-UZF and MT3DMS*. Ground Water 51 p. 237-251 doi: 10.1111/j.1745-6584.2012.00971.x

Langevin, C.D., and Zygnerski, M., 2013. *Effect of sea-level rise on salt water intrusion near a coastal well field in southeastern Florida*. Ground Water 51, p. 781-803. doi: 10.1111/j.17456584.2012.01008.x

La Licata, I., Langevin, C.D., Dausman, A.M., and Alberti, L., 2013. *Effect of tidal fluctuations on transient dispersion of simulated contaminant concentrations in a coastal aquifer*. Hydrogeology Journal, Vol. 18, no. 1: 25-38. doi: 10.1007/s10040-011-0763-9

Langevin, C.D., and Panday, S., 2012. *Future of groundwater modeling*. Ground Water 50 no. 3: 334-339. doi: 10.1111/j.1745-6584.2012.00937.x

Panday, S., and Langevin, C.D., 2012. *Improving sub-grid scale accuracy of boundary features in regional finite-difference models*. Advances in Water Resources 41: 65-75.

Hughes, J.D., Decker, J.D., and Langevin, C.D., 2011. *Use of upscaled elevation and surface roughness data in two-dimensional surface water models*. Advances in Water Resources, Vol. 34, no. 9: 1151-1164. doi: 10.1016/j.advwatres.2011.02.004

Herckenrath, D. Langevin, C.D., and Doherty, J., 2011. *Predictive uncertainty analysis of a saltwater intrusion model using null-space Monte Carlo*. Water Resources Research, Vol. 47, W05504. doi: 10.1029/2010WR009342

Mulligan, A.E., Langevin, C.D., and Post, V., 2011. *Tidal boundary conditions in SEAWAT*, Ground Water 49: 866-879. doi: 10.1111/j.1745-6584.2010.00788.x

Obeysekera, J., Kuebler, L., Ahmed, S., Chang, Miao-LI, Engel, V., Langevin, C., Swain, E., and Wan, Y., 2011. *Use of Hydrologic and Hydrodynamic Modeling for Ecosystem Restoration*. Critical Reviews in Environmental Science and Technology, 41: 6, 447-488.

Dausman, A. M., Doherty, J., Langevin, C. D. and Sukop, M. C., 2010. *Quantifying data worth toward reducing predictive uncertainty*. Ground Water, 48: 729–740. doi: 10.1111/j.1745-6584.2010.00679.x

Langevin, C. D., Dausman, A. M. and Sukop, M. C., 2010. *Solute and heat transport model of the Henry and Hilleke laboratory experiment*: Ground Water, 48: 757–770. doi: 10.1111/j.17456584.2009.00596.x

Dausman, A.M., Doherty, J., Langevin, C.D., and Dixon, J., 2010. *Hypothesis testing of buoyant plume migration using a highly parameterized variable-density groundwater model at a site in Florida, USA*. Hydrogeology Journal vol. 18, no. 1: 147-160. doi: 10.1007/s10040-009-0511-6

Hughes, J.D., Langevin, C.D., and Brakefield-Goswami, L., 2010. *Effect of hypersaline cooling canals on aquifer*

salinization: Hydrogeology Journal vol. 18, no. 1: 25-38. doi: 10.1007/s10040009-0502-7

Langevin, C.D., 2008. *Modeling axisymmetric flow and transport*: Ground Water vol. 46, no. 4:579-590.

Swain, E.D., Langevin, C.D., and Wang, J.D., 2008. *Utilizing spectral analysis of coastal discharge computed by a numerical model to determine boundary influence*. Journal of Coastal Research, vol. 24, no. 6: 1418-1429.

Thorne, D., Langevin, C.D., and Sukop, M.C., 2006. *Addition of simultaneous heat and solute transport and variable fluid viscosity to SEAWAT*: Computer and Geosciences vol. 32, 1758-1768.

Langevin, C.D. and Guo, W., 2006. *MODFLOW/MT3DMS-based simulation of variable density ground water flow and transport*: Ground Water vol. 44, no. 3:339-351.

Mao, X., Prommer, H., Barry, D.A., Langevin, C.D., Panteleit, B., and Li, L., 2006. Three-*dimensional model for multi-component reactive transport with variable density groundwater flow*: Environmental Modelling & Software vol. 21, no. 5:615-628.

Langevin, C.D., Swain, E.D., and Wolfert, M.A. 2005. *Simulation of integrated surface-water/groundwater flow and salinity for a coastal wetland and adjacent estuary*: Journal of Hydrology 314, 212234.

Bakker, M., Oude Essink, G.H.P., and Langevin, C.D. 2004. *The rotating movement of three immiscible fluids a benchmark problem*. Journal of Hydrology 287, 270-278.

Langevin, C.D. 2003b. *Simulation of submarine ground water discharge to a marine estuary: Biscayne Bay, Florida*. Ground Water 41, no. 6: 758-771.

Langevin, C.D. 2003a. *Stochastic ground water flow simulation with a fracture zone continuum model*. Ground Water 41, no. 5: 587-601.

Stewart, M.T., and Langevin, C.D. 1999. *Post Audit of a numerical prediction of wellfield drawdown in a semiconfined aquifer system*. Ground Water 37, no. 2:245-252.

Langevin, C.D., Stewart, M.T., and Beaudoin, C.M. 1998. *Effects of dredge and fill canals on freshwater resources of small oceanic islands. An example from Big Pine Key, Florida*. Ground Water 36, no. 3: 503-513.

PUBLISHED REPORTS, CONFERENCE PAPERS, AND DATA RELEASES

Morway, E., Provost, A., and Langevin, C.D., 2025. *Two 2-Dimensional models patterned after the Barends analytical solution for verifying the accuracy of the new Groundwater Energy (GWE) Transport model built for the MODFLOW 6 hydrologic simulator*: U.S. Geological Survey data release. doi: 10.5066/P13KJF3C

Provost, A.M., Bardot, K., Langevin, C.D., and McCallum, J.L., 2025. *MODFLOW 6 models used to evaluate the accuracy of enhanced cell connectivity for simulation of flow through dipping aquifers*: U.S. Geological Survey data release. doi: 10.5066/P13BNARA

Langevin, C.D., Provost, A.M., Panday, Sorab, and Hughes, J.D., 2022. *Documentation for the MODFLOW 6 Groundwater Transport (GWT) Model*: U.S. Geological Survey Techniques and Methods, book 6, chap. A61, 56 p. doi: 10.3133/tm6A61

Morway, E.D., Langevin, C.D., Hughes, J.D., 2021. *MODFLOW 6 model of two hypothetical stream-aquifer systems to demonstrate the utility of the new Water Mover Package (MVR) available only with MODFLOW 6*: U.S. Geological Survey data release. doi: 10.5066/P9GQETP9

Provost, A.M., Langevin, C.D., and Hughes, J.D., 2017. *Documentation for the "XT3D" option in the Node Property Flow (NPF) Package of MODFLOW 6*: U.S. Geological Survey Techniques and Methods 6–A56, 40 p. doi: 10.3133/tm6A56

Langevin, C.D., Hughes, J.D., Banta, E.R., Niswonger, R.G., Panday, Sorab, and Provost, A.M., 2017. *Documentation for the MODFLOW 6 Groundwater Flow Model*: U.S. Geological Survey Techniques and Methods 6–A55, 197 p. doi: 10.3133/tm6A55

Hughes, J.D., Langevin, C.D., and Banta, E.R., 2017. *Documentation for the MODFLOW 6 framework*: U.S. Geological Survey Techniques and Methods 6–A57, 42 p. doi: 10.3133/tm6A57

Bakker, M., Schaars, F., Hughes, J.D., and Langevin, C.D., 2013. *The sea water intrusion (SWI2) Package for modeling vertically-integrated variable density groundwater flow in regional aquifers with the U.S. Geological Survey Modular Groundwater Model (MODFLOW-2005)*. U.S. Geological Survey Techniques and Methods, 6-A46, 47 p.

Ibaraki, M., Panday, S., Niswonger, R.G., Langevin, C.D., 2013. *Improvement of performance of MODFLOW xMD matrix solver package for heterogeneous computing environments*. MODFLOW and More 2013: Translating Science Into Practice, Golden, Colorado, June 2-5.

Bakker, M., Post, V., Hughes, J., Langevin, C., Frances, A., White, J., 2013. *Enhanced FloPy scripts for constructing and running MODFLOW-based models*. MODFLOW and More 2013: Translating Science Into Practice, Golden, Colorado, June 2-5.

Feinstein, D.T., M.N. Fienen, H.W. Reeves, and Langevin, C.D., 2013. *Application of a "semistructured" approach with MODFLOW-USG to simulate local groundwater/surface-water interactions at the regional scale as basis for a decision-support tool*. MODFLOW and More 2013: Translating Science Into Practice, Golden, Colorado, June 2-5.

Brakefield, L., Hughes, J.D., Langevin, C.D., and Chartier, K., 2013. *Estimation of capture zones and drawdown at the Northwest and West Well Fields, Miami-Dade County, Florida, using an unconstrained Monte Carlo analysis: recent (2004) and proposed conditions*: U.S. Geological Survey Open-File Report 2013–1086, 124 p. http://pubs.usgs.gov/of/2013/1086

Hughes, J.D., Langevin, C.D., Chartier, K.L., and White, J.T., 2012. *Documentation of the Surface Water Routing (SWR1) Process for modeling surface-water flow with the U.S. Geological Survey Modular Groundwater Model (MODFLOW-2005)*, U.S. Geological Survey Techniques and Methods 6-A40.

Ibaraki, M., Panday, S., Niswonger, R.G., and Langevin, C.D., 2011. *Improvement of performance of MODFLOW: XMD matrix solver package*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Provost, A.M. and Langevin, C.D., 2011. *Effect of the difference between water-table elevation and hydraulic head on simulation of unconfined aquifers using MODFLOW*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Brakefield, L.K., Langevin, C.D., and Hughes, J.D., 2011. *Estimating well-field contributing areas in the presence of lakes using an unconstrained Monte-Carlo analysis*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Hughes, J.D., White, J.T., Brakefield, L.K., Walsh, V.M., Langevin, C.D., 2011. *Simulating surface-water control structures and surface-water/groundwater interactions in Miami-Dade County, Florida, using the Surface-Water Routing Process for MODFLOW-2005*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Schaars, F.W., Bakker, M., Hughes, J.D., Dausman, A.M., Langevin, C.D., 2011. *Modeling regional seawater intrusion with MODFLOW2005 and the SWI Package*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Langevin, C.D., Panday, S., Niswonger, R.G., Hughes, J.D., Ibaraki, M., 2011. *Local grid refinement with an unstructured grid version of MODFLOW*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

Panday, S., Niswonger, R.G., Langevin, C.D., Ibaraki, M., 2011. *An un-structured grid version of MODFLOW*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, 2011, International Groundwater Modeling Center, Colorado School of Mines.

White, J.T., Langevin, C.D., and Hughes, J.D. 2010. *Evaluating the effect of Tikhonov regularization schemes on predictions in a variable-density groundwater model*. SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book, Ponta Delgada, Azores, Portugal, June 21-26.

Hughes, J.D., White, J.T., and Langevin, C.D. 2010. *Use of time series and harmonic constituents of tidal propagation to enhance estimation of coastal aquifer heterogeneity*. SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book, Ponta Delgada, Azores, Portugal, June 21-26.

Dausman, A.M., Langevin, C.D., Bakker, M., and Schaars, F. 2010. *A comparison between SWI and SEAWAT – the importance of dispersion, inversion, and vertical anisotropy*. SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book, Ponta Delgada, Azores, Portugal, June 21-26.

Langevin, C.D., Zygnerski, M.R., White, J.T., and Hughes, J.D. 2010. *Effect of sea-level rise on future coastal groundwater resources in southern Florida*, USA. SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book, Ponta Delgada, Azores, Portugal, June 21-26.

Condesso de Melo, M.T., Lebbe, L., Cruz, J.V., Coutinho, R., Langevin, C.D., and Buxo, A., eds. 2010. *SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book*, Ponta Delgada, Azores, Portugal, June 21-26, 2010. 373 p.

Dausman, A., Langevin, C.D., Thorne, D., Sukop, M.C., 2009. *Six benchmark problems for testing heat and solute transport with variable viscosity using SEAWAT Version 4*: U.S. Geological Survey Scientific Investigations Report 2009-5028, 72 p.

Dausman, A.M., Doherty, J., and Langevin, C.D., 2009. *Creative use of pilot points to address site and regional scale heterogeneity in a variable-density model*. The PEST conference 2009, November 2-4, Potomac, Maryland.

Herckenrath, D. Langevin, C.D., and Doherty, J., 2009. *Application of a null space Monte Carlo method to a*

salt water intrusion model. The PEST conference 2009, November 2-4, Potomac, Maryland.

Brakefield, L., Langevin, C.D., *Use of unconstrained Monte Carlo methods to determine effects of uncertainty in hydraulic conductivity and effective porosity on well-field contributing areas*. The PEST conference 2009, November 2-4, Potomac, Maryland.

Langevin, C.D., and Hughes, J.D., 2009. *Effect of numerical dispersion as a source of structural noise in the calibration of a highly parameterized saltwater intrusion model*. The PEST conference 2009, November 2-4, Potomac, Maryland.

Yager, R.M., Misut, P.E., Langevin, C.D., and Parkhurst, D.L., 2009. Brine migration from a flooded salt mine in the Genesee Valley, Livingston County, New York: Geochemical modeling and simulation of variable-density flow: U.S. Geological Survey Professional Paper 1767, 59 p., also available online at http://pubs.usgs.gov/pp/pp1767/

Langevin, C.D., Lebbe, L., Bakker, M., and Voss, C., eds., 2008. *20th Salt Water Intrusion Meeting, Program and Proceedings*, June 23-27, Naples, Florida, U.S.A., 340 p.

Brakefield, L.K., Abarca, E., Langevin, C.D., and Clement, T.P., 2008. *Physical and numerical modeling of buoyant groundwater plumes*: In Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida, U.S.A.

La Licata, I., Langevin, C.D., Dausman, A.M., and Alberti, L., 2008. *Tidal effects on transient dispersion of simulated contaminant concentrations in coastal aquifers*: In Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida, U.S.A.

Zygnerski, M.R., and Langevin, C.D., 2008. *Quantifying effects of natural and anthropogenic stresses on long-term saltwater intrusion in a coastal aquifer*: In Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida, U.S.A.

Dausman, A.M., Langevin, C.D., Sukop, M.C., and Walsh, V., 2008b. *Saltwater/freshwater interface movement in response to deep-well injection in a coastal aquifer*: In Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida, U.S.A.

Bittner, L.D., Richardson, E., Langevin, C.D., England, S.M., and Stevens, G.T., 2008. *Using density-dependent numerical models to evaluate regional groundwater flow patterns in South Florida*: In Proceedings of The World Environmental & Water Resources Congress, May 12-16, Honolulu, Hawaii.

Sukop, M.C., S. Anwar, J.S. Lee, K.J. Cunningham, and C.D. Langevin, 2008. *Modeling groundwater flow and solute transport in karst with Lattice Boltzmann Methods*: Proceedings of the U.S. Geological Survey Karst Interest Group Workshop, May 27-29, Bowling Green, Kentucky, Western Kentucky University Campus. http://pubs.usgs.gov/sir/2008/5023/32sukop.htm

Dausman, A., Doherty, J., Langevin, C.D., and Sukop, M.C., 2008. *Quantifying data contributions toward reducing predictive uncertainty in a variable-density flow and solute/heat transport model*: In MODFLOW and More 2008: Ground Water and Public Policy Conference Proceedings, Golden, Colorado, May 19-21.

Langevin, C.D., Dausman, A.M., Thorne, D., and Sukop, M.C., 2008. *Modeling solute and heat transport with SEAWAT*: In MODFLOW and More 2008: Ground Water and Public Policy Conference Proceedings, Golden, Colorado, May 19-21.

Wolfert-Lohmann, M.A., Langevin, C.D., Jones, S.A., Reich, C.D., Wingard, G.L., Kuffner, I.B., and Cunningham, K.J., 2008. *U.S. Geological Survey science support strategy for Biscayne National Park and surrounding areas in Southern Florida*: U.S. Geological Survey Open-File Report 2007-1288, 47 p.

Zygnerski, M.R., and Langevin, C.D., 2007. *Long-term saltwater intrusion in a coastal limestone aquifer: quantifying effects of natural and anthropogenic stress*: In Proceedings of the 3rd International Symposium on Technology of Seawater Intrusion into Coastal Aquifers, Almeria, Spain, October 16-19.

Langevin, C.D., Lebbe, L., Bakker, M., and Voss, C.I., 2007, *Ground Water Readers' Forum: Twentieth salt water intrusion meeting planned for June 23 to 27, 2008, in Naples, Florida*. Ground Water 46, no. 6: 657-658.

La Licata, I., Langevin, C.D., Dausman, A.M., 2007. *Effect of tidal fluctuations on contaminant transfer to the ocean*, in Sanford, W., Langevin, C.D., Polemio, M., and Povinec. P., eds., 2007, *A new focus on groundwater-seawater interactions*: IAHS Publication 312, Oxfordshire, United Kingdom, p. 334-341.

Dausman, A.M., Langevin, C.D., Sukop, M.C., 2007. *Simulation of submarine groundwater discharge salinity and temperature variations: implications for remote detection*, in Sanford, W., Langevin, C.D., Polemio, M., and Povinec. P., eds., 2007, *A new focus on groundwater-seawater interactions*: IAHS Publication 312, Oxfordshire, United Kingdom, p. 272-280.

Langevin, C.D., Sanford, W., Polemio, M., and Povinec, P., 2007. *Background and summary*, in Sanford, W., Langevin, C.D., Polemio, M., and Povinec. P., eds., 2007, *A new focus on groundwater-seawater interactions*: IAHS Publication 312, Oxfordshire, United Kingdom, p. 3-10.

Sanford, W., Langevin, C.D., Polemio, M., and Povinec. P., eds., 2007. *A new focus on groundwater-seawater*

interactions: IAHS Publication 312, Oxfordshire, United Kingdom, 344 p.

Wang, J.D., Swain, E.D., Wolfert, M.A., Langevin, C.D., James, D.E., and Telis, P.A., 2007. *Application of FTLOADDS to Simulate Flow, Salinity, and Surface-Water Stage in the Southern Everglades, Florida*: U.S. Geological Survey Scientific Investigations Report 2007–5010, 112 p.

Langevin, C.D., 2007b. *Section 4.6. Groundwater discharge to Biscayne Bay, Florida*: In Submarine Groundwater, (eds.) I. Zektser and R. Dzhamalov, CRC Press.

Langevin, C.D., 2007a. *Section 2.1.2. Numerical simulation of submarine groundwater discharge*: In Submarine Groundwater, Zektser, I.S., and Dzhamalov, R.G. (eds.), CRC Press.

Langevin, C.D., and Zygnerski, M., 2006. *Axisymmetric simulation of aquifer storage and recovery with SEAWAT and the Sea Water Intrusion (SWI) Package for MODFLOW*: In Proceedings of MODFLOW and More 2006, Managing Ground-Water Systems, Golden, Colorado, May 22-24.

Thorne, D., Langevin, C.D., and Sukop, M.C., 2006. *MODFLOW/MT3DMS-based simulation of variable-density groundwater flow with simultaneous heat and solute transport*: In Proceedings of the 2006 Conference on Computational Methods in Water Resources XVI, Copenhagen, Denmark, June 19-22, 2006.

Langevin, C.D. and Dausman, A.M. 2005. *Numerical simulation of saltwater intrusion in response to sea-level rise*: In Proceedings of the World Water & Environmental Resources Congress, Impacts of Global Climate Change, American Society of Civil Engineers, Anchorage, Alaska, May 15-19, 2005.

Dausman, A.M. and Langevin, C.D. 2005. *Movement of the saltwater interface in the Surficial Aquifer System in response to hydrologic stresses and water-management practices, Broward County, Florida*: U.S. Geological Survey Scientific Investigations Report 2004-5256

Wolfert, M.A., Dausman, A., Langevin, C.D., Swain, E.D., and Wang, J.D., 2005. *Using numerical models to simulate surface-water and ground-water movement in South Florida*: USGS Science in Florida, Proceedings of Florida Integrated Science Center Meeting, Orlando, Florida, May 3-5. U.S. Geological Survey Open-File Report 2005-1213

Langevin, C.D., and Bean, D.M. 2005. *Software Spotlight/ Ground Water Vistas: A graphical user interface for the MODFLOW family of ground water flow and transport models*. Ground Water 43, no. 2:1-4.

Swarzenski, P.W., Charette, M., and Langevin, C.D. 2004. *An autonomous, electromagnetic seepage meter to study coastal groundwater/surface water exchange*: U.S. Geological Survey Open-File Report 2004-1369. doi: 10.3133/ofr20041369

Wolfert, M.A., Langevin, C.D., and Swain, E.D. 2004. *Assigning boundary conditions to the Southern Inland and Coastal Systems (SICS) model using results from the South Florida Water Management Model (SFWMM)*: U.S. Geological Survey Open-File Report 2004-1195, 30 p. doi: 10.3133/ofr20041195

Langevin, C.D., Swain, E.D., Wang, J.D., Wolfert, M.A., Schaffranek, R.W., and Riscassi, A.L. 2004c. *Development of coastal flow and transport models in support of Everglades restoration*: U.S. Geological Survey Fact Sheet 2004-3130

Langevin, C.D., Swain, E.D., and Wolfert, M.A. 2004b. *Simulation of integrated surface-water/groundwater flow and salinity for a coastal wetland and adjacent estuary*, U.S. Geological Survey Open-File Report 2004-1097

Langevin, C.D., Oude Essink, G.H.P., Panday, S., Bakker, M., Prommer, H., Swain, E.D., Jones, W., Beach, M., and Barcelo, M. 2004a. *Chapter 3, MODFLOW-based tools for simulation of variable-density groundwater flow*: In Coastal Aquifer Management: Monitoring, Modeling, and Case Studies, (eds.) A. Cheng and D. Ouazar, Lewis Publishers, p. 49-76.

Langevin, C.D., Shoemaker, W.B., and Guo, W. 2003. *MODFLOW-2000, the U.S. Geological Survey modular ground-water model—Documentation of the SEAWAT-2000 version with the variabledensity flow process (VDF) and the integrated MT3DMS Transport Process (IMT)*: U.S. Geological Survey Open-File Report 03-426, 43 p. doi: 10.3133/ofr03426

Langevin, C.D., Swain, E.D., and Wolfert, M.A. 2002. *Numerical simulation of integrated surfacewater/ground-water flow and solute transport in the southern Everglades in Florida*. Second Federal Interagency Hydrologic Modeling Conference, Las Vegas, Nevada, July 28-August 1.

Dausman, A., and Langevin, C.D. 2002. *Representing hydrodynamic dispersion in saltwater intrusion models of different temporal scales*. American Water Resources Association's Spring Specialty Conference on "Coastal Water Resources", May 13-15, New Orleans, Louisiana.

Swain, E.D., Langevin, C.D., and Wolfert, M.A. 2002. *Cooperative linking of numerical models for coastal wetland planning*. American Water Resources Association's Spring Specialty Conference on "Coastal Water Resources," May 13-15, New Orleans, Louisiana.

Guo, Weixing, and Langevin, C.D. 2002b. *User's guide to SEAWAT: A computer program for simulation of three-dimensional variable-density ground-water flow*:

U.S. Geological Survey Techniques of Water Resources Investigations Book 6, Chapter A7, 79 p.

Guo, Weixing, and Langevin, C.D. 2002a. *User's guide to SEAWAT: A computer program for simulation of three-dimensional variable-density ground-water flow*: U.S. Geological Survey OpenFile Report 01-434, 79 p. doi: 10.3133/twri06A7

Langevin, C.D. 2001. *Simulation of ground-water discharge to Biscayne Bay, Southeastern Florida*: U.S. Geological Survey Water-Resources Investigations Report 00-4251, 127 p. doi: 10.3133/wri004251

Guo, Weixing, Langevin, C.D., and Bennett, G.D. 2001. Improvements to SEAWAT and application of the variable-density modeling program in southern Florida, in Poeter, E., and others, MODFLOW 2001 and Other Modeling Odysseys Conference, Colorado School of Mines, Golden, Colorado, v. 2, p. 621-627.

Stewart, M.T., and Langevin, C.D. 2000. *AUTHOR'S REPLY*. Ground Water 38, no. 1: 6-6.

Langevin, C.D. 1998. *Stochastic methods for evaluating the potential for wetland rehydration in covered-karst terranes*. Ph.D. Dissertation, University of South Florida.

Langevin, C.D. 1994. *Numerical model of porewater fluxes in a hypothetical Florida Bay mud island*. Master's Thesis, University of South Florida.

UNPUBLISHED TECHNICAL REPORTS

Langevin, C.D., Larabi, A., Lakfifi, L. 2002. *Programme de Gestion des Ressources en Eau': Mode´lisation de l'Intrusion Marine dans les Nappes Coˆtie`res*. Report on the international and national expert's work. A report prepared for the Moroccan Hydraulic Department.

Albury, C.A., Langevin, C.D., and Stewart, M. 1998. *Determining the feasibility for wetland rehydration: Simulation of application rates and transport of reclaimed water*. North Lakes Wetland Project Final Report, prepared for the Southwest Florida Water Management District.

Langevin, C.D., Thompson, D., LaRoche, J., Albury, C.A., Shoemaker, W., and Stewart, M.T. 1998. *North Lakes Wetland Project: Phase II. Development of a Conceptual Hydrogeologic Model from Field and Laboratory Data*. Geology Department, University of South Florida. Report prepared for the Southwest Florida Water Management District.

Langevin, C.D., and Stewart, M.T. 1996. *North Lakes Wetland Project: Phase I*. Geology Department, University of South Florida. A report prepared for the Southwest Florida Water Management District.

Geurink, J., Langevin, C., Tara, P., Stewart, M., and Ross, M. 1995. *A GIS-based multi-scale model for comprehensive water management evaluations, Task II report, groundwater model development and simulation*. Civil Engineering Department, University of South Florida. Report prepared for the Southwest Florida Water Management District.

Latham, D.J., Langevin, C.D., and Stewart, M.T. 1993. *An electromagnetic survey of a North Brevard County Wellfield*. Geology Department, University of South Florida. A report prepared for Post, Buckley, Schuh & Jernigan, Inc.

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M., Morway, E., Bonelli, W., Reno, M., Larsen, J., and Panday, S. 2024. *One platform, many models: MODFLOW 6 as a modular hydrologic simulator*. MODFLOW and More Conference, Princeton, NJ, June 2-5. INVITED, PRESENTED.

Langevin, C.D., Hughes, J.D., and Russcher, M. 2023. *Recent MODFLOW developments*. Presented at the Deltares Hydrology International User Days, Deltares, Delft, The Netherlands, November 30. INVITED, PRESENTED.

Hughes, J.D., Russcher, M., and Langevin, C.D. 2023. *Modeling without limits: Harnessing the power of the MODFLOW API*. Presented at the Civil Engineering seminar series at Delft University, Delft, The Netherlands, November 30. INVITED.

Langevin, C.D., Provost, A.M., Bardot, K., and McCallum, J. 2023. *Secrets to modeling groundwater flow through dipping hydrogeologic layers*. Civil Engineering seminar series at Delft University, Delft, The Netherlands, November 30. INVITED, PRESENTED.

Langevin, C.D. 2023. *Squeezing Water from a Rock: Unveiling recent groundwater modeling advances with MODFLOW 6*. Online presentation to the Pacific Northwest (PNW) Groundwater Modeling Group, September 21. INVITED, PRESENTED.

Langevin, C.D. 2023. *Recent MODFLOW developments*. Online presentation to the Japan Ground Water Technology Association, September 6. INVITED, PRESENTED. *NOTEWORTHY – This was a 3-hour seminar, translated real-time into Japanese, to a large group of scientists and engineers*.

Panday, S., and Langevin, C.D. 2023. *Capabilities and functionality of MODFLOW-USG, USGTRANSPORT, and MODFLOW 6*. Online presentation to Groundwater Resources Association (GRA) of California, GRA 101 Week, July 17-21. INVITED.

Langevin, C.D. 2023. *FloPy, a Python package for creating, running, and post-processing MODFLOW-based models*. Online presentation to the Pacific Northwest (PNW) Groundwater Modeling Group, April 20. INVITED, PRESENTED.

Hughes, J.D., Russcher, M., Langevin, C.D., and Larsen, J. 2023. *MODFLOW application programming interface for coupling MODFLOW 6 to other model components*. Presented online to the 2nd PEST Conference, La Jolla, CA, March 6-10. INVITED.

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M., Panday, S., Verkaik, J., Paulinski, S., Larsen, J., Reno, M., Bonelli, W., Merrick, D., and Hofer, J. 2023. *Current and planned development of the USGS modular hydrologic model*. Presented online to the 2nd PEST Conference, La Jolla, CA, March 6-10. INVITED, PRESENTED.

Panday, S., Langevin, C.D., Hughes, J.D., Provost, A.M., Niswonger, R.G., and Ibaraki, M. 2022. *Post-MODFLOW-USG – ten years after*. MODFLOW and More Conference, Princeton, NJ, June 5-8. INVITED, KEYNOTE.

Langevin, C.D., Hughes, J.D., Provost, A.M., Russcher, M., Panday, S., Verkaik, J., Paulinski, S., Larsen, J., Merrick, D., and Hofer, J. 2022. *Recent advances and future directions for the USGS modular hydrologic model*. MODFLOW and More Conference, Princeton, NJ, June 5-8. INVITED, KEYNOTE.

Langevin, C.D., 2022. *Overview of MODFLOW 6 capabilities for modeling flow, transport, and variable-density flow and transport*. Online webinar to the U.S. Army Corps of Engineers Groundwater Working Committee. May 16. INVITED, PRESENTED.

Hughes, J.D., Langevin, C.D., Russcher, Martijn, Provost, A.M., Panday, Sorab, White, J.T., Paulinski, and Morway E., 2021. *Flexible integrated surface-water/groundwater flow and transport modeling using MODFLOW 6*: 47th IAH Congress, Sao Paulo, Brazil, August 24. INVITED.

Langevin, C.D., 2021. *Advances in modeling groundwater flow and transport with MODFLOW*. Online presentation to the U.S. Environmental Protection Agency Contaminated Site Clean-Up Information (CLU-IN) Webinar, February 3. INVITED, PRESENTED. https://www.clu-in.org/conf/tio/ModFlow_020321/

Langevin, C.D., 2019. *USGS groundwater modeling software development*. Online presentation to the federal Advisory Committee on Water Information (ACWI), Subcommittee on Ground Water, November 18. INVITED, PRESENTED.

Langevin, C.D., Hughes, J.D., Provost, A.P., Sorab, Panday, Niswonger, R.G., Paulinski, S., Verkaik, Jarno, Russcher, Martijn, Morway, E., Bedekar, Vivek, Larsen, J., Black, A., and Witterick, W., 2019. *Ongoing MODFLOW development by the USGS and external collaborators*: Delft Software Days, Delft, Netherlands, November 4-15. INVITED, KEYNOTE.

Langevin, C.D., Panday, S., Provost, A.M., and Mancewicz, L. 2019. *New tools and approaches for simulating the effects of sea level rise on coastal aquifers*. Geological Society of America, National Meeting, Phoenix, AZ, September 22-25. INVITED, PRESENTED.

Langevin, C.D., Hughes, J.D., Provost, A.M., Panday, S., Niswonger, R.G., Paulinski, S., Verkaik, J., Russcher, M., Morway, E.D., Bedekar, V., Larsen, J., Black, A., and Witterick, W., 2019. *Ongoing MODFLOW development by the USGS and external collaborators*. MODFLOW and More, Golden, CO, June 2-5. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D., and Hughes, J.D., 2019. *The MODFLOW 6 modular hydrologic model*. Presentation to the Deltares technical staff, Utrecht, The Netherlands, April 1. INVITED, PRESENTED.

Langevin, C.D., 2018. *MODFLOW 6 as a framework for integrated hydrologic modeling*. Internal USGS Planning Meeting, Austin, TX, November 24-29. INVITED, PRESENTED.

Langevin, C.D., Provost, A.M, Hughes, J.D., and Panday, S. 2018. *Variable-density flow and transport in MODFLOW 6*. 2018 Salt Water Intrusion Meeting, Gdansk, Poland, June 18-22. INVITED, PRESENTED, KEYNOTE.

Langevin, C.D. 2018. *Lessons learned from over 30 years of MODFLOW software development*. EPANET Summit, Reston, VA, April 3. INVITED, PRESENTED. *Asked by the EPA to present on USGS MODFLOW development at a public meeting to discuss the future of the EPANET software for modeling water distribution systems.*

Langevin, C.D. 2017. *New groundwater modeling tools*: MODFLOW 6 and More. National Groundwater Association, Groundwater Summit, Nashville, TN, December 4-7. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D., 2017. *Overview of the MODFLOW Model*. Joint meeting between the USGS and the National Weather Service, National Water Center, Tuscaloosa, AL, November 30. PRESENTED, INVITED.

Langevin, C.D., 2017. *New groundwater modeling tools*: MODFLOW 6 and More. USGS Office of Groundwater Webinar, August 16. INVITED, PRESENTED.

Panday, Sorab, Langevin, C.D., Provost, A.M., and Bedekar, Vivek, 2017. *A hydraulic head formulation for density dependent flow and transport*. MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24. INVITED, KEYNOTE.

Langevin, C.D. 2017. *MODFLOW 6 status*. USGS Regional Groundwater Availability Project Workshop, San Diego, CA, March 21-22. INVITED, PRESENTED.

Langevin, C.D., Hughes, J.D., Banta, E.R., Niswonger, R.G., and Panday, Sorab, 2017. *MODFLOW 6: An object-oriented version of the U.S. Geological Survey's MODFLOW model*.

MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24. INVITED, KEYNOTE, PRESENTED.

Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, M., and Hughes, J.D., 2017. *Fundamentals and application of MODFLOW-USG, an unstructured grid version of MODFLOW*. Workshop Trinity College, Dublin, Ireland, February 28. INVITED.

Langevin, C.D., 2016. *Status and future directions of groundwater modeling in the USGS*, 2016 USGS National Groundwater Workshop, August 29-September 2, Reno, Nevada. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D., 2016. *The role of numerical models in understanding and managing coastal aquifers*. Michigan Technological University, Houghton, MI, October 10. INVITED, PRESENTED.

Hughes, J.D., Langevin, C.D., Niswonger, R.G., Panday Sorab, Banta, E.R., Provost, A.M., 2016. *The new MODFLOW MODFLOW 6*: Groundwater Resources of California Annual Meeting, Concord, California, September 29. INVITED.

Langevin, C.D., Cunningham, W., Hughes, J.D., Provost, A.M., Dawson, C., Niswonger, R., Clark, B., Watt, M., White, J., and Banta, E., 2016. *A national framework for groundwater modeling in the USGS*. USGS National Groundwater Workshop, Reno, NV, August 28-September 2. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D., Hughes, J.D., Panday, S., Provost, A., and Niswonger, R. 2016. *Past, present, and future directions for saltwater intrusion using SEAWAT*. SWIM-APCAMM 2016. 24th Salt Water Intrusion Meeting Proceedings Book, Cairns, Queensland, Australia, July 4-8. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D., 2016. *Navigating the new open data requirements: A plan for groundwater models*, USGS Office of Groundwater Webinar, USGS Headquarters, Reston, VA, May 12. INVITED, PRESENTED.

Langevin, C.D., 2015. *The next generation of MODFLOW, Workshop 2 for "Network on bridging the state of practice with the state of science of groundwater modeling,"* Arhus, Denmark, September 14. INVITED, PRESENTED.

Langevin, C.D., 2015. *A new MODFLOW framework for simulating multiple hydrologic processes*, USGS Office of Groundwater Webinar, USGS Headquarters, Reston, VA, August 13. INVITED, PRESENTED.

Langevin, C.D. 2015. *Modern software development, Workshop 1 for "Network on bridging the state of practice with the state of science of groundwater modeling,"* Colorado School of Mines, Golden, CO, May 28. INVITED, PRESENTED.

Panday, Sorab, Langevin, C.D., Hughes, J.D., Niswonger, R.G., and Banta, E.R., 2015. *The LNF model for a new object-oriented version of MODFLOW*. MODFLOW and More 2015: Modeling a Complex World, Golden, Colorado, May 31-June 3. INVITED, KEYNOTE.

Langevin, C.D., Hughes, J.D., Panday, Sorab, Banta, E.R., and Niswonger, R.G., 2015. *A new object-oriented framework for the U.S. Geological Survey's MODFLOW model*. MODFLOW and More 2015: Modeling a Complex World, Golden, Colorado, May 31-June 3. INVITED, KEYNOTE, PRESENTED.

Langevin, C.D. 2015. *USGS groundwater modeling efforts*, Presentation to Egyptian delegates visiting USGS Headquarters in Reston, VA, February 26. INVITED, PRESENTED.

Langevin, C.D. 2014. *The MODFLOW family of programs*, Department of Energy, Nevada Test Site, Las Vegas, NV, May 22. INVITED, PRESENTED.

Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, M., Hughes, J.D., 2013. *MODFLOW-USG and more*. MODFLOW and More 2013: Translating Science Into Practice, Golden, Colorado, June 2-5. INVITED.

Langevin, C.D., Panday, S., Hughes, J.D., Niswonger, R.G., Ibaraki, M., 2013. *Considerations for grid design with MODFLOW-USG*. MODFLOW and More 2013: Translating Science Into Practice, Golden, Colorado, June 2-5. INVITED, PRESENTED.

Langevin, C.D., Panday, S., Niswonger, R.G., Hughes, J.D., Ibaraki, M., 2011. *Local grid refinement with an unstructured grid version of MODFLOW*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, International Groundwater Modeling Center, Colorado School of Mines. INVITED, PRESENTED.

Panday, S., Niswonger, R.G., Langevin, C.D., Ibaraki, M., 2011. *An un-structured grid version of MODFLOW*. In MODFLOW and More 2011: Integrated Hydrologic Modeling – Conference Proceedings, June 5 – 8, International Groundwater Modeling Center, Colorado School of Mines. INVITED.

Langevin, C.D., Zygnerski, M.R., White, J.T., and Hughes, J.D. 2010. *Effect of sea-level rise on future coastal groundwater resources in southern Florida, USA*. SWIM21 – 21st Salt Water Intrusion Meeting Proceedings Book, Ponta Delgada, Azores, Portugal, June 21-26. INVITED, PRESENTED.

Langevin, C.D. 2009. *The groundwater modeling process*. Florida International University seminar series, Miami, FL, October 20. INVITED, PRESENTED.

Langevin, C.D., 2008. *An integrated model of surface and groundwater flow for evaluating the effects of competing water demands in Miami-Dade County*, South Florida Water Management District, West Palm Beach, Florida, November 21. INVITED, PRESENTED.

Langevin, C.D., 2008. *An integrated model of surface and groundwater flow for evaluating the effects of competing water demands in Miami-Dade County*, Miami-Dade County Water and Sewer Department, Miami, Florida, October 6. INVITED, PRESENTED.

Langevin, C.D. 2007. *Revisiting the "ASR Bubble in the Floridan Aquifer*." University of South Florida, October 19. Tampa, Florida. INVITED, PRESENTED.

Langevin, C.D., 2007. *Overview of South Florida: History and concerns*. Department of Interior Headquarters, Washington, D.C., October 10. INVITED, PRESENTED.

Langevin, C.D., 2007. *Overview of South Florida: History and concerns*. USGS National Headquarters, October 10, Reston, Virginia. INVITED, PRESENTED.

Langevin, C.D. 2007. *The confounding effects of fluid density variations on coastal groundwater flow*, University of Alabama seminar series. Tuscaloosa, AL, February 7. INVITED, PRESENTED.

Thorne, D., Langevin, C.D., and Sukop, M.C., 2006. *MODFLOW/MT3DMS-based simulation of variable-density groundwater flow with simultaneous heat and solute transport*: Presented at the 2006 Conference on Computational Methods in Water Resources XVI, Copenhagen, Denmark, June 19-22. INVITED.

Langevin, C.D., Swain, E.D., and Wolfert, M., 2003. *Flows, Stages, and Salinities: How Accurate is the SICS Integrated Surface-Water/Ground-Water Flow and Transport Model?* Presented to the Steering Committee of the U.S. Geological Survey's Place-Based Studies Program, Miami, Florida, August 27. INVITED, PRESENTED.

Langevin, C.D., Swain, E.D., and Wolfert, M.A., 2003. *Flows, stages, and salinities: How accurate is the SICS integrated surface-water/ground-water flow and transport model?* Presented at the Joint Conference on the Science and Restoration of the Greater Everglades and Florida Bay Ecosystem, Westin Innisbrook, Palm Harbor, Florida, April 13-18. INVITED, PRESENTED.

Swain, E.D., Langevin, C.D., and Wolfert, M.A., 2003. *Developing a computational technique for modeling flow and transport in a density dependent coastal wetland/aquifer system*. Presented at the Joint Conference on the Science and Restoration of the Greater Everglades and Florida Bay Ecosystem, Westin Innisbrook, Palm Harbor, Florida, April 13-18. INVITED.

Schaffranek, R.W., Jenter, H.L., A.L. Riscassi, Langevin, C.D., Swain, E.D., and Wolfert, M.A., 2003. *Applications of a Numerical Model for Simulation of Flow and Transport in Connected Freshwater-Wetland and Coastal-Marine Ecosystems of the Southern Everglades*. Presented at the Joint Conference on the Science and Restoration of the Greater Everglades and Florida Bay Ecosystem, Westin Innisbrook, Palm Harbor, Florida, April 13-18. INVITED.

Langevin, C.D., 2001. *Numerical simulation of submarine groundwater discharge to a marine estuary: An example from southern Florida, USA*. 1st International Conference on Saltwater Intrusion and Coastal Aquifers: Monitoring, Modeling, and Management SWICA-M3, April 22-25, Essaouira, Morocco. PRESENTED.

Langevin, C.D., 2000. *Ground-water discharge to Biscayne Bay*. U.S. Geological Survey Program on the South Florida Ecosystem: 2000 Proceedings, U.S. Geological Survey Open File Report 00449, p. 29. INVITED, PRESENTED.

Langevin, C.D., 2000. *Ground-water discharge to Biscayne Bay*. Greater Everglades Ecosystem Restoration (G.E.E.R.) Science Conference, December 11-15, Naples, Florida, INVITED, PRESENTED.

Langevin, C.D., and Guo, W., 1999. *Improvements to SEAWAT, a variable-density modeling code*. American Geophysical Union Fall meeting Abstracts Volume, December 13-17, San Francisco, CA. PRESENTED,

Langevin, C.D., 1999. *Ground-water flows to Biscayne Bay*. In U.S. Geological Survey Program on the South Florida Ecosystem. Proceedings of South Florida Restoration Science Forum, May 17-19, Boca Raton, Florida. U.S. Geological Survey Open File Report 99-181. p58-59. INVITED, PRESENTED.

Langevin, C.D., Vacher, H.L., and Stewart, M.T., 1994. *Numerical model of porewater fluxes in a hypothetical mud island*. Geological Society of America Abstracts with Programs, Southeastern Section Meeting, April 7-8, Blacksburg, VA. PRESENTED.

CONTRIBUTED PRESENTATIONS

Kollet, S., Condon, L., Houben, G., Gurmessa, S., Langevin, C.D., MacDonald, A., and Zheng, C. 2024. *Groundwater modeling in the Global Energy and Water Exchanges (GEWEX) project: Closing the terrestrial water cycle from the regional to the global scale*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Vazquez-Gasty, S., Panday, S., Roy, T., Russcher, M., Provost, A.M., Langevin, C.D., and Hughes, J.D. 2024. *Exploring variably saturated flow formulations for MODFLOW*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Reno, M., Langevin, C.D., Hughes, J.D., Paulinski, S., Russcher, M., and Bonelli, W.P. 2024. Integrated support for NetCDF in MODFLOW. MODFLOW and More Conference, Princeton, NJ, June 2-5, 2024.

Russcher, M.J., Hughes, J.D., Langevin, C.D., Provost, A.M., Verkaik, J., Bonelli, W.P., Larsen, J., Morway, E.D., and Reno, M. 2024. *Parallel computing with MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Morway, E.D., Provost, A.M., Langevin, C.D., Hughes, J.D., Russcher, M.J., Chen, C.Y., Bonelli, W., Reno, M., and Lin, Y.F. 2024. *Heat transport modeling with MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Provost, A.M., Bardot, K., Langevin, C.D., and McCallum, J. 2024. *Improving the accuracy of MODFLOW 6 flow simulations by ensuring adequate cell connectivity and accounting for flow refraction*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Chen, C.Y., Morway, E.D., Provost, A.M., Langevin, C.D., Hughes, J.D., and Lin, Y.F. 2024. *Demonstration of the new MODFLOW 6 heat-transport model in simulations of 1D vertical heat propagation through the unsaturated and saturated zones driven by transient surface temperature and precipitation*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Bonelli, W.P., Provost, A.M., Langevin, C.D., Hughes, J.D., and Russcher, M.J. 2024. *A fully integrated particle tracking (PRT) model for MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Bakker, M., Panday, S., Falta, R., Lemon, A., Langevin, C.D., Hughes, J.D., and Patterson, C.. 2024. *Towards a reduced-order formulation for seawater intrusion in MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 2-5.

Chen, C.Y., Morway, E.D., Provost, A.M., Langevin, C.D., Hughes, J.D., and Lin, Y.F. 2024. *Testing MODFLOW 6 GWE model on 1D vertical Stallman problem and 2D multi-Scale Tothian groundwater system for heat transport through unsaturated zone*. Online presentation to the Illinois State Water Survey (ISWS) Groundwater Section, January 25.

Morway, E.D., Provost, A.M., Langevin, C.D., Hughes, J.D., Russcher, M.J., Chen, C.Y., and Lin, Y.F. 2023. *A new Groundwater Energy (GWE) transport model for the MODFLOW 6 hydrologic simulator*. American Geophysical Union Fall Meeting, San Francisco, CA, December 11-15.

Hofer, J., Hughes, J.D., Langevin, C.D., and Russcher, M.J. 2022. *Exploring the PETSc Toolkit for solving hydrologic models with MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 5-8.

Russcher, M.J., Hughes, J.D., Langevin, C.D., Provost, A.M., and Verkaik, J. 2022. *Generalized model coupling in MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 5-8.

Provost, A.M., and Langevin, C.D. 2022. *The role and benefits of the XT3D capability in groundwater flow and transport modeling using MODFLOW 6*. MODFLOW and More Conference, Princeton, NJ, June 5-8.

Larsen, J.D., Langevin, C.D., Hughes, J.D., Niswonger, R.G. 2022. *Simulating irrigated agriculture in MODFLOW 6 through the MODFLOW Application Programming Interface*. MODFLOW and More Conference, Princeton, NJ, June 5-8.

Hughes, J.D., Russcher, M., Langevin, C.D., McDonald, R.M., and Hofer, J. 2022. *MODFLOW application programming interface for coupling MODFLOW 6 to other model components*. MODFLOW and More Conference, Princeton, NJ, June 5-8.

Mancewicz, L., Langevin, C.D., Mayer, A., and Gulley, J., 2019. *Methods for representing lake formation in an island setting with sea level rise: a comparison of alternative approaches*. Geological Society of America Annual Meeting, Phoenix, AZ, September 22-25.

Verkaik, J., Hughes, J.D., Langevin, C.S., and Russcher, M., 2019. *Parallel groundwater modeling using MODFLOW 6*. MODFLOW and More, Golden, CO, June 2-5.

Bedekar, V., Scantlebury, L., Panday, S., and Langevin, C.D. 2019. *Axisymmetric modeling with unstructured grids of MODFLOW*. MODFLOW and More, Golden, CO, June 2-5.

Provost, A.M., and Langevin, C.D. 2019. *Generalization of Pollock's particle-tracking method for unstructured MODFLOW 6 grids*. MODFLOW and More, Golden, CO, June 2-5.

Verkaik, Jarno, Hughes, J.D., Langevin, C.D., Russcher, Martijn, 2019. *Parallel Groundwater Modeling using MODFLOW 6*: MODFLOW and More 2019: Groundwater Modeling and Beyond, Golden, Colorado, June 2-5.

Provost, A.M., and Langevin, C.D., 2018. *A semi-analytical particle-tracking method for groundwater flows simulated on unstructured control-volume finite-difference grids*. 2018 AGU Fall Meeting, December 10-14, Washington, D.C.

Langevin, C.D., Hughes, J.D., Provost, A.M., Niswonger, R.G., and Panday, S., 2018. *The MODFLOW 6 hydrologic model*. National Groundwater Association, Groundwater Week Summit, Las Vegas, NV, December 3-6. PRESENTED.

Verkaik, Jarno, Hughes, J.D., and Langevin, C.D., 2018, *Parallel Groundwater Modeling using MODFLOW 6*. 2018 AGU Fall Meeting, December 10-14, Washington, D.C.

Hughes, J.D., and Langevin, C.D., 2018. *Aquifer compaction – a threat to coastal aquifers*. Proceedings of the 25th Salt Water Intrusion Meeting, Gdan´sk, Poland, June 17-22.

Hughes, J.D. and Langevin, C.D., 2017. *Hyper-Resolution Groundwater Modeling using MODFLOW 6*. 2017 AGU Fall Meeting, December 11-15, New Orleans, Louisiana.

Provost, A.M., Langevin, C.D., and Hughes, J.D., 2017. *The "XT3D" option for simulating fully three-dimensional anisotropy on regular and irregular MODFLOW 6 grids*. MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24.

Hughes, J.D., Langevin, C.D., Panday, Sorab, Banta, E.R., Provost, A.M., and Niswonger, R.G., 2017. *Use of the advanced packages and demand-based boundary flows in the MODFLOW 6 Groundwater Flow Model*. MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24.

Hughes, J.D., Langevin, C.D., Banta, E.R., Provost, A.M., Niswonger, R.G., and Panday, Sorab, 2017. *Use of MODFLOW 6 to Simulate Demand-Based Boundary Flows*. 2017 Groundwater Resources Association of California – Tools for developing SGMA Groundwater Sustainability Plans, Modesto, California, May 3-May 4.

Hughes, J.D., Bakker, M., Schaars, F., and Langevin, C.D. 2016. *Development of an unstructured sharp-interface model for MODFLOW*. SWIM-APCAMM 2016. 24th Salt Water Intrusion Meeting Proceedings Book, Cairns, Queensland, Australia, July 4-8.

Masterson, J.P., Walter, J.P., and Langevin, C.D., 2015. *Effects of sea-level rise on coastal aquifer systems – potential economic and ecological impacts*, Eastern U.S., Geological Society of America, Baltimore, MD, November 1-4.

Langevin, C.D., Hughes, J.D., Panday, Sorab, Banta, E.R., and Niswonger, R.G., 2015. *An object-oriented framework for consolidating MODFLOW functionality*: AQUA 2015 – 42nd IAH Congress – Hydrogeology: Back to the Future, Rome, Italy, September 13-18.

Hughes, J.D., Bakker, Mark, White, J.T., Langevin, C.D., Post, Vincent, Fienen, M.N., and Starn, J.J., 2015. *FloPy Version 3 – a Python package for MODFLOW-based models*: MODFLOW and More 2015: Modeling a Complex World, Golden, Colorado, May 31-June 3.

Hughes, J.D. and Langevin, C.D., 2015. *Simulating multi-aquifer wells using a new object-oriented version of MODFLOW*: MODFLOW and More 2015: Modeling a Complex World, Golden, Colorado, May 31-June 3.

Professional and Scientific Service

SCIENTIFIC REVIEW PANELS

Technical Advisor – Aquifer Storage and Recovery Project Development Team of the Comprehensive Everglades Restoration Plan, 2000-2005.

Expert consultant for the Bureau of Indian Affairs – SEAWAT modeling study, Lummi Indian Reservation, Washington State, November, 2002.

International expert consultant – United Nations Food and Agricultural Organization, Rabat, Morocco. Met in person with government ministry hydrologists and university professor from July 22-August 4, 2002. Served as an international expert on saltwater intrusion for the Moroccan government applying SEAWAT to examine water supply issues for two coastal aquifers in Morocco.

Participant – an international committee to "bridge the state of practice with the state of science of groundwater modeling." This projected was funded by the Danish International Network Programme for the 2015 calendar year. Attended two meetings (one in Golden CO, and one at Arhus University, Denmark) and prepared a written report with recommendations for improving the way research is translated into practice.

Team member and coauthor – Office of Groundwater *Technical Memorandum 2015.02 — Policy and guidelines for archival of surface-water, groundwater, and water-quality model applications*, December 5, 2014.

Team leader and lead author – Office of Groundwater *Technical Memorandum 2016.02— Policy for documenting, archiving, and public release of numerical groundwater flow and transport models*, September 30, 2016.

Team member – groundwater model archive policy. This resulted in all new USGS groundwater models being publicly available on the web. As of October 29, 2024, a total of 212 groundwater models have been released based on this policy. The list of models can be accessed by searching "usgsgroundwatermodels" on data.gov.

Steering group member – Groundwater Network of the Global Energy and Water Exchanges (GEWEX) program. January 2024 through present. Website: https://www.wcrp-climate.org/gewex

EDITORIAL

Associate Editor, Groundwater Journal. 2006–Present

CONFERENCES

Scientific Committee Member – 2025 Salt Water Intrusion Meeting, Barcelona, Spain, June 9-13, 2025.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More Conference, Princeton, NJ, June 2-5, 2024.

Scientific Committee Member – MODFLOW and More Conference, Princeton, NJ, June 5-8, 2022.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More, Golden, CO, June 2-5, 2019.

Scientific Committee Member and Session Chair for multiple sessions – 2018 Salt Water Intrusion Meeting, Gdansk, Poland, June 18-22, 2018.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24, 2017.

Session Chair – Groundwater Modeling to Support Water Management Decisions, USGS National Groundwater Workshop, August 29 – September 2, 2016, Reno, NV.

Scientific Committee Member and Session Chair for multiple sessions – 24th Salt Water Intrusion Meeting, Cairns, Queensland, Australia, July 4-8, 2016.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More Conference, May 31-June 3, 2015, Golden, CO.

Scientific Committee Member and Session Chair for multiple sessions – 2014 Salt Water Intrusion Meeting, Husum, Germany, June 16-20, 2014

Session Chair H062 – Open-Source Programming, Scripting, and Tools for the Hydrological Sciences, American Geophysical Union 2013 Fall Meeting, December 9-13, 2013, San Francisco, CA.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More 2013: Translating Science Into Practice, Golden, CO, June 2-5, 2013.

Session Co-chair, H51L – Measurement, Modeling, and Management of Coastal Aquifers, American Geophysical Union 2012 Fall Meeting, December 3-7, 2012, San Francisco, CA.

Scientific Committee – 2012 Salt Water Intrusion Meeting, Buzios, Brazil, June 17-22, 2012.

Scientific Committee Member and Session Chair for multiple sessions – MODFLOW and More Conference, Golden, Colorado, June 5-8, 2011.

Session Chair – MODFLOW: An Evolving Standard, 2011 Ground Water Summit and 2011 Ground Water Protection Council Spring Meeting, May 2-4, 2011, Baltimore, MD.

Co-chair – 21st Salt Water Intrusion Meeting, Azores, Portugal, June 21-26, 2010.

Chair and Lead conference organizer – 20th Salt Water Intrusion Meeting (SWIM), Naples, Florida, June 23-27, 2008. http://www.swim-site.nl/pdf/swim20.html

Co-chair – IAHS/IAPSO Symposium, A new focus on groundwater-seawater interactions, IUGG2007, the XXIV General Assembly of the international Union of Geodesy and Geophysics, Perugia, Italy, July 2-13, 2007.

Panel Member on saltwater intrusion discussion – 5th Washington Hydrogeologic Symposium, Tacoma, WA, April 12-14, 2005.

JOURNAL REFEREE

Frequent reviewer of journal articles for a wide variety of journals, mostly within the hydrology subject.

Academic Service

COURSES AND SEMINARS – TECHNICAL TRAININGS

Course coordinator and lead instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), San Diego, CA, January 4-8, 2025.

Instructor – Advanced Modeling of Groundwater Flow (GW3099), Boise, ID, September 16-20, 2024.

Lead instructor – MODFLOW Workshop, Offered as part of the Hydrogeology Field Camp, ESci4971W/5971, Earth and Environmental Sciences, University of Minnesota, August 13, 2024.

Course coordinator and lead instructor – MODFLOW 6 and FloPy: Take Your Modeling Skills to the Next Level, workshop offered as part of the 2024 MODFLOW and More Conference, Princeton, NJ, May 31-June 1, 2024.

Course coordinator and lead instructor – Python for Hydrogeology, workshop offered as part of the 14th Washington Hydrogeology Symposium, Auburn, WA, April 25, 2024.

Instructor – Python Programming Language and Groundwater Modeling (GW1774), Albuquerque, NM, January 29-February 2, 2024.

Instructor – Parallel MODFLOW, Delft, The Netherlands, November 27-December 1, 2023.

Course coordinator and lead instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), Memphis, TN, September 11-15, 2023

Instructor – Running Parallel MODFLOW on Denali, Lakewood, CO, July 13-14, 2023.

Course coordinator and lead instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), San Diego, CA, January 9-13, 2023

Instructor – Take your groundwater modeling skills to the next level with FloPy and Python, MODFLOW and More 2019: Modeling for Sustainability and Adaptation, Golden, Colorado, June 2-5, 2019.

Course coordinator and lead instructor – Introduction to groundwater flow modeling with MODFLOW 6, MODFLOW and More 2019: Modeling for Sustainability and Adaptation, Golden, Colorado, June 2-5, 2019.

Course coordinator and lead instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), San Diego, CA, May 20-24, 2019

Instructor – FloPy and MODFLOW 6 workshop, Delft, the Netherlands, March 25-29, 2019

Instructor – Advanced Modeling of Groundwater Flow (GW3099), Lincoln, NE, October 22-26, 2018.

Course coordinator and lead instructor – Groundwater flow and solute transport modeling, course requested by the U.S. Navy, Naval Facilities Engineering Systems Command (NAVFAC), Port Hueneme, CA, August 2018.

MODFLOW 6 Learning session – Workshop offered at the 2018 Chlorinated Conference, Palm Springs, CA, April 8-12, 2018.

Modeling saltwater intrusion – SWIM, Gdansk, Poland, June 12-16, 2018.

Instructor – Python Programming Language and Groundwater Modeling (GW1774), USGS National Training Center, Lakewood, CO, February 2018

Instructor – FloPy: Python Package for Creating, Running, and Post-Processing MODFLOW-based Models, National Groundwater Association, Groundwater Week, Nashville, TN, December 3-8, 2017.

Instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), Portland, OR, September 11-15, 2017.

Instructor – Take your groundwater modeling skills to the next level with FloPy and Python, MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24, 2017.

Course coordinator and lead instructor – Introduction to groundwater flow modeling with MODFLOW 6, MODFLOW and More 2017: Modeling for Sustainability and Adaptation, Golden, Colorado, May 21-24, 2017.

Instructor – MODFLOW 6: A hydrologic simulation framework for solving structured and unstructured groundwater flow problems, 2016 USGS National Groundwater Workshop, Reno, NV, August 29-September 2, 2016.

Instructor – Making sense of the new Open Data Policy Metadata and USGS Data Releases for the masses, 2016 USGS National Groundwater Workshop, Reno, NV, August 29-September 2, 2016.

Course coordinator and lead instructor – SEAWAT/SWI training course, Groundwater in coastal zones: modeling and measurement, offered at the 24th Salt Water Intrusion Meeting, Cairns, Queensland, Australia, June 28 – July 2, 2016.

Instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), Reston, VA, May 16 20, 2016.

Course coordinator and instructor – Python Programming Language and Groundwater Modeling (GW1774), San Diego, California, August 3-7, 2015.

Coordinator and instructor – Python Programming Language and Groundwater Modeling, Honolulu, Hawaii, April 30-May 1, 2015.

Instructor – Python Programming Language and Groundwater Modeling (GW1774), Portland, Oregon, February 2015.

Instructor – Advanced Modeling of Groundwater Flow (GW3099), led sessions on (1) Modeling Needs, (2) MODFLOW-USG, (3) GitHub, and (4) an overview of MODFLOW 6, Lakewood, Colorado, November 2014.

Instructor – Five-day training class titled “Introduction to Groundwater Modeling Using MODFLOW (GW2096)”, Reston, VA, June 2-6, 2014. Co-instructors: Dave Pollock, Joseph Hughes, and Tom Reilly.

Course coordinator and instructor – Groundwater Modeling and Python (GW1774), Tucson, Arizona, May 5-9, 2014.

Instructor – Using Python to improve GW modeling effectiveness, Python Basics, USGS National Groundwater Workshop, Denver, CO. August 9, 2012.

Lead instructor – Workshop on recent MODFLOW developments, offered at the 2012 USGS National Groundwater Workshop, Denver, CO, August 6, 2012.

Instructor – Introduction to Groundwater Modeling Using MODFLOW (GW2096), Tucson, AZ, April 30May 4, 2012.

Instructor – Advanced Modeling of Groundwater Flow (GW3099), USGS National Training Center, Denver, CO, November 15-19, 2010.

Lead instructor – SEAWAT training course, Introduction to Three-Dimensional Variable-Density Groundwater Modeling Using SEAWAT, offered at the 21st Salt Water Intrusion Meeting, June 21-26, 2010, Ponta Delgada, Azores, Portugal.

Instructor – Half-day SEAWAT workshop at the U.S. Geological Survey, National Ground Water Meeting, August 2008.

Lead Instructor – 1-week USGS NTC Course ID1392, Introduction to Three-Dimensional VariableDensity Groundwater Modeling Using SEAWAT, February 26-March 2, 2007, Fort Lauderdale, FL.

Instructor – USGS NTC Course GW2099, Advanced Modeling of Ground Water, October 30 November 3, 2006, San Diego, CA.

Instructor – Saltwater intrusion modeling workshop, SWIM-SWICA Conference, Cagliari, Italy, September 24, 2006.

Field Trip Guide – Everglades National Park, May 2005. Presented the geology and hydrogeology of south Florida to undergraduate students from the University of South Florida.

Instructor – Half-day SEAWAT workshop at the 5th Washington Hydrogeologic Symposium, April 12-14, 2005, Tacoma, Washington.

Lead Instructor – 1-week USGS NTC Course ID1392, Introduction to Three-Dimensional VariableDensity Groundwater Modeling Using SEAWAT-2000, February 14-18, 2005, Fort Lauderdale Beach, FL.

Instructor – Half-day SEAWAT workshop at the U.S. Geological Survey, National Ground Water Meeting, June 24, 2004.

Field Trip Guide – Everglades National Park, May 2004. Presented the geology and hydrogeology of south Florida to undergraduate students from the University of South Florida.

Lead Instructor – 1-week SEAWAT Training Course, August 11-15, 2003, South Florida Water Management District, West Palm Beach, FL.

Instructor – SEAWAT training session, U.S. Geological Survey, Water Resources Division, Massachusetts District Office, Northborough, MA, February 21-23, 2001.

Instructor – Training session on Groundwater Vistas, U.S. Geological Survey, Water Resources Division, Texas District Office, Austin, TX. September 7-8, 2000.

Instructor – half-day SEAWAT workshop at the University of South Florida, August 25, 2000, Tampa, Florida.

Vivek Bedekar, Ph.D., P.E.

Associate, Engineer

Dr. Bedekar is a water resources and environmental consultant with experience working on a variety of modeling and software development projects. His experience includes the development of numerous local and regional models, surface-water/groundwater interaction models, flow-and-transport models, and variable density models. He has developed numerous modeling codes and is the lead author of MT3D-USGS. Dr. Bedekar publishes research papers, provides peer reviews, and instructs at modeling and software training courses.

REPRESENTATIVE EXPERIENCE

S.S. Papadopulos & Associates, Inc. *– Rockville, Maryland*

Airborne Electromagnetic (AEM) Survey Data Application, Department of Water Resources (DWR), California: In collaboration with Woodard & Curran, the project involves the development of methods, utility tools, documentation, and case studies with application of AEM data. The first phase of the project is currently underway.

Delayed-Subsidence in Integrated Water Flow Model (IWFM), California Department of Water Resources (DWR): Developed numerical code within DWR's IWFM flow simulator for DWR's Bay Delta Office. The code development accounted for delayed effect of pumping on storage change within clay interbeds that results in land subsidence. A technical memorandum provided to the DWR summarized mathematical formulation, numerical implementation, and examples.

Goleta Groundwater Basin, California: Assisted senior staff in support of a litigation matter. Reviewed models developed using several alternate groundwater and land surface models, including MODFLOW-SURFACT, Parflow-CLM, and DPWM. Supported evaluations of model development, recalibration, assessment of appropriate boundary conditions, and review of hydrogeology to develop a thorough understanding of the hydrogeologic system. Also performed water budget assessment, particle tracking, and solute transport simulations.

Monterey Peninsula Water Supply Project, California Marine Sanctuary Foundation: Teamed with Weiss Associates for a project that involved the calculation of freshwater captured by slant wells proposed for a desalination plant. The desalination plant would incur penalties for any freshwater captured by the withdrawal wells. An existing flow model was utilized, and boundary conditions and parameters were modified to perform sensitivity analysis and meet project objectives. In place of the original methodology of particle tracking used by the previous version of the model to assess flow paths, MT3D was used to identify the source of water and to quantify the amount of saltwater captured by the pumping wells.

South Fork Eel River Model, State Water Resources Control Board (SWRCB), California: Lead groundwater modeler for developing two integrated groundwater-surface water models for SWRCB in collaboration with Paradigm Environmental. LSPC was integrated with MODFLOW-USG to simulate the effects of pumping on instream flow. The calibrated model provided the basis for instream temperature modeling.

Shasta River Model, State Water Resources Control Board (SWRCB), California: Lead groundwater modeler for developing two integrated groundwater-surface water models for SWRCB in collaboration with Paradigm Environmental. LSPC was integrated with MODFLOW-NWT to simulate the effects of pumping on

YEARS OF EXPERIENCE

25+

EDUCATION

- **PhD**, Civil Engineering, Auburn University, 2019
- **MS**, Environmental Engineering, Indian Institute of Technology, 2001
- **BS**, Civil Engineering, University of Pune, India, 1998

REGISTRATION

- Professional Civil Engineer, Washington District of Columbia No. PE904565

EXAMPLE AREAS OF EXPERTISE

- Flow and Transport Modeling
- Numerical Software Development
- Surface Water-Groundwater Modeling
- MODFLOW, MT3D, and IWFM Development

AWARDS AND HONORS

- DAAD scholarship for master's project, Institute for Hydraulics and Water Resource Management, RWTH-Aachen, Germany: 2000–2001
- Gold Medal awarded for best academic performance in MS, Department of Civil Engineering, Indian Institute of Technology (IIT), Madras, India: 1999–2001

APPOINTMENTS

- 2023 – 2024: Co-convener, California Water and Environmental Modeling Forum (CWEMF), California
- 2023: Chair, GRACast subcommittee, Groundwater Resources Association (GRA), California

Continued on next page

instream flow. The model provides a scientific basis for making a variety of groundwater management decisions.

Sacramento Valley Model (SVSim), California Department of Water Resources (DWR): The Sacramento Valley model (SVSim) was calibrated in a stepwise systematic manner, by first targeting water budgets, then calibrating land use parameters, and finally calibrating aquifer parameters. This holistic approach helped obtain a reasonably calibrated model for estimating reliable water budgets, calibrating the model to streamflow and groundwater heads. Sensitivity analysis was also performed. Cluster analysis was performed to assess groundwater head trends and the identified trends called type-hydrographs were utilized as additional calibration targets. Aquifer parameters were developed utilizing sediment texture data with the use of the Texture2Par utility. Valley-wide water budgets were calculated using time-series analysis and reviewing CalSim reports. Issues in the IWFM code were identified and feedback on the IWFM code with respect to convergence and robustness was provided to DWR. Code changes in IWFM were made to accommodate variable wetted perimeter and dynamic connection to GW over wide stream reaches. Model comparisons with Femflow3D were performed. The model was applied to estimate stream depletion caused by pumping. Two technical memorandums were written at the conclusion of this project.

Fine-grid Central Valley Model (C2VSim-FG), California Department of Water Resources: Model calibration of the central valley model, C2VSim-FG, was performed using parameter estimation software, PEST. Groundwater head data was synthesized using cluster analysis to identify short- and long-term temporal trends from groundwater level data available for more than ten-thousand wells and the developed type-hydrographs were used as additional calibration targets. Texture2Par utility was used for developing aquifer parameters based on sediment-based texture data. A technical memorandum was produced at the conclusion of the project.

Texture2Par Utility Development: An open-source utility, Texture2Par, was developed to calculate aquifer parameters based on sediment-based texture data. Power-law averaging is used to compute bulk aquifer parameters based on percent coarse information available from well log texture data and relevant aquifer parameter model input files for MODFLOW or IWFM are written by the utility. Texture2Par incorporates capability to implement depth-decay of hydraulic conductivity. The standalone utility can also be incorporated seamlessly within the parameter estimation software, PEST. Sediment-based aquifer parameters can be varied and interpolated between pilot points.

Kings River Conservation District Model Conversion, California: Converted an existing surface-water/groundwater interaction model (originally developed using IGSM) to California Department of Water Resources' IWFM modeling code. The model was extended in time with new data, finer vertical discretization was added, and the model was recalibrated to root- zone water requirements and groundwater head and surface-water flow measurements. The model calculated regional budgets, stream flows, and groundwater hydrographs using irrigation data, crop distribution, and dynamically changing land-use. This model will be used as a scientifically based management tool to evaluate various Integrated Regional Water Management Plan projects.

Daly City, California: Developed a solute transport model for the assessment of fate and transport of methyl tertiary butyl ether (MTBE) and tert-butyl-alcohol (TBA) in the subsurface released at a gas station. The numerical model developed using MT3D-USGS simulated the production of TBA resulting from the degradation of MTBE and the movement of both plumes in groundwater;

Continued from previous page

- 2022: Co-chair, GRACast subcommittee, Groundwater Resources Association (GRA), California
- 2021 – 2023: External faculty in the Civil Engineering Department at the University of Memphis (three-year term)
- 2017: Member, Scientific Advisory Committee, Seventh International Groundwater Conference (IGWC-2017), Coimbatore, India, February.
- 2016: Judge for NASA's Special Award at 35th Annual Loudoun County Public Schools Regional Science & Engineering Fair (RSEF), Freedom High School, March.
- 2013 – 2015: Committee Member, Loudoun County Water Resources Technical Advisory Committee, Virginia.
- 2012: Panel Member, International Groundwater Conference (IGWC) panel on fracture flow modeling and issues related to local farmers, Aurangabad, India.

PROFESSIONAL HISTORY

- S.S. Papadopulos & Associates, Inc.: 2008–present
  - Associate: 2023–present
  - Senior Engineer: 2020–2023
  - Senior Project Engineer: 2008–2020
- University of Memphis, External Graduate Faculty: 2021–2023
- HydroGeoLogic, Inc., Senior Engineer: 2001–2008
- Shashi Prabhu and Associates, Civil Engineer: 1999

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and provided projections of long-term concentrations of both MTBE and TBA in the subsurface.

Livermore Valley Groundwater Basin Surface-Water Transport in MT3D, California: Added surface-water transport capability to MT3DMS to simulate contaminant transport in surface-water features, particularly to work with the lake (LAK) and the stream flow routing (SFR) packages of MODFLOW. Capability was also added to these packages to interact with the unsaturated zone transport in the case where the vadose zone is simulated using the unsaturated-zone flow (UZF) package of MODFLOW. A flexible numerical solution was implemented to easily select a spatial and temporal weighting scheme. Solutions were compared to analytical solutions and OTIS as part of the verification process. This development was performed to provide Zone 7 a tool to develop salt-management strategies so that Zone 7 could use the capability of transport of salt between groundwater and surface-water features in the Livermore Valley Groundwater Basin.

Data and Model Review for Litigation, Orange County, California: Provided data and model reviews in support of a litigation case for evaluating the fate and source of VOC plumes.

Confidential Client, California: Assisted senior staff in support of a litigation matter. Reviewed models developed using several alternate groundwater and land surface models. Supported evaluations of model development, calibration, and application.

Confidential Client, California: Provided expert opinion to a confidential client in support of a litigation matter. A Declaration was provided that demonstrated the connection between groundwater pumping wells and streamflow depletion, which formed the basis for judgement in the matter.

Confidential Client, California: Developed MODFLOW 6 models to evaluate the fate and transport of injectate from UIC wells. Benchmarked aspects of model against analytical solutions before implementing 3D models. Incorporated client's detailed 3D geologic model using sediment texture data to derive hydraulic conductivity using power law averaging.

Model Review, Gallup, New Mexico: Reviewed models to evaluate the accuracy of data, modeling results, and interpretations resulting from models that were created in support of pumping well permit applications by the City of Gallup. Impacts were evaluated on the water levels of wells in the vicinity of pumping wells owned by Tri-State Generation and Transmission Association, Inc.

Third-party Review of GULF and Groundwater Management Area 14 (GMA 14) Models, Lone Star Groundwater Conservation District, Conroe, Texas: Lead Reviewer for a groundwater model that is currently being developed for joint planning purposes for GMA 14, which partially or fully includes five GCDs and two subsidence districts.

Phoenix AMA Groundwater Model, Arizona: Calibrated the Phoenix AMA Groundwater Model for the Arizona Department of Water Resources. The model is used by AZ-DWR to assess groundwater conditions in the Phoenix AMA. The model is used by AZ-DWR to make basin-scale water availability projections into the future to achieve the objectives laid out in Arizona's Groundwater Management Act of 1980.

Confidential Client, Arizona: A third-party model review was performed for two different models in support of two litigation cases. The models were developed for source identification of pumped water. Expert reports and rebuttal comments were submitted; and appeared for depositions in both cases.

Texas Water Development Board: Teamed with WSP, created an online tool for TWDB for mapping statewide injectate migration in Class II injection wells. Literature review was performed for existing solution methodologies. Evaluated various numerical experiments to demonstrate the sensitivity of assumptions in the screening level analysis performed by the online mapping tool. Analytical solutions were implemented in the tool. The mapping tool was developed to work in coordination with other database processor tools developed by the teaming partner WSP that compiles well information from the Railroad Commission databases. Presented the methodology and tool at workgroup meetings comprised of close to 40 oil and gas, water resources, academic, and government professionals.

Texas Water Development Board – Aquifer Parameters: Managing an ongoing project for TWDB's groundwater modeling team to develop a statewide aquifer/well test data compilation. More than 150,000 PDF documents were evaluated, and relevant information was digitized and assembled in a database. A concerted stakeholder outreach effort was conducted by SSP&A and TWDB to obtain any aquifer or well pumping information available with organizations, agencies, GCDs, and other stakeholders. The TWDB documents and other data sources obtained from the stakeholder outreach were synthesized into usable, consistent, traceable and reproducible form.

MODFLOW-USG Development: Solute Transport in Lakes: Arcadis, Chile tasked SSP&A to add capability in MODFLOW-USG to simulate solute transport in lakes. The new capability added to the MODFLOW-USG code enables the simulation of solute transport within lakes, assuming instantaneous mixing within each lake, and their interaction with the underlying groundwater system.

The project was completed in collaboration with Dr. Sorab Panday.

MODFLOW-USG Development – Transient Domain and Transport Properties: In collaboration with Dr. Sorab Panday, added transient IBOUND capability; added transient transport properties capability; added an option to reorder matrix to solve only active nodes, reducing run-times proportional to number of active cells in the model.

Development of MT3D-USGS: In collaboration with U.S. Geological Survey (USGS), developed a new version of solute transport simulator, MT3D-USGS. This software is based on MT3DMS, developed by Dr. Chunmiao Zheng, but with new features in MT3D-USGS including simulation of transport in lakes and streams, a kinetic reaction module to simulate multiple electron-donors and acceptors, a contaminant treatment system package for simulating aboveground treatment and circulation of solutes, and unsaturated-zone transport. Other improvements include the handling transport in dry cells of MODFLOW-NWT and corrections to the storage formulation.

Red Hill Bulk Storage Facility, Hawaii: Provided technical guidance at the Facility regarding simulation of fuel components in the subsurface, and analyses of calculations made using MODFLOW-USG in particular, the main modeling code used at the Red Hill Facility by the Navy and its contractors.

Evaluation of Repetitive Sump Pump Failure at Private Residence, Maryland: The project involved the evaluation of the repetitive failure of a sump pump at a private residence. Analysis demonstrated that flow of water through alkaline fill material into the drains was causing the pump to fail. Tasks involved water level analysis in the vicinity of the residential property, model development to simulate groundwater flow to compute a drain elevation required to lower groundwater levels at the residential property to avoid the flow of water through the fill material.

Confidential Client, Atlanta: The project involved the release of organic compounds from a cleaning facility and the source identification associated with the contaminant release. The project involved reviewing data, expert reports, and depositions provided by subject matter experts. Tasks involved vadose zone modeling, developing analytical models for saturated zone transport, and linking the vadose and saturated zone models.

Confidential Client, North Dakota: Developed a flow and transport model to simulate the fate and transport of contaminants resulting from a pipeline leak. Sensitivity analyses were performed to evaluate parameter uncertainty and predicted results related to the percolation of contaminant at the site. Vadose zone modeling was also performed for additional analysis.

Confidential Client, Salisbury, Maryland: The project initially involved the evaluation of the reactive transport and fate of hexavalent chromium (Cr [VI]), which arose as the result of historical plating activities at a manufacturing facility, within an alluvial aquifer in Maryland. Tasks involved reactive transport analyses to assess short- and long-term remedial effectiveness and support long-term monitoring (LTM) design. Subsequently, the project also involved the delineation and mobility-assessment of light non-aqueous phase liquid (LNAPL); and evaluating the disposition, transport, and fate of chlorinated volatile organic compounds (CVOCs).

Nevada Energy: A 2D density-dependent flow and transport model was developed to assess the fate of a highly dense TDS plume. The objective of the model was to determine the timing and expected maximum concentration of TDS at the downstream end of the existing plume. The groundwater system in this case represented a 'theoretically' unstable system with a higher-density TDS plume overlying a relatively lower-density system in lower aquifer formations.

Analysis of Impact of Lakes on Subsurface Freshwater Resources of Low-lying Islands: Collaborative project with University of South Florida, Michigan Technological University, University of Florida, and SSP&A, exploring impacts of lake formation on low-lying islands resulting from inundation due to climate change. Research found that on low-lying islands with dry climates (evapotranspiration exceeds rainfall) freshwater storage can substantially decrease if sea level rise results in lake formation within interior topographic lows, splitting the freshwater lens and reducing available freshwater. Results were published in Geophysical Research Letters (Gulley *et al*, 2016). Follow up work included the evaluation of climate change impacts on small islands like the Abaco Island in The Bahamas.

Bannister Federal Complex Groundwater Model, Kansas City, Missouri: Developed a groundwater model as part of a comprehensive due diligence investigation of the Bannister Federal Complex (BFC) in Kansas City. The groundwater model assisted with the evaluation of redevelopment scenarios and evaluation of remedial alternatives and costs. Predictive results from the model were beneficial in identifying locations at the site that are prone to flooding during and post-demolition. Uncertainty analysis was performed using PEST to assess the range of possible groundwater levels in the anticipated flooding areas during the post-demolition phase. Predictive results were also used to design a well network to capture the plume. Analysis was also performed to assess the efficacy of slurry walls in maintaining inward head gradients.

New York State Department of Environmental Conservation, Elmont, New York: Co-developed capabilities in MT3DMS to simulate natural attenuation

processes using multi-species kinetic reactions. A general form of reaction equation was implemented in MT3DMS to simulate the consumption of multiple electron donors by multiple electron acceptors.

U.S. Department of Energy (DOE), Hanford, Washington: As part of a multi-firm team, contributed to the evaluation and development of remedial alternatives and strategies for RI/FS and post-ROD activities. Developed and applied modeling approaches for remedy design and analysis. Evaluated remedy performance using multiple lines of evidence approach. Evaluated the capacity of an infiltration pond with an axisymmetric model developed using MODFLOW-SURFACT and MODFLOW-USG. Developed MODFLOW, MT3D, and MODPATH as part of the DOE software approval process.

Treated Water Discharge Impact Evaluation, Freeland, Washington: Evaluated the impacts of discharging treated water on groundwater and surface water in the vicinity of an infiltration site. Developed a groundwater model using MODFLOW.

Halliburton Energy Services, Inc., Duncan, Oklahoma: Assisted Halliburton Energy Services, Inc. in their effort to investigate and remediate perchlorate contamination. Seepage from evaporation ponds containing perchlorate impacted groundwater beneath the site. Evaluation of the spread of a perchlorate plume and the development of potential source terms contributing to the plume were analyzed using MODFLOW, MT3D, and analytical models.

Evaluation of Corrosion Inhibitor Spreading, Cushing, Oklahoma: Evaluated the distribution and spreading of a vapor-phase corrosion inhibitor upon application in porous and permeable materials beneath large aboveground storage tanks at a petroleum tank farm. Constructed a flow-and-transport model (using MODFLOW-SURFACT) to simulate the migration of the aqueous solution injected beneath the tanks and the subsequent transport of the vapor-phase inhibitor compound in the sand pack air beneath the tanks.

Water Resource Assessment, White Bear Lake, Minnesota: Developed a transient integrated surface water – groundwater model based on USGS' NMLG model. The transient model evaluated potential reasons for declining lake levels in White Bear Lake and other lakes in the region. The model is being used by MDNR for predictive assessment and development of mitigation strategies. MODFLOW-NWT was utilized for groundwater modeling and Soil Water Balance (SWB) was utilized for simulating land surface processes. At the conclusion of the project, technology transfer was conducted to pass the model to MDNR staff; attended a public meeting in Minnesota that shared modeling results with stakeholders.

Model Review and Contamination Calculations, Great Neck, New York: Reviewed a DYNFLOW model and provided calculations of the mass and volume of contamination.

Hardage-Criner Superfund Site, Oklahoma: Performed flow-and-transport modeling in 2011 to analyze the migration of contaminants across Criner Creek, safe shut-down duration of V-trench, and decreasing flow rates in the V-trench, and future scenarios were performed through 2025 to evaluate the fate and transport of the VOC plume. Post-audit simulations were performed in 2021, ten years subsequent to the original model to evaluate the robustness of the model calibrated in 2011.

Agrico MODFLOW Model Evaluation for Litigation, Florida: Evaluated a MODFLOW model in support of a litigation case to estimate the impact of historical activity at a fertilizer plant on the local groundwater system.

Model Review, St Croix, Virgin Islands: Reviewed ARMOS, BioTrans, and MODFLOW-SURFACT models.

Dry Cell Problem of MODFLOW and MT3D: Developed MODFLOW, MT3D and MODPATH codes to handle dry cells in a numerically stable, robust, and efficient manner. Work primarily involved reformulation of governing equations to incorporate Newton-Raphson numerical techniques and addition of solvers to the MODFLOW code and to handle mass flowing through unsaturated cells in the MT3D code. Other features were also added, including recirculation for pump-and-treat systems and simple reaction module.

Development of a Source Screening Module: Developed an Excel module to implement an analytical solution for tracking transport from a contaminant source to a receptor well through the vadose zone and saturated zone. Documentation was completed for the Excel module. The module was then applied to onsite data to compare against STOMP results.

Data Management and Analyses, New York, NY: Managed data and performed analysis for a 60-acre urban area underlain by petroleum hydrocarbons. Mapped apparent product thickness and evaluated product recovery. Evaluated gradients caused by pumping activities.

CTS Package for MT3D: Developed a contaminant treatment system (CTS) module in MT3D. The objective of this project was to enable simulation of a typical pump-and-treat system and to represent mixing and reinjection of treated contaminated groundwater. Tasks involved planning, conceptualization, programming, testing, and preparing the documentation for the module.

MODFLOW Developments: Several features were added to MODFLOW: injection/extraction well management in WEL and MNW2 packages; adaptive time-stepping; nodal mass

balance for tracking local mass balance error; and general head boundary time series as part of the FHB package.

MT3D Developments and Related Research: Activities included:

- Adding chain decay and MONOD kinetics options; prescribed concentration boundary on the highest active node; separate Kd for mobile and immobile domains.
- Density-Dependent Reactive Transport Modeling Code Development: Ph.D. research at Auburn University, with Dr. Prabhakar Clement. Objective is to develop a simulation code to simulate density-dependent flow and reactive transport. These capabilities exist individually in separate codes, SEAWAT and RT3D. This project will combine these capabilities into one code to investigate the impact of density on reactive transport.
- Laboratory and Modeling Investigation of Saltwater Intrusion in Strip Islands: Ph.D. research at Auburn University, with Dr. Prabhakar Clement. Lab-scale sand-tank experiments were simulated using SEAWAT to study transient changes in freshwater lenses during dry and wet cycles were studied. The findings have been submitted to the journal Water Resources Research.

HydroGeoLogic, Inc. *– Reston, Virginia*

Upper Santa Clara River Chloride TMDL Collaborative Process, California: Developed a numerical model for the Upper Santa Clara River (USCR) watershed for the Santa Clarita Valley Sanitation District of Los Angeles County and the Los Angeles Regional Water Quality Control Board. The model evaluated the fate and transport of chloride in surface-water and groundwater basins of the USCR in accordance with the chloride total maximum daily load (TMDL) collaborative process. A water supply systems module was developed to deal with the complex water routing and resulting water quality between purveyors, groundwater, surface-water and water reclamation plants.

South Florida Ecosystem Office of the National Park Service (NPS), Florida: Developed a groundwater/surface-water interaction model simulating flow and transport to analyze the effectiveness of a Marsh Driven Operations Plan for three pumps and detention basins along the L-31N canal. Used the calibrated model to analyze the migration of total phosphorus (TP) and estimate TP budgets in detention ponds in the vicinity of the canal. Training was provided to NPS staff and students at Florida International University. The objective of the Marsh Driven Operations Plan was to manage surface-water flows to achieve flood protection and ecosystem protection by implementing operation strategies.

Groundwater Interactions in Western Orange and Seminole Counties, Florida: As Project Engineer of a project funded by the St. Johns River Water Management District, developed an integrated regional groundwater/surface-water model for western Orange and Seminole counties in east-central Florida. Responsible for data assimilation and processing, MODHMS model development and simulations, and post-processing of results and model calibration. The model developed assisted the water management district in more efficient management of the water resources in its jurisdiction, including balancing of surface-water and groundwater sources for water supply, and establishing a sound scientific and engineering basis for water use permitting.

St. John's River Water Management District, Florida: Assisted with litigation support to the Division of Water Use Regulation in reviewing three-dimensional groundwater flow, saltwater-intrusion models. Provided data analysis relating to a consumptive use permit application for a wellfield. Reviewed MODFLOW and SEAWAT models and prepared presentation material in assisting senior staff to support the District's attorneys in formulating questions and responding to questions from other parties. The judgment was in favor of the District.

Modeling in Support of a Well Permit Application, Florida: Performed numerical modeling in support of a well permit application for the county. The project involved performing sensitivity simulations for the pre-development ECF model, preparing, and simulating future conditions, compiling observations within the county, processing and analyzing results, and preparing the report.

Regional Saltwater Intrusion Modeling for Water Supply Planning, Okaloosa, Santa Rosa, and Coastal Walton Counties, Florida: As the Project Engineer, responsible for supporting the development of two regional, density-dependent saltwater intrusion models covering coastal Walton County in the northwest Florida panhandle. The DSTRAM-based model is designed to address concerns of upconing of deeper saline waters and of saltwater intrusion from the Gulf of Mexico and its impact on water supplies and existing wellfields. Responsibilities included pre-processing of input files, DSTRAM simulations, post-processing using TecPlot and other tools, sensitivity analysis and calibration.

Three-Dimensional Density-Dependent Flow and Transport Modeling of Saltwater Intrusion, Southern Water Use Caution Area, Florida: Supported the predictive simulations to assess the benefits and consequences of establishing a sub-surface trough or a pressure ridge along the Tampa Bay coast. Responsible for preliminary simulations assessing the effects of a sub-surface trough and pressure ridge, predictive simulations and post-processing using ArcView, ViewHMS and Tecplot.

Gilbert & Mosley Site, Wichita, Kansas: Developed a groundwater transport model for the Gilbert & Mosley Site. This project used a MODFLOW-SURFACT-based contaminant transport model to simulate a PCE-TCE-

DCE-VC plume. Tasks involved pre-processing of the field observation data, calibration of the model, remediation well simulations, post-processing of results using TECPLOT, and plotting and presentation of calibration results.

U.S. Army Corps of Engineers, Buffalo District, Niagara Falls Storage Site, Lewiston, New York: Developed groundwater models for the Niagara Falls Storage Site. This model simulated flow and transport of a variety of radionuclides and metals. One-dimensional flow was simulated using Hydrologic Evaluation of Landfill Performance (HELP) program for modeling unsaturated zone. Three-dimensional flow and transport were simulated using MODFLOW-SURFACT. Tasks involved data compilation, model development using MODFLOW-SURFACT and HELP, analyses of results, and post-processing.

Enhancement of Generic Soil Column Module (GSCM): The objective of the project was to enhance the existing module (GSCM) to include kinetic mass transfer between solid, aqueous, and gaseous phases. Tasks included code development in Fortran and C++ languages, performing test cases in MOFLOW-SURFACT and verification cases for GSCM, performing sensitivity runs, generating plots using MS Excel, and generating a static library (LIB) file compatible with C++ wrapper for GSCM. The proposed use of this module was for the dynamic simulation of fate and transport of chemical constituents in various types of waste management units.

Dyes and Pigment Industry Waste Listing Determination: Provided modeling services in support of human health risk modeling and sensitivity analysis corresponding to exposures from the disposal of dyes and pigment industry wastes. Tasks included data collection and the preparation, management, and execution of EPACMTP simulations.

Fossil Fuel Combustion Waste Listing Determination: Provided modeling services in support of human health and ecological groundwater risk modeling and sensitivity analysis corresponding to exposures from the disposal of fossil fuel combustion wastes. Tasks included data collection, preparation, management, and execution of EPACMTP simulations.

Development of a Probabilistic Screening Module for Industrial Waste Management Evaluation Model (IWEM) Software: Developed a model for the EPA's Office of Solid Waste for the management of non-hazardous industrial wastes. The probabilistic screening module used parameter generation techniques to ensure that only physically feasible scenarios were executed by the IWEM software.

U.S. Environmental Protection Agency Office of Radiation and Indoor Air, Probabilistic Risk Assessment Modeling of Low-Level Activity Waste: This project coupled EPACMTP with a source release model that tracked a radioactive parent and its daughter products. The project involved development of a Monte Carlo wrapper for a source release model, MCDUST (Monte Carlo - Disposal Unit Source Term), that produced results usable by EPACMTP. Tasks involved development of Monte Carlo wrapper capable of exchanging information with MS access database, understanding the structure of model input files, stochastic variables, and distributions from CMTP code, verification using MODFLOW-SURFACT, writing tools for pre- and post-processing using Visual-Fortran, data transfer from databases using Fortran, data assimilation, model simulations, testing and documentation.

Development of MODHMS/MODFLOW-SURFACT: Developed software as a part of the research and development program. Tasks involved formulation, code development, source control, and testing and documentation of MODHMS/MODFLOW-SURFACT. Tasks also included sales and technical software support. Specific modules/features added to the code included two additional numerical matrix equation solvers, a Land Use Parameterization (LUP) package and a Water Supply Systems (WSS) package, a Zone Budget (ZNB) package, enhancement of MODFLOW packages like the Flow and head boundary (FHB) package, a subsidence (SUB) package, and a Channel Package with two new channel structures. Related tools like MODPATH and PEST were enhanced to work seamlessly with MODHMS/MODFLOW-SURFACT.

Courses & Workshops

COURSES TAUGHT:

- 2024 – Training on PEST-facilitated calibration of SVSIM and C2VSimFG models for California Department of Water Resources staff in Sacramento, February 5-9, 2024
- 2022 – Invited talk (webinar) given to faculty and students at the University of Maryland Baltimore Campus' Center for Urban Environmental Research and Education, Spring 2022 Seminar Series, May 6, 2022.
- 2021 – Invited talk given to faculty and students at Indian Institute of Technology, Madras (IIT Madras) India. November 6, 2021.
- 2020 – Invited talk (webinar) given to faculty and students in India. November 16, 2020.
- 2018 – Provided a groundwater demonstration with a water tank at Discovery Elementary School, Ashburn, Virginia, 2018.
- 2013 – Assisted Mr. Chris Neville in teaching a short course "*Effective Solute Transport Simulation*." GeoMontreal, Montreal, Canada, September 2013.

- 2003 – 2008 – Assisted Dr. Sorab Panday in teaching MODHMS / MODFLOW-SURFACT courses to the following organizations: University of Washington; Federal Energy Regulatory Commission; Malcolm Pirnie; U.S. Army Corps of Engineers; Jacksonville District, Florida; Everglades National Park; National Parks Service, Florida; Florida International University (at HydroGeoLogic, Inc.).

COURSES ATTENDED:

- 2017 – MODFLOW 6 Training Workshop, Golden, CO, May 2017
- 2014 – IWFM Training Workshop in Sacramento, CA, January 2014
- 2013 – Numerical Methods in Hydraulics and Hydrology, Auburn University
- 2013 – MODFLOW-USG 2-day course, Bethesda, MD
- 2013 – Integrated Water Flow Model, IWFM training workshop
- 2012 – Numerical Modeling of Free Surface Flows, Auburn University
- 2012 – Chemical Principles of Environmental Engineering, Auburn University
- 2011 – Subsurface Transport Over Multiple Phases – STOMP short course
- 2010 – Parameter Estimation – PEST short course

Publications & Presentations

Scantlebury, L., Bedekar, V., Tonkin, M.J., Karanovic, M., and Harter, T., 2025. *Texture2Par: A Texture-Driven Tool for Estimating Subsurface Hydraulic Properties*. Environmental Modelling & Software. doi: 10.1016/j.envsoft.2025.106372

Bedekar, V., Hatch, T., Traum, J.A., Tolley, G., Singh, A., and Faunt, C.C., 2024. *Models: Tools for Estimating and Predicting Subsidence*. Hydrovisions, 2024 Spring Issue, p. 14-17.

Hatch, T., Neely, W., Bedekar, V., and Tolley, G., 2023. *California's Sinking Feeling: An Introduction to Subsidence*. Hydrovisions, 2023 Fall Issue, p. 10-12.

Bedekar, V., C. Neville, M.J. Tonkin, R.D. Bartlett, and P. Plato, 2023. *A Unit-Concentration Method to Quantify Source Contribution*: Groundwater, vol 62, issue 2, p. 303-309. doi: 10.1111/gwat.13333

Bedekar, V., R. Goswami, 2023. *Aquifer Characterization Using Texture2Par. Texas Groundwater Summit*, August 29-31, San Antonio, Texas.

Bedekar, V., 2023. *Regional-scale Groundwater Modeling Utilizing Well Log and Geophysical Data*. Arizona Hydrological Society Symposium, September 13-16, Flagstaff, AZ.

Bedekar, V., 2023. *Lessons Learned from Groundwater Management in Arizona*. Western Groundwater Congress, GRA, September 12-14, Burbank, CA.

Tonkin, M., Scantlebury, L., V. Bedekar, M. Ou, J. Baer, M. Cayar, S. Ceyhan, S. Najmus, 2023. *Effective Use of Airborne Electromagnetic (AEM) Data for Groundwater Modeling*. Western Groundwater Congress, GRA, September 12-14, Burbank, CA.

Bedekar, V., 2023. *Groundwater Management in Arizona*. California Water & Environmental Modeling Forum (CWEMF), April 17-19, Folsom, CA.

Bedekar, V., C. Neville, M.J. Tonkin, R.D. Bartlett, and P. Plato, 2023. *A Unit-Concentration Method to Quantify Source Contribution*. California Water & Environmental Modeling Forum (CWEMF), April 17-19, Folsom, CA.

Bedekar, V., C. Dogrul, S. Ceyhan, and A. Taghavi, 2023. *Delayed Subsidence in IWFM*. California Water & Environmental Modeling Forum (CWEMF), April 17-19, Folsom, CA.

Bedekar, V., R. Goswami, J. Sharp, J. Acevedo, and M.(J.) Fagan, 2023. *Delineating Buffer Zones for Brackish Water Resource Protection in Texas*. California Water & Environmental Modeling Forum (CWEMF), April 17-19, Folsom, CA.

Ou, M., C. Muffels, M. Tonkin, and V. Bedekar, 2023. *Example Applications of a New Zone Budget Utility Developed for ParFlow*. California Water & Environmental Modeling Forum (CWEMF), April 17-19, Folsom, CA.

Goswami R.R., M. Fagan, T. Chen, U. J. Mohandass, C. Bente, V. Bedekar, C. Neville, and J.M. Sharp, 2022. *Develop Procedures and Tools to Delineate Areas Designated or Used for Class II Well Wastewater Injectate*, Final Report for TWDB Contract # 2000012453. (State Agency Contract Report).

Scantlebury, L., V. Bedekar, M. Karanovic, M. Tonkin, 2022. *Texture2Par: A Parsimonious Hydraulic Parameter Estimation Utility for IWFM and MODFLOW*. Western Groundwater Congress, GRA, September 19-21, Sacramento, CA.

Bedekar, V., M. O'Connell, M. Tonkin, 2022. *Applications of Data Analyses Techniques*. Western Groundwater Congress, GRA, September 19-21, Sacramento, CA.

Zhang, Y., A. Mayer, J. Gulley, V. Bedekar, and J. Martin, 2022. *Brackish Water Depletion on Tropical Islands under Seasonal Climate Patterns as Lakes Form and Expand with Rising Sea Level*. Frontiers in Hydrology, AGU, June 19-24, San Juan, Puerto Rico.

Bedekar, V., R. Goswami, J. Sharp, Jr., J. Acevedo, and M. Fagan, 2022. *Statewide Mapping of Class II Well*

Injectate Migration in Texas. World Environmental & Water Resources Congress 2022, June 5-8, Atlanta, GA.

Ou, G., C. Muffels, M. Tonkin, and V. Bedekar, 2022. *Lessons Learned Developing a Zone Budget Utility for ParFlow*. MODFLOW and More 2022, June 5-8, Princeton, NJ.

Ou, G., V. Bedekar, C. Neville, D. Hayes, M. Fagan, R. Goswami, J. Sharp, Jr., and J. Acevedo, 2022. *A State-Wide Automated Web-Based Tool for Class II Well Wastewater Injectate Analysis, Part 2*. MODFLOW and More 2022, June 5-8, Princeton, NJ.

Fagan, M., G. Ou, R. Goswami, V. Bedekar, J. Sharp, Jr., and J. Acevedo, 2022. *State-Wide Automated Web-Based Tools for Class II Well Wastewater Injectate Analysis, Part 1*. MODFLOW and More 2022, June 5-8, Princeton, NJ.

Bedekar, V., G. Ou, and M. Tonkin, 2022. *Reactive Transport Capabilities in MT3D-USGS for Simulating Subsurface Contaminant Transport*. Twelfth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle's Chlorinated Conference, May 22-26, Palm Springs, CA.

Cayar, M., V. Bedekar, and S. Ceyhan, 2022. *C2VSimFG: Historical Calibration & Sensitivity Analysis*. California Water & Environmental Modeling Forum (CWEMF) 2022, April 22, Folsom, CA.

Sharp, Jr. J, R. Goswami, and V. Bedekar, 2022. *Potential to Use Class II Wells to Dispose of Desalination Residual Fluids in Texas*: Geological Society of America Abstracts with Programs, v. 54, no.1. doi: 10.1130/abs/2022SC-373425

Baer, J., S. Ceyhan, M. Cayar, and V. Bedekar, 2021. *Technical Memorandum on AEM Data Application in Groundwater Models*. (Report prepared for the Department of Water Resources, Sacramento, CA).

Bedekar, V., Durbin, T., Bond L., 2021. *Sacramento Valley Groundwater-Surface Water Simulation Model Technical Memorandum 5 (SVSim TM-5), Stream Depletion Calculation*, prepared for the Department of Water Resources, Sacramento, CA. SVSim: Sacramento Valley Groundwater-Surface Water Simulation Model - SVSim TM-5: Stream Depletion Calculation - California Natural Resources Agency Open Data.

Bedekar, V., M. Cayar, F. Qian, and T. Durbin, 2021. *Sacramento Valley Groundwater-Surface Water Simulation Model Technical Memorandum 4 (SVSim TM-4), Model Calibration and Sensitivity Analysis*, prepared for the Department of Water Resources, Sacramento, CA. SVSim: Sacramento Valley Groundwater-Surface Water Simulation Model - SVSim TM-4: Model Calibration and Sensitivity Analysis - California Natural Resources Agency Open Data.

Goswami, R., V. Bedekar, T. Chen J. Fagan, C. Neville, J.M. Sharp Jr., and J.P. Acevedo, 2021. *Use of Class II Injection Wells to Dispose of Desalination Residual Fluids in Texas* [abs.]: GEOGULF2021, Oct 27-29.

Mei, Y., Mayer, A. S., Bedekar, V., Nan, Q., Gulley, J, 2020. *Dispersive Mixing and Sea Level Rise Rates Control Depletion of Freshwater in Island-Lake-Aquifer Systems Undergoing Groundwater and Coastal Inundation*. American Geophysical Union, Fall Meeting 2020, December. Abstract H223-04.

Bedekar, V.S., Matt O'Connell, Matt Tonkin, Linda Bond, Chris Bonds, Tyler Hatch, Mesut Cayar, Tim Durbin, 2020. *Hydrograph Pattern Identification Using Fuzzy Cluster Analysis*. Western Groundwater Congress, GRA, Sep. 14-17, Virtual Conference.

Bedekar, V.S., Sorab Panday, Christian Langevin, Eric Morway, 2020. *Water Quality Modeling Capabilities in MT3D-USGS and MODFLOW-USG Relevant for SGMA*. Western Groundwater Congress, GRA, Sep. 14-17, Virtual Conference.

Bedekar, V.S., S.S. Memari, and T.P. Clement, 2020. *Saltwater Intrusion – Lessons Learnt from Laboratory Experiments and Numerical Modeling*. Groundwater Monitoring Measurements, Management, and Applications; GRA, Mar. 3-4, Monterey, CA.

Bedekar, V.S., J. Riverson, S. Carter, S. Panday, R. Hassan, A. Weinberg, V. Zimmer, and D. Worth, 2020. *Modeling the Complexities of Water Supply and Demand, Instream Flows, and Sustainable Water Management Scenarios for the South Fork Eel River Watershed*. Groundwater Monitoring Measurements, Management, and Applications; GRA, Mar. 3-4, Monterey, CA.

Memari, S. S., V.S. Bedekar, and T.P. Clement, 2020. *Laboratory and Numerical Investigation of Saltwater Intrusion Processes in a Circular Island Aquifer*. Water Resources Research, 56, e2019WR025325. doi: 10.1029/2019WR025325

Memari, S. S., V.S. Bedekar, and T.P. Clement, 2019. *Laboratory and Numerical Investigation of Saltwater Intrusion Processes in a Circular Island*. World Environment and Water Resources Congress 2019, May 19-23, Pittsburgh, PA.

Bedekar, V., L. Scantlebury, S. Panday, and C. Langevin, 2019. *Axisymmetric Modeling with Unstructured Grids of MODFLOW-USG and MODFLOW 6*. MODFLOW and More 2019, June 2-5, Golden, CO.

Bedekar, V., S. Memari, and T.P. Clement, 2019. *Understanding Transient Changes in Freshwater Storage Patterns in Island Aquifers*. MODFLOW and More 2019, June 2-5, Golden, CO.

Morway, E.D., D.T. Feinstein, R.J. Hunt, and V. Bedekar, 2019. *Modeling Flow and Heat Transport in Connected Stream-Aquifer Systems with a Warming Climate*. MODFLOW and More 2019, June 2-5, Golden, CO.

Muffels, C., V. Bedekar, and M. Kulbersch, 2019. *Designing the Ghost-Node Correction Package of MODFLOW-USG to Mitigate Local Flow Oscillations*. MODFLOW and More 2019, June 2-5, Golden, CO.

Langevin, C.D., J.D. Hughes, A.M. Provost, S. Panday, R.G. Niswonger, S. Paulinski, J. Verkaik, E.D. Morway, V. Bedekar, and J. Larsen, 2019. *Ongoing MODFLOW Development by the USGS and External Collaborators*. MODFLOW and More 2019, June 2-5, Golden, CO.

Hunt, R.J., Feinstein, D.T., Morway, E.D., and V. Bedekar, 2019. *Challenges and Insights from Heat Transport Modeling of a Humid Temperate Watershed*. MODFLOW and More 2019, June 2-5, Golden, CO.

Tonkin, M., V. Bedekar, T. Durbin, L. Bond, C. Bonds, and M. Cayar, 2019. *Simultaneous Texture-Based Calibration of Three California Central Valley Models*. MODFLOW and More 2019, June 2-5, Golden, CO.

Bedekar, Vivek. "*Development, Numerical Implementation, and Application of Methods to Simulate Solute Transport Processes in Porous Media Systems*." PhD diss., Auburn University, 2019. http://hdl.handle.net/10415/6609

Bedekar, V., Memari, S.S., and T.P. Clement, 2019. *Investigation of Transient Freshwater Storage in Island Aquifers*. Journal of Contaminant Hydrology. Vol. 221, February 2019, p. 98-107. doi: 10.1016/j.jconhyd.2019.02.004

Bedekar, V., L. Scantlebury, and S. Panday, 2019. *Axisymmetric Modeling Using MODFLOW-USG*. Groundwater. doi: 10.1111/gwat.12861

Bedekar, V., T.P. Clement, and S.S. Memari, 2018. *Understanding Transient Changes in Freshwater Lens Volumes in Island Aquifers*. American Geophysical Union Fall Meeting 2018, Abstract # H13L-1910.

Tonkin, M., and V. Bedekar, 2018. *Use of Automated Calibration with IWFM-IDC Models: Examples from C2VSIM and SVSIM Applications*. California Water & Environmental Modeling Forum (CWEMF) 2018, April 2-4, Folsom, CA.

Panday, S., V. Bedekar, and C.D. Langevin, 2017. *Impact of Local Groundwater Flow Model Errors on Transport and a Practical Solution for the Issue*. Groundwater. doi: 10.1111/gwat.12627

Panday, S., C. Langevin, A. Provost, and V. Bedekar, 2017. *A Hydraulic Head Formulation for Density Dependent Flow and Transport*. MODFLOW and More 2017, May 21-24, Golden, CO.

Gulley, J. D., A. S. Mayer, J. B. Martin, and V. Bedekar, 2016. *Sea Level Rise and Inundation of Island Interiors: Assessing Impacts of Lake Formation and Evaporation on Water Resources in Arid Climates*, Geophys. Res. Lett., 43, 9712–9719 doi:10.1002/2016GL070667.

Bedekar, V., E.D. Morway, C.D. Langevin, and M. Tonkin, 2016. *MT3D-USGS Version 1: A U.S. Geological Survey Release of MT3DMS Updated with New and Expanded Transport Capabilities for Use With MODFLOW*: U.S. Geological Survey Techniques and Methods 6-A53, 69 p., doi: 10.3133/tm6A53

Bedekar, V., E.D. Morway, C.D. Langevin, and M. Tonkin, 2016. *MT3D-USGS Version 1.0.0: Groundwater Solute Transport Simulator for MODFLOW*: U.S. Geological Survey Software Release, 30 September 2016. doi: 10.5066/F75T3HKD

Neville, C.J. and V.S. Bedekar, 2016. *Simulation of Flow and Transport in Fractured Rocks: An Approach for Practitioners*. Chapter 17 in Groundwater Assessment, Modeling, and Management, M. Thangarajan and V.P. Singh eds. CRC Press, Boca Raton, FL. p.269-282.

Bedekar, V., E. Morway, C. Langevin, and M. Tonkin, 2015. *New and Expanded Transport Capabilities of MT3D-USGS*. MODFLOW and More 2015, May 31–June 3, Golden, CO.

Morway, E., V. Bedekar, C. Langevin, M. Tonkin, and R.G. Niswonger, 2015. *Demonstration of Enhanced Groundwater Solute Transport Capabilities in MT3D-USGS*. MODFLOW and More 2015, May 31–June 3, Golden, CO.

Bessinger, B., V. Bedekar, M. Truex, and M. Tonkin, 2015. *Simulation of a Co-Precipitated Chromate-Calcite at a Large Waste Site*. MODFLOW and More 2015, May 31–June 3, Golden, CO.

Morway, E., V. Bedekar, and C. Langevin, 2014. *Recent Enhancements to MT3DMS for Simulation of Solute Exchange in Hydraulically Connected Stream-Aquifer Systems*. the 2014 National Ground Water Association (NGWA) Ground Water Summit, Denver, CO, May 5-7.

Bedekar, V., E. Morway, C. Tana, C. Langevin, T. Rooze, and M. Tonkin, 2013. *Enhancing MT3DMS for Simulating Solute Transport in a Coupled Groundwater/Surface-water System*. MODFLOW and More 2013, June 2-5, Golden, CO.

Bedekar, V., T.P. Clement, and J. Vasconcelos, 2013. *Stability and Accuracy of Implicit and Explicit Linear and Non-linear Schemes*. MODFLOW and More 2013, June 2-5, Golden, CO.

Bedekar, V., R.G. Niswonger, K. Kipp, S. Panday, and M. Tonkin, 2012. *Approaches to the Simulation of Unconfined Flow and Perched Groundwater Flow*

in MODFLOW. Ground Water, v. 50, pp. 187–198. doi: 10.1111/j.1745-6584.2011.00829

Bedekar, V., C. Neville, and M. Tonkin, 2012. *Source Screening Module for Contaminant Transport Analysis Through Vadose and Saturated Zones*. Ground Water, v. 50, pp. 954–958. doi: 10.1111/j.1745-6584.2012.00954

Bedekar, V., M. Tonkin, and M. Karanovic, 2012. *Challenges and Solutions to Numerical Modeling of Deep Basalt Aquifers for Groundwater Management*. International Groundwater Conference (IGWC) 2012, December 18-21, Aurangabad, India.

Bedekar, V., M. Tonkin, and A. Spiliotopoulos, 2011. *Implementation of a Contaminant Treatment System (CTS) Module in MT3DMS*. MODFLOW and More 2011, June 5-8, Golden, CO.

Bedekar, V., and M. Tonkin, 2011. *The Dry Cell Problem: Simulation of Solute Transport with MT3DMS*. MODFLOW and More 2011, June 5-8, Golden, CO.

Bedekar, V., S. Panday, and M. Tonkin, 2011. *Approaches for Solving Unconfined Flow in MODFLOW*, 2011. National Ground Water Association (NGWA) Ground Water Summit and the 2011 Ground Water Protection Council Spring Meeting, May 1-5, Baltimore, MD.

Bedekar, V., C.J. Neville, and M. Tonkin, 2010. *Analysis of Contaminant Transport through the Vadose and Saturated Zones for Source Screening*. American Geophysical Union Fall Meeting 2010, Abstract #H53C-1059.

Guvanasen, V., V. Bedekar, D. Shinde, and R. Price, 2010. *Development of a Flow and Transport Model in a Highly Interactive Surface-Water/Groundwater System Near the Everglades National Park*. Submitted to 7th Annual International Symposium on Managed Aquifer Recharge, Abu Dhabi, October 9-13, 2010.

S. Panday, N. Brown, T. Foreman, V. Bedekar, J. Kaur, and P.S. Huyakorn, 2009. *Simulating Dynamic Water Supply Systems in a Fully Integrated Surface-Subsurface Flow and Transport Model*. Vadose Zone Journal, v. 8, no. 4, pp. 858-872.

Brown, N., B. Louie, F. Guerrero, T. Foreman, S. Panday, V. Bedekar, and J. Kaur, 2009. *Managing Salinity in the Upper Santa Clara River System of California*. Proceedings of the World Environmental and Water Resources Congress 2009: Great Rivers, May 17-21, Kansas City, MO.

Panday, S., T. Foreman, V. Bedekar, N. Brown, P. Sampath, and J. Kaur, 2008. *Water Supply Systems in Groundwater/ Surface-Water Models*. The 2008 Computational Methods in Water Resources International Conference, San Francisco, CA, July 6-10, 2008.

Bedekar, V., S. Panday, H. Ahn, and F. Miralles-Wilhelm, 2006. *Surface-Water Groundwater Interaction Model for Marsh Driven Operations to Manage the Ecosystem of the Rocky Glades*. MODFLOW and More 2006: Managing Ground-Water Systems. International Ground Water Modeling Center, Colorado School of Mines Golden, CO, May 22-24, 2006.

Gabora, M., V. Bedekar, B. Linderfelt, and A. Davis, 2006. *Integration of the LAK3 Package into MODFLOW-SURFACT to Simulate an Ephemeral Pit Lake, Northern California*. MODFLOW and More 2006: Managing Ground-Water Systems. International Ground Water Modeling Center, Colorado School of Mines Golden, CO, May 22-24, 2006.

Huber, N.P., V.S. Bedekar, G. Demny, V. Lagendijk, T. Vogel, and J. Koengeter, 2001. *Sensitivitaetsuntersuchungen an NumerischenGrundwassermoddellen (Sensitivity Analysis on Numerical Groundwater Models)*. Fourth FWU-Workshop of GIS-based Applications in Water Resources Management, University of Siegen, Siegen, Germany, February 21, 2001.

CONTRIBUTING AUTHOR TO:

Interstate Technology & Regulatory Council (ITRC), 2011. *Development of Performance Specifications for Solidification/Stabilization*. S/S-1. Washington, DC: Interstate Technology & Regulatory Council, Solidification/ Stabilization Team. www.itrcweb.org.

Deposition & Testimony Experience

- 2021 – *United States of America, et al. vs. Gila Valley Irrigation District, et al*. United States District Court for the District of Arizona. Case No. CV-31-0059-TUC-SHR. September 22.
- 2021 – *Gila River Indian Community vs. Cranford et al*. United States District Court for the District of Arizona. Case No. 4:19-cv-00407-SHR. September 24.

Gengxin (Michael) Ou, Ph.D.

Senior Project Scientist, Hydrogeologist

Dr. Ou is a hydrologic and groundwater modeler with extensive experience in model implementation and development, water resources planning and assessments, development of graphical user interfaces, and statistical and spatial analysis. He brings strong computational and advanced mathematics skills and experience programming with Python, Fortran, R, and VBA. He has developed many software applications including several MODFLOW packages to enhance model capability. Dr. Ou analyzes and customizes modeling software architecture, performs model simulations, and provides data analysis and data integration.

REPRESENTATIVE EXPERIENCE

S.S. Papadopulos & Associates, Inc. *– Rockville, Maryland*

Private Client, Long Beach, California: Updated and calibrated a groundwater flow and transport model that was used to evaluate the magnitude, extent, and impact to drinking water wells from petroleum releases.

Third-party Review of GULF and Groundwater Management Area 14 (GMA 14) Models, Lone Star Groundwater Conservation District, Conroe, Texas: Modeler for a groundwater model that is currently being developed for joint planning purposes for GMA 14, which partially or fully includes five GCDs and two subsidence districts.

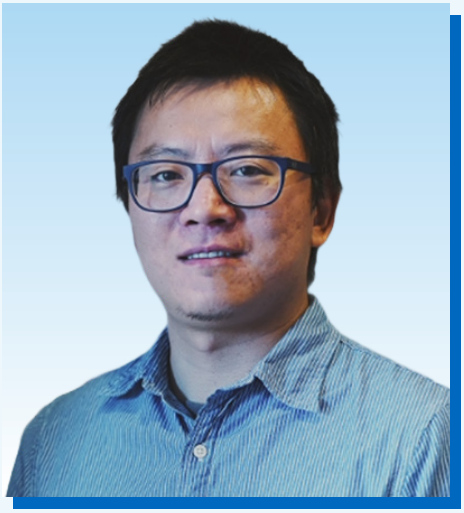
Water Resources Assessment, Lower Rio Grande Basin, New Mexico Interstate Stream Commission: Provided simulation support, model-run processing, and scripting automation. Updated ET and Pumping packages for the LRG model. Prepared automated scenario construction and evaluation workflow.

Assessing Potential Impacts of the Tulla Transfer Application, State of New Mexico, Copper Flats Mine: Lead Modeler for a sensitivity and uncertainty analysis. Evaluated representativeness of groundwater model for site characterization. Performed sensitivity analysis on potential impact estimation of water right transfer. Quantified uncertainty in transfer impact assessment. Drafted final report and presentation.

Water Resources Assessment, Pecos River Basin, State of New Mexico, Roswell and Carlsbad Basins: Lead Modeler for next generation refinements. Reviewed prior Pecos River Basin model and refined the model grid discretization with LiDAR and geologic modeling data. Converted prior Pecos River Basin model using MODFLOW 6. Optimized model numerical solver efficiency and accuracy. Constructed SFR and LAK packages representing the stream-lake-aquifer interactions. Presented project progress and drafted reports.

Private Client, Albuquerque, New Mexico: Updated and calibrated a groundwater flow and transport model that was used to evaluate operations of TCE treatment. Tasks included reconstructing the River package with transient river stage, extending MNW and Well packages with new TCE treatment operation data, and setting up calibration targets with new groundwater level and contaminant measurements. Also calibrated the groundwater flow and transport models to evaluate operations of TCE treatment.

Private Client, Albuquerque, New Mexico: Updated and calibrated a groundwater flow and transport model that was used to evaluate operations of TCE treatment.



YEARS OF EXPERIENCE

10+

EDUCATION

- **PhD**, Civil Engineering (minor in Natural Resource Sciences), University of Nebraska-Lincoln, 2015
- **MS**, Hydrology and Water Resources, Hohai University, Nanjing, China, 2009
- **BE**, Hydrology and Water Resources Engineering, Hohai University, Nanjing, China, 2006

EXAMPLE AREAS OF EXPERTISE

- Groundwater Modeling
- Surface and Vadose Zone Hydrology
- Scientific Programming (Python, Fortran)
- Desktop and Web App Development
- Data Analysis and Visualization
- Geospatial Analysis

LANGUAGES

English, Cantonese, Mandarin

PROFESSIONAL HISTORY

- S.S. Papadopulos & Associates, Inc.: 2020–present
- Long Spring, Inc., Water Resources Engineer, On-Call Services: 2016–2019
- University of Nebraska:
  - Research Assistant Professor: 2018–2020
  - Postdoctoral Research Associate: 2017–2018
- University of Washington, Postdoctoral Research Associate: 2016–2017
- Nebraska Department of Natural Resources, Integrated Water Management Analyst: 2014–2016

EMAIL

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SOFTWARE DEVELOPMENT

MODFLOW-SDA: MODFLOW-SDA is a new MODFLOW package to improve the computational efficiency and reduce the computational noises for stream depletion analyses using MODFLOW. Using the assumption of unchanged flow coefficients between the baseline and scenario runs, the nonlinear groundwater flow system is linearized for solving the flow equations. The new package has been successfully applied to a regional groundwater model in Nebraska to simulate responses to flow perturbations such as streamflow depletion induced by new pumping wells.

MODFLOW-CSR: The Cross-Section streamflow Routing (CSR) package is developed to simulate the streamflow and the interaction between streams and aquifers for streams with a width larger than the MODFLOW grid size. In the CSR package, a cross-section is described by a number of streambed points that determine the geometry and hydraulic properties of the streambed. A rapid algorithm is used to compute the submerged area of the MODFLOW grid. The streambed conductance of a grid cell is computed based on its submerged area, streambed hydraulic conductivity and thickness.

PPSGS: PPSGS is a geostatistical tool developed for stochastic groundwater modeling with pilot point parameterization using sequential Gaussian simulation. PPSGS can be used with PESTPP-IES for model calibration. By implementing the similar concept in PLPROC/PPFAC, PPSGS generates the Kriging weighting factor files that can be used during calibration to recreate various stochastic parameter fields retained in each respective realization. PPSGS can improve uncertainty quantification by taking the kriging errors into account.

CHUMP: The Configuration-Based Uniform Model Post-processor (CHUMP), a framework for post-processing data and model results. CHUMP simplifies the process through a configuration file that uses intuitive keywords to define data abstraction and manipulation parameters, providing coding-level flexibility without requiring programming knowledge. With generalized input, CHUMP directly reads a variety of data and model outputs and applies a series of data processing operations to create consistent, precise, and publication-quality figures and animations.

SWAT-MODFLOW: SWAT-MODFLOW is an integrated surface-water groundwater interaction model that couples SWAT and MODFLOW by a soil water module (SWM), which is developed based on a non-iterative solution of the 1D Richards equation. SWM explicitly represents infiltration, soil evaporation, unsaturated water flow, root water update, and lateral drainage and solves them simultaneously. Taking advantage of the simulation capacities of SWAT, MODFLOW and SWM, the integrated model can simulate the physical hydrologic processes in three domains and their interactions.

RESEARCH AND DEVELOPMENT

- Automated workflow and visualization
- Calibration-constrained stochastic groundwater modeling
- Multi-source, multi-scale data assimilation
- Hydrologic model code development

University of Nebraska-Lincoln *– Lincoln, Nebraska*

Developed curricula and taught Physical Hydrology, Python Programming and Geospatial Information Science. Recent research projects included:

- **Lower Elkhorn Natural Resources District (LENRD) Pilot-scale Groundwater Model with Airborne Electromagnetic Data:** Integrated airborne electromagnetic data in groundwater model development to improve modeling performance. The model is being used as a decision-making tool by the local agency for groundwater resources management.
- **Characterization of Nitrogen Loading in the Unsaturated Zone Using Hydrologic Models in the Central Platte River Basin:** Developed a no-iterative Richards' equation computing scheme to simulate nitrogen movement in the unsaturated zone.
- **Evaluation of Buffalo Creek Reservoir 1 (B-1) for Central Platte Natural Resources District:** Estimated surface water and groundwater supply and demands based on the existing measurement and modeling datasets. Developed a hydrologic model to evaluate hydrologic impacts of the construction of the reservoir.

University of Washington *– Seattle, Washington*

Developed the hydrologic modeling framework Structure for Unifying Multiple Modeling Alternatives (SUMMA); Implemented large-domain hydrologic modeling with SUMMA in the Columbia River Basin.

Nebraska Department of Natural Resources *– Lincoln, Nebraska*

Developed and applied tools and models to assist water resources management in the department.

Publications & Presentations

Ou, G., Bedekar, V., Tonkin, M., Barth, G., 2024. *CHUMP: A Configuration-Based Postprocessing Framework for Automated Workflows*. Presented at MODFLOW and More, 2024, Princeton University, June 5.

Ou, G., Muffels, C., Tonkin, M., Bedekar, V., 2024. *Incorporating Kriging Errors through Sequential Gaussian Simulation for Pilot Point Parameterization*. Presented at MODFLOW and More, 2024, Princeton University, June 5.

Ou, G., 2020. *Development of GUI Applications for Groundwater Modeling Using Python*. Groundwater, v. 58, no. 4, pp. 496-497. doi: 10.1111/gwat.12979

Ou, G., F. Munoz-Arriola, D.R. Uden, D. Martin, C.R. Allen and N. Shank, 2018. *Climate change implications for irrigation and groundwater in the Republican River Basin, U.S.A*. Climatic Change, v. 151, no. 2, pp. 303-316. doi: 10.1007/s10584-018-2278-z

Li, R., G. Ou*, M. Pun, and L. Larson, 2018. *Evaluation of Groundwater Resources in Response to Agricultural Management Scenarios in the Central Valley, California*. Water Resources Planning and Management, v. 144, no. 12: 04018078. doi: 10.1061/(ASCE)WR.1943-5452.00010

Ou, G., R. Li, M. Pun, C. Osborn, J. Bradley, J. Schneider, and X. Chen, 2016. *A MODFLOW Package to Linearize Stream Depletion Analysis*. Journal of Hydrology, v. 532, no. 1, pp. 9-15. doi: 10.1016/j.jhydrol.2015.11.025

Li, R., M. Pun, J. Bradley, G. Ou, J. Schneider, B. Flyr, J. Winter, and S. Chinta, 2016. *Evaluating Hydrologically Connected Surface Water and Groundwater Using a Groundwater Model*. JAWRA Journal of the American Water Resources Association, v. 52, no. 3, pp. 799-805. doi: 10.1111/1752-1688.12420

Ou, G., X. Chen, R.J. Bitner, and M. Krausnick, 2015. *SMPP: The Spreadsheet-Based MODFLOW Pre-Processor*. Groundwater, v. 53, no. 5, pp. 675-676.

Dong, W., G. Ou*, X. Chen, and Z. Wang, 2014. *Effect of Temperature on Streambed Vertical Hydraulic Conductivity*. Hydrology Research v. 45, no. 1, p. 89. doi:10.2166/nh.2013.021

Ou, G., X. Chen, A. Kilic, S. Bartelt-Hunt, Y. Li, and A. Samal, 2013. *Development of a Cross-Section Based Streamflow Routing Package for MODFLOW*. Environmental Modelling & Software, v. 50, no. 12, pp. 132-143.

Ou, G., X. Chen, C. She, Z. Hu, and X. Li, 2009. *Three Dimensional Visualization of Groundwater Simulation Based on VTK*. Journal of China Hydrology, v. 29, no. 1.

John Riverson, Jr.
Modeling Lead

EDUCATION AND EXPERIENCE
Master of Science, Civil and Environmental Engineering, 1999, University of Virginia
Bachelor of Science, Civil and Environmental Engineering, 1997, University of Virginia

PROFESSIONAL SUMMARY
John has 20 years of experience developing and applying hydrologic models and conducting supporting data analyses services, with a focus on public-domain models typically used to support water resources management and regulations and subject to peer review (e.g., HSPF, LSPC, SWMM, SWAT, TR-55, CE-QUAL-W2, QUAL2E/2K, SUSTAIN). He has an in-depth understanding of meteorological and hydrological processes and interactions, climate change assessment, watershed and stormwater management, water quality, and pollutant source characterization. John led the development of USEPA's LSPC from 2003 and was responsible for designing system architecture and developing algorithms for most of the core LSPC modules including: (1) high-resolution meteorological data (2) crop-associated irrigation, (3) hydraulic withdrawals and diversions, and (4) the time-variable land use module. John's experience also includes computer programming of customized supporting applications to store, manage, process, and analyze complex data sets. He's proficient at engineering highly effective graphical and tabular displays for journal/report- and web-based publication media and has published his work in high-impact peer-reviewed journals (e.g. Water Resources Research, Water Research, Climatic Change). John is regularly sought by different agencies to provide third-party review and QA/QC of modeling applications. He is highly regarded for his ability to present highly technical content to a wide variety of audiences though in-person presentation, webinars, and on-site training workshops.

PROJECT EXPERIENCE
Supply and Demand Assessment Hydrology Modeling, State Water Resources Control Board, CA. Paradigm supports the California State Water Resources Control Board with hydrologic modeling of multiple watersheds across the state, incorporating representation of surface water and groundwater withdrawals. The model development process is data-intensive, sourcing geospatial data sets from various local, state, and national sources. The team is currently developing work plans, calibrated models, and reports for 18 different watersheds across the state using the Loading Simulation Program C++ (LSPC) with linked MODFLOW models in specific watersheds when appropriate. John is serving as the primary technical advisor to the team, providing guidance and critical review of modeling approaches, decisions, and outcomes. He has also provided hands-on modeling training to the client, teaching the modeling philosophy, calibration techniques, results interpretation, and the technical foundation in the underlying Hydrological Simulation Program--Fortran (HSPF) process algorithms used by LSPC.

Water Quality Benefits Evaluation & Analysis. King County Department of Natural Resources & Parks, WA. Paradigm is supporting the King County, WA Department of Natural Resources & Parks in conducting an integrated hydrology, water quality, and stormwater planning modeling study. It includes a linked Loading Simulation Program C++ (LSPC) watershed model, along with a SUSTAIN optimization model, for representing both structural and non-structural stormwater management strategies across King County. The objective of the potential management strategies was to evaluate Benthic Index of Biological Integrity (B-IBI) metrics, reduce tributary pollutant loads, and evaluate the effects on the instream flow duration curve (FDC) across five regional watershed planning units. During Phase 1 of this initiative, Paradigm's team rebuilt multiple HSPF models into a single integrated LSPC model simulating the entirety of King County's watersheds. This effort concluded with a model verification, a step ahead of formal calibration and validation, to demonstrate the current performance of the translated models. The verification not only tested the translation of the HSPF model parameters to LSPC but also demonstrated the robustness of supplementing local observed data with next-generation gridded meteorological boundary conditions (i.e., PRISM, NLDAS). The preliminary outputs of the LSPC water quality model (i.e., HRU unit-area time series) were linked to a Tier-1 SUSTAIN

model representing both structural and non-structural practices. Structural practices included LID targeting individual parcels, roadside programs aimed at treating runoff from roads and highways, and regional projects treating larger nested drainage areas. Non-structural strategies included implementation options such as street sweeping and removal of impervious cover. John is serving as a modeling lead providing systems design; support with model setup, configuration, and calibration; and communication and engagement with various municipal and industry stakeholders.

Little Bear Creek Watershed Basin Planning, Snohomish County, WA. In partnership with NHC, Paradigm supported the Department of Public Works Surface Water Management Division in developing a comprehensive basin plan for stormwater management in the Little Bear Creek watershed. Plan development includes linked Hydrological Simulation Program--Fortran (HSPF) and System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) models for representing structural and non-structural management strategies for stormwater and agricultural non-point sources. The SUSTAIN network included nested low-impact development BMPs, regional detention/retention ponds, and other programmatic strategies aimed at source control. Management objectives include achieving main stem Benthic Index of Biological Integrity (B-IBI) metrics and reducing tributary pollutant loads. These multi-scale management objectives were formulated using a two-tiered cost-benefit optimization approach in SUSTAIN to identify and prioritize cost-effective management opportunities at the subcatchment, subbasin, and watershed scales. The Little Bear Creek modeling and planning process included collaborative interaction and input from the Department of Public Works and other stakeholder groups to incorporate management strategies that would have a high likelihood of public adoption and easily integrate with existing operation-and-maintenance programs.

San Mateo County Reasonable Assurance Analysis for GI, San Mateo County, CA. Paradigm is currently supporting San Mateo County Co-permittees in modeling to demonstrate reasonable assurance that GI and associated schedules for implementation will result in attainment of MRP requirements and TMDL wasteload allocations. John is serving as lead modeler in the development of HSPF/LSPC and SUSTAIN models to simulate baseline pollutant loadings for all watersheds in the county, optimize selection of GI projects, and demonstrate pollutant load reductions to meet interim and final schedule milestones. John developed procedures for efficient HSPF model development and calibration for all watersheds in the County, and is developing a comprehensive model calibration report to be submitted to the Regional Board. To support this effort, John updated the HSPF model of the Guadalupe River for simulation of sediment transport, performed model calibration, and developed approaches for representing baseline/historic mercury and PCB loads associated with stormwater.

Watershed Management Modeling System (WMMS) 2.0, Los Angeles, County, CA. Alvi led the software updates and enhancements for WMMS 2.0 systems development. WMMS is a comprehensive watershed (LSPC) and best management practice (BMP) modeling (SUSTAIN) system for evaluating hydrologic and water quality management opportunities and the associated cost-benefit implications of different planning scenarios for attaining in-stream water quality objectives. The project involved the development of a representative baseline model for the 12,000 km2 area study area, which was divided into 2,655 catchments and 941 hydraulic routing segments. Alvi supported the hydrology calibration effort and led the water quality calibration of the watershed model. The model calibration captured extremes ranging from the highest storm flows to critical low flow conditions. Alvi also made updates to the EPA SUSTAIN model to support the updates for the WMMS web utilities. Alvi worked closely with the web developers to facilitate seamless linkage and operation of the LSPC and SUSTAIN models with the WMMS online utilities.

HSPF Hydrology Model for the Ventura River Watershed, Including Natural Conditions Scenario, Ventura, CA (*experience from previous employer*) – John supported the development of a detailed HSPF model for the Ventura River watershed for Ventura County, CA. Because the modeling effort was used to support a FEMA flood insurance study, the model used 15-minute and 5-minute time steps and locally derived stream cross-sections to better characterize instream peak flow. Another unique aspect of the model was that it was temporally divided into consecutive snapshots with changing land uses to characterize the impacts of urbanization and land use changes in the watershed. Within the natural areas, land use changes also represented clearing due to some notable forest fires in the watershed. The model also simulated irrigation impacts, groundwater interactions, and reservoir management activities. John assisted with developing meteorological boundary condition for the model to represent 30 years of land use change. He also produced

graphical and tabular time series summaries comparing overall water balance and flow of existing conditions versus a simulated "natural" condition of the watershed to help quantify anthropogenic impacts on the hydrologic water budget. The model was later enhanced to include water quality simulations. Services were from 2008-2009.

Khalid Alvi, P.E.
Senior Project Engineer

EDUCATION
Master of Science, Civil and Environmental Engineering, 1999, Asian Institute of Technology, Thailand
Bachelor of Science, Civil Engineering, 1993, University of Engineering and Technology Lahore, Pakistan
Professional Engineer, Virginia No. 0402046509 (since 2010)

PROFESSIONAL SUMMARY
Mr. Alvi is a Professional Engineer and an experienced stormwater, watershed, and water quality modeler, and data and GIS application developer with more than 24 years of experience in the development of watershed and BMP modeling systems. He has extensive experience in developing the practical solutions for a variety of management objectives (e.g., flow volume reduction or pollutant load reduction target) by identifying the best mix of cost-effective stormwater controls using the state-of-the-art optimization algorithms at watershed scale. Alvi was the project manager and technical lead for the development of Opti-Tool, a spreadsheet-based stormwater best management practices optimization tool. The Opti-Tool is designed for use by municipal SW managers and their consultants to assist in developing technically sound and optimized cost-effective SW management plans. The Opti-Tool uses EPA's System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) optimization module as a back-end computational engine to identify the best mix of cost-effective stormwater controls. He co-led the development of EPA's Loading Simulation Program C++ (LSPC) to modernize the watershed model HSPF and EPA's SUSTAIN - a decision support system for the EPA's Office of Research and Development to develop, evaluate, optimize, select, and place BMPs based on cost and effectiveness. He managed the two-year technical support contract with EPA Region 10 to enhance SUSTAIN version 1.2 and to provide guidance and technical support in applying the enhanced modeling features to the case studies in the State of Washington. He has provided national technical support to EPA 319 grantees in the use of the STEPL model and has conducted several hands-on training courses across the country. Mr. Alvi's programming expertise includes FORTRAN, C++, VBA, and Python.

PROJECT EXPERIENCE
Development of the Loading Simulation Program C++ (LSPC). Since its inception, Alvi has led development of the LSPC modeling framework (working with John Riverson and others). First released in 2003 by the USEPA Office of Research and Development, LSPC has been applied throughout the US and Canada for analysis of hydrology, TMDLs, watershed planning, and climate change, and can be directly applied or linked to other models to support water rights assessment or other environmental and ecosystem resources management studies. The underlying model is based on HSPF routines including snowmelt, hydrology, and water quality; however, because the model input file is a relational database (Microsoft Access) and the computational engine is coded in a C++ platform, LSPC can manage data large datasets for modeling complex watersheds. LSPC enhancements also include: (1) ability to integrate high-resolution spatial and temporal meteorological inputs, (2) crop-associated irrigation module, (3) water withdrawal and diversion management, and (4) time-variable land use change for modeling transient changes on the land. With Paradigm, Alvi continues leading updates and enhancement of this public-domain, open-source model. Alvi has also successfully applied LSPC to support hundreds of TMDL and watershed planning efforts.

Supply and Demand Assessment Hydrology Modeling, State Water Resources Control Board, CA. Paradigm supports the California State Water Resources Control Board with hydrologic modeling of multiple watersheds across the state, incorporating representation of surface water and groundwater withdrawals. The model development process is data-intensive, sourcing geospatial data sets from various local, state, and national sources. The team is currently developing work plans, calibrated models, and reports for 18 different watersheds across the state using the Loading Simulation Program C++ (LSPC) with linked MODFLOW models in specific watersheds when appropriate. Alvi is serving as the project lead for multiple watersheds with direct oversight of model development, calibration, quality assurance, and deliverable preparation. He provides as-needed technical training and support to team members on the

underlying Hydrological Simulation Program--Fortran (HSPF) process algorithms used by LSPC. As the primary developer of LSPC, Alvi continues to maintain the LSPC codebase actively in support of the Supply and Demand Assessment modeling by incorporating new features and model outputs as needed to enhance the functionality of the model further to support the client's needs. Development often requires interacting with the underlying HSPF modules and algorithms to adapt outputs or integrate new features into existing parts of the model.

Sustainable Planning of Hydrology: South Fork Eel and Shasta River Watersheds, State Water Resources Control Board, CA. Paradigm supported the State Board in developing hydrologic and temperature characterization models for the South Fork Eel River and Shasta River watersheds. Alvi supported the development and calibration of surface water-groundwater interaction modeling systems to investigate watershed hydrology and simulate flows in both watersheds under various conditions. He performed analyses of spatial datasets characterizing land cover, topography, geology, soil types, and other features that influence hydrology in each watershed. Alvi and utilized these datasets to develop a spatial representation of hydrologic response units (HRUs) that serve as the foundation for parameterizing the hydrologic model. He also led the compilation and analysis of various meteorological datasets (local gages, gridded products from NLDAS and PRISM) to prepare spatially variable time series of hourly rainfall and potential evapotranspiration and processed these time series for the development of boundary conditions to the LSPC hydrology model. Alvi supported the development python codes for the coupling of LSPC and MODFLOW models and supported the development of the modeling reports for the South Fork Eel River and Shasta River watershed. He processed model outputs to demonstrate model calibration and performance and developed maps that reflected key aspects and complexities in the model configuration.

Water Quality Benefits Evaluation & Analysis. King County Department of Natural Resources & Parks, WA. Paradigm is supporting the King County, WA Department of Natural Resources & Parks in conducting an integrated hydrology, water quality, and stormwater planning modeling study. It includes a linked Loading Simulation Program C++ (LSPC) watershed model with a SUSTAIN optimization model for representing both structural and non-structural stormwater management strategies across King County. The objective of the potential management strategies was to evaluate Benthic Index of Biological Integrity (B-IBI) metrics, reduce tributary pollutant loads, and evaluate the effects on the instream flow duration curve (FDC) across five regional watershed planning units. During Phase 1 of this project, Paradigm's team rebuilt multiple Hydrological Simulation Program--Fortran (HSPF) models into a single integrated LSPC model simulating the entirety of King County's watersheds. This effort concluded with a model verification, a step ahead of formal calibration and validation, to demonstrate the current performance of the translated models. The verification tested the translation of the HSPF model parameters to LSPC and demonstrated the robustness of supplementing local observed data with next-generation gridded meteorological boundary conditions (i.e., PRISM, NLDAS). Five streamflow gages representing large watershed confluences were evaluated during Phase 1. Alvi served as the technical lead for this modeling effort, where he was responsible for model development, calibration, quality assurance, and reporting.

Watershed Management Modeling System (WMMS) 2.0, Los Angeles, County, CA. Alvi led the software updates and enhancements for WMMS 2.0 systems development. WMMS is a comprehensive watershed (LSPC) and best management practice (BMP) modeling (SUSTAIN) system for evaluating hydrologic and water quality management opportunities and the associated cost-benefit implications of different planning scenarios for attaining in-stream water quality objectives. The project involved the development of a representative baseline model for the 12,000 km2 area study area, which was divided into 2,655 catchments and 941 hydraulic routing segments. Alvi supported the hydrology calibration effort and led the water quality calibration of the watershed model. The model calibration captured extremes ranging from the highest storm flows to critical low flow conditions. Alvi also made updates to the EPA SUSTAIN model to support the updates for the WMMS web utilities. Alvi worked closely with the web developers to facilitate seamless linkage and operation of the LSPC and SUSTAIN models with the WMMS online utilities.

Eros Bilyeu, PG, CHG, CGWP, QSD/QSP

PROJECT ROLE

CLASSIFICATION
Senior Hydrogeologist I

EDUCATION
BS, Geology, University of South Alabama, 2009

REGISTRATIONS/CERTIFICATIONS
Professional Geologist, CA #9351;
Certified Hydrogeologist, CA #1061

Qualified Stormwater Pollution Prevention Plan Developer and Practitioner (QSD/QSP), #27447

Certified Groundwater Professional (CGWP), #4016962

YEARS OF EXPERIENCE

- 17 years total
- 2 years with Wood Rodgers

Eros Bilyeu is a California Certified Hydrogeologist with over 17 years of experience in high-resolution hydrogeologic characterization and three-dimensional conceptual and numerical modeling of groundwater basins, karst terrains, and fractured bedrock aquifer systems. He has provided consulting services to federal, state, military, aerospace, and municipal clients throughout Southern California and across the United States.

Eros has extensive experience in groundwater management and planning, including implementation of key components of Groundwater Sustainability Plans (GSPs) under California's Sustainable Groundwater Management Act (SGMA) in high-priority basins. He has managed and executed a wide range of groundwater and well-related projects, including managed aquifer recharge (MAR), recharge basins, well siting, well design, and construction management for municipal supply wells.

His technical expertise also includes the design and installation of multi-level and nested monitoring wells, remedial extraction wells, and Aquifer Storage and Recovery (ASR) wells, as well as horizontal wells. Eros is skilled in interpreting complex geologic and hydrogeologic datasets and has worked extensively with local, state, and federal agencies to evaluate groundwater resources and characterize the vertical and spatial distribution of groundwater contaminants, including PFAS.

RELEVANT PROJECT EXPERIENCE

Agua Mansa Commerce Park (former Riverside Cement Plant), Viridian Partners – Jurupa Valley, CA | Project Hydrogeologist. Prior to joining Wood Rodgers, served as the lead hydrogeologist on a site located directly along the Rialto-Colton fault boundary at the interface of the Chino and Rialto-Colton Basins, an area recognized for hydrogeologic complexity and uncertainty. Supported site redevelopment efforts under a California Land Reuse and Revitalization Act (CLRRA) agreement with DTSC. Responsibilities included hydrogeologic evaluations, soil and groundwater investigations, and preparation of soil management plans. Performed technical assessment of hexavalent chromium transport and impact on shallow groundwater and deeper production zones, evaluating potential migration pathways into the regional aquifer system. The work integrating geological, soil and water quality, and site-specific hydrostratigraphic data to assess aquifer connectivity, localized recharge behavior, and the historic operations on long-term groundwater quality and yield.

Rialto-Colton Groundwater Well Installations, Kinder Morgan Energy Company – Colton, CA | Hydrogeologist, 2015-2017. Prior to joining Wood Rodgers, Led field operations and project delivery for hydrogeologic investigations near the Rialto-Colton fault zone, within the Upper Santa Ana Valley Groundwater Basin, adjacent to the Chino Basin boundary. Oversaw installation and testing of groundwater monitoring wells across perched, unconfined, and confined/semi-confined alluvial aquifers, with a focus on characterizing aquitards and confining units critical to vertical flow and storage behavior. Developed and implemented qualitative lithologic mapping protocols tied to quantitative USCS grain-size

data, enhancing correlation between borehole observations and geophysical resistivity logs across multiple drilling methods. The work informed stratigraphic correlations, hydraulic parameter estimation, and LNAPL delineation, offering valuable insight into aquifer heterogeneity and the performance of numerical groundwater models in alluvial settings with complex boundary conditions.

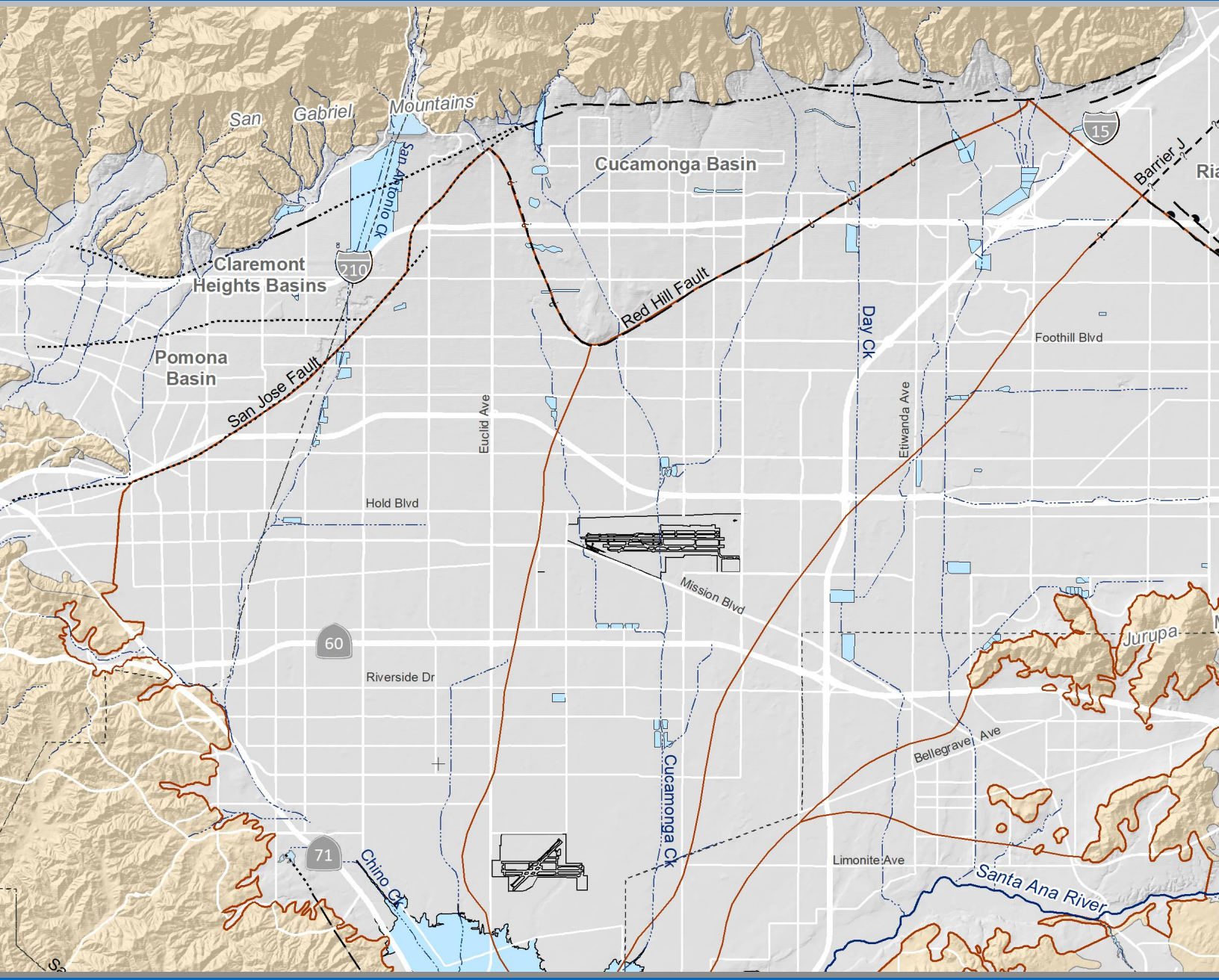
San Bernardino Basin Model (SBBM) Update – Steering Committee Technical Advisor– San Bernardino Valley Municipal Water District, CA | Senior Hydrogeologist. Currently supporting the technical team and steering committee in the update of the San Bernardino Basin groundwater flow model (SBBM), which is used to quantify safe yield and assess groundwater management strategies. Supporting providing peer review of model framework, hydrostratigraphic layering, calibration datasets, and boundary conditions. Supporting evaluating simulation of historical recharge and production data, coordinated with stakeholders and modeling consultants, and provided recommendations for improving model accuracy and applicability for long-term basin sustainability planning.

SGMA Hydrostratigraphic Conceptual and Preliminary Numerical Model of the Los Posas Basins, Calleguas Municipal Water District – Ventura County, CA | Hydrogeologist. Prior to joining Wood Rodgers, developed the SGMA-compliant hydrostratigraphic conceptual model and preliminary numerical groundwater model for the Los Posas Valley and East Las Posas Basins under the Fox Canyon Groundwater Management Agency (FCGMA). Responsibilities included basin-wide subsurface mapping, stakeholder engagement, and interagency coordination with United Water Conservation District and otherstakeholders. Conducted structural and stratigraphic interpretation across 66 square miles and 3,500 feet of subsurface, integrating paleostratigraphic data from proprietary oil well logs into a secure SQL database. Updated the basin hydrostratigraphy, identified structural controls on groundwater flow, refined vertical boundaries, and delineated lateral boundary conditions for inflow/outflow zones to support both the conceptual model and the numerical flow model. Supported groundwater budget development, ASR well field integration, and GSP documentation. Defined aquifer parameters, boundary conditions, and model geometry is directly applicable to assessing assumptions and uncertainty in Net Recharge estimation, storage volume, and structural constraints on flow.

Owner's Agent Contract for Hydrogeological Services in the San Fernando Basin, Los Angeles Department of Water and Power – Los Angeles, CA | Principal Hydrogeologist. Served as the Owner's Agent for the Los Angeles Department of Water and Power (LADWP), delivering expert hydrogeologic and engineering consulting services in support of the San Fernando Groundwater Basin Remediation Program. Prior to joining Wood Rodgers, Eros supported the development, calibration, and application of LADWP's numerical groundwater flow model, which was used to guide well siting, remedial system design, and long-term basin planning. Work included the planning, siting, design, permitting, and construction of groundwater production and monitoring wells, as well as groundwater remediation infrastructure. Led a $1 million remedial investigation and reporting project, updating and incorporating groundwater flow model insights to delineate contaminant pathways, evaluate aquifer responses to pumping, and optimize system designs.This project offered direct involvement in model-based decision-making, evaluation of aquifer parameters, and integration of conceptual hydrogeologic understanding into predictive modeling tools for sustainable basin management and contaminant control.

Perchlorate Cleanup Project – Proposition 1 Grant Funding Project, Water Replenishment District of Southern California – Los Angeles County, CA | Principal Hydrogeologist. Led technical efforts on a Proposition 1–funded cleanup of one of California's most concentrated perchlorate plumes, impacting deep aquifers in the Los Angeles Forebay. Prior to joining Wood Rodgers, Eros was responsible for designing and expanding a nine-well triple-nested monitoring network, along with five remedial progress wells and four extraction wells, to improve plume delineation and guide remedial action. Refined WRD's conceptual model by transitioning from the legacy DWR lithostratigraphy to the comprehensive "Upper San Pedro" hydrostratigraphic framework, now used by USGS and WRD. This framework formed the basis for a newly developed numerical groundwater flow model, which was used to simulate aquifer behavior, define groundwater flow paths, and evaluate the long-term effectiveness of proposed extraction strategies. The modeling work supported both regulatory engagement and grant compliance, while informing the operational design of the extraction system. These efforts are directly supported evaluating aquifer parameter assumptions, boundary condition sensitivity, model calibration, and the use of numerical tools for tracking contaminant transport and assessing Net Recharge in complex, multi-aquifer systems.

S.S. Papadopulos & Associates, Inc.



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Additional personnel are located in Maine, Minnesota, West Virginia, and the Pacific Northwest.

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Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

Other Plumes

Watermaster continues to track the monitoring programs and mitigation measures associated with other point sources of contamination in the Chino Basin, including: Alumax Aluminum Recycling, Alger Manufacturing Facility, General Electric Test Cell and Flatiron facilities, the Former Kaiser Steel Mill, Milliken Landfill, Mid-Valley Landfill, Upland Landfill, ~~Chino~~ California Institution for Men, and the Stringfellow National Priorities List sites. In October 2024 Watermaster prepared the most recent annual status reports for the GE Test Cell, GE Flatiron, Milliken Landfill, California Institution for Men, Stringfellow Plumes, and the former Kaiser Steel Mill site. During this reporting period, the most current Watermaster delineations of the extent of these plumes were completed in June 2025 for the 2024 *Chino Basin OBMP State of the Basin* report (see 2024 State of the Basin Report section in this report).

Water Quality Management Program

Through the collaborative stakeholder process to update the OBMP in 2020 (see 2020 OBMP Update section of this report), the parties identified a new management action under Program Element 6 to develop a Water Quality Management Program that addresses contaminants of emerging regulations of concern to better prepare the parties for addressing compliance with new State and Federal drinking water regulations, and provide for the long-term maximum beneficial use of the basin. It was identified that reconvening the Water Quality Committee (WQC) that met historically from 2003 to 2010 to implement Program Element 6 of the 2000 OBMP would be the ideal approach to guide the development and implementation of the Water Quality Management Plan (WQMP). Watermaster held a kick-off meeting in October 2023 to reconvene the WQC. Two additional WQC meetings were conducted during the first half of 2024 to develop an initial Emerging Contaminants Monitoring Plan (ECMP), and a framework and scope for a WQMP. From July to December 2024, Watermaster collected samples for the parameters that are part of the ECMP during the routine groundwater sampling that is part of Program Element 1. During this reporting period, there was no activities for the WQMP.

Program Element 7: Develop and Implement a Salt Management Program

Maximum Benefit Salt and Nutrient Management Plan

In January 2004, the Santa Ana Water Board amended the Basin Plan to incorporate an updated TDS and nitrogen (N) management plan. The Basin Plan amendment includes both "antidegradation" and "maximum-benefit" objectives for TDS and nitrate for the Chino-North and Cucamonga groundwater management zones (GMZs). The maximum-benefit objectives allow for recycled water reuse and recharge of recycled and imported waters, which is an integral part of the OBMP, without the immediate need for mitigation. The application of the maximum-benefit objectives is contingent on the implementation of specific projects and requirements termed the maximum-benefit commitments by Watermaster and IEUA. The status of compliance with each commitment is reported to the Santa Ana Water Board annually in April. The nine maximum-benefit commitments include:

1. The development and implementation of a surface water monitoring program.
2. The development and implementation of a groundwater monitoring program.
3. The expansion of the Chino I Desalter to a capacity of 10 MGD and the construction of the Chino II Desalter with a design capacity of 10 MGD.
4. The additional expansion of desalter capacity (to 40 MGD) pursuant to the OBMP and the Peace Agreement (tied to the IEUA's agency-wide effluent TDS concentration).
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program.
6. The management of recycled water quality to ensure that the IEUA agency-wide, 12-month volume-weighted running average TDS and TIN concentrations do not exceed 550 mgl and 8 mgl, respectively.
7. The management of water quality in artificial recharge to ensure that the five-year volume-weighted running average TDS and nitrate concentrations in artificial recharge of recycled, imported, and storm waters are less than or equal to the maximum-benefit objectives of 420 mgl and 5 mgl, respectively.

CHINO BASIN WATERMASTER

ADVISORY COMMITTEE

September 18, 2025

INLAND EMPIRE UTILITIES AGENCY REPORTS

The following items are provided for receive and file.

- Metropolitan Water District Activities Report
- Water Supply Conditions
- State and Federal Legislative Reports

IEUA's Summary on Metropolitan Water District of Southern California (MWD) Board Activities

Submitted September 2025

For More Information Contact:

Eddie Lin

elin@ieua.org

909.993.1740

See www.MWDh2o.com for the latest information from MWD and tune into livestream broadcasts of meetings.

Golden Mussels Detected in Silverwood Lake

On September 4th, MWD notified member agencies that the Department of Water Resources confirmed the presence of a golden mussel veliger in a sample from Silverwood Lake. This is the southernmost detection of golden mussels in the State Water Project to date. MWD staff plans to add an invasive mussel control program to the Capital Improvement Plan at October Board.

MWD Explores Increasing Biennium Capital Improvement Plan (CIP) Budget

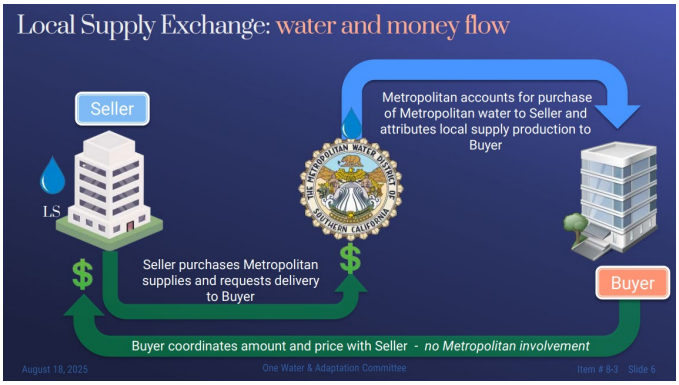
On August 18th, the MWD Engineering, Operations, & Technology Committee was briefed that to date biennium CIP expenditures are outpacing planned expenditures by approximately $30 million. Two options were presented and will be brought before the MWD Board as an action item in October. Option 1 stays within the current $688 million biennium budget, but the Foothill/Inland Feeder Intertie, Weymouth Admin Building Seismic Upgrade, Gene & Iron Utilities Replacement, Colorado River Aqueduct Sump Piping Replacement, and Sepulveda Feeder Prestressed Concrete Cylinder Pipe Rehab Reach 2 projects would not be awarded this biennium. Option 2 increases the CIP by $30 to $50 million but allows these five critical projects to be funded this biennium.

MWD Authorizes Agreement for Inspection and Verification of Conservation Programs

On August 19th, the MWD Board of Directors entered into a new three-year sole source agreement with WaterWise Consulting, Inc. for inspection and verification services for MWD's conservation programs, for a total agreement not to exceed $4.5 million. The approval comes with the condition that the contract will be sent to competitive bid in 2028.

MWD Authorizes Local Supply Exchange Framework

On August 19th, the MWD Board of Directors authorized the Local Supply Exchange Framework. The framework allows MWD to facilitate an exchange of local supplies between MWD agencies who lack a physical connection. The buying agency will coordinate a price with the selling agency with no MWD involvement. The selling agency will then purchase MWD supplies and request delivery to the buying agency. MWD accounts for the purchase of MWD water to the selling agency and attributes local supply production to the buying agency. The framework does not include wheeling or transfer and exchange of outside water. Exchanges are not guaranteed and are subject to Metropolitan's discretion. The credit and benefit of local supply production are assigned to the buying agency, and exchanged supplies are accounted to the selling agency as MWD purchases.



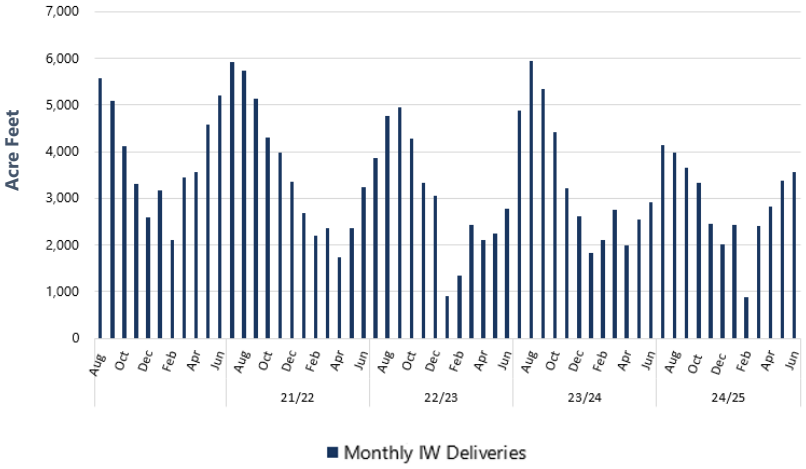
Local Supply Exchange Framework – MWD August 19th, 2025

GENERAL MANAGER'S REPORT

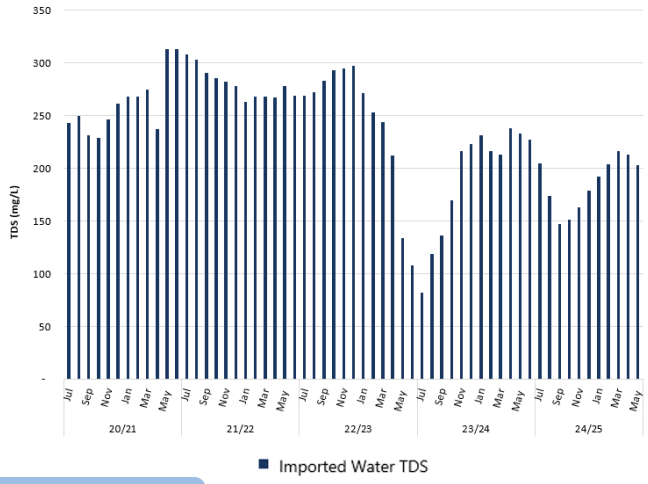
AUGUST 2025

Imported Water

Full Service Imported Water Deliveries Summary (FY 2020/21 to 2024/25)

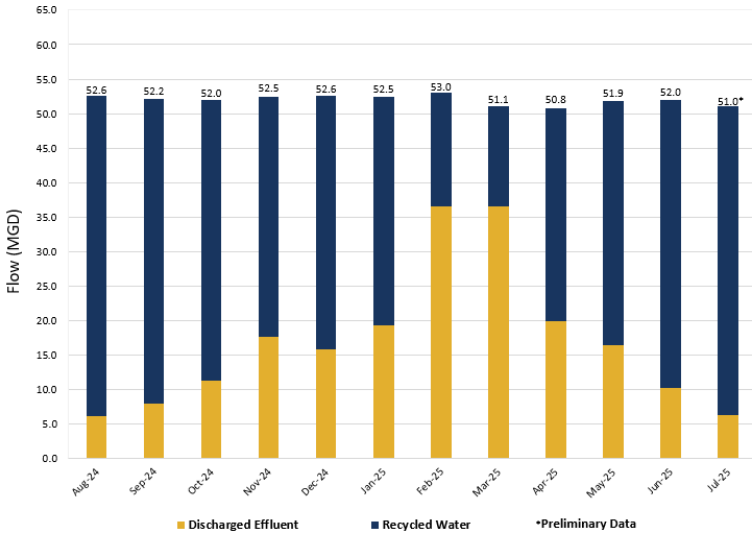


Imported Water TDS Summary (FY 2020/21 to 2024/25)

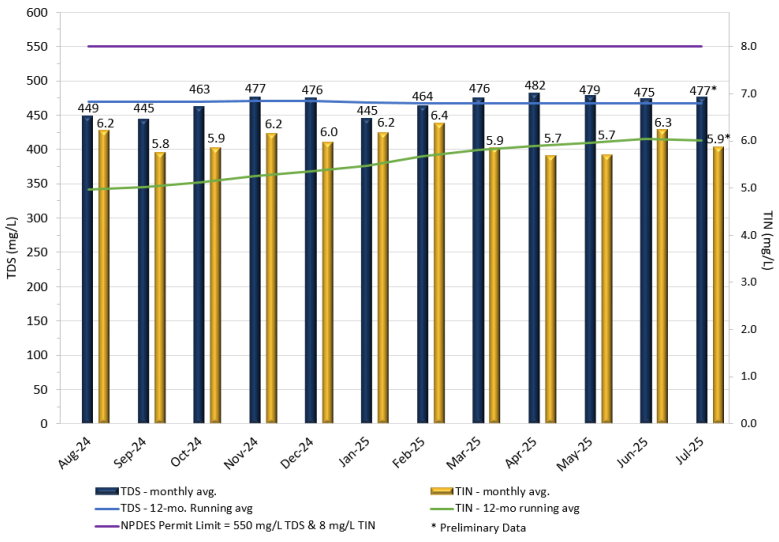


Recycled Water

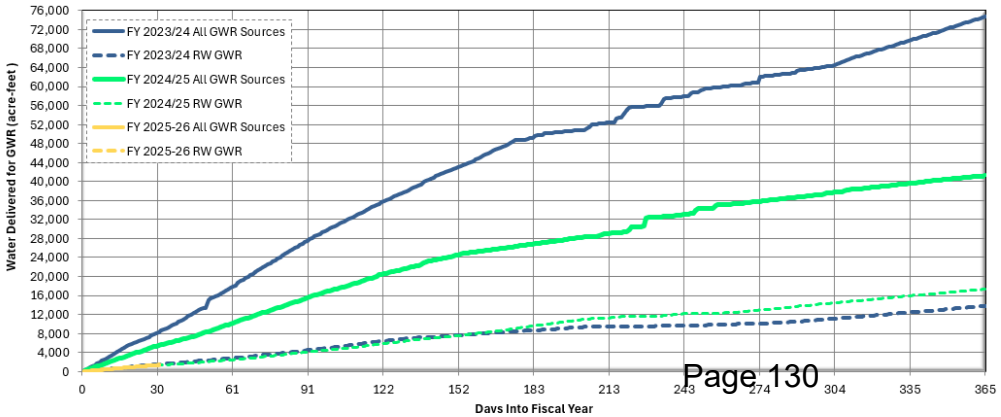
Discharged Effluent & Recycled



Agencywide Effluent TDS & TIN



Groundwater Recharge



JULY 2025 NOTES:

- Total stormwater and dry weather flow recharged is preliminarily estimated at 91.2 acre-feet.
- Recycled water delivered for recharge totaled 1,353.3 acre-feet.
- There was no imported water recharged in the Chino Basin from MWD.
- Chino Basin Watermaster will remove 4.2% for evaporation losses from delivered supplemental water sources (imported water and recycled water).
- Considering evaporation losses, total recharge is preliminarily estimated at 1,387.6 acre-feet.

The Metropolitan Water District of Southern California's

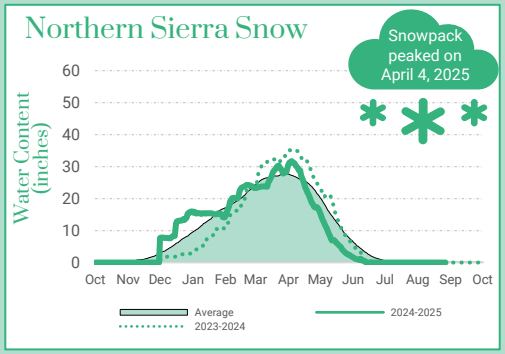
Water Supply Conditions Report (WSCR)

https://www.mwdh2o.com/WSCR

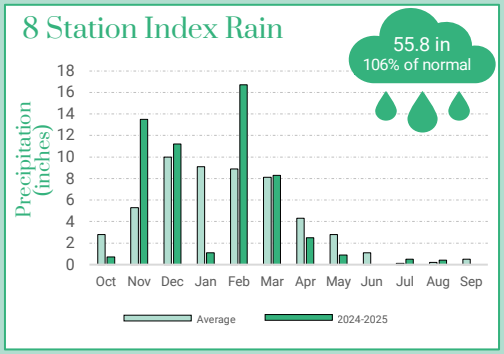
Water Year 2024-2025
As of: 08/27/2025

State Water Project

Northern Sierra Snow

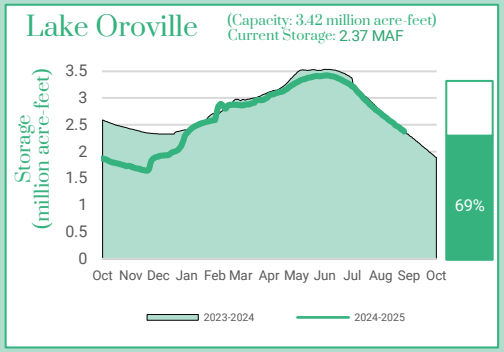


8 Station Index Rain



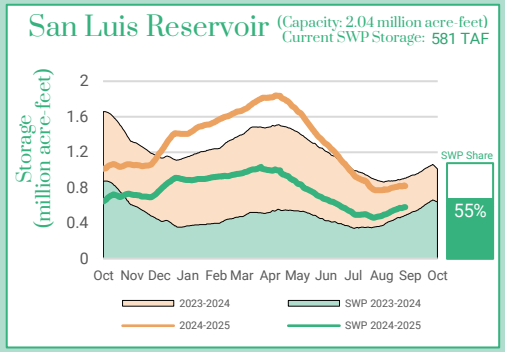
Lake Oroville

(Capacity: 3.42 million acre-feet)
Current Storage: 2.37 MAF



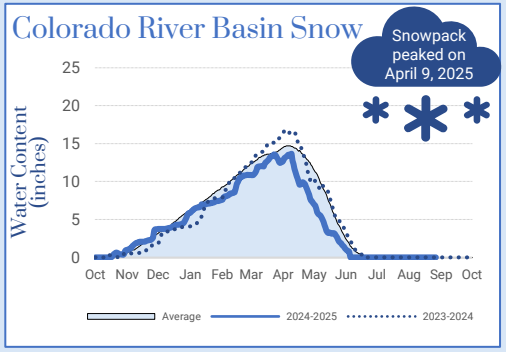
San Luis Reservoir

(Capacity: 2.04 million acre-feet)
Current SWP Storage: 581 TAF

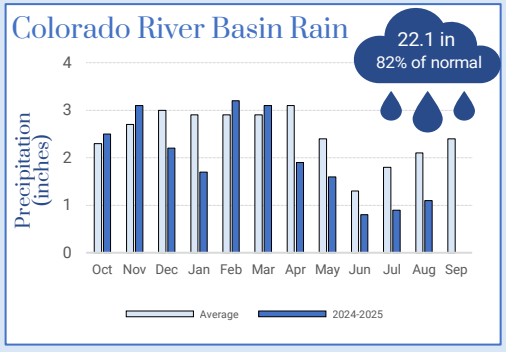


Colorado River

Colorado River Basin Snow

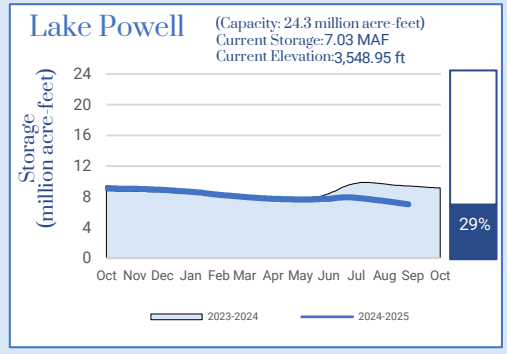


Colorado River Basin Rain



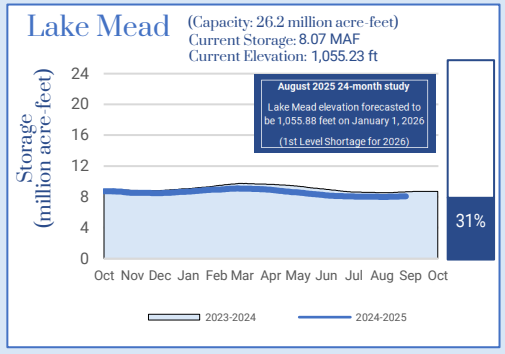
Lake Powell

(Capacity: 24.3 million acre-feet)
Current Storage: 7.03 MAF
Current Elevation: 3,548.95 ft



Lake Mead

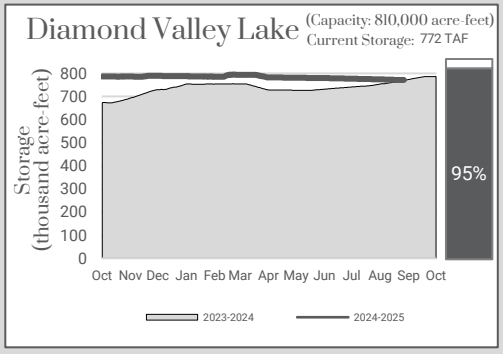
(Capacity: 26.2 million acre-feet)
Current Storage: 8.07 MAF
Current Elevation: 1,055.23 ft



Metropolitan

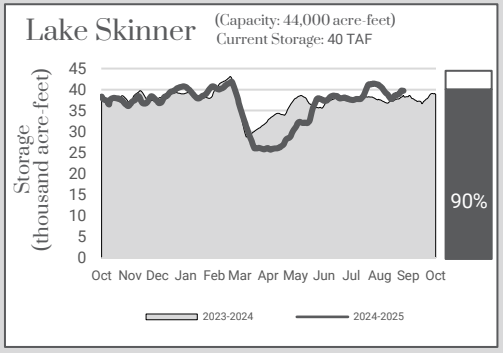
Diamond Valley Lake

(Capacity: 810,000 acre-feet)
Current Storage: 772 TAF



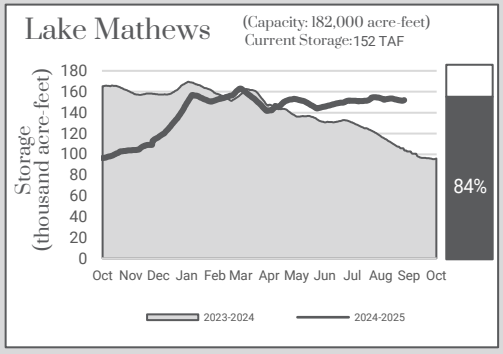
Lake Skinner

(Capacity: 44,000 acre-feet)
Current Storage: 40 TAF

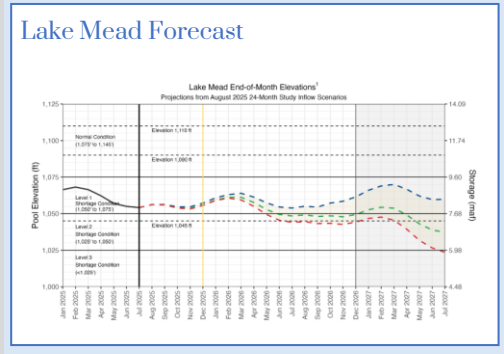


Lake Mathews

(Capacity: 182,000 acre-feet)
Current Storage: 152 TAF



Lake Mead Forecast



Inland Empire Utilities Agency, a Municipal Water District Federal Update

August 27, 2025

California Sets Special Election on Congressional Redistricting

On August 21, Governor Gavin Newsom signed a measure setting up a November 4 special election on Proposition 50, which would temporarily institute new boundaries for the state's 52 congressional districts until the Citizens Redistricting Commission adopts new maps in 2031 following the next decennial census. The measure would declare it the policy of California to support the nationwide use of independent redistricting commissions and urges Congress to pass related federal legislation and a constitutional amendment. Proponents have argued this measure would respond to redistricting efforts in Texas to add Republican seats in the U.S. House of Representatives, while opponents have criticized the proposal as partisan gerrymandering and overriding the voter-approved independent redistricting process. The plan could shift up to five House seats currently held by Republicans to Democrats in 2026.

EPA Announces Cancellation of $7 Billion Solar Program

On August 7, Environmental Protection Agency (EPA) Administrator Zeldin **announced** the cancellation of the $7 billion "Solar for All" grant program, saying the move is required under the *One Big Beautiful Bill Act* (OBBBA) signed into law in July. The OBBBA repealed the program's funding and statutory authority. The Solar for All Program was part of a broader $27 billion fund for climate-related projects created through the 2022 *Inflation Reduction Act*.

Fiscal Year 2026 Appropriations Update

Before departing for the traditional August recess, the Senate passed three appropriations bills (Agriculture-Rural Development-FDA, Legislative Branch, Military Construction-VA) as part of a "minibus" package. This was the first time the chamber has cleared any appropriations measures before the August break since 2018. With only weeks until the September 30 funding deadline, leaders in both chambers have acknowledged that a continuing resolution will likely be needed to extend current funding levels and avoid a federal government shutdown. Both the House and Senate are scheduled to reconvene on Tuesday, September 2.

FY26 Appropriations Bill	House Subcommittee Allocation (in Billions)	Passed House Committee	Passed House	Passed Senate Committee	Passed Senate
Agriculture-Rural Development-FDA	$25.523	June 23 by a 35-27 vote		July 10 by a 27-0 vote	August 1 by an 87-9 vote
Commerce-Justice-Science	$76.824			July 17 by a 19-10 vote	
Defense	$831.513	June 12 by a 36-27 vote	July 18 by a 219-202 vote	July 31 by a 26-3 vote	
Energy-Water Development	$57.300	July 10 by a 35-27 vote			
Financial Services-General Government	$23.198				
Homeland Security	$66.361	June 24 by a 36-27 vote			
Interior-Environment	$37.971	July 22 by a 33-28 vote		July 24 by a 26-2 vote	
Labor-HHS-Education	$184.491			July 31 by a 26-3 vote	
Legislative Branch	$6.700	June 26 by a 34-28 vote		July 10 by a 26-1 vote	August 1 by an 81-15 vote
MilCon-VA	$152.091	June 10 by a 36-27 vote	June 25 by a 218-206 vote	July 26 by a 26-3 vote	August 1 by an 87-9 vote
State-Foreign Operations	$46.218	July 23 by a 35-27 vote			
Transportation-HUD	$89.910	July 17 by a 35-28 vote		July 24 by a 27-1 vote	

LEGISLATIVE ACTIVITY

Senate Confirms Telle as Assistant Secretary for Civil Works. On August 2, the Senate **confirmed** Adam Telle as the Assistant Secretary of the Army for Civil Works by a 72-22 vote. Telle previously served as Chief of Staff for Senator Bill Hagerty (R-TN) and Special Assistant to the President for Legislative Affairs during the first Trump administration.

Senate Confirms Nesvik as Fish and Wildlife Director. On August 1, the Senate **confirmed** Brian Nesvik as the Director of the U.S. Fish and Wildlife Service by a 54-43 vote. Nesvik is a former director of the Wyoming Game and Fish Department and is a retired brigadier general in the Wyoming Army National Guard.

Lawmakers Introduce Bipartisan Bill on Pre-Disaster Mitigation Funds. Representatives Shomari C. Figures (D-AL) and Chuck Edwards (R-NC) introduced the *Building Resilient*

Infrastructure and Communities (BRIC) Act (**H.R. 4560**), which would reinstate and reform FEMA's BRIC program. The bill would replace the current fully competitive grant process with a formula-based system: one-third of BRIC funds allocated equally among states, one-third based on population, and one-third directed to states most vulnerable to natural disasters.

Bipartisan Bill Introduced to Revive Federal Water Assistance Program. Representatives Eric Sorensen (D-IL) and Rob Bresnahan (R-PA) introduced the *Low-Income Household Water Assistance Program (LIHWAP) Establishment Act* (**H.R. 4733**). The bill would re-establish and make permanent the federal program, which provided aid to more than 1.5 million households before funding expired in 2022. The proposal would authorize $2.5 billion over five years for distribution through local utilities to help households afford water and wastewater services.

Bipartisan Congressional Recycling Caucus Relaunches. On August 13, Representative Haley Stevens (D-MI) **announced** the relaunch of the bipartisan Congressional Recycling Caucus, which she will co-chair alongside Representatives David Joyce (R-OH), Chellie Pingree (D-ME), and Marinette Miller-Meeks (R-IA). Founded in 2006, the Caucus promotes policies to expand recycling access, support U.S. manufacturers, and strengthen America's leadership in the circular economy. Currently, according to the Caucus, 21% of recyclable materials in the U.S. are actually recycled, and less than half of households have reliable access to recycling.

FEDERAL FUNDING OPPORTUNITIES

DOL Releases Industry-Driven Skills Training Fund NOFO. The Department of Labor has released a **Notice of Funding Opportunity**, offering up to $30 million to support workforce training in high-demand and emerging industries. The grants—up to $8 million per state—will reimburse employers for outcome-based training programs aligned with federal priorities, including advanced manufacturing, artificial intelligence infrastructure, nuclear energy, domestic mineral production, and information technology. At least $5 million will be dedicated to building a skilled workforce in the shipbuilding industry. Applications are due by September 5, 2025 at 11:59 p.m. ET.

FEDERAL AGENCY ACTIONS AND PERSONNEL CHANGES

President Trump Signs Executive Order on Federal Grantmaking. On August 7, President Trump signed an **executive order** directing federal agencies and the Office of Management and Budget (OMB) to implement new policies for awarding and managing discretionary grants. The order requires agencies to designate senior political appointees to review all funding opportunity announcements and awards for alignment with agency priorities and the national interest, and to conduct annual reviews of active grants. It also promotes expanded use of "termination-for-convenience" clauses, allowing agencies to end grants if they no longer meet agency objectives, and directs OMB to revise the Uniform Guidance to make such provisions standard across discretionary awards. The order includes new prohibitions on using grant

funds for certain activities and requires grantees to provide detailed justifications for each drawdown of funds.

President Trump Imposes Tariffs on Copper Imports. President Trump signed a **proclamation** imposing tariffs of up to 50% on a range of imported copper products, including pipes, wires, rods, sheets, and electrical components. The action follows a Section 232 investigation by the Department of Commerce, which concluded that rising copper imports—particularly from China—pose a threat to national security by undercutting domestic production and increasing foreign reliance. Effective August 1, the tariffs exclude raw materials such as copper ores, cathodes, anodes, and scrap. The order also invokes the Defense Production Act to boost domestic copper processing by requiring a portion of U.S.-produced copper inputs and scrap to be sold domestically, gradually increasing from 25% in 2027 to 40% by 2029.

White House Suspends Public Tours. The White House **announced** that public tours will be paused beginning in September while construction begins on a new 90,000-square-foot ballroom. Tours, which had resumed in February, will be suspended indefinitely during construction. No timeline for resuming tours has been provided.

Judge Blocks FEMA From Redirecting Disaster Mitigation Funds Amid Legal Challenge. On August 5, a federal judge in Massachusetts issued a **preliminary injunction** blocking FEMA from reallocating $4 billion from the Building Resilient Infrastructure and Communities (BRIC) program while a multistate lawsuit is pending. District Judge Richard Stearns ruled that the plaintiff states are likely to succeed on the merits and face potential irreparable harm if funds are diverted. The court found that FEMA has taken steps toward dismantling the BRIC program and that the federal government failed to demonstrate any immediate hardship from pausing the reallocation. Judge Stearns noted that the federal government could still request court approval to access the funds in the event of an extraordinary disaster, even while the injunction is in effect.

DOJ Publishes List of Sanctuary Jurisdictions. On August 5, the Department of Justice (DOJ) **released** a list of 35 jurisdictions identified as having policies that limit cooperation with federal immigration enforcement. The list was published in accordance with Executive Order 14287, signed by President Trump in April, which directed the identification of jurisdictions that "impede the enforcement of federal immigration laws." DOJ has stated it will continue pursuing legal action against noncompliant jurisdictions and will assist local governments seeking to revise policies to align with federal enforcement priorities. DOJ also noted this list will be updated periodically as more information becomes available.

EPA to Defend 2024 Lead in Drinking Water Rule. The Environmental Protection Agency (EPA) has **said** it will defend a 2024 drinking water regulation requiring the replacement of nearly all lead service lines in the U.S. by 2037. The Biden-era rule, paused earlier this year, also lowers the lead action level and requires utilities to provide water filters if elevated lead levels are detected. The American Water Works Association has sued to overturn the rule, citing cost and timeline concerns. EPA said it is developing tools to support implementation flexibility and will announce any potential adjustments in the coming months.

EPA Proposes Partial Disapproval of California Heavy-Duty Vehicle Rule. On August 25, EPA **announced** a proposal to partially disapprove California's State Implementation Plan establishing inspection and maintenance requirements for heavy-duty vehicles, including those registered out of state or outside the country. The agency said the proposal is based on concerns that applying the rule to non-California vehicles could conflict with the Constitution's Commerce Clause and with Section 110 of the *Clean Air Act*. EPA will accept public comments for 30 days following the rule's publication in the *Federal Register* before issuing a final decision.

EPA to Host Webinar on Water Utility Workforce. EPA will **host** a webinar in its "Creating the Water Workforce of the Future" series on Wednesday, September 10 from noon-1:30 p.m. ET. The session will feature the Rural Community Assistance Partnership and Water Finance Assistance, highlighting a new certification program that provides leadership and management training for water and wastewater utility administrative professionals. The initiative aims to strengthen decision-making, resource management, and support for small communities.

GAO Issues Report on Water Infrastructure in Vulnerable Communities. On August 15, the Government Accountability Office (GAO) **released** a report finding that the Environmental Protection Agency, Federal Emergency Management Agency, and Department of Agriculture provided $64 billion in financial assistance for drinking water and wastewater projects between FY 2014-2023 but face challenges ensuring that vulnerable communities fully benefit. While the agencies have taken steps to reduce barriers, such as providing technical support and allowing federal cost-share flexibility, GAO found FEMA has not adequately communicated options for meeting matching requirements, and limited data also make it difficult to assess which communities benefit from programs. GAO recommended that EPA, FEMA, and USDA use EPA's new water service area mapping tools to better track assistance.

Reclamation Announces 2026 Operating Conditions for Lake Powell and Lake Mead. On August 15, the Bureau of Reclamation **released** its August 2025 24-Month Study, setting the 2026 operating conditions for Lake Powell and Lake Mead. Lake Powell is projected to be at 3,538 feet on Jan. 1, 2026, placing it in the Mid-Elevation Release Tier with a planned release of 7.48 million acre-feet. Lake Mead is expected to remain in a Level 1 Shortage Condition at 1,055 feet, triggering significant water reductions for Arizona, Nevada, and Mexico under existing agreements. Current Colorado River operating guidelines expire at the end of 2026, and Interior officials emphasized the urgency of finalizing new post-2026 operating rules to address long-term drought and ensure water security for the 40 million people who rely on the river.

USDA Ends Funding for Large Solar Projects on Farmland. On August 19, Secretary Brooke Rollins **announced** the Department of Agriculture (USDA) is rescinding programs that support building utility-scale solar arrays on agricultural land, citing concerns about impacts on farmland availability and costs. USDA later clarified that smaller projects funded through the Rural Energy for America Program (REAP) will continue, but loan guarantees for ground-mounted systems larger than 50 kilowatt-hours, as well as solar and wind projects under the Rural Development Business and Industry Guaranteed Loan Program, will face new restrictions

September 2, 2025

To: Inland Empire Utilities Agency

From: Michael Boccadoro
Beth Olhasso

RE: August Report

Overview:
While limited Delta pumping operations this Spring and early Summer kept water from reaching San Luis Reservoir when spring melt was available, San Luis Reservoir is finally back at normal levels for this time of year. Had pumping been available, the reservoir could be well above average, allowing for significant carryover for next year. Lake Oroville is sitting at 69 percent capacity, 113 percent of normal; Lake Shasta is sitting at 63 percent of capacity, 104 percent of average; while San Luis Reservoir is at just 42 percent of capacity, 103 percent average for this time of year.

Efforts to pass a Trailer Bill introduced by the Governor aimed at helping remove some barriers to the Delta Conveyance Project are continuing in the final weeks of the session. The Governor is proposing expedited judicial review of CEQA challenges. The proposal saw swift condemnation from in-Delta interests. The State Water Contractors have been organizing supporters and had several lobby days in Sacramento to earn votes for the Trailer Bill. It remains to be seen if Senate and Assembly leadership will bring the bill to the floor for a vote.

Perhaps in conjunction with the Trailer Bill effort, the Department of Water Resources has launched an effort to educate the public on water supply issues in the state by publishing short papers on Maven's Notebook. The latest highlighted how much water has been lost through the San Francisco Bay that could have been moved through the Delta and into storage if Delta Conveyance was available.

The second of two court cases concerning the validity of tiered water rates under Proposition 218 in San Diego was just decided at the appellate level. The court found that the City of San Diego failed to justify its rates.

A Proposition 4 spending plan has still not been released by either house. However, stakeholders remain hopeful that a plan will be passed before the end of the session following intense lobbying to get both of the houses moving toward a compromise. Progress has been made over the past several days.

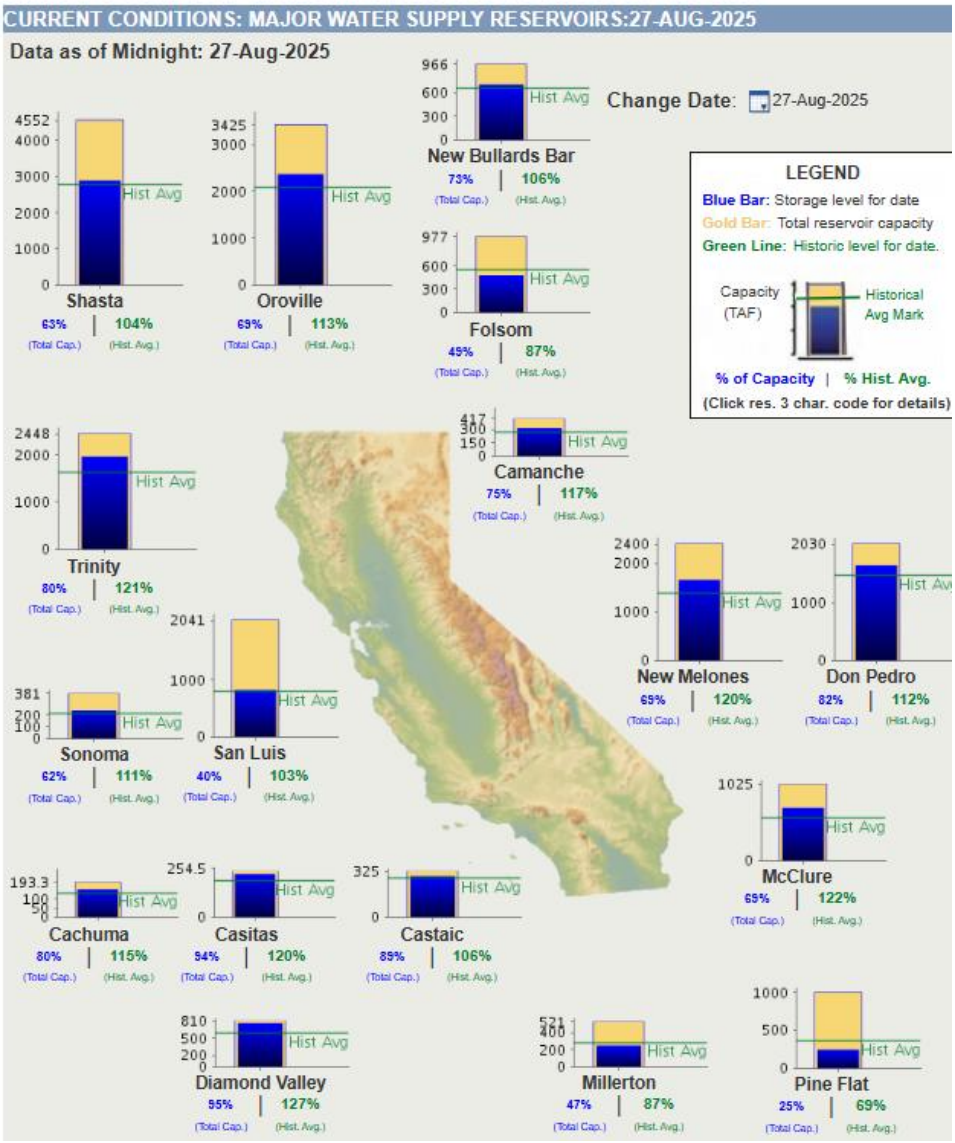
September 12 marks the end of the first year of the two-year session. August 29 was the deadline for bills to pass out of Appropriations Committees. The Assembly passed 190 of 261 Senate bills and the Senate passed 307 of 425 Assembly bills. By design, or just coincidence, both held 27 percent of bills on the Suspense File. Both SB 601 (Allen) which would create the new term "nexus waters" and SB 445 (Weiner), which would have given authority to the High Speed Rail Authority to move utility infrastructure did not advance to the floor. CASA's PFAS control bill,

SB 862 (Allen), WateReuse's SB 31, and Western MWD's SB 72 (Caballero) all advanced to the floor. The final two weeks will be full of floor sessions to take final action on legislation.

Inland Empire Utilities Agency
Status Report – August 2025

Water Supply Conditions

The water supply situation is positive throughout the state. Failure to move water into San Luis Reservoir in the Spring and early Summer left the storage facility below averages, however as the end of summer nears, the south of delta storage facility is at normal levels for this time of the year. San Luis Reservoir is at 103 percent of historical average and just 42 percent capacity. Lake Oroville is sitting at 69 percent capacity, 113 percent of normal; Lake Shasta is sitting at 63 percent of capacity, 104 percent of average for this time of the year.



Delta Conveyance Budget Trailer Bill Update

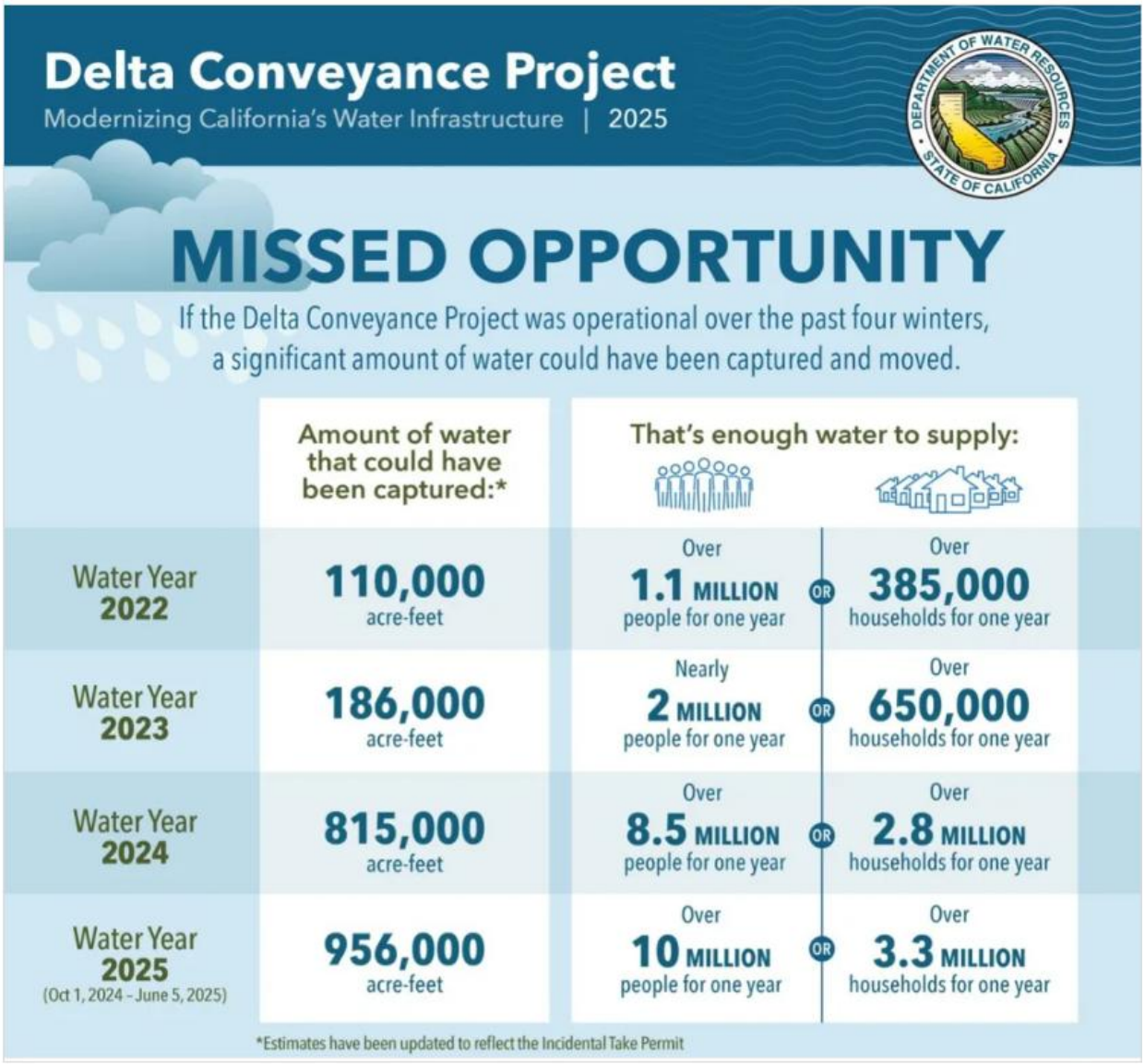
As discussed in previous reports, as part of his "May Revise" of the 2025-26 budget, Governor Newsom released a proposal to help streamline the Delta Conveyance Project (DCP). The Governor's proposal would streamline the project by:

- **Simplifying permitting.** The proposal would simplify permitting for the project by eliminating certain deadlines from existing State Water Project water rights permits — recognizing that the State Water Project should continue serving Californians' water needs indefinitely. The proposal would also strengthen enforcement of the Water Board's existing rules for permit protests.
- **Confirming funding authority**. The proposal confirms that the Department of Water Resources has the authority to issue bonds for the cost of the DCP, to be repaid by participating public water agencies.
- **Preventing unnecessary litigation delays**. The proposal narrows and streamlines judicial review of future challenges to the DCP, building on models that have served other large public works projects.
- **Supporting construction.** The proposal streamlines the authority to acquire land, supporting construction of the DCP.

In-Delta legislators and advocates have come out in very strong opposition to the proposal. The State Water Contractors and MWD organized Southern California water agencies to support the proposal. IEUA staff have helped coordinate a coalition to rally Inland Empire interests to support the proposal and lobby legislators, and General Manager Deshmukh traveled to Sacramento for a second time to participate in a Lobby Day in support of the proposal, this time with Director Elie.

The trailer bill was not part of the budget that passed before the start of the Fiscal Year on July 1. The goal is for action before the Legislature adjourns the first year of the two-year session in September.

As mentioned in previous reports, the Department of Water Resources is trying to help by publishing various informational pieces about the benefits of Delta Conveyance. Their latest piece included data about how much water could have been captured if the project were available for use.



Prop 218 Challenge Update:
A pair of recent court decisions in San Diego—*Patz v. City of San Diego* and *Coziahr v. Otay Water District*—have thrust California's Proposition 218 back into the spotlight. In both decisions, the courts have rejected tiered rates that cost more if you use more water and ordered money—$79 million in the *Patz* case—refunded to ratepayers.

Most recently, a class of single-family residential customers ("Patz") sued the City of San Diego, alleging its tiered water rate structure (2014–2022) violated Proposition 218, which prohibits charging more than the proportional cost of service.

The City charged higher per-unit rates for water as usage increased, based on "peaking factors"—generalized multipliers from the AWWA MI Manual estimating higher costs during peak demand periods. However, the City did not collect specific time-of-use data or conduct

parcel-specific cost studies. Meanwhile, non-residential users paid a flat rate, regardless of consumption.

Trial and Appellate Court Findings:

- The trial court ruled the City's rates violated Prop. 218 due to lack of evidence that higher tiers reflected actual proportional costs.
- The Fourth District Court of Appeal affirmed, holding:
    - The City failed to justify its rate tiers with concrete, system-specific cost data.
    - Reliance on industry assumptions or conservation goals (e.g., from the AWWA Manual) was not sufficient under Prop. 218 §6(b)(3).
    - The City's methodology lacked evidence connecting costs to peak usage or water sources.
    - The mathematical design of the tiers (e.g., Tier 4 being exactly 2.25x Tier 1) showed reliance on formulas, not cost analysis.

Importantly, the court rules that tiered rates are not inherently constitutional—they must be backed by detailed cost-of-service evidence. The Court offered guidance to agencies:
Agencies must:

- Prove each rate tier reflects the actual cost of service for the parcel.
- Avoid imposing tiered rates without a vote if substantial evidence shows the tiers are not cost-proportional.
- Use detailed, system-specific data, not just projections or policy goals.

Implications for Agencies:

- Agencies using tiered rates must collect and analyze specific cost data to justify higher usage charges.
- Generalized assumptions or conservation policies are not enough.
- Courts are likely to demand strict proof of cost proportionality under Prop. 218.

The Public Policy Institute of California (PPIC) offers the following analysis of the path forward for water agencies:

> *"In the aftermath of these court decisions, you'll probably see some public water providers stop using tiered rates because it's too risky, and they'll charge the same rate for everybody. Flat rates have an intuitive appeal, but you could see legal attacks on flat rates as well. There's no safe haven for public water providers here.*
>
> *There are a few ways forward. First, the California Supreme Court may decide to give water agencies a little more leeway in setting rates. A ballot initiative could amend the state constitution to make tiered water rates constitutional. Finally, the state could impose a tax on water consumption and use some revenues to offset water costs for low- and moderate-income users. With a two-thirds vote, a city also could impose a new tax on water consumption, and the tax could include exemptions for low-income users and could generate revenues to support conservation projects. Proposition 218 has implications for water conservation and affordability, and it's worth seeking a solution."*

Budget Update
The main portion of the Fiscal Year 2025-26 budget was passed by the Legislature ahead of the start of the fiscal year on July 1. However, legislators did not pass key aspects of the budget including a Proposition 4 spending plan, the Greenhouse Gas Reduction Fund, re-authorizing the Cap & Trade Program, re-capitalizing the Catastrophic Wildfire Fund and dealing with revenue losses as a result of H.R. 1. Budget leadership have indicated that further revisions of the budget are likely as more federal funding is cut from various programs as Congress passes a federal budget. Revisions could happen before September 12, though there are also rumors of a Special Session being called if that deadline passes without action.

Balancing a $12 billion state shortfall with potential federal funding cuts leaves some tough choices and contentious negotiations ahead for the Legislature and the Governor.

Proposition 4 Implementation
While the Governor's January and May budget proposals allocated close to three billion dollars in Proposition 4 funds, the Legislature has yet to release a plan. However, in recent days, both houses have indicated that they have a draft plan and are starting to discuss specific allocations.

Legislative Update
August 29 was the deadline for bills to advance to the floor out of appropriations committees. In total, 189 bills were held while 497 were passed to the floor. Bills will need to pass off the floor, and, if amended in the opposite house, return to their house of origin for concurrence before advancing to the Governor's desk.

Low-Income Rate Assistance: AB 532 (Ransom) is the CA Municipal Utilities Association (CMUA) proposal to establish voluntary LIRA programs. The measure has passed the Senate Natural Resources & Water Committee but did not pass off of the Appropriations Suspense File.

Water Supply: CMUA and Western Municipal Water District have reintroduced legislation to add new requirements into the CA Water Plan which sets volumetric targets for new water supplies as **SB 72 (Caballero)**. They believe they have removed the concerns of the SWRCB, which was the stated reason the bill was vetoed last session. The bill passed out of the Assembly Water, Parks & Wildlife Committee and Appropriations Committee and awaits action on the Senate Floor.

Recycled Water: WateReuse CA's **SB 31 (McNerney)**, which makes some long-overdue updates to Title 22 of the CA Code of Regulations, has moved through the Legislature without a single "no" vote.

IEUA staff has been instrumental in helping develop the legislation that would, among other things, codify how an "unauthorized discharge" of recycled water is treated by regional boards. Recently, SWRCB staff have indicated they have concerns with the bill, but have not articulated any amendments that would make the measure workable to them. It awaits action on the Assembly Floor.

PFAS: The CA Association of Sanitation Agencies' reintroduced PFAS source control bill, **SB 682 (Allen)**, would ban the use of any intentionally added PFAS to products. The bill hit a roadblock last year with the CA Manufacturers and Technology Association who worked to load costs into the bill to get it held in Appropriations Committee. The bill has been significantly narrowed to only ban the use of PFAS when there is a commercially available alternative, but will still go a long way to addressing the source of PFAS in sewage. The bill awaits action on the Assembly Floor.

Additionally, ACWA and the League of CA Cities have introduced **SB 454 (McNerney)** that would establish a PFAS mitigation fund. Though the bill does not yet have a funding source, it passed the Senate and out of its first Assembly committee and awaits action on the Assembly Floor.

SB 394 (Allen) is ACWA and Las Virgenes MWD's bill to increase penalties for water theft from fire hydrants. The bill has moved easily through the process and has already passed both houses. SB 394 currently awaits action by the Governor.

SB 445 (Wiener) was a late-in-the-process gut-and-amend that would have originally put a "shot clock" on an agency's ability to review transit construction plans that may interfere with utility infrastructure. The Senator received strong opposition not only from CMUA, ACWA, CSDA, CASA & WateReuse CA, but a broader coalition of utilities and broadband providers. The immediate and strong opposition forced the Senator to amend his bill to only apply to the Highspeed Rail Authority. While Highspeed Rail is not planned to enter IEUA service territory, the Senator said in each of the three Assembly policy committee hearings that he intends to expand this authority to all transit projects, likely next year. For these reasons, the local government coalition has remained in opposition. The bill was held in the Assembly Appropriations Committee.

IEUA Bill List 9.2.2025

Note: *bills in italics are not moving in 2025*

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 259	***Rubio, Blanca, D***	*Open meetings: local agencies: teleconferences.*	*04/21/2025*	*Held in Sen Judiciary*	*05/14/2025 - Senate L. GOV.*		*This bill would extend the alternative teleconferencing procedures until January 1, 2030. (Based on 04/21/2025 text)*	*Three Valleys MWD and CSDA Sponsor* *SUPPORT*
AB 339	**Ortega, D**	Local public employee organizations: notice requirements.	08/29/2025		Sen. Floor		This bill would require the governing body of a public agency, and boards and commissions designated by law or by the governing body of a public agency, to give the recognized employee organization no less than 45 days' written notice before issuing a request for proposals, request for quotes, or renewing or extending an existing contract to perform services that are within the scope of work of the job classifications represented by the recognized employee organization, subject to certain exceptions. The bill would require the notice to include specified information, including the anticipated duration of the contract.	OPPOSE
AB 514	***Petrie-Norris, D***	*Water: emergency water supplies.*	*05/01/2025*	*05/22/2025 - Failed Deadline pursuant to Rule 61(a)(5). (Last location was APPR. SUSPENSE FILE on 5/14/2025)(May be acted upon Jan 2026)*	*05/22/2025 - Assembly 2 YEAR*		*Would declare that it is the established policy of the state to encourage, but not mandate, the development of emergency water supplies by both local and regional water suppliers, as defined, and to support their use during times of drought or unplanned service or supply disruption, as provided. (Based on 05/01/2025 text)*	*IRWD Sponsor* *SUPPORT*

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 523	**Irwin, D**	Metropolitan water districts: proxy vote authorizations.	05/05/2025	06/19/2025-Read second time. Ordered to third reading.	06/19/2025-S THIRD READING.	ASSEMBLY BILLS - THIRD READING FILE (Floor Mgr. - Stern)	Under the Metropolitan Water District Act, the board of a metropolitan water district is required to consist of at least one representative from each member public agency, as prescribed. This bill would, until January 1, 2030, authorize a representative of a member public agency that is entitled to designate or appoint only one representative to the board of directors to assign a proxy vote authorization to a representative of another member public agency to be exercised when the assigning representative is unable to attend a meeting or meetings of the board, as provided. (Based on 05/05/2025 text)	Eastern MWD Sponsor SUPPORT
AB 532	***Ransom, D***	*Water rate assistance program.*	*07/17/2025*	*Held on Appr Suspense*			*The Low Income Household Water Assistance Program was only operative until March 31, 2024. This bill would repeal the above-described requirements related to the Low Income Household Water Assistance Program. (Based on 05/23/2025 text)*	*CMUA Sponsor* *SUPPORT*
AB 580	**Wallis, R**	Surface mining: Metropolitan Water District of Southern California.	07/17/2025	On Governor's Desk			Current law authorizes the Metropolitan Water District of Southern California (MWD) to prepare a master reclamation plan, as provided, that identifies each individual surface mining operation in specified counties and satisfies all reclamation plan requirements for each individual surface mining site. Existing law repeals the provisions authorizing the preparation and approval of the master reclamation plan for the MWD on January 1, 2026. This bill would extend the operation of those provisions until January 1, 2051. (Based on 03/26/2025 text)	MWD Sponsored Bill SUPPORT

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 794	***Gabriel, D***	*California Safe Drinking Water Act: emergency regulations.*	*04/10/2025*	*INACTIVE FILE*			*This bill would provide that the authority of the state board to adopt an emergency regulation pursuant to these provisions includes the authority to adopt requirements of a specified federal regulation that was in effect on January 19, 2025, regardless of whether the requirements were repealed or amended to be less stringent. The bill would prohibit an emergency regulation adopted pursuant to these provisions from implementing less stringent drinking water standards, as provided, and would authorize the regulation to include monitoring requirements that are more stringent than the requirements of the federal regulation. The bill would prohibit maximum contaminant levels and compliance dates for maximum contaminant levels adopted as part of an emergency regulation from being more stringent than the maximum contaminant levels and compliance dates of a regulation promulgated pursuant to the federal act. (Based on 04/10/2025 text)*	*OPPOSE UNLESS AMENDED*
AB 810	***Irwin, D***	*Local government: internet websites and email addresses.*	*04/10/2025*	*05/22/2025 - Failed Deadline pursuant to Rule 61(a)(5). (Last location was APPR. SUSPENSE FILE on 5/7/2025)(May be acted upon Jan 2026)*	*05/22/2025 - Assembly 2 YEAR*		*Current law requires that a local agency that maintains an internet website for use by the public to ensure that the internet website uses a ".gov" top-level domain or a ".ca.gov" second-level domain no later than January 1, 2029. The bill would also require a special district, joint powers authority, or other political subdivision to comply with similar domain requirements no later than January 1, 2031. (Based on 04/10/2025 text)*	*OPPOSE*

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 31	**McNerney, D**	Water quality: recycled water.	06/09/2025	Asm Floor	.ASM Floor		This bill would, for the purposes of the above provision, redefine "recycled water" and provide that water discharged from a decorative body of water during storm events is not to be considered an unauthorized discharge if recycled water was used to restore levels due to evaporation. (Based on 05/12/2025 text)	WateReuse Sponsored Bill SUPPORT
SB 72	**Caballero, D**	The California Water Plan: long-term supply targets.	04/10/2025	Asm. Floor	Asm Floor		The bill would require "The California Water Plan." to include specified components, including a discussion of the estimated costs, benefits, and impacts of any project type or action that is recommended by the department within the plan that could help achieve the water supply targets. (Based on 04/10/2025 text)	CMUA and Western MWD Bill. SUPPORT
SB 239	***Arreguín, D***	*Open meetings: teleconferencing: subsidiary body.*	*04/07/2025*	*INACTIVE FILE.*			*This bill would authorize a subsidiary body, as defined, to use alternative teleconferencing provisions and would impose requirements for notice, agenda, and public participation, as prescribed. The bill would require the subsidiary body to post the agenda at each physical meeting location designated by the subsidiary body, as specified. The bill would require the members of the subsidiary body to visibly appear on camera during the open portion of a meeting that is publicly accessible via the internet or other online platform, as specified. (Based on 04/07/2025 text)*	*SUPPORT*

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 350	***Durazo, D***	*Water Rate Assistance Program.*	*05/07/2025*	*05/22/2025 - Failed Deadline pursuant to Rule 61(a)(5). (Last location was APPR. SUSPENSE FILE on 5/12/2025)(May be acted upon Jan 2026)*	*05/22/2025 - Senate 2 YEAR*		*Would establish the Water Rate Assistance Program. As part of the program, the bill would establish the Water Rate Assistance Fund in the State Treasury (Based on 05/07/2025 text)*	*Environmental justice community bill.* *OPPOSE UNLESS AMENDED*
SB 394	**Allen, D**	Water theft: fire hydrants.	07/03/2025	Governor's Desk.			This bill would add to the list of acts for which a utility may bring a civil cause of action under these circumstances to include tampering with a fire hydrant, fire hydrant meter, or fire detector check, or diverting water, or causing water to be diverted, from a fire hydrant with knowledge of, or reason to believe, that the diversion or unauthorized connection existed at the time of use for nonfirefighting purposes or without authorization from the appropriate water system or fire department. (Based on 02/14/2025 text)	Las Virgenes and ACWA sponsored SUPPORT
SB 454	**McNerney, D**	State Water Resources Control Board: PFAS Mitigation Program	05/23/2025	Asm. Floor	Asm. Floor		his bill, which would become operative upon an appropriation by the Legislature, would enact a PFAS mitigation program. As part of that program, the bill would create the PFAS Mitigation Fund in the State Treasury and would authorize certain moneys in the fund to be expended by the state board, upon appropriation by the Legislature, for specified purposes.	Sponsored by ACWA and League of CA Cities SUPPORT

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 496	***Hurtado, D***	*Advanced Clean Fleets Regulation: appeals advisory committee: exemptions.*	*04/07/2025*	*05/22/2025 - Failed Deadline pursuant to Rule 61(a)(5). (Last location was APPR. SUSPENSE FILE on 5/5/2025)(May be acted upon Jan 2026)*	*05/22/2025 - Senate 2 YEAR*		*This bill would require the state board to establish the Advanced Clean Fleets Regulation Appeals Advisory Committee by an unspecified date for purposes of reviewing appeals of denied requests for exemptions from the requirements of the Advanced Clean Fleets Regulation. (Based on 04/07/2025 text)*	*CSDA and other local gov sponsored bill* *SUPPORT*
SB 601	**Allen, D**	Water: waste discharge.	07/10/2025	Two-Year Bill	Asm Appr		This bill would authorize the state board to adopt water quality control plans for nexus waters, which the bill would define as all waters of the state that are not also navigable, except as specified. The bill would require any water quality standard that was submitted to, and approved by, or is awaiting approval by, the United States Environmental Protection Agency or the state board that applied to nexus waters as of May 24, 2023, to remain in effect, as provided.	Coastkeeper sponsor OPPOSE
SB 682	**Allen, D**	Environmental health: product safety: perfluoroalkyl and polyfluoroalkyl substances.	07/17/2025	Asm. Floor	Asm. Floor		This bill would, on and after January 1, 2028, prohibit a person from distributing, selling, or offering for sale a cleaning product, dental floss, juvenile product, food packaging, or ski wax, as provided, that contains intentionally added PFAS, as defined, except for previously used products and as otherwise preempted by federal law. The bill would, on and after January 1, 2030, prohibit a person from distributing, selling, or offering for sale cookware that contains intentionally added PFAS, except for previously used products and as otherwise preempted by federal law. The bill would authorize the department, on or before January 1, 2029, to adopt regulations to carry out these provisions.	CASA Sponsored SUPPORT

Watch Bills

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 823	**Boerner, D**	Solid waste: plastic microbeads: plastic glitter.	05/23/2025	Sen. Floor.	Sen Floor		This bill would, on and after January 1, 2029, prohibit a person from selling, offering for sale, distributing, or offering for promotional purposes in this state a personal care product containing plastic glitter, or a personal care product in a non-rinse-off product or a cleaning product containing one ppm or more by weight of plastic microbeads that are used as an abrasive, as specified. The bill would authorize, until January 1, 2030, a person to continue to sell, offer for sale, distribute, or offer for promotional purposes in this state an existing stock of personal care products containing plastic glitter, as specified. By adding these prohibitions to the Plastic Microbeads Nuisance Prevention Law, the bill would impose the civil penalty for violations of these prohibitions. (Based on 05/23/2025 text)	
SB 74	***Seyarto, R***	*Office of Land Use and Climate Innovation: Infrastructure Gap-Fund Program.*	*04/07/2025*	*Held on Suspense*	*APPR*		*The bill would authorize the office to provide funding for up to 20% of a project's additional projected cost, as defined, after the project has started construction, subject to specified conditions, including, among other things, that the local agency has allocated existing local tax revenue for at least 45% of the initially budgeted total cost of the infrastructure project. When applying to the program, the bill would require the local agency to demonstrate challenges with completing the project on time and on budget and how the infrastructure project helps meet state and local goals, as specified. (Based on 04/07/2025 text)*	

Watch Bills

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 224	**Hurtado, D**	Department of Water Resources: water supply forecasting.	07/17/2025	Asm. Floor			This bill would require the department, on or before January 1, 2027, to adopt a new water supply forecasting model and procedures that better address the effects of climate change and implement a formal policy and procedures for documenting the department's operational plans and the department's rationale for its operating procedures, including the department's rationale for water releases from reservoirs. (Based on 05/23/2025 text)	
SB 279	**McNerney, D**	Solid waste: compostable materials.	06/30/2025	Asm. Floor	Asm. Floor		This bill would require that the total amount of feedstock and compost onsite at any one time not exceed 500 cubic yards instead of the 100 cubic yards and 750 square feet in the regulations. The bill would also require the composting of agricultural materials and residues that are from a large-scale biomass management event at an agricultural facility that does not otherwise operate as a solid waste facility to be an excluded activity, as specified. This bill contains other related provisions and other existing laws. (Based on 05/23/2025 text)	
SB 317	**Hurtado, D**	Wastewater surveillance.	06/18/2025	Asm. Floor	Asm. Floor		Would require the State Department of Public Health, in consultation with participating wastewater treatment facilities, local health departments, and other subject matter experts, to maintain the Cal-SuWers network of monitoring programs to test for pathogens, toxins, and other public health indicators in wastewater. The bill would require participation in the Cal-SuWers network from local health departments and wastewater treatment facilities to be voluntary. (Based on 04/28/2025 text)	
SB 431	***Arreguín, D***	*Assault and battery: public utility employees and essential infrastructure workers.*	*05/23/2025*	*Held on Suspense*			*This bill would make an assault or battery committed against an employee of a public utility or other worker engaged in essential infrastructure work, as defined, punishable by imprisonment in a county jail not exceeding one year, by a fine not exceeding $2,000, or by both that fine and imprisonment. (Based on 05/23/2025 text)*	

Watch Bills

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 445	***Stern, D***	*Transportation: planning: complete streets facilities: sustainable transportation projects.*	*07/17/2025*	*Held on Suspense*			*This bill would instead require the Department of Transportation to develop and adopt the above-described project intake, evaluation, and encroachment review process on or before February 1, 2027. The bill would also state the intent of the Legislature to amend this bill with legislation that accelerates and makes more reliable third-party permits and approvals for preconstruction and construction activities on sustainable transportation projects.*	
SB 654	***Stern, D***	*California Environmental Protection Agency: contract: registry: greenhouse gas emissions that result from the water-energy nexus.*		*05/22/2025 - Failed Deadline pursuant to Rule 61(a)(5). (Last location was APPR. SUSPENSE FILE on 4/21/2025)(May be acted upon Jan 2026)*	*05/22/2025 - Senate 2 YEAR*		*The California Environmental Protection Agency is required to oversee the development of a registry for greenhouse gas emissions that result from the water-energy nexus using the best available data. Current law provides that participation in the registry is voluntary and open to any entity conducting business in the state. Existing law authorizes the agency to enter into a contract with a qualified nonprofit organization to do specified things, including to recruit broad participation in the registry from all economic sectors and regions of the state. Current law limits the term of the term of the contract to 3 years, except as provided. This bill would instead require the agency to oversee the administration of the above-described registry and would authorize the agency to enter into a new contract, limited to a term of 3 years and with a total budget of $2,000,000, to do specified things, including to recruit broad participation in the registry from all economic sectors and regions of the state to meet the different needs of water users throughout the state by various means, as provided. (Based on 02/20/2025 text)*	

Project Status: Wineville/Jurupa/RP3 Basin Improvements

Budget:

- Authorized capital budget: $28,846,016

Available Funding:

- $15.4 M in SRF Loan at 0.55%
- $10.8 M is State and Federal Grants

Cost Summary:

- Actual Cost as of June 6, 2025: **$ 26,736,992**
- Remaining Budget: **$ 2,109,024**

Progress:

- Construction Contract with MNR is 99% completed
- Overall construction is 90% completed (March 2026)

Completed scope items

- Rubber dam system at Wineville Basin's spillway
- Control slide gates within Wineville Basin
- Basin grading for a new pump station at Wineville
- Power, controls, and communication systems at Wineville
- 2-miles of 30-Inch Pipeline passing through Fontana and Ontario.
- Stormwater diversion to Jurupa Basin.

Remaining scope items with MNR:

- Finalize Punchlist Items
- Resolve Rubber Dam Connection and Control Issues
- Perform Site Acceptance Walk with IEUA and Contractor

Updates:

- Finalize contract with MNR Construction
- Requesting additional SRF funds
- See updated progress schedule
    - Pump delivery moved to Nov/Dec due to factory backlogs/high demands

TASK	PROGRESS	START	END
Prepare Solicitation Documents		**06-Jun-24**	**11-Nov-24**
Draft Documents	100%	06-Jun-24	22-Aug-24
Review Documents	100%	23-Aug-24	28-Aug-24
Finalize Documents	100%	29-Aug-24	11-Nov-24
Request for Qualification of Pump Suppliers		**19-Nov-24**	**14-Jan-25**
Enter into PlanetBids	100%	19-Nov-24	19-Nov-24
Solicitation (Q&A Period)	100%	20-Nov-24	12-Dec-24
Final Week of Solicitation for RFQ	100%	16-Dec-24	19-Dec-24
Close Solicitation for RFQ (milestone)	100%	19-Dec-24	19-Dec-24
Review Responses to the RFQ	100%	20-Dec-24	13-Jan-25
Notify Prequalified Suppliers (milestone)	100%	14-Jan-25	14-Jan-25
Request for Proposal of Prequalified Suppliers		**14-Jan-25**	**21-May-25**
Prequalified Supplier Draft Initial Submittal and Pricing	100%	14-Jan-25	13-Feb-25
Receive Initial Submittal (milestone)	100%	13-Feb-25	13-Feb-25
Review Initial Submittal	100%	13-Feb-25	27-Feb-25
Prequalified Supplier Draft Final Submittal	100%	28-Feb-25	21-Mar-25
Receive Final Submittal (milestone)	100%	21-Mar-25	21-Mar-25
IEUA Reviews Final Submittal to Decide Pump Supplier	100%	24-Mar-25	07-Apr-25
Board of Directors' Authorization of Purchase Order (milestone)	100%	21-May-25	21-May-25
Pump Fabrication/Installation/Testing/Close-out		**22-May-25**	**17-Mar-26**
Finalized Pump Submittals	100%	22-May-25	01-Jul-25
Fabrication	58%	22-May-25	18-Nov-25
Delivery	0%	18-Nov-25	02-Dec-25
Installation	0%	02-Dec-25	31-Jan-26
Testing	0%	31-Jan-26	03-Mar-26
Close Out	0%	03-Mar-26	17-Mar-26

Outlet Control Gate/Rubber Dam System

Completed Basin at Wineville