CHINO BASIN WATERMASTER

NOTICE OF MEETING

Thursday, June 18, 2026

9:00 a.m. – Advisory Committee Meeting

Watermaster's function is to administer and enforce provisions of the Judgment and subsequent orders of the Court, and to develop and implement an Optimum Basin Management Program

CHINO BASIN WATERMASTER
ADVISORY COMMITTEE MEETING
9:00 a.m. – June 18, 2026
Mr. Scott Burton, Chair
Mr. Jeff Pierson, Vice-Chair
Ms. Hye Jin Lee, 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 May 21, 2026 *(Page 1)*

B. FINANCIAL REPORTS
Receive and file as presented:
Monthly Financial Report for the Period Ended April 30, 2026 *(Page 8)*

C. ANNUAL REPORT OF THE PRADO BASIN HABITAT SUSTAINABILITY PROGRAM WATER YEAR 2025
Recommend the Watermaster Board adopt the 2025 Annual Report. *(Page 25)*

D. APPLICATION: WATER TRANSACTION – 802.36 AF FROM SAN ANTONIO WATER COMPANY TO MONTE VISTA WATER DISTRICT
Provide advice and assistance to the Watermaster Board on the proposed transaction. *(Page 247)*

E. APPLICATION: RECHARGE – SAN ANTONIO WATER COMPANY
Provide advice and assistance to the Watermaster Board on the proposed application. *(Page 254)*

II. BUSINESS ITEMS

A. REVIEW FINAL 2025 SAFE YIELD REEVALUATION REPORT *(Page 265)*
Provide advice and assistance to Watermaster on the Final 2025 Safe Yield Reevaluation Report.

B. ECONOMIC ANALYSIS OF PEACE II AGREEMENT TERMS - PHASE II (ORAL REPORT ONLY)

III. REPORTS/UPDATES

A. WATERMASTER LEGAL COUNSEL

1. June 12, 2026 Court Hearing (Watermaster Motion for Approval of Corrected and Amended Assessment Packages; Request for Approval of Intervention of San Gabriel Band of Mission Indians)
2. Inland Empire Utilities Agency, et al. v. LS-Fontana LLC (C.D. Cal Cases Nos.: 5:25-cv-00809, 5:25 cv01159)
3. Court of Appeal Case No. E088249 (City of Ontario appeal re: January 30, 2026 Attorney Fees Ruling)
4. Petition to Santa Ana Regional Water Quality Control Board to Require Stormwater Permits for Commercial, Industrial, and Institutional Facilities in re Chino Creek

B. ENGINEER

1. 2025 Annual Report of the Prado Basin Habitat Sustainability Program

C. GENERAL MANAGER

1. West Yost Associates, Inc. Fiscal Year 2026/27 Rate Schedule
2. Notice of Budget Transfer
3. July Meeting Schedule
4. Other

D. INLAND EMPIRE UTILITIES AGENCY *(Page 495)*

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

E. OTHER METROPOLITAN MEMBER AGENCY REPORTS

IV. INFORMATION

A. RECHARGE INVESTIGATION AND PROJECTS COMMITTEE (PROJECT 23a STATUS) *(Page 519)*

B. CHINO BASIN DAY WITH THE REGIONAL BOARD *(Page 520)*

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.

None

VIII. FUTURE MEETINGS AT WATERMASTER

06/18/26	Thu	9:00 a.m.	Advisory Committee
06/25/26	Thu	9:30 a.m.	Watermaster Orientation (in person only)
06/25/26	Thu	11:00 a.m.	Watermaster Board
07/09/26	Thu	9:00 a.m.	Appropriative Pool Committee (Tentative)
07/09/26	Thu	11:00 a.m.	Non-Agricultural Pool Committee (Tentative)
07/09/26	Thu	1:30 p.m.	Agricultural Pool Committee (Tentative)
07/16/26	Thu	9:00 a.m.	Advisory Committee (Tentative)
07/16/26	Thu	10:00 a.m.	Recharge Investigations and Projects Committee (RIPComm)
07/23/26	Thu	9:30 a.m.	Watermaster Orientation (in person only) (Tentative)
07/23/26	Thu	11:00 a.m.	Watermaster Board (Tentative)

ADJOURNMENT

DRAFT MINUTES
CHINO BASIN WATERMASTER
ADVISORY COMMITTEE MEETING
May 21, 2026

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 May 21, 2026.

ADVISORY COMMITTEE MEMBERS PRESENT

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

Scott Burton, **Chair**	City of Ontario

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

Brian Geye	California Speedway Corporation
Alexis Mascarinas	City of Ontario (Non-Ag)

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

Jeff Pierson, **Vice-Chair**	Crops
Jimmy Medrano	State of California

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

Imelda Cadigal	State of California
Lewis Callahan	State of California

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

Ben Orosco for Hye Jin Lee	City of Chino
Courtney Jones	City of Ontario
Chris Diggs	City of Pomona
Eduardo Espinoza for John Bosler	Cucamonga Valley Water District
Eric Tarango for Cris Fealy	Fontana Water Company
Justin Castruita	Fontana Union Water Company
Jesse Pompa for Chris Berch	Jurupa Community Services District
Brian Lee	San Antonio Water Company

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

Ron Craig	City of Chino Hills
Nicole deMoet	City of Upland
Andrew Gagen	Monte Vista Irrigation Company
Andrew Gagen	Monte Vista Water District

WATERMASTER BOARD MEMBERS PRESENT ON ZOOM

Marty Zvirbulis	Fontana Water Company
Bob Kuhn	Three Valleys Municipal Water District
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
Frank Yoo	Data Services and Judgment Reporting Manager

Daniela Uriarte	Senior Accountant
Ruby Favela Quintero	Executive Assistant
Kirk Richard Dolar	Administrative Analyst
Jordan Garcia	Water Resources Associate
Noemi Medrano	Administrative Assistant

WATERMASTER CONSULTANTS PRESENT AT WATERMASTER

Andy Malone	West Yost

WATERMASTER CONSULTANTS PRESENT ON ZOOM

Ben Markham	Brownstein Hyatt Farber Schreck, LLP
Garrett Rapp	West Yost
Lauren Sather	West Yost
Lucy Hedley	West Yost

OTHERS PRESENT AT WATERMASTER

Amanda Coker	Cucamonga Valley Water District
Cris Fealy	Fontana Water Company
Josh Swift	Fontana Union Water Company
Bryan Smith	Jurupa Community Services District
Stephanie Reimer	Monte Vista Water District

OTHERS PRESENT ON ZOOM

Gino Filippi	Agricultural Pool – Crops
Nichole Horton	City of Pomona
Richard Gonzales	City of Upland
Derek Hoffman	Fennemore Law
Aimee Zhao	Inland Empire Utilities Agency
Eddie Lin	Inland Empire Utilities Agency
John Russ	Inland Empire Utilities Agency
Manny Martinez	Monte Vista Water District
Alyssa Coronado	Santa Ana River Water Company
David De Jesus	Three Valleys Municipal Water District
Jeff Hanlon	Three Valleys Municipal Water District
Ryan Shaw	Western Municipal Water District
Rick Rees	WSP USA
Scott Cooper	

CALL TO ORDER

Chair Scott Burton called the Advisory Committee meeting to order at 9:00 a.m.

ROLL CALL

(00:00:11) Ms. Nelson conducted the roll call and announced that a quorum was present.

AGENDA – ADDITIONS/REORDER

None

SAFETY MINUTE

(00:02:23) Mr. Corbin stated that fire season is underway and encouraged everyone to consider using the Watch Duty application, which provides real time notifications of fire activity across counties.

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 April 16, 2026

B. FINANCIAL REPORTS

Receive and file as presented:
Monthly Financial Reports for the Periods Ended February 28, 2026, and March 31, 2026

(00:03:49)
Motion by Vice-Chair Jeff Pierson, seconded by Mr. Justin Castruita, there being no dissent, the motion was deemed passed unanimously by voice vote among those present.
Moved to approve the Consent Calendar as presented.

II. BUSINESS ITEMS

A. WATERMASTER FISCAL YEAR 2026/27 PROPOSED BUDGET

Approve the Watermaster Fiscal Year 2026/27 Proposed Budget as presented.

(00:04:08) Mr. Corbin prefaced the item and asked Ms. Uriarte to give a report. A discussion ensued.

(00:15:56)
Motion by Mr. Chris Diggs, seconded by Mr. Ron Craig, there being no dissent, the motion was deemed passed unanimously by voice vote among those present.
Moved to approve Business Item II.A. as presented.

B. FISCAL YEAR 2025/26 ASSESSMENT PACKAGE

Review the final Fiscal Year 2025/26 Assessment Package and reconciliation, as presented, and provide advice and assistance to Watermaster Board.

(00:16:59) Mr. Corbin prefaced the item and asked Mr. Yoo to give a report. A discussion ensued.

(00:31:16)
Motion by Mr. Brian Lee, seconded by Mr. Chris Diggs, the motion passed by majority 71.034% volume votes in favor, as attached to these minutes.
Moved to approve Business Item II.B. as presented.

C. RESOLUTION 2026-02 TO LEVY REMAINING REPLENISHMENT AND ADMINISTRATIVE ASSESSMENTS FOR FISCAL YEAR 2025/26, BASED ON PRODUCTION YEAR 2024/25

Review Resolution 2026-02, as presented, and offer advice to Watermaster.

(00:49:27) Mr. Corbin indicated that this item is the resolution that allows for the levying of assessments based on the approval of Business Item II.B. as shown above.

(00:49:32)
Motion by Vice-Chair Jeff Pierson, seconded by Mr. Chris Diggs, the motion passed by majority 71.034% volume votes in favor, as attached to these minutes.
Moved to approve Business Item II.C. as presented.

D. CALENDAR YEAR 2026 ADVISORY COMMITTEE VOLUME VOTE

Approve the Calendar Year 2026 Advisory Committee Volume Vote as presented, subject to Watermaster Board approval of the Fiscal Year 2025/26 Assessment Package at the May 28, 2026 meeting.

(00:51:46) Mr. Corbin gave a report.

(00:52:20)
Motion by Mr. Chris Diggs, seconded by Mr. Brian Lee, there being no dissent, the motion was deemed passed unanimously by voice vote among those present.
Moved to approve the Business Item II.D. as presented.

III. REPORTS/UPDATES

A. WATERMASTER LEGAL COUNSEL

1. June 12, 2026, Court Hearing (Watermaster Motion for Approval of Corrected and Amended Assessment Packages; Request for Approval of Intervention of San Gabriel Band of Mission Indians)
2. Inland Empire Utilities Agency, et al. v. LS-Fontana LLC (C.D. Cal Cases Nos.: 5:25-cv-00809, 5:25 cv01159)
3. Court of Appeal Case No. E088249 (City of Ontario appeal re: January 30, 2026 Attorney Fees Ruling)

(00:52:45) Mr. Ben Markham gave a report.

B. ENGINEER

1. 2025 Safe Yield Reevaluation
2. Annual Report for the Prado Basin Habitat Sustainability Program
3. Data Collection and Evaluation Report

(00:54:55) For Item 1, Mr. Malone prefaced and asked Mr. Rapp to give a report. For Item 2, Ms. Hedley gave a report. For Item 3, Ms. Sather gave a report. A discussion ensued.

C. GENERAL MANAGER

1. Other

(01:39:07) Mr. Corbin informed the Committee that Chino Basin Day was held on May 19, 2026, and noted that more information will be provided at next month's Pool meetings.

D. INLAND EMPIRE UTILITIES AGENCY

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

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

E. OTHER METROPOLITAN MEMBER AGENCY REPORTS

None

IV. INFORMATION

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

(01:40:18) Mr. Corbin reported that the project is substantially complete and noted that staff are working collaboratively with IEUA on the ribbon-cutting ceremony which is contemplated for later this year to recognize the project's significance and regional impact.

V. COMMITTEE MEMBER COMMENTS

(01:41:04) Mr. Burton stated that the first Rules and Regulations Ad Hoc Committee meeting was well-attended and that the discussions were productive. He also announced that the next meeting is scheduled for June 11, 2026, at 3:30 p.m. and will be held in person at the Watermaster's offices.

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 Burton adjourned the Advisory Committee meeting at 10:42 a.m.

Secretary: _____

Approved: _____

Attachments:

1. 20260521 Volume Vote Outcome for Business Item II.B.
2. 20260521 Volume Vote Outcome for Business Item II.C.

2026 ADVISORY COMMITTEE INTERIM[1] VOLUME VOTE
(Based on Production Year 2023-2024)

QUORUM MET?

YES

*Enter **Y** or **N** in Each Cell*

Party	Present (Y/N)	Vote (Y/N)	Assigned	Reallocated	Available	Quorum	Total Yes
Minor 1	Y	Y	3.221	0.000	3.221	3.221	3.221
Minor 2	Y	Y	3.221	0.000	3.221	3.221	3.221
Chino Hills, City Of	Y	Y	2.472	0.000	2.472	2.472	2.472
Chino, City Of	Y	Y	4.983	0.000	4.983	4.983	4.983
Cucamonga Valley Water District	Y	N	10.805	0.000	10.805	10.805	0.000
Fontana Union Water Company	Y	N	4.371	0.000	4.371	4.371	0.000
Fontana Water Company	Y	Y	1.889	0.000	1.889	1.889	1.889
Jurupa Community Services District	Y	Y	6.287	0.000	6.287	6.287	6.287
Monte Vista Water District	Y	Y	6.686	0.000	6.686	6.686	6.686
Ontario, City Of	Y	N	13.789	0.000	13.789	13.789	0.000
Pomona, City Of	Y	Y	14.570	0.000	14.570	14.570	14.570
Upland, City Of	Y	Y	2.706	0.000	2.706	2.706	2.706
AGRICULTURAL POOL	Y	Y	20.000	0.000	20.000	20.000	20.000
NON-AGRICULTURAL POOL	Y	Y	5.000	0.000	5.000	5.000	5.000
			100.000	**0.000**	**100.000**	**100.000**	**71.034**

CALCULATE QUORUM

CALCULATE VOTES

RESET ALL

RESET VOTES

"YES" VOTES
71.034%

"NO" VOTES
28.966%

PASSED

[1] Approved by the Advisory Committee on December 18, 2025, to be used until the Fiscal Year 2025/26 Assessment Package is approved/adopted by the Board.

ATTACHMENT 2

2026 ADVISORY COMMITTEE INTERIM[1] VOLUME VOTE
(Based on Production Year 2023-2024)

QUORUM MET?

YES

*Enter **Y** or **N** in Each Cell*

Party	Present (Y/N)	Vote (Y/N)	Assigned	Reallocated	Available	Quorum	Total Yes
Minor 1	Y	Y	3.221	0.000	3.221	3.221	3.221
Minor 2	Y	Y	3.221	0.000	3.221	3.221	3.221
Chino Hills, City Of	Y	Y	2.472	0.000	2.472	2.472	2.472
Chino, City Of	Y	Y	4.983	0.000	4.983	4.983	4.983
Cucamonga Valley Water District	Y	N	10.805	0.000	10.805	10.805	0.000
Fontana Union Water Company	Y	N	4.371	0.000	4.371	4.371	0.000
Fontana Water Company	Y	Y	1.889	0.000	1.889	1.889	1.889
Jurupa Community Services District	Y	Y	6.287	0.000	6.287	6.287	6.287
Monte Vista Water District	Y	Y	6.686	0.000	6.686	6.686	6.686
Ontario, City Of	Y	N	13.789	0.000	13.789	13.789	0.000
Pomona, City Of	Y	Y	14.570	0.000	14.570	14.570	14.570
Upland, City Of	Y	Y	2.706	0.000	2.706	2.706	2.706
AGRICULTURAL POOL	Y	Y	20.000	0.000	20.000	20.000	20.000
NON-AGRICULTURAL POOL	Y	Y	5.000	0.000	5.000	5.000	5.000
			100.000	**0.000**	**100.000**	**100.000**	**71.034**

CALCULATE QUORUM

CALCULATE VOTES

RESET ALL

RESET VOTES

"YES" VOTES
71.034%

"NO" VOTES
28.966%

PASSED

[1] Approved by the Advisory Committee on December 18, 2025, to be used until the Fiscal Year 2025/26 Assessment Package is approved/adopted by the Board.

CHINO BASIN WATERMASTER

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

STAFF REPORT

DATE: June 2026

TO: Watermaster Committees & Board

SUBJECT: Monthly Financial Reports (For the Reporting Period Ended April 30, 2026)
(Consent Calendar Item I.B.)

Issue: Record of Monthly Financial Reports for the reporting period ended April 30, 2026 [Normal Course of Business]

Recommendation: Receive and file Monthly Financial Reports for the reporting period ended April 30, 2026 as presented.

Financial Impact: Unless otherwise noted, all expenditures were included in the Fiscal Year 2025/26 budget as approved by the Advisory Committee and adopted by the Watermaster Board in May 2025, and subsequently amended in July 2025, and in January 2026.

ACTIONS:
Appropriative Pool – June 11, 2026 [Final]: Received and filed.
Non-Agricultural Pool – June 11, 2026 [Final]: Received and filed without approval.
Agricultural Pool – June 11, 2026 [Final]: Received and filed.
Advisory Committee – June 18, 2026 [Recommended]: Receive and file.
Watermaster Board – June 25, 2026 [Recommended]: Receive and file.

BACKGROUND

A monthly financial reporting packet is provided to keep all members apprised of Watermaster revenues, expenditures, and other financial activities. Monthly reports include the following:

1. Cash Disbursements – Summarized report of all payments made during the reporting month.
2. Credit Card Expense Detail – Detail report of all credit card activity during the reporting month.
3. Combining Schedule of Revenues, Expenses & Changes in Net Assets – Detail report of all revenue and expense activity for the fiscal year to date (YTD), summarized by pool category.
4. Treasurer's Report – Summary of Watermaster investment holdings and anticipated earnings as of month end.
5. Budget to Actual Report – Detail report of actual revenue and expense activity, shown for reporting month and YTD, comparatively to the amended budget and carryover budget.
6. Monthly Variance Report & Supplemental Schedules – Supporting schedule providing explanation for major budget variances, additional tables detailing pool fund balances, salaries expense, legal expense, engineering expense, and carryover budget.

DISCUSSION

Detailed explanations of major variances and other additional information can be found on the "Monthly Variance Report & Supplemental Schedules."

Watermaster staff is available to provide additional explanations or respond to any questions on these reports during the monthly meetings as requested.

ATTACHMENT

1. Monthly Financial Reports (Period Ended April 30, 2026)

Chino Basin Watermaster
Cash Disbursements
April 2026

Date	Number	Vendor Name	Description	Amount
04/02/2026	25983	BOWCOCK, ROBERT		$ (1,125.00)
04/02/2026	25984	BURRTEC WASTE INDUSTRIES, INC.	Utilities: Waste	(168.79)
04/02/2026	25985	CONCENTRA	Pre-employment screening	(219.00)
04/02/2026	25986	CUCAMONGA VALLEY WATER DISTRICT - UTILITY	Utilities: Water	(439.50)
04/02/2026	25987	EMPOWER LAB	CVI assessments	(100.00)
04/02/2026	25988	FRONTIER COMMUNICATIONS	Office alarm lines, teams phones, and DIA - April 2026	(1,189.47)
04/02/2026	25989	GREAT AMERICA LEASING CORP.	Copy machine lease - March 2026	(1,234.66)
04/02/2026	25990	HUITSING, JOHN		(625.00)
04/02/2026	25991	IN-SITU, INC.	Quarterly pressure transducer downloads and replacements	(10,827.20)
04/02/2026	25992	KUHN, BOB		(500.00)
04/02/2026	25993	MIKE THE PRINTER, INC.	47th Annual Report printing	(1,603.17)
04/02/2026	25994	PITNEY BOWES GLOBAL FINANCIAL SVCS.	Quarterly postage meter lease	(454.87)
04/02/2026	25995	RUBEN LLAMAS		(125.00)
04/02/2026	25996	SOCALGAS	Utilities: Gas	(205.62)
04/02/2026	25997	SOUTHERN CALIFORNIA EDISON	Utilities: Electric - Annex	(176.93)
04/02/2026	25998	VC3, INC.	IT services - March 2026	(1,969.21)
04/02/2026	25999	VISION SERVICE PLAN	Vision insurance premium - April 2026	(110.18)
04/02/2026	26000	WESTERN MUNICIPAL WATER DISTRICT		(375.00)
04/06/2026	ACH 4.6.26	JOHN J. SCHATZ	AP legal services - March 2026	(550.00)
04/08/2026	ACH 4.8.26	CALPERS	Medical Insurance Premiums - April 2026	(17,430.96)
04/09/2026	26001	ACP PUBLICATIONS & MARKETING	Name plates for administrative staff	(229.51)
04/09/2026	26002	ACWA JOINT POWERS INSURANCE AUTHORITY	Life insurance - May 2026	(282.48)
04/09/2026	26003	APPLIED COMPUTER TECHNOLOGIES	Remote support for database services	(656.25)
04/09/2026	26004	BAY ALARM COMPANY	Quarterly monitoring services and burglar/fire alarm systems - April 2026	(481.51)
04/09/2026	26005	BROWNSTEIN HYATT FARBER SCHRECK	Legal services - February 2026	(139,873.03)
04/09/2026	26006	CUCAMONGA VALLEY WATER DISTRICT	Building lease - May 2026	(12,319.51)
04/09/2026	26007	GARCIA, JORDAN	Reimbursement: Field operations work pants	(140.06)
04/09/2026	26008	PIERSON, JEFFREY		(5,125.00)
04/09/2026	26009	S.S. PAPADOPULOS & ASSOCIATES, INC.	Safe yield reevaluation peer review - March 2026	(941.50)
04/09/2026	26010	STANDARD INSURANCE CO.	Disability coverage - April 2026	(847.74)
04/09/2026	26011	STATE COMPENSATION INSURANCE FUND	FY 26 worker's compensation insurance	(2,265.50)
04/09/2026	26012	UNION 76	Fuel purchases - March 2026	(175.76)
04/09/2026	26014	VANGUARD CLEANING SYSTEMS	April janitorial services and March electrostatic spraying	(1,220.00)
04/09/2026	26015	WEST YOST	Engineering services - February 2026	(232,587.54)
04/14/2026	ACH 4.14.26	JOHN J. SCHATZ	AP legal services - February 2026	(935.00)
04/15/2026	26016	SUNRISE FORD	Maintenance and repair - 2023 Ford F150 Lightning	(208.05)
04/16/2026	26017	CALIFORNIA BANK & TRUST	Account ending 6198 - See detail attached	(3,368.17)
04/17/2026	ACH 4.17.26	PUBLIC EMPLOYEES' RETIREMENT SYSTEM	Annual Unfunded Accrued Liability-Plan 3299 - April 2026	(14,363.08)
04/17/2026	ACH 4.17.26	PUBLIC EMPLOYEES' RETIREMENT SYSTEM	Annual Unfunded Accrued Liability-Plan 27239 - April 2026	(379.08)
04/23/2026	26018	BOWCOCK, ROBERT		(625.00)
04/23/2026	26019	BURTON, CURTIS		(500.00)
04/23/2026	26020	CHINO, CITY OF - FINANCE DEPT		(125.00)
04/23/2026	26021	CORELOGIC INFORMATION SOLUTIONS	Geographic package services - March 2026	(125.00)
04/23/2026	26022	DE BOOM, NATHAN		(125.00)
04/23/2026	26023	EGOSCUE LAW GROUP, INC.	OAP legal services - March 2026	(27,562.50)
04/23/2026	26024	ELIE, STEVEN		(250.00)
04/23/2026	26025	FAVELA QUINTERO, RUBY	Reimbursement: Meeting supplies	(140.06)
04/23/2026	26026	FEENSTRA, BOB		(1,000.00)
04/23/2026	26027	FILIPPI, GINO		(375.00)
04/23/2026	26028	GEYE, BRIAN		(500.00)
04/23/2026	26029	INLAND EMPIRE UTILITIES AGENCY	FY 25/26 Groundwater recharge O&M 3rd quarter cost reimbursement	(44,711.33)
04/23/2026	26030	KUHN, BOB		(875.00)
04/23/2026	26031	LEGAL SHIELD	Employee paid legal insurance - April 2026	(103.60)
04/23/2026	26032	PIERSON, JEFFREY		(4,500.00)
04/23/2026	26033	SOUTHERN CA EDISON	Utilities: Electric - Main building	(1,621.66)
04/23/2026	26034	UNITED HEALTHCARE	Dental insurance coverage - May 2026	(1,250.26)
04/23/2026	26035	VC3, INC.	Adobe license annual renewal	(2,878.80)
04/23/2026	26036	VELTO, BILL		(875.00)
04/23/2026	26037	VERIZON WIRELESS	Internet services for field ops tablets and extensometer site - April 2026	(277.17)
04/23/2026	26038	VIDES, ERIK	Reimbursement: Field operations work pants	(132.58)
04/23/2026	26039	WEST YOST	Engineering services - March 2026	(249,820.32)
04/23/2026	26040	ZVIRBULIS, MARTIN		(625.00)
04/23/2026	ACH 4.23.26	JOHN J. SCHATZ	AP legal services - March 2026 second invoice	(1,980.00)
04/29/2026	26041	CHEF DAVE'S CATERING & EVENT SERVICES	Board meeting catering services - March and April 2026	(1,179.06)
04/29/2026	26042	CUCAMONGA VALLEY WATER DISTRICT - UTILITY	Utilities: Water	(457.34)
04/29/2026	26043	ROI SAFETY SERVICES, LLC	Office OSHA safety training deposit - Spring 2026	(500.00)

Chino Basin Watermaster
Cash Disbursements
April 2026

Date	Number	Vendor Name	Description	Amount
04/29/2026	26044	SOCALGAS	Utilities: Gas	(64.15)
04/29/2026	26045	SOUTHERN CALIFORNIA EDISON	Utilities: Electric - Annex	(194.45)
04/29/2026	26046	STANDARD INSURANCE CO.	Disability coverage - May 2026	(847.74)
04/29/2026	26047	VISION SERVICE PLAN	Vision insurance premiums - May 2026	(110.18)
04/29/2026	ACH 4.29.26	PITNEY BOWES GLOBAL FINANCIAL SERVICES	Postage meter refill - March 2026	(559.30)
04/30/2026	26048	USAFACT, INC.	Pre-employment screening	(65.54)
			Total for Month $	**(800,784.37)**

Chino Basin Watermaster
Credit Card Expense Detail
April 2026

Date	Number	Description	Expense Account	Amount
04/16/2026	26017	**CALIFORNIA BANK & TRUST**		
		The Toll Roads - West Yost meeting - 03/04/26 - E. Tellez-Foster	6173 Airfare/Mileage	(15.02)
		Panera Bread - Ops meeting - E. Tellez-Foster, A. Jurado, J. Garcia, E. Vides	6141.1 Meeting Supplies	(56.56)
		The Toll Roads - West Yost meeting - 03/08/26 - E. Tellez-Foster	6173 Airfare/Mileage	(3.50)
		IHop - Breakfast meeting - E. Tellez-Foster, CBWCD	6141.1 Meeting Supplies	(52.74)
		The Toll Roads - West Yost meeting - 03/11/26 - E. Tellez-Foster	6173 Airfare/Mileage	(15.20)
		Southwest Airlines - Flight to Sacramento for ACWA Conference - E. Tellez-Foster	6173 Airfare/Mileage	(201.40)
		Microsoft Software - Mapping and visualization software subscription	6054 Computer Software	(15.00)
		REV Subscription - Speech to text transcription services	6112 Subscriptions/Publications	(29.99)
		The Home Depot - Key copies - N. Medrano	6031.7 General Office Supplies	(37.55)
		CVCC - Chino State of the City - Registration - E. Tellez-Foster	6191 Conferences - General	(45.00)
		The Deli - Lunch meeting - E. Tellez-Foster, B. Smith & C. Burton	6141.1 Meeting Supplies	(87.49)
		Ace Parking - Landsea deposition - T. Corbin	6173 Airfare/Mileage	(15.00)
		RC Mongolian BBQ - Employee Appreciation lunch	6141.1 Meeting Supplies	(74.68)
		The Pozole Place - Lunch meeting - T. Corbin, C. Diggs & C. Burton	6141.1 Meeting Supplies	(78.42)
		IAAP - Professional Annual Renewal 2026 - A. Nelson	6111 Membership Dues	(200.00)
		Amazon - Office supplies	6031.7 General Office Supplies	(352.25)
		Amazon - First aid kit supplies	6031.7 General Office Supplies	(31.73)
		Costco - Copy paper	6031.1 Copy Paper	(79.98)
		Costco - Meeting snacks and drinks	6312 Board Meeting Expenses	(183.98)
		BambooHR - HR and payroll system - March 2026	6061.2 HRIS System	(296.44)
		BlueHost - Monthly software renewal - Standard VPN server with cPanel	6056 Website Services	(94.99)
		Amazon - Asurion office equipment protection plan	6031.7 General Office Supplies	(24.99)
		RC Mongolian BBQ - Admin meeting	6141.1 Meeting Supplies	(121.30)
		Amazon - New employee supplies	6031.7 General Office Supplies	(228.53)
		Amazon - IT supplies	6031.7 General Office Supplies	(173.62)
		Sea of Sweets - Dessert for staff meeting	6141.1 Meeting Supplies	(74.99)
		FedEx - March 2026 Board meeting package - J. Pierson, S. Elie	6042 Postage - General	(30.50)
		Amazon - Amazon Web Services - February 2026	6052.5 IT Data Backup/Storage	(747.32)
			Total for Month	**$ (3,368.17)**

Chino Basin Watermaster

Combining Schedule of Revenues, Expenses & Changes in Net Assets

For the Period of July 1, 2025 through April 30, 2026

(Unaudited)

	JUDGMENT ADMIN.	OPTIMUM BASIN MGMT.	TOTAL JUDGMENT ADMIN & OBMP	POOL ADMINISTRATION & SPECIAL PROJECTS			GROUND WATER REPLENISH.	GRAND TOTALS	ADOPTED BUDGET 2025-2026 WITH CARRYOVER
				AP POOL	OAP POOL	ONAP POOL			
Administrative Revenues:									
Administrative Assessments	$ 6,578,699	$ -	$ 6,578,699	$ 112,641	$ -	$ 31,000	$ -	$ 6,722,340	$ 11,453,849
Interest Revenue	-	250,191	250,191	13,976	42,026	2,549	1,366	310,108	368,030
Groundwater Replenishment	-	-	-	-	-	-	105,187	105,187	-
Mutual Agency Project Revenue	195,850	-	195,850	-	-	-	-	195,850	195,850
Miscellaneous Income	-	-	-	-	-	-	-	-	-
Total Administrative Revenues	**6,774,548**	**250,191**	**7,024,740**	**126,617**	**42,026**	**33,549**	**106,553**	**7,333,484**	**12,017,729**
Administrative & Project Expenditures:									
Watermaster Administration	2,454,839	-	2,454,839	-	-	-	-	2,454,839	2,789,042
Watermaster Board-Advisory Committee	356,516	-	356,516	-	-	-	-	356,516	442,947
Optimum Basin Mgmt Administration	-	871,490	871,490	-	-	-	-	871,490	1,236,522
OBMP Project Costs	-	3,655,823	3,655,823	-	-	-	-	3,655,823	4,699,276
Pool Legal Services	-	-	-	26,138	167,888	935	-	194,961	-
Pool Meeting Compensation	-	-	-	-	35,500	5,875	-	41,375	-
Pool Special Projects	-	-	-	-	-	-	-	-	-
Pool Administration	-	-	-	-	-	-	-	-	411,149
Debt Service	-	565,507	565,507	-	-	-	-	565,507	2,438,793
Agricultural Expense Transfer [1]	-	-	-	203,388	(203,388)	-	-	-	-
Replenishment Water Assessments	-	-	-	-	-	-	62,834	62,834	-
Total Administrative Expenses	**2,811,355**	**5,092,820**	**7,904,175**	**229,526**	**-**	**6,810**	**62,834**	**8,203,345**	**12,017,729**
Net Ordinary Income	**3,963,193**	**(4,842,629)**	**(879,436)**	**(102,908)**	**42,026**	**26,739**	**43,718**	**(869,861)**	**-**
Other Income/(Expense)									
Refund-Recharge Debt Service	-	-	-	-	-	-	-	-	-
Carryover Budget	-	-	-	-	-	-	-	-	553,870
Net Other Income/(Expense)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**553,870**
Net Transfers To/(From) Reserves	**$ 3,963,193**	**$ (4,842,629)**	**$ (879,436)**	**$ (102,908)**	**$ 42,026**	**$ 26,739**	**$ 43,718**	**$ (869,861)**	**$ 553,870**
Net Assets, July 1, 2025			9,139,181	586,974	1,468,387	79,752	42,777	11,317,071	
Refund-Excess Operating Reserves			-	-	-	-	-	-	
Net Assets, End of Period			**8,259,745**	**484,066**	**1,510,413**	**106,491**	**86,495**	**10,447,210**	
Pool Assessments Outstanding				(4,422)	(586,852)	(632)			
Pool Fund Balance				**$ 479,644**	**$ 923,561**	**$ 105,859**			

[1] Fund balance transfer pursuant to Peace Agreement § 5.4(a)

Chino Basin Watermaster

Treasurer's Report

April 2026

	Type	Monthly Yield	Cost	Market	% Total
Cash & Investments					
Local Agency Investment Fund (LAIF) *	Investment	3.81%	$ 694,414	$ 694,401	6.3%
CA CLASS Prime Fund **	Investment	3.74%	7,824,604	7,825,884	71.5%
CA CLASS Pool Restricted Funds **	Investment	3.74%	1,509,063	1,509,310	13.8%
Bank of America	Checking		916,376	916,376	8.4%
Bank of America	Payroll		-	-	0.0%
Total Cash & Investments			**$ 10,944,457**	**$ 10,945,972**	**100.0%**

* The LAIF Market Value factor is updated quarterly in September, December, March, and June.

** The CLASS Prime Fund Net Asset Value factor is updated monthly.

Certification

I certify that (1) all investment actions executed since the last report have been made in full compliance with Chino Basin Watermaster's Investment Policy, and (2) Funds on hand are sufficient to meet all foreseen and planned administrative and project expenditures for the next six months.

Anna Nelson, Director of Administration

Prepared By:
Daniela Uriarte, Senior Accountant

Chino Basin Watermaster
Budget to Actual
For the Period July 1, 2025 to April 30, 2026
(Unaudited)

		April 2026	YTD Actual	FY 25 Carryover Budget	FY 26 Adopted Budget	$ Over / (Under) Budget	% of Budget
1	**Administration Revenue**						
2	Local Agency Subsidies	$ -	$ 195,850	$ -	$ 195,850	$ -	100%
3	Admin Assessments-Appropriative Pool	-	6,426,042	-	11,131,622	(4,705,580)	58%
4	Admin Assessments-Non-Ag Pool	-	152,657	-	322,227	(169,570)	47%
5	**Total Administration Revenue**	**-**	**6,774,548**	**-**	**11,649,699**	**(4,875,151)**	**58%**
6	**Other Revenue**						
7	Appropriative Pool-Replenishment	-	81,011	-	-	81,011	N/A
8	Non-Ag Pool-Replenishment	-	24,176	-	-	24,176	N/A
9	Interest Income	29,957	250,191	-	368,030	(117,839)	68%
10	Miscellaneous Income	-	-	-	-	-	N/A
11	**Total Other Revenue**	**29,957**	**355,378**	**-**	**368,030**	**(12,652)**	**97%**
12	**Total Revenue**	**29,957**	**7,129,927**	**-**	**12,017,729**	**(4,887,802)**	**59%**
13	**Judgment Administration Expense**						
14	Judgment Administration	67,710	577,875	14,344	910,511	(346,980)	62%
15	Admin. Salary/Benefit Costs	103,307	921,507	-	1,127,840	(206,333)	82%
16	Office Building Expense	18,220	195,651	-	228,535	(32,884)	86%
17	Office Supplies & Equip.	3,370	25,850	10,038	35,750	(19,937)	56%
18	Postage & Printing Costs	1,148	14,859	-	27,190	(12,331)	55%
19	Information Services	14,797	76,485	-	224,400	(147,915)	34%
20	Contract Services	841	52,278	-	103,950	(51,672)	50%
21	Watermaster Legal Services	-	603,386	-	346,011	257,375	174%
22	Insurance	-	65,894	-	55,000	10,894	120%
23	Dues and Subscriptions	230	38,897	-	40,900	(2,003)	95%
24	Watermaster Administrative Expenses	570	7,743	-	9,630	(1,887)	80%
25	Field Supplies	722	2,832	-	3,900	(1,068)	73%
26	Travel & Transportation	3,918	20,943	-	35,600	(14,657)	59%
27	Training, Conferences, Seminars	364	18,306	-	43,500	(25,194)	42%
28	Advisory Committee Expenses	9,078	87,528	-	111,785	(24,257)	78%
29	Watermaster Board Expenses	20,461	268,988	-	331,162	(62,174)	81%
30	ONAP - WM & Administration	3,414	51,678	-	123,585	(71,907)	42%
31	OAP - WM & Administration	659	61,864	-	140,528	(78,664)	44%
32	Appropriative Pool- WM & Administration	9,549	117,473	-	147,036	(29,563)	80%
33	Allocated G&A Expenditures	(51,292)	(398,683)	-	(403,675)	4,992	99%
34	**Total Judgment Administration Expense**	**207,065**	**2,811,355**	**24,382**	**3,643,138**	**(856,165)**	**77%**
35	**Optimum Basin Management Plan (OBMP)**						
36	Optimum Basin Management Plan	31,616	871,490	59,443	1,236,522	(424,475)	67%
37	Groundwater Quality Monitoring	-	1,636	-	4,500	(2,864)	36%
38	Groundwater Level Monitoring	44,605	447,269	15,800	500,880	(69,411)	87%
39	Program Element (PE)2- Comp Recharge	72,176	1,130,774	55,000	1,968,267	(892,493)	56%
40	PE3&5-Water Supply/Desalte	49,671	164,570	9,100	173,320	(17,850)	90%
41	PE4- Management Plan	101,603	443,961	124,788	604,076	(284,903)	61%
42	PE6&7-CoopEfforts/SaltMgmt	44,953	403,776	96,394	772,078	(464,696)	46%
43	PE8&9-StorageMgmt/Conj Use	78,456	665,154	168,963	272,480	223,711	151%
44	Recharge Improvements	-	565,507	-	2,438,793	(1,873,286)	23%
45	Administration Expenses Allocated-OBMP	9,021	111,422	-	139,094	(27,672)	80%
46	Administration Expenses Allocated-PE 1-9	42,270	287,261	-	264,581	22,680	109%
47	**Total OBMP Expense**	**474,372**	**5,092,820**	**529,488**	**8,374,591**	**(3,811,259)**	**57%**
48	**Other Expense**						
49	Groundwater Replenishment	-	62,834	-	42,777	20,058	147%
50	Other Expenses	-	-	-	-	-	N/A
51	**Total Other Expense**	**-**	**62,834**	**-**	**42,777**	**20,058**	**147%**
52	**Total Expenses**	**681,437**	**7,967,010**	**553,870**	**12,060,506**	**(4,647,366)**	**63%**
53	**Increase / (Decrease) to Reserves**	**$ (651,480)**	**$ (837,083)**		**$ (42,777)**	**$ (794,306)**	

Budget to Actual

The Budget to Actual report summarizes the operating and non-operating revenues and expenses of Chino Basin Watermaster for the fiscal year-to-date (YTD). Columns are included for current monthly and YTD activity shown comparatively to the FY 26 amended budget and FY 25 carryover budget. The final two columns indicate the amount over or under budget, and the YTD percentage of total budget used. As of April 30th, the target budget percentage is generally 83%.

Revenues

Lines 1-5 Administration Revenue – Includes local agency subsidies and administrative assessment for the Appropriative, Agricultural and Non-Agricultural Pools.

- Line 2 Local Agency Subsidies includes the annual Dry Year Yield (DYY) administrative fee received. This account is at 100% of budget due to the timing of payment.

Lines 6-12 Other Revenue – Includes Pool replenishment assessments, interest income, miscellaneous income, and carryover budget from prior years.

Expenses

Lines 13-34 Judgment Administration Expense – Includes Watermaster general administrative expenses, contract services, insurance, office and other administrative expenses. Below is a summary of notable account variances at month end:

- Line 21 Watermaster Legal Services includes outside legal counsel expenses. The account is over budget due to increased administration matters and court coordination not originally anticipated in the budget.
- Line 22 Insurance includes general liability insurance, directors' and officers' liability, umbrella coverage, environmental pollution liability and other various insurance policies. The account is over budget due to an unanticipated increase in the cost of Municipalities Umbrella coverage, as well as the implementation of a Cyber insurance policy that was not included in the original budget.
- Line 23 Dues and Subscriptions include annual dues for ACWA, CA Groundwater Coalition, SHRM, and other miscellaneous subscriptions. The account is at 95% of budget due to the timing of subscription renewals.

Lines 35-47 Optimum Basin Management Plan (OBMP) Expense – Includes legal, engineering, groundwater level monitoring, allocated administrative expenses, and other expenses.

Lines 48-51 Other Expense – Includes groundwater replenishment, settlement expenses, and various refunds as appropriate.

Pool Services Fund Accounting

Each Pool has a fund account created to pay their own legal service invoices. The legal services invoices are funded and paid using the fund accounts (8467 for the Overlying Agricultural Pool (OAP), 8567 for the Overlying Non-Agricultural Pool (ONAP), and 8367 for the Appropriate Pool (AP)). Along with the legal services fund account for the OAP (8467), the OAP also has two other fund accounts for Ag Pool Meeting Attendance expenses (8470), and Special Projects expenses (8471). The ONAP also has a meeting compensation fund account (8511). Additionally, the OAP has a reserve fund that is held by Watermaster and spent at the direction of the OAP. The AP also has account 8368 relating to the Thomas Harder & Company contract. These fund accounts are replenished at the direction of each Pool, and the legal service invoices are approved by the Pool leadership and when paid by Watermaster, are deducted from the existing fund account balances. If the fund account for any pool reaches zero, no further payments can be paid from the fund, and a replenishment action must be initiated by the Pool.

The following tables detail the fund balance accounts as of April 30, 2026 (continued next page):

Fund Balance For Non-Agricultural Pool **Account 8567 - Legal Services**		
Beginning Balance July 1, 2025:	$	77,376.71
Additions:		
Interest Earnings		2,548.96
Payments received on ONAP Assessment invoices issued 11/25/25		24,490.40
Subtotal Additions:		27,039.36
Reductions:		
Invoices paid July 2025 - April 2026		(935.00)
Subtotal Reductions:		(935.00)
Available Fund Balance as of April 30, 2026	**$**	**103,481.07**

Fund Balance For Appropriative Pool **Account 8367 - Legal Services**		
Beginning Balance July 1, 2025:	$	224,225.46
Additions:		
Interest Earnings		13,976.28
Payments received on AP Assessment invoices issued 11/17/22		81,892.83
Payments received on appellant share of Post-TOA legal fees		112,640.87
Subtotal Additions:		208,509.98
Reductions:		
Invoices paid July 2025 - April 2026		(26,138.00)
Budget Transfer		(25,000.00) *
Subtotal Reductions:		(51,138.00)
Available Fund Balance as of April 30, 2026	**$**	**381,597.44**

**Transfer of funds issued to OAP meeting stipends per AP Chair direction.*

Fund Balance For Non-Agricultural Pool **Account 8511 - Meeting Compensation**		
Beginning Balance July 1, 2025:	$	2,375.00
Additions:		
Payments received on ONAP Assessment invoices issued 11/25/25		5,877.70
Subtotal Additions:		5,877.70
Reductions:		
Compensation paid July 2025 - April 2026		(5,875.00)
Subtotal Reductions:		(5,875.00)
Available Fund Balance as of April 30, 2026	**$**	**2,377.70**

Fund Balance For Appropriative Pool **Account 8368 - Tom Harder Contract**		
Beginning Balance July 1, 2025:	$	20,577.61
Additions:		
Subtotal Additions:		-
Reductions:		
Invoices paid July 2025 - April 2026		-
Subtotal Reductions:		-
Available Fund Balance as of April 30, 2026	**$**	**20,577.61**

Chino Basin Watermaster
Monthly Variance Report & Supplemental Schedules
For the period July 1, 2025 to April 30, 2026
(Unaudited)

Pool Services Fund Accounting – Cont.

Fund Balance for Agricultural Pool Account 8467 - Legal Services (Held by AP)		
Beginning Balance July 1, 2025:	$	225,597.51
Reductions:		
Invoices paid July 2025 - April 2026		(167,887.50)
Subtotal Reductions:		(167,887.50)
Available Fund Balance as of April 30, 2026	**$**	**57,710.01**

Agricultural Pool Reserve Funds As shown on the Combining Schedules		
Beginning Balance July 1, 2025:	$	881,534.98
Additions:		
YTD Interest earned on Ag Pool Funds FY 26		42,025.77
Transfer of Funds from AP to Special Fund for Legal Service Invoices		167,887.50
Total Additions:		209,913.27
Reductions:		
Legal service invoices paid July 2025 - April 2026		(167,887.50)
Subtotal Reductions:		(167,887.50)
Agricultural Pool Reserve Funds Balance as of April 30, 2026:	**$**	**923,560.75**

Fund Balance For Agricultural Pool Account 8470 - Meeting Compensation (Held by AP)			
Beginning Balance July 1, 2025:	$	18,069.65	
Additions:			
Budget Transfer		25,000.00	*
Subtotal Additions:		25,000.00	
Reductions:			
Compensation paid July 2025 - April 2026		(35,500.00)	
Subtotal Reductions:		(35,500.00)	
Available Fund Balance as of April 30, 2026	**$**	**7,569.65**	

**Transfer of funds issued from AP legal services per AP Chair direction.*

Fund Balance For Agricultural Pool Account 8471 - Special Projects (Held by AP)		
Beginning Balance July 1, 2025:	$	12,189.00
Reductions:		
Invoices paid July 2025 - April 2026		-
Subtotal Reductions:		-
Available Fund Balance as of April 30, 2026	**$**	**12,189.00**

Watermaster Salary Expenses

The following table details the Year-To-Date (YTD) Actual Watermaster burdened salary costs compared to the FY 26 adopted budget. The "$ Over Budget" and the "% of Budget" columns are a comparison of the YTD actual to the annual budget. As of April 30th, the target budget percentage is generally 83%.

	Year to Date Actual	FY 25-26 Budget	$ Over / (Under) Budget	% of Budget
WM Salary Expense				
5901.1 · Judgment Admin - Doc. Review	94,656	74,466	20,190	127.1%
5901.3 · Judgment Admin - Field Work	594	14,357	(13,763)	4.1%
5901.5 · Judgment Admin - General	5,857	55,535	(49,678)	10.5%
5901.7 · Judgment Admin - Meeting	47,289	45,648	1,641	103.6%
5901.9 · Judgment Admin - Reporting	3,843	21,742	(17,899)	17.7%
5910 · Judgment Admin - Court Coord./Attendance	9,608	28,837	(19,229)	33.3%
5911 · Judgment Admin - Exhibit G	876	6,396	(5,520)	13.7%
5921 · Judgment Admin - Production Monitoring	-	9,471	(9,471)	0.0%
5931 · Judgment Admin - Recharge Applications	2,743	33,092	(30,349)	8.3%
5941 · Judgment Admin - Reporting	1,155	44,602	(43,447)	2.6%
5951 · Judgment Admin - Rules & Regs	2,721	11,350	(8,629)	24.0%
5961 · Judgment Admin - Safe Yield	72,423	106,006	(33,583)	68.3%
5971 · Judgment Admin - Storage Agreements	4,819	20,671	(15,852)	23.3%
5981 · Judgment Admin - Water Accounting/Database	120,505	112,036	8,469	107.6%
5991 · Judgment Admin - Water Transactions	8,935	13,062	(4,127)	68.4%
6011.11 · WM Staff - Overtime	6,055	18,000	(11,945)	33.6%
6011.10 · Admin - Accounting	238,292	280,410	(42,118)	85.0%
6011.15 · Admin - Building Admin	14,081	31,040	(16,959)	45.4%
6011.20 · Admin - Conference/Seminars	35,238	50,660	(15,422)	69.6%
6011.25 · Admin - Document Review	91,046	54,110	36,936	168.3%
6011.50 · Admin - General	239,020	278,870	(39,850)	85.7%
6011.60 · Admin - HR	53,754	100,980	(47,226)	53.2%
6011.70 · Admin - IT	57,022	72,830	(15,808)	78.3%
6011.80 · Admin - Meeting	121,352	93,640	27,712	129.6%
6011.90 · Admin - Team Building	15,359	33,490	(18,131)	45.9%
6011.95 · Admin - Training (Give/Receive)	42,488	79,580	(37,092)	53.4%
6017· Temporary Services	-	28,250	(28,250)	0.0%
6201 · Advisory Committee	44,269	61,397	(17,128)	72.1%
6301 · Watermaster Board	93,811	101,669	(7,858)	92.3%
8301 · Appropriative Pool	79,033	89,707	(10,674)	88.1%
8401 · Agricultural Pool	31,544	83,199	(51,655)	37.9%
8501 · Non-Agricultural Pool	23,622	66,256	(42,634)	35.7%
6901.1 · OBMP - Document Review	44,189	50,364	(6,175)	87.7%
6901.3 · OBMP - Field Work	2,418	9,471	(7,053)	25.5%
6901.5 · OBMP - General	44,243	52,005	(7,762)	85.1%
6901.7 · OBMP - Meeting	49,542	33,487	16,055	147.9%
6901.9 · OBMP - Reporting	4,987	39,176	(34,189)	12.7%
7104.1 · PE1 - Monitoring Program	211,356	166,708	44,648	126.8%
7201 · PE2 - Comprehensive Recharge	88,280	49,649	38,631	177.8%
7301 · PE3&5 - Water Supply/Desalter	-	19,189	(19,189)	0.0%
7301.1 · PE5 - Reg. Supply Water Prgm.	1,170	16,759	(15,589)	7.0%
7401 · PE4 - MZ1 Subsidence Mgmt. Plan	865	25,595	(24,730)	3.4%
7501 · PE6 - Coop. Programs/Salt Mgmt.	15,842	22,984	(7,142)	68.9%
7501.1 · PE 7 - Salt Nutrient Mgmt. Plan	594	16,786	(16,192)	3.5%
7601 · PE8&9 - Storage Mgmt./Recovery	56,635	33,288	23,347	170.1%
Subtotal WM Staff Costs	**2,083,038**	**2,656,820**	**(573,782)**	**78%**
60184.1 · Administrative Leave	5,997	-	5,997	100.0%
60185 · Vacation	97,627	110,082	(12,455)	88.7%
60185.1 · Comp Time	8,240	-	8,240	100.0%
60186 · Sick Leave	56,543	81,688	(25,145)	69.2%
60187 · Holidays	75,684	102,102	(26,418)	74.1%
Subtotal WM Paid Leaves	**244,091**	**293,872**	**(49,781)**	**83%**
Total WM Salary Costs	**2,327,129**	**2,950,692**	**(623,563)**	**78.9%**

Engineering

The following table details the Year-To-Date (YTD) Actual Engineering costs compared to the FY 26 adopted budget. The "$ Over Budget" and the "% of Budget" columns are a comparison of the YTD actual to the annual budget. As of April 30th, the target budget percentage is generally 83%.

	Year to Date Actual	FY 25-26 Budget	$ Over / (Under) Budget	% of Budget
Engineering Services Costs				
5901.8 · Judgment Admin - Meetings-Engineering Services	$ -	$ 38,909	$ (38,909)	0.0%
5906.71 · Judgment Admin - Data Requests-CBWM Staff	76,892	109,124	(32,232)	70.5%
5906.72 · Judgment Admin - Data Requests-Non-CBWM Staff	55,831	56,483	(652)	98.8%
5925 · Judgment Admin - Ag Production & Estimation	33,162	31,992	1,170	103.7%
5935 · Judgment Admin - Mat'l Physical Injury Requests	3,802	41,668	(37,866)	9.1%
5945 · Judgment Admin - WM Annual Report Preparation	12,260	17,762	(5,502)	69.0%
5965 · Judgment Admin - Support Data Collection & Mgmt Process	19,903	17,302	2,601	115.0%
6206 · Advisory Committee Meetings-WY Staff	16,841	22,624	(5,783)	74.4%
6306 · Watermaster Board Meetings-WY Staff	25,347	22,624	2,723	112.0%
8306 · Appropriative Pool Meetings-WY Staff	22,242	22,624	(382)	98.3%
8406 · Agricultural Pool Meetings-WY Staff	14,782	22,624	(7,842)	65.3%
8506 · Non-Agricultural Pool Meetings-WY Staff	11,858	22,624	(10,766)	52.4%
6901.8 · OBMP - Meetings-WY Staff	74,454	38,909	35,545	191.4%
6901.95 · OBMP - Reporting-WY Staff	66,058	66,832	(774)	98.8%
6906 · OBMP Engineering Services - Other	58,754	65,810	(7,056)	89.3%
6906.1 · OBMP Watermaster Model Update	43,731	8,176	35,555	534.9%
7104.3 · Grdwtr Level-Engineering	213,122	274,794	(61,672)	77.6%
7104.8 · Grdwtr Level-Contracted Services	6,246	29,128	(22,882)	21.4%
7104.9 · Grdwtr Level-Capital Equipment	5,063	19,000	(13,937)	26.6%
7202 · PE2-Comp Recharge-Engineering Services	15,256	23,350	(8,095)	65.3%
7202.2 · PE2-Comp Recharge-Engineering Services	120,984	181,496	(60,512)	66.7%
7302 · PE3&5-PBHSP Monitoring Program	126,706	77,792	48,914	162.9%
7303 · PE3&5-Engineering - Other	8,425	21,080	(12,655)	40.0%
7306 · PE3&5-Engineering - Outside Professionals	24,703	31,500	(6,797)	78.4%
7402 · PE4-Engineering	158,892	301,531	(142,639)	52.7%
7402.10 · PE4-Northwest MZ1 Area Project	203,423	169,378	34,045	120.1%
7403 · PE4-Eng. Services-Contracted Services-InSar	23,277	28,600	(5,324)	81.4%
7406 · PE4-Engineering Services-Outside Professionals	46,069	55,155	(9,086)	83.5%
7408 · PE4-Engineering Services-Network Equipment	8,748	19,107	(10,359)	45.8%
7502 · PE6&7-Engineering	257,152	365,564	(108,412)	70.3%
7502.2 · PE7-Groundwtr Quality Model	1,579	70,216	(68,638)	2.2%
7505 · PE6&7-Laboratory Services	38,941	41,300	(2,359)	94.3%
7510 · PE6&7-IEUA Salinity Mgmt. Plan	27,433	9,522	17,911	288.1%
7511 · PE6&7-SAWBMP Task Force-50% IEUA	26,272	28,022	(1,750)	93.8%
7517 · Surface Water Monitoring Plan-Chino Creek - 50% IEUA	35,964	28,434	7,530	126.5%
7520 · Preparation of Water Quality Mgmt. Plan	-	39,250	(39,250)	0.0%
7610 · PE8&9-Support 2020 Mgmt. Plan	-	21,720	(21,720)	0.0%
7614 · PE8&9-Support Imp. Safe Yield Court Order	608,519	79,656	528,863	763.9%
7615 · PE8&9-Develop 2025 Storage Plan	-	137,816	(137,816)	0.0%
Total Engineering Services Costs	**$ 2,492,691**	**$ 2,659,500**	**$ (166,807)**	**93.7%**

* West Yost and Subcontractor Engineering Budget of $2,659,500 plus Carryover Funds from FY 2024/25 of $508,838

Legal

The following table details the YTD Brownstein Hyatt Farber Schreck (BHFS) expenses and costs compared to the FY 26 adopted budget. The "$ Over Budget" and the "% of Budget" columns are a comparison of the YTD actual to the annual budget. As of April 30th, the target budget percentage is generally 83%. Due to timing of billing, the figures below represent legal services provided through March 31, 2026, with a target budget percentage of 75%.

	Year to Date Actual	FY 25-26 Budget	$ Over / (Under) Budget	% of Budget
6070 · Watermaster Legal Services				
6071 · BHFS Legal - Court Coordination	$ 370,659	$ 76,000	$ 294,659	487.7%
6072 · BHFS Legal - Rules & Regulations	-	10,495	(10,495)	0.0%
6073 · BHFS Legal - Personnel Matters	40,140	28,150	11,990	142.6%
6074 · BHFS Legal - Interagency Issues	-	40,536	(40,536)	0.0%
6077 · BHFS Legal - Party Status Maintenance	-	13,590	(13,590)	0.0%
6078 · BHFS Legal - Miscellaneous (Note 1)	192,587	177,240	15,347	108.7%
Total 6070 · Watermaster Legal Services	**603,386**	**346,011**	**257,375**	**174.4%**
6275 · BHFS Legal - Advisory Committee	26,418	27,764	(1,346)	95.2%
6375 · BHFS Legal - Board Meeting	109,148	88,704	20,444	123.0%
6375.1 · BHFS Legal - Board Workshop(s)	-	29,215	(29,215)	0.0%
8375 · BHFS Legal - Appropriative Pool	16,198	34,705	(18,507)	46.7%
8475 · BHFS Legal - Agricultural Pool	15,538	34,705	(19,167)	44.8%
8575 · BHFS Legal - Non-Ag Pool	16,198	34,705	(18,507)	46.7%
Total BHFS Legal Services	**183,500**	**249,798**	**(66,298)**	**73.5%**
6907.3 · WM Legal Counsel				
6907.31 · Archibald South Plume	-	12,565	(12,565)	0.0%
6907.32 · Chino Airport Plume	-	12,565	(12,565)	0.0%
6907.33 · Desalter/Hydraulic Control	-	38,680	(38,680)	0.0%
6907.34 · Santa Ana River Water Rights	8,157	21,405	(13,248)	38.1%
6907.38 · Reg. Water Quality Cntrl Board	-	63,200	(63,200)	0.0%
6907.39 · Recharge Master Plan	8,948	14,270	(5,322)	62.7%
6907.41 · Prado Basin Habitat Sustainability	330	10,290	(9,960)	3.2%
6907.44 · SGMA Compliance	-	10,290	(10,290)	0.0%
6907.45 · OBMP Update	8,799	177,240	(168,441)	5.0%
6907.47 · 2020 Safe Yield Reset	28,353	151,180	(122,827)	18.8%
6907.50 · San Sevaine Basin Discharge - State Court	-	54,130	(54,130)	0.0%
6907.51 · San Sevaine Basin Discharge CWA Litigatio	418,490	150,440	268,050	278.2%
6907.90 · WM Legal Counsel - Unanticipated	-	38,885	(38,885)	0.0%
Total 6907 · WM Legal Counsel	**473,077**	**755,140**	**(282,063)**	**62.6%**
Total Brownstein, Hyatt, Farber, Schreck Costs	**$ 1,259,963**	**$ 1,350,949**	**$ (90,986)**	**93.3%**

Chino Basin Watermaster
Monthly Variance Report & Supplemental Schedules
For the period July 1, 2025 to April 30, 2026
(Unaudited)

Optimum Basin Management Plan (OBMP)

The following table details the Year-To-Date (YTD) Actual OBMP costs compared to the FY 26 adopted budget. The "$ Over Budget" and the "% of Budget" columns are a comparison of the YTD actual to the annual budget. As of April 30th, the target budget percentage is generally 83%.

	Year to Date Actual	FY 25-26 Budget	$ Over / (Under) Budget	% of Budget
6900 · Optimum Basin Mgmt Plan				
6901.1 · OBMP - Document Review-WM Staff	$ 44,189	$ 50,364	$ (6,175)	87.7%
6901.3 · OBMP - Field Work-WM Staff	2,418	9,471	(7,053)	25.5%
6901.5 · OBMP - General-WM Staff	44,243	52,005	(7,762)	85.1%
6901.7 · OBMP - Meeting-WM Staff	49,542	33,487	16,055	147.9%
6901.8 · OBMP - Meeting-West Yost	74,454	38,909	35,545	191.4%
6901.9 · OBMP - Reporting-WM Staff	4,987	39,176	(34,189)	12.7%
6901.95 · OBMP - Reporting-West Yost	66,058	66,832	(774)	98.8%
Total 6901 · OBMP WM and West Yost Staff	**285,889**	**290,244**	**(4,355)**	**98.5%**
6903 · OBMP - SAWPA				
6903 · OBMP - SAWPA Group	7,608	18,952	(11,344)	40.1%
Total 6903 · OBMP - SAWPA	**7,608**	**18,952**	**(11,344)**	**40.1%**
6906 · OBMP Engineering Services				
6906.1 · OBMP - Watermaster Model Update	43,731	8,176	35,555	534.9%
6906.21 · State of the Basin Report	-	-	-	0.0%
6906 · OBMP Engineering Services - Other	58,754	65,810	(7,056)	89.3%
Total 6906 · OBMP Engineering Services	**102,485**	**73,986**	**28,499**	**138.5%**
6907 · OBMP Legal Fees				
6907.31 · Archibald South Plume	-	12,565	(12,565)	0.0%
6907.32 · Chino Airport Plume	-	12,565	(12,565)	0.0%
6907.33 · Desalter/Hydraulic Control	-	38,680	(38,680)	0.0%
6907.34 · Santa Ana River Water Rights	8,157	21,405	(13,248)	38.1%
6907.36 · Santa Ana River Habitat	-	-	-	0.0%
6907.38 · Reg. Water Quality Cntrl Board	-	63,200	(63,200)	0.0%
6907.39 · Recharge Master Plan	8,948	14,270	(5,322)	62.7%
6907.41 · Prado Basin Habitat Sustainability	198	10,290	(10,092)	1.9%
6907.44 · SGMA Compliance	132	10,290	(10,158)	1.3%
6907.45 · OBMP Update	8,799	177,240	(168,441)	5.0%
6907.47 · 2020 Safe Yield Reset	28,353	151,180	(122,827)	18.8%
6907.50 · San Sevaine Basin Discharge - State	-	54,130	(54,130)	0.0%
6907.51 · San Sevaine Basin Discharge CWA	418,490	150,440	268,050	278.2%
6907.90 · WM Legal Counsel - Unanticipated	-	38,885	(38,885)	0.0%
Total 6907 · OBMP Legal Fees	**473,077**	**755,140**	**(282,063)**	**62.6%**
6909 · OBMP Other Expenses				
6909.6 · OBMP Expenses - Miscellaneous	-	96,000	(96,000)	0.0%
Total 6909 · OBMP Other Expenses	**-**	**98,200**	**(98,200)**	**0.0%**
Total 6900 · Optimum Basin Mgmt Plan	**$ 869,059**	**$ 1,236,522**	**$ (367,463)**	**70.3%**

Chino Basin Watermaster
Monthly Variance Report & Supplemental Schedules
For the period July 1, 2025 to April 30, 2026
(Unaudited)

Judgment Administration

The following table details the Year-To-Date (YTD) Actual Judgment Administration costs compared to the FY 26 adopted budget. The "$ Over Budget" and the "% of Budget" columns are a comparison of the YTD actual to the annual budget. As of April 30th, the target budget percentage is generally 83%.

	Year to Date Actual	FY 25-26 Budget	$ Over / (Under) Budget	% of Budget
5901 · Admin-WM Staff				
5901.1 · Admin-Doc. Review-WM Staff	$ 94,656	$ 74,466	$ 20,190	127.1%
5901.3 · Admin-Field Work-WM Staff	594	14,357	(13,763)	4.1%
5901.5 · Admin-General-WM Staff	5,857	55,535	(49,678)	10.5%
5901.7 · Admin-Meeting-WM Staff	47,289	45,648	1,641	103.6%
5901.8 · Admin-Meeting - West Yost	-	38,909	(38,909)	0.0%
5901.9 · Admin-Reporting-WM Staff	3,843	21,742	(17,899)	17.7%
Total 5901 · Admin-WM Staff	**152,240**	**250,657**	**(98,417)**	**60.7%**
5900 · Judgment Admin Other Expenses				
5906.71 · Admin-Data Req-CBWM Staff	76,892	109,124	(32,232)	70.5%
5906.72 · Admin-Data Req-Non CBWM Staff	55,831	56,483	(652)	98.8%
5910 · Court Coordination/Attend-WM	9,608	28,837	(19,229)	33.3%
5911 · Exhibit G-WM Staff	876	6,396	(5,520)	13.7%
5921 · Production Monitoring-WM Staff	-	9,471	(9,471)	0.0%
5925 · Ag Prod & Estimation-West Yost	33,162	31,992	1,170	103.7%
5931 · Recharge Applications-WM Staff	2,743	33,092	(30,349)	8.3%
5935 · Admin-Mat'l Phy Inj Requests	3,802	41,668	(37,866)	9.1%
5941 · Reporting-WM Staff	1,155	44,602	(43,447)	2.6%
5945 · WM Annual Report Prep-West Yost	12,260	17,762	(5,502)	69.0%
5951 · Rules & Regs-WM Staff	2,721	11,350	(8,629)	24.0%
5961 · Safe Yield-WM Staff	72,423	106,006	(33,583)	68.3%
5965 · Support Data Collect-West Yost	19,903	17,302	2,601	115.0%
5971 · Storage Agreements-WM Staff	4,819	20,671	(15,852)	23.3%
5981 · Water Acct/Database-WM Staff	120,505	112,036	8,469	107.6%
5991 · Water Transactions-WM Staff	8,935	13,062	(4,127)	68.4%
Total 5900 · Judgment Admin Other Expenses	**425,636**	**659,854**	**(234,218)**	**64.5%**
Total 5900 · Judgment Administration	**$ 577,875**	**$ 910,511**	**$ (332,636)**	**63.5%**

"Carry Over" Funding:

The "Carry Over" funding was calculated at the start of FY 26. The Total "Carry Over" funding amount of $553,870 has been posted to the general ledger accounts. The total amount consisted of $508,838 from Engineering Services, $34,994 from OBMP Activities, and $10,038 from Administration Services. More detailed information is provided on the table below.

Carry Over Budget Detail FY 2025/26

Account	Description	Amount	Fiscal Year	Type
6038	Other Office Equipment - Boardroom Upgrades	$ 10,038	FY 2020/21	ADMIN
7545	Meter Installation - New Meter Installation, Calibration and Testing	34,994	FY 2018/19	OBMP
5925	Agriculture Production and Estimation	4,344	FY 2024/25	ENG
5965	Support for Implementation of Improved Data Collection and Management Process	10,000	FY 2024/25	ENG
6906.1	Watermaster Model Application and Required Demonstrations	59,443	FY 2024/25	ENG
7104.3	Groundwater Level Monitoring Program	15,800	FY 2024/25	ENG
7202.2	Comprehensive Recharge Program	55,000	FY 2024/25	ENG
7302	PBHSP Monitoring Program- 50% IEUA Cost Share	9,100	FY 2024/25	ENG
7402.1	PE4/MZ-1: Subsidence Management Plan for Northwest MZ-1	124,788	FY 2024/25	ENG
7502	Groundwater Quality Monitoring and Reporting Program and as-needed Consulting	41,400	FY 2024/25	ENG
7517	Implementation of Chino Creek Monitoring Program - IEUA Cost Share	20,000	FY 2024/25	ENG
7614	Support Implementation of the Safe Yield Court Order	168,963	FY 2024/25	ENG
Total Carryover Budget		**$ 553,870**		

CHINO BASIN WATERMASTER

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

STAFF REPORT

DATE: June 18, 2026

TO: Advisory Committee Members

SUBJECT: Annual Report of the Prado Basin Habitat Sustainability Program Water Year 2025 (Consent Calendar Item I.C.)

Issue: Pursuant to the monitoring and mitigation requirements of the Peace II Subsequent Environmental Impact Report, the Prado Basin Habitat Sustainability Committee must prepare an Annual Report. The Committee presents its 10th Annual Report for Water Year 2025. [Discretionary Function]

Recommendation: Recommend the Watermaster Board adopt the 2025 Annual Report.

Financial Impact: None.

ACTIONS:
Appropriative Pool – June 11, 2026 [Final]: Provided advice and assistance.
Non-Agricultural Pool – June 11, 2026 [Final]: Provided advice and assistance.
Agricultural Pool – June 11, 2026 [Final]: Provided advice and assistance.
Advisory Committee – June 18, 2026 [Recommended]: Advice and assistance.
Watermaster Board – June 25, 2026 [Recommended]: Adopt and file.

BACKGROUND

The Prado Flood Control Basin (Prado Basin) is located in the southernmost, downgradient portion of the Chino Groundwater Basin (Chino Basin). Surface-water flow within the middle Santa Ana River (SAR) and its tributaries discharge into and through the Prado Basin behind Prado Dam, the main flood-control facility on the middle SAR. The US Army Corps of Engineers, in coordination with the Orange County Water District (OCWD), regulates releases from Prado Dam for the purposes of flood control and groundwater recharge in Orange County. The SAR and its tributaries are unlined across the Prado Basin, which allows for groundwater/surface-water interaction. Depth to groundwater is relatively shallow in the Prado Basin, where groundwater losses can occur via evapotranspiration by riparian vegetation and rising-groundwater outflow to the SAR and its tributaries.

The surface-water impoundments behind Prado Dam and the shallow groundwater have created within Prado Basin the largest riparian forest in Southern California. The riparian forest provides critical habitat for various threatened and endangered species including the Least Bell's Vireo, Southwestern Willow Flycatcher, and the Santa Ana Sucker.

To further implement the goals and objectives of the Chino Basin Optimum Basin Management Program (OBMP), the Chino Basin Watermaster (Watermaster) executed the Peace II Agreement in 2007. The primary features of the Peace II Agreement are expansion of pumping at the Chino Basin Desalter wells and Basin Re-operation for the attainment of Hydraulic Control of the Chino Basin. Hydraulic Control is defined as the elimination of groundwater discharge from the Chino-North Groundwater Management Zone (GMZ) to the Prado Basin, or its reduction to *de minimis* quantities (i.e., less than 1,000 acre-feet per year [afy]). Hydraulic Control ensures that the water management activities in the Chino-North GMZ will not impair the beneficial uses designated for the SAR downstream of Prado Dam. Basin Re-operation means the increase in controlled overdraft of the Chino Basin, as defined in the Judgment, from 200,000 acre-ft (af) over the period of 1978 through 2017 to 600,000 af through 2030. Both Chino Basin Desalter expansion and Basin Re-operation are required to achieve Hydraulic Control. Hydraulic Control was achieved in 2016 and will be maintained through Chino Desalter well pumping of 40,000 afy, and the completion of Basin Re-operation.

At the time of its consideration, OCWD expressed concern that one of the potential impacts of the Peace II Agreement activities described above would be the lowering of groundwater levels (drawdown) in the Prado Basin, which might impact the riparian habitat that is dependent upon groundwater. To address the potential drawdown and its impact on the riparian habitat, the monitoring and mitigation requirements in the Peace II Subsequent Environmental Impact Report (SEIR) call for the development and implementation of an adaptive management program for the Prado Basin habitat:

Biological Resources/Land Use & Planning—Section 4.4-3 of the Peace II SEIR
The Chino Basin Stakeholders are committed to ensuring that the Peace II Agreement actions will not significantly adversely impact the Prado Basin riparian habitat. This includes the riparian portions of Chino and Mill Creek's between the terminus of hard lined channels and Prado Basin proper.

The available modeling data in the SEIR indicates that Peace II Agreement implementation will not cause significant adverse effects on the Prado Basin riparian habitat. However, the following contingency measure will be implemented to ensure that the Prado Basin riparian habitat will not incur unforeseeable significant adverse effects, due to implementation of Peace II. IEUA, Watermaster, OCWD and individual stakeholders, that choose to participate, will jointly fund and develop an adaptive management program that will include, but not be limited to:

- *monitoring riparian habitat quality and extent;*
- *investigating and identifying essential factors to long-term sustainability of Prado Basin riparian habitat*
- *identification of specific parameters that can be monitored to measure potential effects of Peace II Agreement implementation effects on Prado Basin; and*
- *identification of water management options to minimize the Peace II Agreement effects on Prado Basin*

This adaptive management program will be prepared as a contingency to define available management actions by Prado Basin stakeholders to address unforeseeable significant adverse impacts, as well as to contribute to the long-term sustainability of the Prado Basin riparian habitat.

The above effort will be implemented under the supervision of a newly formed Prado Basin Habitat Sustainability Committee. This Committee will include representatives from all interested parties and will be convened by the Watermaster and IEUA. Annual reports will be prepared and will include recommendations for ongoing monitoring and any adaptive management actions required to mitigate any measured loss or prospective loss of riparian habitat that may be attributable to the Peace II Agreement. As determined by Watermaster and IEUA, significant adverse impacts to riparian habitat that are attributable to the Peace II Agreement will be mitigated.

Pursuant to the monitoring and mitigation requirements of the Peace II SEIR, the Inland Empire Utilities Agency (IEUA) and the Watermaster convened the Prado Basin Habitat Sustainability Committee (PBHSC) to develop the Prado Basin Habitat Sustainability Program (PBHSP). The PBHSP is an adaptive management program to ensure that the riparian habitat in the Prado Basin will not incur unforeseeable significant adverse effects due to implementation of the Peace II Agreement. Annual reports are prepared to document monitoring and modeling activities, the analysis and interpretation of the monitoring and modeling results, and any recommendations for changes to the PBHSP, including implementation of mitigation measures if deemed necessary.

DISCUSSION

The Annual Report of the PBHSP (Annual Report) for Water Year (WY) 2025 is the tenth annual report prepared by the Watermaster and IEUA for the PBHSP. It documents the collection, analysis, and interpretations of the data and information generated by the PBHSP through October 31, 2025, and is organized into the following sections:

Section 1 – Background and Objectives This section describes the background and objectives of the PBHSP and the Annual Report.

Section 2 – Monitoring, Data Collection, and Methods This section describes the collection of recent monitoring data and the groundwater-modeling activities performed during WY 2025 for the PBHSP.

Section 3 – Results and Interpretations This section describes the results and interpretations that were derived from the information, data, and groundwater-modeling.

Section 4 – Conclusions and Recommendations This section summarizes the main conclusions derived from the PBHSB through WY 2025 and describes the recommended activities for the subsequent fiscal year as a proposed scope-of-work, schedule, and budget.

Section 5 – References This section lists the publications cited in the report.

The draft Annual Report for WY 2025 was published and distributed on April 30, 2026. Watermaster and IEUA presented the draft report to members of the PBHSC at a meeting on May 6, 2026. A four-week comment period was provided in which no comments were received.

The main interpretations and findings of the Annual Report for WY 2025 are:

- Based on the NDVI time series analysis, NDVI spatial change maps, and aerial photos, the quality (greenness) of the riparian habitat vegetation remained stable or increased across most of the Prado Basin from 2024 to 2025, with the exception of two areas where NDVI decreased. These decreases were minor and within the range of historical one-year variability. These changes occurred during a time of stable groundwater levels and during a slightly warmer, drier year following two consecutive wet years.
- There were three notable areas of decreases and increases in greenness observed in the Prado Basin between 2024 and 2025: (i) increases and decreases along the lower reach of Chino Creek; (ii) increases along the SAR; and (iii) decreases below the OCWD wetlands. Increases were likely caused by growth of perennial vegetation in a dryer year following two consecutive wet years during which scouring occurred along the channels and areas behind the dam were inundated with water from the conservation pool. The potential causes of the observed decreases varied by area and included a 2025 wildfire, ongoing management of the invasive plant species Arundo (*Arundo donax)*, and/or reduced perennial vegetation growth associated with a dry year. None of the reductions in greenness were related to declining groundwater levels resulting from the implementation of the Peace II Agreement.
- From 2024-2025, groundwater levels at the PBHSP monitoring wells in the Prado Basin along Chino Creek, Mill Creek, and the SAR remained stable and less than one foot of change was noted at most wells.
- From 2016-2025, groundwater levels throughout most of the riparian vegetation extent in reaches of Chino Creek, Mill Creek and the SAR changed less than 5 feet; however, there were some notable areas of change:
    - The northern portion of Mill Creek just south of monitoring well PB-2 saw groundwater levels decline by about eight feet from 2016-2022, likely due to increased pumping at the Chino Desalter wells to the north. From 2023 to 2025, groundwater levels increased and have since leveled out in this area, for a net change in groundwater levels of minus four feet since 2016. Analysis of NDVI, air photos, and the 2025 vegetation surveys suggest that there have been no notable declines in the greenness of the riparian vegetation in the northern area of Mill Creek where groundwater levels have declined.
    - In the northern reach of Chino Creek, groundwater levels increased by about ten feet from 2016 to 2025, likely due to decreased groundwater pumping in the area.
- The depth to groundwater in the northernmost reach of Mill Creek where groundwater levels have declined the most (near PB-2) was estimated at 10-15 feet below ground surface in WY 2025. Future declines in groundwater levels in this reach could result in adverse impacts to the riparian habitat.
- Vegetation surveys conducted in WY 2025 supported the findings of the NDVI and air photo analysis, concluding that the monitoring sites appeared healthy and that the riparian system is functioning properly. Any changes noted since the previous vegetation surveys in 2022 were observed to have been driven by climatic variability and were within the normal range of variability, and it is unlikely that any observable declines in the riparian system are related to groundwater pumping.

PBHSP monitoring and reporting should continue to monitor the extent and quality of the riparian habitat and the factors that can influence it as it has been conducted through WY 2025, including the additional monitoring in the northernmost reach of Mill Creek set up in 2022. The high-frequency monitoring for groundwater elevation, temperature and EC at each pair of PBHSP monitoring wells and nearby surface water field measurements, initiated in 2023 should also be continued to better characterize groundwater/surface water interactions. While the overall threat to riparian vegetation health has decreased following an increase in groundwater levels from 2023 to 2025 and reduced production at the CDA wells, it remains important to monitor any potential impacts to the extent and quality of the riparian habitat that could be caused by past or future lowering of groundwater levels in this area. The triennial vegetation surveys conducted in 2025 by a biological consultant were tailored to focus on the northern portion of Mill Creek and reduced to key locations along Chino Creek and the SAR for continued representative monitoring. Based on the results of the surveys, the biological consultant recommended to continue conducting the surveys on a triennial basis. Based on this recommendation, the next vegetation surveys would be conducted in 2028.

- Because the Annual Report for WY 2025 documented no trend in the degradation of the extent or quality of riparian habitat along Chino Creek, Mill Creek, or the SAR that is contemporaneous with

decreasing groundwater levels from implementation of the Peace II Agreement, the report stated that no mitigation measures or adjustments to the AMP are recommended at this time.

At the June 11th Pool Committee meetings, all Pool Committees considered the item and unanimously recommended the Advisory Committee to recommend the Board to adopt.

ATTACHMENTS
1. Annual Report of the Prado Basin Habitat Sustainability Program Water Year 2025 (Draft)

Annual Report of the Prado Basin Habitat Sustainability Program Water Year 2025

PREPARED FOR

Chino Basin Watermaster and
Inland Empire Utilities Agency

DRAFT

PREPARED BY

WEST YOST
Water. Engineered.

Annual Report of the Prado Basin Habitat Sustainability Program
Water Year 2025

Prepared for

Chino Basin Watermaster and Inland Empire Utilities Agency

Project No. 941-80-25-15

DRAFT

Project Manager: Lucy Hedley	Date
Project Manager: Veva Weamer	Date
QA/QC Review: Andy Malone	Date

Table of Contents

1.0 Background and Objectives....1

1.1 Prado Basin....1

1.2 Chino Basin Judgment, OBMP, and Peace Agreement....4

1.3 The Peace II Agreement and its Subsequent EIR....5

1.4 AMP for the PBHSP....7

1.5 Annual Report Organization....8

2.0 Monitoring, Data Collection, and Methods....9

2.1 Riparian Habitat Monitoring....9

2.1.1 Regional Monitoring of Riparian Habitat....11

2.1.1.1 Multi-Spectral Remote Sensing Data....11

2.1.1.2 Collection and Analysis of Air Photos....12

2.1.2 Site-Specific Monitoring of Riparian Habitat....12

2.2 Factors that Potentially Affect the Riparian Habitat....13

2.2.1 Groundwater Monitoring Program....13

2.2.1.1 Groundwater Production....13

2.2.1.2 Groundwater Level....14

2.2.1.3 Groundwater Quality....16

2.2.2 Surface-Water Monitoring Program....16

2.2.3 Climatic Monitoring Program....17

2.2.4 Other Factors That Can Affect Riparian Habitat....17

2.2.4.1 Wildfires....18

2.2.4.2 Polyphagous Shot-Hole Borer (PSHB)....18

2.2.4.3 Arundo Removal....19

2.3 Prospective Loss of Riparian Habitat....21

3.0 Results and Interpretations....22

3.1 Trends in Riparian Habitat Extent and Quality....22

3.1.1 Extent of the Riparian Habitat....22

3.1.2 Quality of the Riparian Habitat....24

3.1.2.1 Spatial Analysis of NDVI....24

3.1.2.2 Temporal Analysis of NDVI....29

3.1.2.3 Temporal Analysis of NDVI in Prado Basin....31

3.1.2.4 Temporal Analysis of NDVI within Large Areas along Chino Creek and Mill Creek....32

3.1.2.5 Temporal Analysis of NDVI within Small Areas along Chino Creek, Mill Creek, and the Santa Ana River....38

3.1.3 Analysis of Vegetation Surveys....53

3.1.3.1 Overstory Canopy Cover....53

3.1.3.2 Overstory Tree Condition....54

3.1.3.3 Understory Monitoring....54

3.1.3.4 Presence of the Polyphagous Shot Hole Borer (PSHB)....54

3.1.3.5 Presence of Non-native and Nuisance Plant Species....55

DRAFT

3.1.4 Summary 57
3.2 Groundwater and Its Relationship to Riparian Habitat 58
3.2.1 Groundwater Pumping 58
3.2.2 Groundwater Levels 62
3.2.3 Groundwater Levels Compared to NDVI 67
3.2.4 Summary 73
3.3 Analysis of Groundwater/Surface-Water Interactions 73
3.3.1 Past Monitoring of Groundwater/Surface-Water Interactions: 74
3.3.2 Current Monitoring for Groundwater/Surface-Water Interactions 75
3.4 Climate and Its Relationship to the Riparian Habitat 86
3.4.1 Precipitation 86
3.4.2 Temperature 86
3.4.3 Climate Compared to NDVI 90
3.5 Stream Discharge and Its Relationship to the Riparian Habitat 94
3.5.1 Stream Discharge 94
3.5.2 Stream Discharge Compared to NDVI 96
3.6 Other Factors and Their Relationships to Riparian Habitat 102
3.6.1 Wildfire 102
3.6.2 Polyphagous Shot Hole Borer 103
3.6.3 Arundo Removal and Maintenance 104
3.6.4 Non-native and Nuisance Plant Species 105
3.6.5 Miscellaneous Factors 106
3.7 Analysis of Prospective Loss of Riparian Habitat 115
4.0 Conclusions and Recommendations 119
4.1 Main Conclusions and Recommendations 119
4.1.1 Conclusions 119
4.1.2 Recommendations 120
4.2 Recommended Mitigation Measures and/or Adjustments to the AMP 120
4.3 Recommended PBHSP for Fiscal Year 2026/27 120
5.0 References 126

LIST OF TABLES

Table 3-1. Mann-Kendall Test Results of the Average Growing-Season NDVI Trends for Defined Areas in the Prado Basin 30
Table 3-2. Characterization of Variability in the Average-Growing Season NDVI for Defined Areas in the Prado Basin 31
Table 3-3. Summary of Vegetation Surveys in 2007, 2013, 2016, 2019, 2022, and 2025 in the Prado Basin - Canopy Cover, Tree Condition, and Occurrence of Polyphagous Shot-Hole Borer 56

DRAFT

Table 3-4. Annual Groundwater Pumping in the Groundwater Monitoring Program Study Area 59

Table 3-5 Analysis of Groundwater/Surface-Water Interactions in the Prado Basin.....85

Table 4-1. Work Breakdown Structure and Cost Estimate - Prado Basin Habitat Sustainability Program: FY 2026/27 125

LIST OF FIGURES

Figure 1-1. Prado Basin Area 2

Figure 1-2. Critical Habitat for Endangered or Threatened Species in the Prado Basin Area 3

Figure 1-3. Projected Change in Groundwater Levels – FY 2005 to 2030 – Peace II Alternative 6

Figure 2-1. Riparian Habitat Monitoring Program.....10

Figure 2-2. Groundwater Monitoring Program 15

Figure 2-3. Surface-Water and Climate Monitoring Programs 20

Figure 3-1a. Air Photos and Extent of the Riparian Vegetation – 2024 and 2025 23

Figure 3-1b. Air Photo and Spatial NDVI for the Prado Basin – 2025.....26

Figure 3-2. Spatial NDVI for the Prado Basin – 2024 and 2025 27

Figure 3-3. Spatial Change in NDVI for the Prado Basin – 2024 to 2025.....28

Figure 3-4. Areas for Analysis of NDVI Time Series 33

Figure 3-5. Time Series of NDVI for the Riparian Vegetation Extent – 1984 to 2025 34

Figure 3-6. Time Series of NDVI and Air Photos along Chino Creek Area for 1984 to 2025 35

Figure 3-7a. Time Series of NDVI and Air Photos along Mill Creek Area for 1984 to 2025..36

Figure 3-7b. Time Series of NDVI and Air Photos along Upper Mill Creek Area for 1984 to 2025 37

Figure 3-8a. Time Series of NDVI and Air Photos – *CC-1 Area for 1984 to 2025*.....40

Figure 3-8b. Time Series of NDVI and Air Photos – *CC-2 Area for 1984 to 2025*.....41

Figure 3-8c. Time Series of NDVI and Air Photos – *CC-3 Area for 1984 to 2025* 42

Figure 3-8d. Time Series of NDVI and Air Photos – *CC-4 Area for 1984 to 2025*.....43

Figure 3-8e. Time Series of NDVI and Air Photos – *MC-1 Area for 1984 to 2025* 44

Figure 3-8f. Time Series of NDVI and Air Photos – *MC-2 Area for 1984 to 2025* 45

Figure 3-8g. Time Series of NDVI and Air Photos – *MC-3 Area for 1984 to 2025* 46

Figure 3-8h. Time Series of NDVI and Air Photos – *MC-4 Area for 1984 to 2025* 47

Figure 3-8i. Time Series of NDVI and Air Photos – *MC-5 Area for 1984 to 2025* 48

Figure 3-8j. Time Series of NDVI and Air Photos – *MC-6 Area for 1984 to 2025* 49

Figure 3-8k. Time Series of NDVI and Air Photos – *SAR-2 Area for 1984 to 2025*.....50

DRAFT

Table of Contents

Figure 3-8l. Time Series of NDVI and Air Photos – *SAR-3 Area for 1984 to 2025*.....51

Figure 3-8m. Time Series of NDVI and Air Photos – *SAR-4 Area for 1984 to 2025* 52

Figure 3-9. Groundwater Pumping – Water Year 2025.....61

Figure 3-10a. Map of Groundwater Elevation – September *2016 – Shallow Aquifer System* 63

Figure 3-10b. Map of Groundwater Elevation – September *2025 – Shallow Aquifer System* 64

Figure 3-11. Change in Groundwater Elevation – *September 2016 to September 2025* 65

Figure 3-12. Depth to Groundwater – *September 2025*.....66

Figure 3-13a. Groundwater Levels and Production versus NDVI – Chino Creek Area for 1984-2025.....70

Figure 3-13b. Groundwater Levels and Production versus NDVI – Mill Creek Area for 1984-2025.....71

Figure 3-13c. Groundwater Levels and Production versus NDVI – Santa Ana River Area for 1984-2025.....72

Figure 3-14a. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-9 Near Chino Creek 76

Figure 3-14b. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-8 and RP2-MW3 Near Chino Creek 77

Figure 3-14c. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-7 Near Chino Creek 78

Figure 3-14d. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-6 Near Chino Creek 79

Figure 3-14e. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-2 and HCMP-5/1 Near Mill Creek.....80

Figure 3-14f. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-1 Near Mill Creek.....81

Figure 3-14g. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-5 Near Mill Creek.....82

Figure 3-14h. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-4 Near Santa Ana River.....83

Figure 3-14i. Monitoring to Characterize Groundwater and Surface Water Interactions – PB-3 Near Santa Ana River.....84

Figure 3-15. Annual Precipitation in the Chino Basin – Water Year 1986-2025 88

Figure 3-16. Maximum and Minimum Temperature in the Prado Basin – 1895-2025 89

Figure 3-17a. Climate versus NDVI – Chino Creek Area for 1984 to 2025 91

Figure 3-17b. Climate versus NDVI – Mill Creek Area for 1984 to 2025 92

Figure 3-17c. Climate versus NDVI – Santa Ana River for 1984 to 2025 93

DRAFT

Figure 3-18. Discharge Tributary to Prado Dam Water Year 1960 – 2025 95

Figure 3-19a. Surface-Water Discharge versus NDVI – *Chino Creek Area for 1984 to 2025* 99

Figure 3-19b. Surface-Water Discharge versus NDVI – *Mill Creek Area for 1984 to 2025*.100

Figure 3-19c. Surface-Water Discharge versus NDVI – *Santa Ana River Area for 1984 to 2025* 101

Figure 3-20a. Location Map of Other Factors That Can Affect Riparian Habitat - Wildfire108

Figure 3-20b. Spatial NDVI Change 2021-2024 and 2024 Air Photo with Prado Basin Wildfires in 2015, 2018, and 2020.....109

Figure 3-21a. Other Factors That Can Affect Riparian Habitat versus NDVI – Chino Creek Area for 1984-2024.....110

Figure 3-21b. Other Factors That Can Affect Riparian Habitat versus NDVI – Mill Creek Area for 1984-2024 111

Figure 3-21c. Other Factors That Can Affect Riparian Habitat versus NDVI– Santa Ana River and Lower Prado Area for 1984-2024 112

Figure 3-22a. Location Map of Other Factors That Can Affect Riparian Habitat versus NDVI – Arundo and PHSB.....113

Figure 3-22b. Spatial NDVI Change 2023-2024 and 2024 Air Photo with Prado Basin Arundo Removal and Management in 2019-2024 114

Figure 3-23 Predicted Change in Groundwater Levels – 2018 to 2030 – Scenario 2020 SRY1 117

Figure 3-24. Predicted Groundwater Pumping and Groundwater Levels – 2018 to 2030 – Scenario 2020 SRY1 118

LIST OF APPENDICES

Appendix A. NDVI

Appendix B. Mann-Kendall Analysis of NDVI

Appendix C. Draft 2025 Prado Basin Vegetation Survey Report

DRAFT

Table of Contents

LIST OF ACRONYMS AND ABBREVIATIONS

ACOE	Army Corps of Engineers	1
af	Acre-Feet	5
afy	Acre-Feet Per Year	5
AMP	Adaptive Management Plan	1
Annual Report	Annual Report of The Prado Basin Habitat Sustainability Committee	1
CAL FIRE	California Department of Forestry and Fire Protection	21
CBMWD	Chino Basin Municipal Water District	2
CBWM	Chino Basin Watermaster	1
CCWF	Chino Creek Well Field	5
CDA	Chino Basin Desalter Authority	2
CDFM	cumulative departure from the mean	72
CDFW	California Department of Fish and Wildlife	91
CEQA	California Environmental Quality Act	2
Chino Basin	Chino Groundwater Basin	1
DBH	Diameter at Breast Height	110
EC	Electrical Conductivity	16
EIR	Environmental Impact Report	1
EROS	Earth Resources Observation and Science	11
ESPA	Center Science Processing Architecture	11
FD	Fusarium Dieback	21
ft-amsl	Feet Above Mean Sea Level	1
ft-bgs	Feet Below Ground Surface	59
FRAP	Fire And Resource Assessment Program	21
GIS	Geographic Information System	110
GMP	Groundwater Monitoring Program	12
GMZ	Groundwater Management Zone	1
HCMP	Hydraulic Control Monitoring Program	64
IEUA	Inland Empire Utilities Agency	1
in/yr	Inches Per Year	87
LEDAPS	Landsat Ecosystem Disturbance Adaptive Processing System	129
mi^2	Square Miles	23
MWD	Metropolitan Water District of Southern California	
NDVI	Normalized Difference Vegetation Index	11
NASA	National Aeronautics and Space Administration	
NEXRAD	Next Generation Radar	18
OBMP	Optimum Basin Management Program	1
OC-59	The OCWD's Imported Water Turnout Tributary to Prado Basin	1
OCWD	Orange County Water District	1
Parties	Parties to The Chino Basin Judgment	4
PBHSC	Prado Basin Habitat Sustainability Committee	1
PBHSP	Prado Basin Habitat Sustainability Program	1

DRAFT

PBMZ	Prado Basin Management Zone	1
POTWs	Publicly Owned Treatment Works	18
ppm	Parts Per Million	73
Prado Basin	Prado Basin Management Zone	1
PSHB	Polyphagous Shot Hole Borer - *Euwallacea Fornicates*	21
QA/QC	Quality Assurance and Quality Control	13
RHMP	Riparian Habitat Monitoring Program	8
SAWA	Santa Ana Watershed Association	22
SAR	Santa Ana River	1
SARWM	Santa Ana River Watermaster	
SEIR	Subsequent Environmental Impact Report	1
SWMP	Surface-Water Monitoring Program	18
TDS	total dissolved solids	2
USBR	United States Bureau of Reclamation	12
USGS	United States Geological Survey	11
USDA	United State Department of Agriculture	21
USFWS	United States Fish and Wildlife Service	1
VOCs	Volatile Organic Compounds	4
Watermaster	Chino Basin Watermaster	4
WEI	Wildermuth Environmental Inc.	
WRCRWA	Western Riverside County Regional Wastewater Authority	84
WY	Water Year	8

DRAFT

1.0 BACKGROUND AND OBJECTIVES

This *Annual Report of the Prado Basin Habitat Sustainability Program for Water Year 2025* (Annual Report) was prepared on behalf of the Prado Basin Habitat Sustainability Committee (PBHSC), convened by the Inland Empire Utilities Agency (IEUA) and the Chino Basin Watermaster (Watermaster) pursuant to the mitigation monitoring and reporting requirements of the Peace II Subsequent Environmental Impact Report (SEIR) (Tom Dodson, 2010).

This introductory section provides background on the general hydrologic setting of the Prado Basin Management Zone (Prado Basin); the Chino Basin Judgment; the Optimum Basin Management Program (OBMP), its Programmatic Environmental Impact Report (EIR) and the Peace Agreement; the Peace II Agreement and its SEIR; and the formation of the PBHSC and the development of the adaptive management plan (AMP) for the Prado Basin Habitat Sustainability Program (PBHSP).

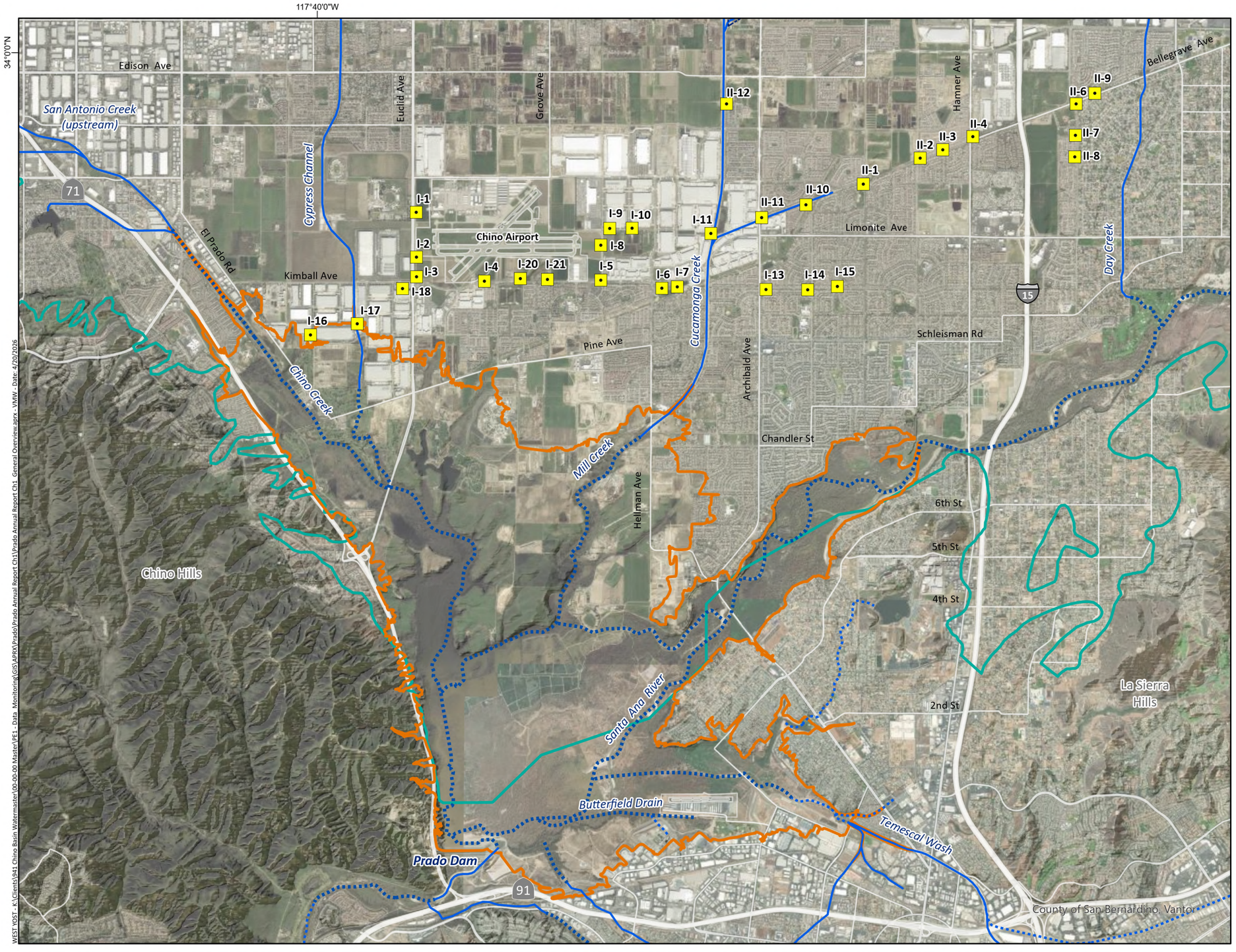
1.1 Prado Basin

The Prado Basin is the flood control area behind Prado Dam, which was constructed in 1941 as the major flood-control facility within the Santa Ana River (SAR) Watershed. The U.S. Army Corps of Engineers (ACOE) regulates releases of water from Prado Dam for both purposes of flood control and groundwater recharge in Orange County Groundwater Management Zone (GMZ). Releases of water temporarily held in storage in the Prado Basin for groundwater recharge in Orange County is coordinated with the Orange County Water District (OCWD). Figure 1-1 shows the location of the Prado Basin in the southern portion of the Chino Groundwater Basin (Chino Basin). The Prado Basin boundary shown on Figure 1-1 is the Prado Basin Management Zone (PBMZ) boundary as defined in the Water Quality Control Plan for the SAR Basin ([Basin Plan] Santa Ana Regional Water Quality Control Board [Santa Ana Water Board], 2016), which approximately follows the 566 feet above mean sea level (ft-amsl) elevation contour behind Prado Dam.

Approximately 4,300 acres of riparian habitat have developed within the Prado Basin, creating the largest riparian habitat in Southern California. Portions of the riparian habitat have been designated as critical habitat to several endangered or threatened species. Figure 1-2 shows the locations of the critical habitat, as defined by the U.S. Fish and Wildlife Service (USFWS). Most of the riparian habitat in Prado Basin is designated as critical habitat for one or multiple species, including the Santa Ana Sucker, the Southwestern Willow Flycatcher, and the Least Bell's Vireo.

The SAR flows through the Prado Basin from east to west. The tributaries of the SAR that flow into the Prado Basin include San Antonio/Chino Creeks, Cucamonga/Mill Creeks, and Temescal Creek. The major components of flow within the SAR and its tributaries are runoff from precipitation, discharge of tertiary-treated effluent from wastewater treatment plants, rising groundwater, and dry-weather runoff.[1]

[1] Dry-weather runoff consists of excess irrigation runoff, purging of wells, dewatering discharges, etc.



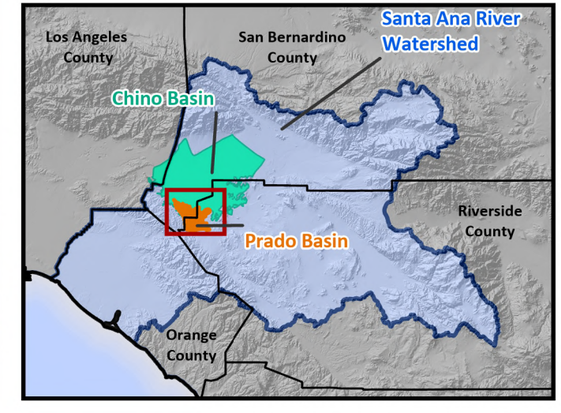
Prado Basin - The Prado Basin Management Zone (PBMZ) defined in the Santa Ana Region Basin Plan (Santa Ana Water Board, 2016), which approximately follows the 566 feet above mean sea level elevation contour in the flood control area behind Prado Dam.

Hydrologic Boundary of the Chino Groundwater Basin (Chino Basin)

Concrete-Lined Channels

Unlined Rivers and Streams

Chino Basin Desalter Well



Prepared by: WEST YOST

0 1 2 Miles

0 1 2 Km

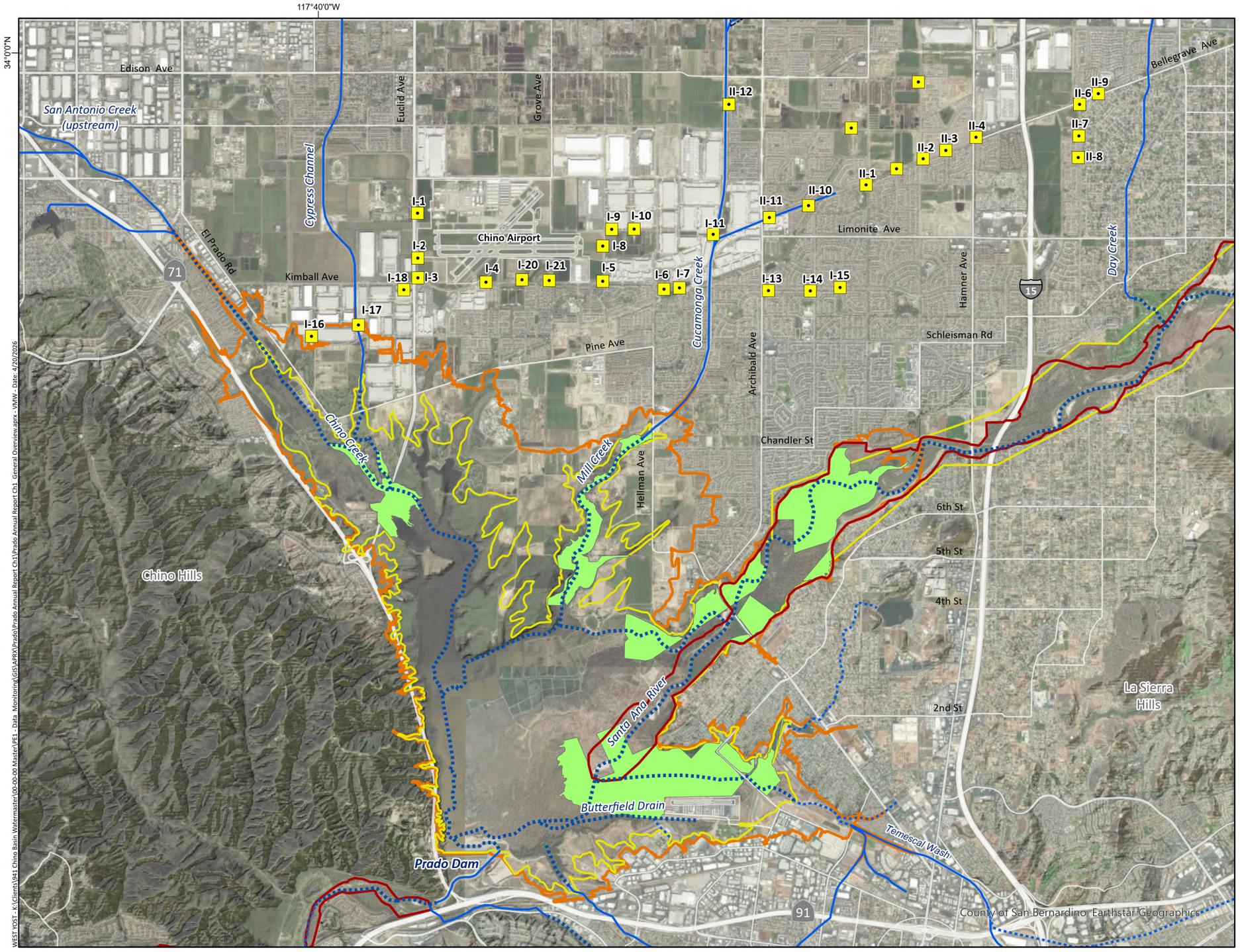
N

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Prado Basin Area

Figure 1-1

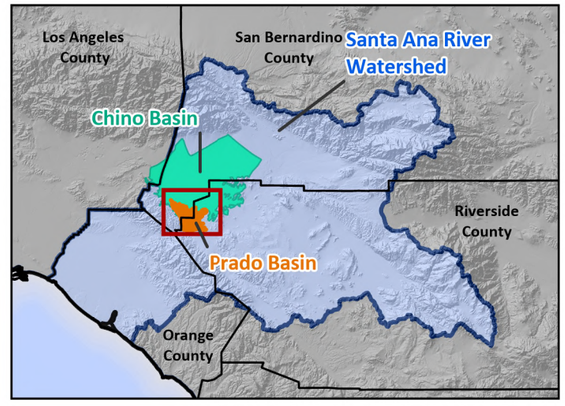
WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1 General Overview.aprx - VMW - Date: 4/20/2026



Critical Habitat

- Santa Ana Sucker
- Southwestern Willow Flycatcher
- Least Bell's Vireo

- Prado Basin
- Concrete-Lined Channels
- Unlined Rivers and Streams
- Chino Basin Desalter Well



WEST YOST - K:\Clients\1941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1 General Overview.aprx - VMW - Date: 4/20/2026

Prepared by: WEST YOST

0 1 2 Miles
0 1 2 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Critical Habitat for Endangered or Threatened Species in the Prado Basin Area

Figure 1-2

The Prado Basin is a hydrologically complex region of the lower Chino Basin. Groundwater in the Chino Basin generally flows from the forebay regions in the north towards the Prado Basin in the south. Depth to groundwater is relatively shallow in the Prado Basin area, and the SAR and its tributaries are unlined across the Prado Basin, which allows for groundwater/surface-water interaction. Groundwater outflows in the Prado Basin occur via evapotranspiration by riparian vegetation, groundwater pumping, and rising-groundwater discharge to the SAR and its tributaries.

To the north of the Prado Basin, the Chino Basin Desalter Authority (CDA) owns and operates the Chino Basin Desalters that consist of 28 wells that pump groundwater with high concentrations of total dissolved solids (TDS) and nitrate and treats at two regional facilities using reverse osmosis, ion exchange, and blending to produce a potable water supply for the region. Figure 1-1 shows the locations of Chino Basin Desalter wells. CDA operations are fundamental to achieving many of the management goals outlined in the OBMP and both Peace Agreements, which are discussed below. The Chino Basin Desalters facilities were expanded in 2021 and 2023 with additional treatment processes of air stripping and granulated activated carbon to treat for volatile organic compounds (VOCs) associated with the South Archibald plume and Chino Airport plume, respectively.

1.2 Chino Basin Judgment, OBMP, and Peace Agreement

A 1978 Judgment entered in the Superior Court of the State of California for the County of San Bernardino (Chino Basin Municipal Water District vs. City of Chino et al.) established pumping and storage rights in the Chino Basin. The Judgment established Watermaster to oversee the implementation of the Judgment and provided Watermaster with the discretionary authority to develop an OBMP to maximize the beneficial use of the Chino Basin. The OBMP was developed by Watermaster and the parties to the Judgment (Parties) in the late 1990s (Wildermuth Environmental Inc. [WEI], 1999). The OBMP maps a strategy to enhance the yield of the Chino Basin and provide reliable high-quality water supplies for the development expected to occur in the region. The goals of the OBMP are to enhance Basin water supplies, to protect and enhance water quality, to enhance the management of the Basin, and to equitably finance the OBMP.

In 2000, the Parties executed the Peace Agreement (Watermaster, 2000), which documented their intent to implement the OBMP. The Peace Agreement included an OBMP Implementation Plan which outlined the time frame for implementing tasks and projects in accordance with the Peace Agreement and the OBMP. The OBMP Implementation Plan is a comprehensive, long-range water-management plan for the Chino Basin and includes: the use of recycled water for direct reuse and artificial recharge, the capture of increased quantities of high-quality storm-water runoff, the recharge of imported water when TDS concentrations are low, the desalting of poor-quality groundwater in impaired areas of the Basin via the Chino Basin Desalters, the support of regulatory efforts to improve water quality in the Basin, subsidence management, storage management, and the implementation of management activities to reduce the discharge of high-TDS/high-nitrate groundwater to the SAR, thus ensuring the protection of downstream beneficial uses in the Orange County GMZ.

The Chino Basin Municipal Water District (CBMWD) was the plaintiff in the legal action that resulted in the Judgment. CBMWD was formed in 1950 to supply supplemental, imported water purchased from the Metropolitan Water District of Southern California (MWD) to the Chino Basin. On July 1, 1998, CBMWD changed its name to the IEUA and expanded its role to become the regional supplier of recycled water for most of the Chino Basin. For OBMP implementation, the IEUA has served as the lead agency for compliance with the California Environmental Quality Act (CEQA). A Programmatic EIR for the OBMP (SCH#2000041047) was certified by the IEUA in July 2000 (Tom Dodson, 2000).

1.3 The Peace II Agreement and its Subsequent EIR

To further implement the goals and objectives of the OBMP, the Parties executed the Peace II Agreement in 2007, which modified the OBMP Implementation Plan (Watermaster, 2007). The two main activities of the Peace II Agreement are: (i) increasing the controlled overdraft of the Chino Basin, as defined in the Judgment,[2] by 400,000 acre-feet (af) through 2030 (re-operation), and (ii) refining the planned expansion of the Chino Basin Desalters facilities to increase groundwater pumping from about 30,000 to 40,000 acre-feet per year (afy). Re-operation is allocated specifically to offset the production of the Chino Basin Desalters. Both re-operation and desalter expansion contribute to the attainment of "hydraulic control" of groundwater outflow from the Chino Basin to the SAR. The attainment and maintenance of hydraulic control is a requirement of Watermaster and the IEUA, as defined in the Basin Plan (Santa Ana Water Board, 2016). Hydraulic control ensures that the water management activities in the Chino Basin will not impair the beneficial uses designated for SAR water quality downstream of Prado Dam.

The expansion of the Chino Basin Desalters, described in the Peace II Agreement, was accomplished, in part, by the construction and operation of the Chino Creek Well Field (CCWF) in the southwest portion of Chino Basin (see Figure 1-3). During Peace II Agreement planning, the estimated capacity of the CCWF was about 5,000 to 7,700 afy (WEI, 2007). The CCWF wells were constructed in 2011-2012, and their actual capacity is about 1,500 afy.

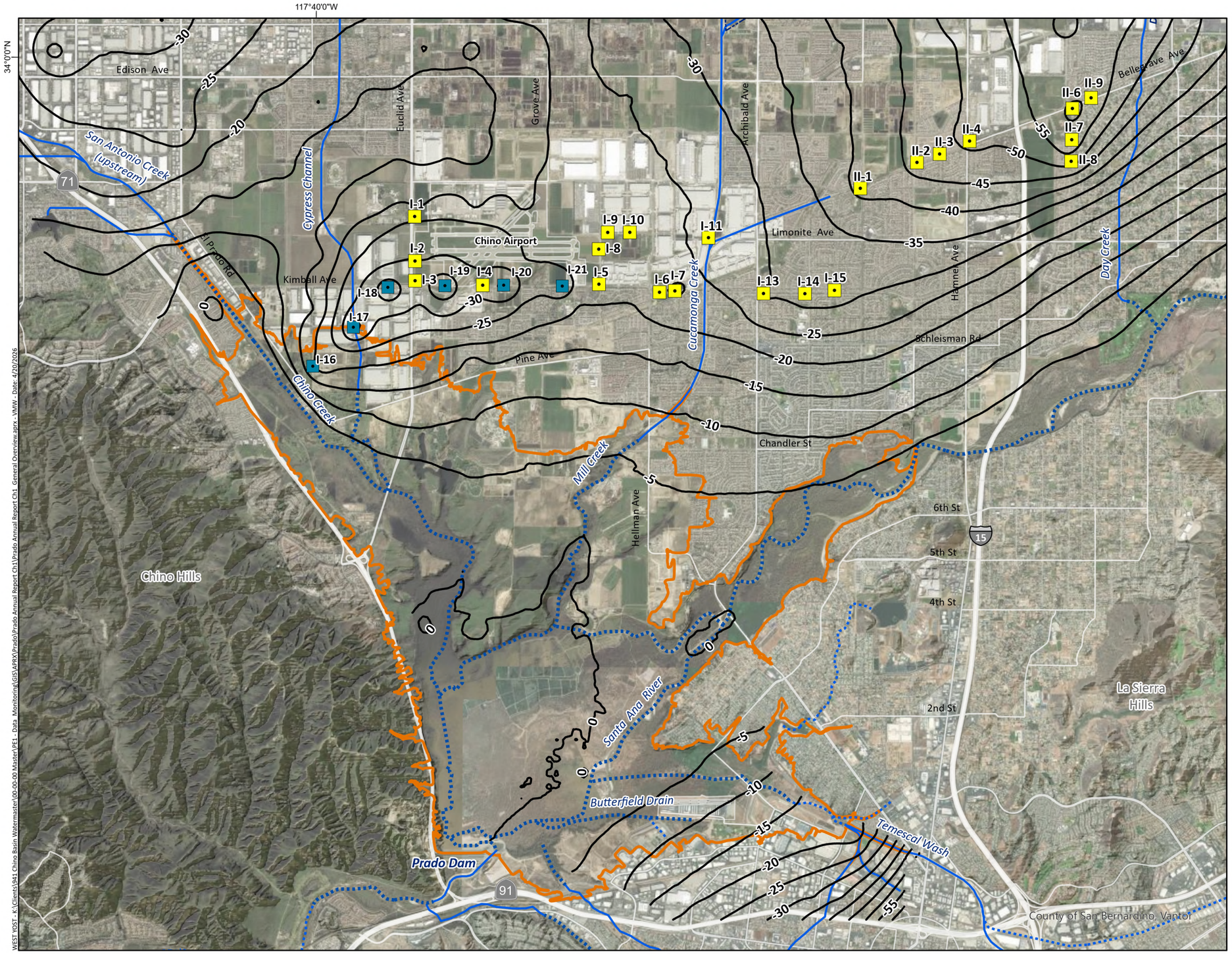
In 2010, the IEUA certified the Peace II SEIR (Tom Dodson, 2010) to evaluate the environmental impacts that could result from implementing the Peace II Agreement. One of the potential impacts evaluated was the possible lowering of groundwater levels (drawdown) in the Prado Basin area, which could impact riparian vegetation that is dependent upon shallow groundwater. In order to assess this potential impact, Watermaster used its 2007 groundwater model to predict the extent and magnitude of the drawdown associated with the implementation of the Peace II Agreement, using the planned capacity of 7,700 afy[3] of the CCWF (WEI, 2007). Figure 1-3 (modified from Figure 4.4-10 from the Peace II SEIR) shows the 2007 model-predicted drawdown in the Prado Basin area for the period of 2005 to 2030. The 2007 model predictions showed drawdown of less than five feet by 2030 throughout the riparian habitat areas and less than 10 feet along the northern portion of Prado Basin near the northern reaches of Chino Creek, Mill Creek, and the SAR.[4]

Although this modeling work indicated that implementing the Peace II Agreement would not cause significant adverse effects on Prado Basin riparian habitat, a contingency measure to address the potential for drawdown of groundwater levels and its impact on riparian vegetation was included in the Peace II SEIR as Mitigation Measure 4.4-3 (Biological Resources/Land Use & Planning section of the Mitigation Monitoring and Reporting Program).

[2] The Judgment established 200,000 af of controlled overdraft over the period of 1978 to 2017. Re-operation increases the controlled overdraft to 600,000 af through 2030.

[3] The CCWF wells were constructed in 2011-2012 and their actual capacity is about 1,500 afy, not the 7,700 afy used as the planning assumption for this modeling work in 2007 for the Peace II SEIR. The PBHSP includes the use of Watermaster's most recent groundwater model update and planning data (including actual capacity of the CCWF) to evaluate potential impacts to groundwater levels from the implementation of the Peace II Agreement and identify areas of prospective loss of riparian habitat. This updated modeling work is described in Section 3.7.

[4] The primary area that would be influenced by the Peace II Agreement implementation is the upper portion of Prado Basin. The Temescal Wash area is outside of the Chino Basin hydrologic boundary and is not an area of influence of potential impacts of groundwater levels from pumping at the Chino Desalter well field and implementation of the Peace II Agreement.



-10 Projected Change in Groundwater Levels
FY 2005 to FY 2030, feet

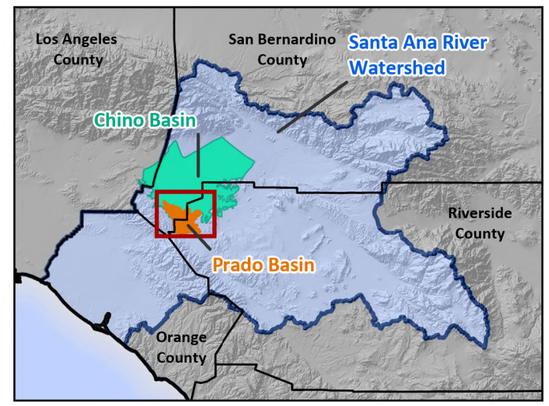
Chino Basin Desalter Well -
Location of Existing wells in 2007 modeled for the Peace II SEIR

Chino Desalter Well –
Planned Location of the Chino Creek Well Field (CCWF) in 2007 as modeled for the Peace II SEIR with a Planned Capacity of 7,700 afy. Actual Location of the CCWF Constructed in 2011-2012 Shown in Figure 1-1 with an Actual Capacity 1,500 afy

Prado Basin

Concrete-Lined Channels

Unlined Rivers and Streams



Projected Change in Groundwater Levels
FY 2005 to 2030 - Peace II Alternative

Figure 1-3

Prepared by:
WEST YOST

0 1 2 Miles
0 1 2 Km

Prepared for:
Prado Basin Habitat Sustainability Committee
2025 Annual Report

WEST YOST - K:\Clients\1941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1 General Overview.aprx - VMW - Date: 4/20/2026

Mitigation Measure 4.4-3 was developed to ensure that the riparian habitat would not incur unforeseeable significant adverse effects from the Peace II implementation and to contribute to the long-term sustainability of the riparian habitat. Mitigation Measure 4.4-3 calls for:

- Watermaster, the IEUA, the OCWD, and other stakeholders that choose to participate to jointly fund the development of an adaptive management program to monitor the extent and quality of the Prado Basin riparian habitat and investigate and identify essential factors to its long-term sustainability.
- Watermaster and the IEUA to convene the PBHSC, comprised of representatives from all interested parties to implement the adaptive management program.
- The PBHSC to prepare annual reports pursuant to the adaptive management program. Annual reports are to include recommendations for ongoing monitoring and any adaptive management actions required to mitigate any measured or prospective loss of riparian habitat resulting from Peace II activities.

1.4 AMP for the PBHSP

Pursuant to Mitigation Measure 4.4-3 in the SEIR, Watermaster and the IEUA convened four meetings of the PBHSC, starting in late-2012, to develop the AMP for the PBHSP and facilitate its implementation. Watermaster and the IEUA adopted the final 2016 Adaptive Management Plan for the Prado Basin Habitat Sustainability Program (AMP) in August 2016 (WEI, 2016). The AMP was designed to answer the following questions to satisfy the monitoring and mitigation requirements of the Peace II SEIR:

1. What are the factors that can potentially affect the extent and quality of the riparian habitat?
2. What is a consistent, quantifiable definition of "riparian habitat quality", including metrics and measurement criteria?
3. What has been the historical extent and quality of the riparian habitat in the Prado Basin?
4. How has the extent and quality of the riparian habitat changed during implementation of Peace II?
5. How have groundwater levels and quality, surface-water discharge, weather, and climate changed over time? What were the causes of the changes? And, did those changes result in an adverse impact to riparian habitat in the Prado Basin?
6. Are there other factors besides groundwater levels, surface-water discharge, weather, and climate that affect riparian habitat in the Prado Basin? What are those factors? And, did they (or do they) result in an adverse impact to riparian habitat in the Prado Basin?
7. Are the factors that result in an adverse impact to riparian habitat in the Prado Basin related to Peace II implementation?
8. Are there areas of prospective loss of riparian habitat that may be attributable to the Peace II Agreement?
9. What are the potential mitigation actions that can be implemented if Peace II implementation results in an adverse impact to the riparian habitat?

DRAFT

The AMP outlines a process for monitoring, modeling, and annual reporting to answer and address the questions listed above. Appendix A to the AMP is the initial monitoring program: *2016 Monitoring Program for the Prado Basin Habitat Sustainability Program*. Annual reports are intended to document monitoring and modeling activities, the analysis and interpretation of the monitoring and modeling results, and recommendations for changes to the PBHSP, which may include monitoring, modeling, and/or mitigation, if deemed necessary. Any future mitigation measures that are deemed necessary will be developed jointly by Watermaster and the IEUA.

1.5 Annual Report Organization

This Annual Report for water year (WY) 2025 is the tenth annual report of the PBHSC; it documents the collection, analysis, and interpretations of the data and information generated by the PBHSP through October 31, 2025[5]. The remainder of this report is organized as follows:

- **Section 2.0 – Monitoring, Data Collection, and Methods**. This section describes the collection of historical information and recent monitoring data and describes the groundwater-modeling activities performed during WY 2024 for the PBHSP.
- **Section 3.0 – Results and Interpretations**. This section describes the results and interpretations that were derived from the information, data, and groundwater-modeling.
- **Section 4.0 – Conclusions and Recommendations**. This section summarizes the main conclusions derived from the PBHSP through 2024 and describes the recommended activities for the subsequent fiscal year as a proposed scope-of-work, schedule, and budget.
- **Section 5.0 – References**. This section lists the publications cited in the report.

DRAFT

[5] Includes the WY 2025 Period of October 1, 2024 to September 30, 2025 and the month of October 2025 cover the entire growing season period.

2.0 MONITORING, DATA COLLECTION, AND METHODS

The PBHSP was designed, in part, to answer Question 1 from the AMP:

- What are the factors that can potentially affect the extent and quality of the riparian habitat?

The main hydrologic factors that can potentially affect the extent and quality of the riparian habitat in the Prado Basin include, but are not limited to, groundwater levels, surface-water discharge, weather events, and long-term climate. As such, the PBHSP includes integrated monitoring and analysis programs for riparian habitat, groundwater, surface-water, climate, and other potential factors (e.g., wildfire, pests, etc.).

During the implementation of the AMP in WY 2016, data collection efforts include the compilation of historical data through the present. The period of data available for each data type varies, but all span both pre- and post-Peace II Agreement implementation. Data collection efforts for all historical data were described in the first two annual reports for WY 2016 and WY 2017. Data collection efforts for subsequent water years have focused on recent water year monitoring data. All data collected and compiled for this effort were uploaded to Watermaster's centralized relational database, HydroDaVE^{SM}, and used in the analyses.

This section describes the collection of recent monitoring data during WY 2025 and the groundwater-modeling activities performed for the PBHSP.

2.1 Riparian Habitat Monitoring

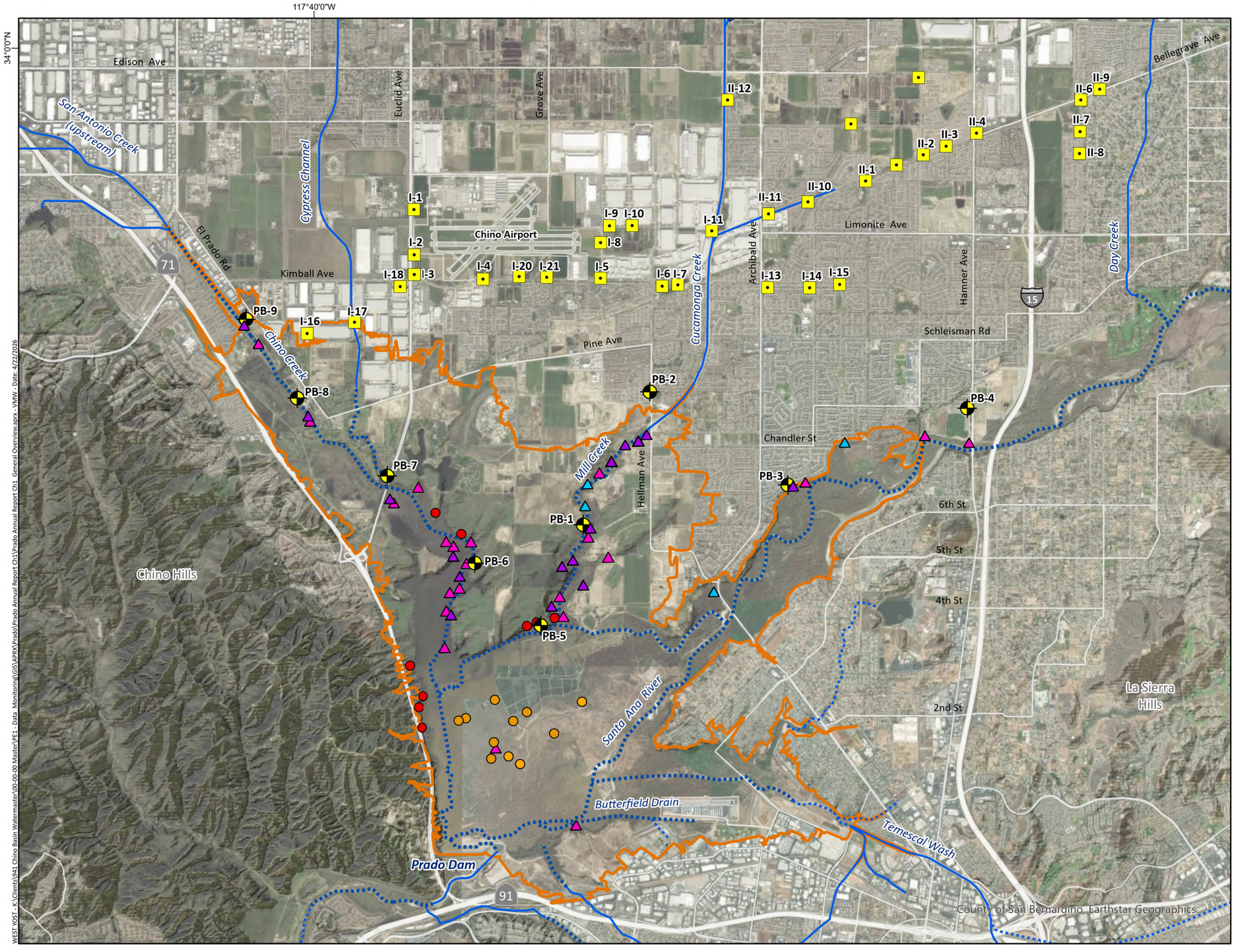
The objective of the Riparian Habitat Monitoring Program (RHMP) is to collect data to help answer questions 2, 3, and 4 from the AMP:

- What is a consistent quantifiable definition of "riparian habitat quality", including metrics and measurement criteria?
- What has been the historical extent and quality of the riparian habitat in the Prado Basin?
- How has the extent and quality of the riparian habitat changed during the implementation of Peace II?

To answer these questions, the RHMP includes time series data and information on the extent and quality of riparian habitat in the Prado Basin over a historical period, including both pre- and post-Peace II implementation.

Figure 2-1 displays the features of the RHMP. Two types of monitoring and assessment are performed: regional and site-specific. Regional monitoring and assessment are appropriate because the main potential stress to the riparian habitat associated with Peace II activities is the regional drawdown of groundwater levels. The intent of site-specific monitoring and assessment is to verify and complement the results of regional monitoring.

DRAFT



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00.00.00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1 General Overview.aprx - VMW - Date: 4/22/2026

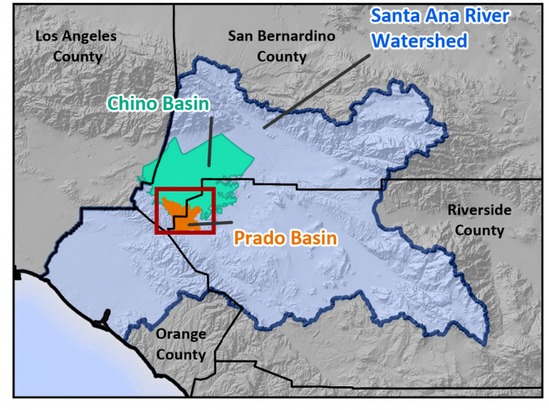
Riparian Habitat Monitoring Program - Site Specific Monitoring

Vegetation Survey Site

- Site surveyed in Prior Monitoring Events
- Site surveyed in 2025
- Site surveyed added in 2025

OCWD Site-Specific Monitoring

- Understory Photo Stations
- Canopy Photo Stations
- PBHSP Monitoring Well
- Prado Basin
- Concrete-Lined Channels
- Unlined Rivers and Streams
- Chino Basin Desalter Well



Prepared by:

WEST YOST

0 1 2 Miles

0 1 2 Km

Prepared for:

Prado Basin Sustainability Committee

2025 Annual Report

Riparian Habitat Monitoring Program

Figure 2-1

2.1.1 Regional Monitoring of Riparian Habitat

Regional monitoring and assessment of the riparian habitat is performed by mapping the extent and quality of riparian habitat over time using: 1) multi-spectral remote-sensing data and 2) air photos.

2.1.1.1 Multi-Spectral Remote Sensing Data

The Normalized Difference Vegetation Index (NDVI), derived from remote sensing measurements by Landsat Program satellites, is used to assess the extent and quality of the riparian vegetation in the Prado Basin over a long-term historical period. NDVI is a commonly used numerical indicator of vegetation health that can be calculated from satellite remote-sensing measurements (Ke et al., 2015; Xue, J. and Su, B., 2017). NDVI is calculated from visible and near-infrared radiation reflected by vegetation and is an index of greenness correlated with photosynthesis that can be used to assess spatial and temporal changes in the distribution and productivity of vegetation (Pettorelli, 2013). Areas where the NDVI is higher have greener vegetation than areas where NDVI is lower— indicating areas where the overall vegetation is healthy.

NDVI provides a "first indicator" of regional changes in the extent and quality (health) of vegetation. Because NDVI represents a composite view of plant species diversity, form, structure, density, and vigor, changes in NDVI can reflect a range of shifts within the riparian habitat (Markon et al., 1995; Markon and Peterson, 2002). These changes can then be ground-truthed using other types of monitoring. Appendix A provides background information on NDVI, further explains why NDVI was chosen as an analytical tool for the PBHSP, discusses additional advantages and limitations of NDVI, and describes how NDVI estimates were used for the PBHSP.

NDVI data are available for the entire extent of the Prado Basin dating from the early 1980s to present from the United States Geological Survey (USGS), and provide a historical characterization of the spatial extent and quality of the riparian vegetation prior to and after the implementation of Peace II activities (2007).

For the current reporting period, NDVI estimates were collected from the USGS using the Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface[6] (USGS, 2017b) for the period of November 2024 through October 2025, to span the entire growing-season period (March-October 2025). To obtain complete spatial coverage of the Prado Basin area, NDVI estimates were requested for all Landsat scenes for Path 040, Rows 036 and 037 from the Landsat 8 and Landsat 9 satellites. The NDVI were processed and uploaded to Watermaster's centralized relational database, HydroDaVE^{SM}, which includes tools to manage, review, and extract NDVI estimates. The frequency of NDVI estimates from the Landsat 8 and 9 satellites is once every eight days. However, not all NDVI estimates are useable due to disturbances that can be caused by cloud cover, unfavorable atmospheric conditions, or satellite equipment malfunction. NDVI estimates were reviewed for these disturbances and excluded from analysis if they were determined erroneous due to these disturbances. Appendix A describes how the NDVI estimates were collected, reviewed, and assembled for the PBHSP, including an explanation of the decision to calculate the Average Growing-Season NDVI data for WY 2025 from April through October, instead of March through October, as was previously done in prior reports.

[6] ESPA USGS

2.1.1.2 Collection and Analysis of Air Photos

Georeferenced air photos are used to visually characterize the spatial extent and quality of the riparian habitat in the Prado Basin. The air photos also serve as an independent check on interpretations of NDVI, which involves visual comparison of the extent and density of the riparian habitat (as shown in the air photos) to the NDVI maps. For ongoing monitoring, a high-resolution (3-inch pixel) image of the visible spectrum for the entire Prado Basin is acquired during the middle of the growing season, typically in late June or early July.

For the current reporting period, the acquisition of the 2025 air photo included a custom flight that was performed by Tetra Tech on June 26, 2025. The cost to acquire the 2025 air photo was shared with the OCWD. This was the ninth annual high-resolution air photo acquired for the PBHSP and cost-shared with the OCWD.

2.1.2 Site-Specific Monitoring of Riparian Habitat

The objective of the site-specific monitoring of riparian habitat is to collect data that can be used to ground-truth the interpretations derived from the regional monitoring and assessment of the riparian habitat (Pettorelli, 2013). The site-specific monitoring for the PBHSP includes vegetation surveys at established sites in the Prado Basin that have evolved over time. The United States Bureau of Reclamation (USBR) conducted this site-specific monitoring both prior to and after the implementation of the AMP, during 2007, 2013, 2016, 2019, and 2022 (USBR, 2008; 2016; 2017; 2020; 2023) — and ECORP conducted in 2025 over this reporting period (ECORP, 2026). The following summarizes the vegetation surveys conducted since AMP implementation:

- **2016 and 2019 USBR vegetation surveys**. Consists of 37 sites— 23 previously established sites surveyed in 2007 and 2013, and 14 new sites located near the PBHSP monitoring wells.
- **2022 USBR vegetation surveys**. Consists of 39 sites— 37 previously established sites surveyed in 2016 and 2019, and two additional sites in the upper portion of Mill Creek to increase monitoring in an area where there has been some observed drawdown of groundwater levels.
- **2025 ECORP vegetation surveys.** Consists of 20 sites— 16 previously established sites surveyed by the USBR in 2022 and four new sites in representative areas. The number of sites was reduced to 20 to focus on key representative areas where: field data are important for verifying regional assessment monitoring; the Peace II implementation has potential to impact riparian vegetation; and/or groundwater level declines or changes in vegetation health have been observed. The four new sites include two along Mill Creek and two along the SAR. The two Mill Creek sites are in areas where a browning of the vegetation was observed in the 2024 air photo, and NDVI decreased slightly. The two SAR sites were added to better align with the defined areas where NDVI data is analyzed over time (SAR-3 and SAR-4), as described in Section 3.1.2.5.

The OCWD also performs site-specific monitoring in the southern portion of Prado Basin to monitor for effects of the operation of Prado Dam on riparian habitat. OCWD site-specific monitoring includes seasonal monitoring at nine canopy photo stations located along the edge of Prado Basin. OCWD also implements a vegetation monitoring program in which ground vegetation surveys are conducted to support basin-wide and focus-area vegetation mapping and asses the extent and health of Mulefat in the focus area. The most recent annual report prepared by OCWD on the results of this monitoring is the *Prado Basin Water Conservation and Habitat Assessment 2024-2025* report (OCWD, 2026).

DRAFT

Figure 2-1 shows the locations of historic USBR vegetation survey sites, sites surveyed by ECORP during the most recent field survey in 2025, and the OCWD photo monitoring sites.

2.2 Factors that Potentially Affect the Riparian Habitat

The main factors that can potentially affect riparian habitat in Prado Basin include but are not limited to groundwater levels, surface-water discharge, weather/climate, wildfires, and invasive species and pests. This section describes the methods employed to collect and analyze information on these factors to help answer questions 5, 6, and 7 from the AMP:

- How have groundwater levels and quality, surface-water discharge, weather, and climate changed over time? What were the causes of the changes? And did those changes result in an adverse impact to riparian habitat in the Prado Basin?
- Are there other factors besides groundwater levels, surface-water discharge, weather, and climate that affect riparian habitat in the Prado Basin? What are those factors? And did they (or do they) result in an adverse impact to riparian habitat in the Prado Basin?
- Are the factors that result in an adverse impact to riparian habitat in the Prado Basin related to Peace II implementation?

2.2.1 Groundwater Monitoring Program

A primary result of implementation of the Peace II Agreement is the lowering of groundwater levels (drawdown) in the southern portion of Chino Basin. Hence, drawdown is a factor that is potentially related to Peace II implementation and could adversely impact riparian habitat that relies on shallow groundwater.

The Groundwater Monitoring Program (GMP) includes the collection of three types of data: groundwater production, groundwater level, and groundwater quality. Watermaster has been implementing a GMP across the entire Chino Basin to support various Basin management initiatives and activities, and all data within Watermaster's centralized relational database are available to the GMP.

In 2015, Watermaster's groundwater monitoring network was expanded specifically for the PBHSP, with the construction of 16 new monitoring wells at nine sites located along the fringes of the riparian habitat and between the riparian habitat and the CDA well field. These wells, along with two existing monitoring wells, HCMP-5/1 and RP2-MW3, are specifically monitored for the PBHSP and are referred to as the "PBHSP monitoring wells" in the remainder of the report.

Figure 2-2 shows the extent of the study area for which the GMP data are compiled and used for the PBHSP. The area covers the Prado Basin and the upgradient areas to the north that encompass the Chino Basin Desalter well field. Figure 2-2 also shows the wells in the study area where groundwater data were available in WY 2025.

2.2.1.1 Groundwater Production

Groundwater production influences groundwater levels and groundwater-flow patterns. Groundwater-production data are analyzed together with groundwater-level data to characterize the influence of groundwater production on groundwater levels. Groundwater-production data are also used as an input to the Chino Basin groundwater-flow model to evaluate past and future conditions in the Chino Basin, which, for the PBHSP, supports the analysis of prospective losses of riparian habitat (see Section 2.3).

DRAFT

Watermaster collects quarterly groundwater-production data for all active production wells within the Chino Basin. The data are checked for quality assurance and quality control (QA/QC) and uploaded to Watermaster's centralized relational database. The active production wells within the study area include CDA wells and privately owned wells used for agricultural, dairy, or domestic purposes.

During WY 2025, Watermaster collected groundwater-production data at 75 wells in the GMP study area.

2.2.1.2 Groundwater Level

Monitoring groundwater levels in the Prado Basin is a key component of the PBHSP, as the potential for declining groundwater levels related to Peace II implementation could be a factor that adversely impacts riparian habitat. Groundwater-level data are analyzed together with production data to characterize how groundwater levels have changed over time in the GMP study area and to explore the relationship(s) to any observed changes that occurred in the extent and quality of the riparian habitat. Groundwater-level and production data are also used as input to the Chino Basin groundwater-flow model to evaluate past and future conditions in the Chino Basin, which, for the PBHSP, supports the analysis of prospective losses of riparian habitat (see Section 2.3). Groundwater level data are also used with other data to evaluate groundwater/surface-water interactions (see Section 3.3).

Watermaster collects groundwater-level data at various frequencies at wells in the GMP study area to support various groundwater-management initiatives. The data are checked for QA/QC and uploaded to Watermaster's centralized relational database.

During WY 2025, Watermaster collected groundwater-level data from 278 wells in the study area (see Figure 2-2). Approximately 100 wells are CDA wells, dedicated monitoring wells, or private wells that are monitored by Watermaster using manual methods once per month or with pressure transducers that record water levels once every 15 minutes. This includes the PBHSP monitoring wells where water levels are measured with pressure transducers. At the remaining 178 wells, water levels were measured by well owners at varying frequencies and provided to Watermaster.

DRAFT

117°40'0"W

34°0'0"N

Edison Ave

San Antonio Creek (upstream)

Euclid Ave

Grove Ave

Archibald Ave

Hamner Ave

Bellegrave Ave

Cypress Channel

El Prado Rd

71

Kimball Ave

Chino Airport

Limonite Ave

Day Creek

Cucamonga Creek

Schleisman Rd

15

Pine Ave

Chino Creek

Mill Creek

Hellman Ave

Chandler St

6th St

5th St

4th St

2nd St

Chino Hills

La Sierra Hills

Santa Ana River

Butterfield Drain

Temescal Wash

Prado Dam

91

County of San Bernardino, Vantor

I-1 I-2 I-3 I-4 I-5 I-6 I-7 I-8 I-9 I-10 I-11 I-13 I-14 I-15 I-16 I-17 I-18 I-20 I-21

II-1 II-2 II-3 II-4 II-6 II-7 II-8 II-9 II-10 II-11

PB-1 PB-2 PB-3 PB-4 PB-5 PB-6 PB-7 PB-8 PB-9

Wells with Groundwater Data - Water Year 2025

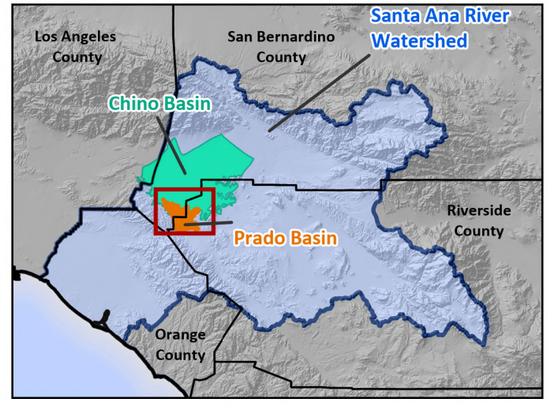
- Well with Production Data
- Well with Water Level Data
- Well with Water Quality Data

Wells Labeled on the Map

Chino Basin Desalter Well - Labeled with **"I-" or "II-"**

PBHSP Monitoring Well - Labeled with **"PB-"**

- Groundwater Monitoring Program (GMP) Study Area
- Prado Basin
- Concrete-Lined Channels
- Unlined Rivers and Streams



Prepared by:

WEST YOST

0 1 2 Miles

0 1 2 Km

N

Prepared for:

Prado Basin Habitat Sustainability Committee
2025 Annual Report

Groundwater Monitoring Program

Figure 2-2

2.2.1.3 Groundwater Quality

Water-quality data can be used to understand the various potential sources of shallow groundwater in the Prado Basin. Groundwater-quality data are compared to surface-water-quality data to characterize groundwater/surface-water interactions in the Prado Basin and assess the importance of those interactions to the extent and quality of the riparian habitat.

Watermaster collects groundwater-quality data from wells in the GMP study area to support various groundwater-management initiatives. These data are checked for QA/QC and uploaded to Watermaster's centralized relational database. During WY 2025, groundwater-quality data were collected from 177 wells in the study area (see Figure 2-2). Of these wells, 78 are dedicated monitoring wells or private wells sampled by Watermaster quarterly, annually, or triennially (every three years); and/or using transducers that record high-frequency (15-minute) temperature and specific conductance (EC) readings. The remaining 99 were sampled by the well owners at varying frequencies.

Watermaster has performed groundwater-quality sampling at the PBHSP monitoring wells since they were constructed in 2015. The groundwater-quality monitoring has been tailored to discern the groundwater/surface-water interactions important to the sustainability of the riparian habitat. Currently Watermaster conducts triennial water-quality sampling at the 18 PBHSP monitoring wells as part of their Basin-wide water-quality monitoring to support various groundwater-management initiatives. The most recent water-quality sampling event occurred during September 2024 and the next triennial monitoring event will occur in summer of 2027.

In 2023, Watermaster began collecting the high-frequency (15 minute) temperature and EC readings from the transducers at the PBHSP monitoring wells. This was a recommendation from the WY 2022 Annual Report to replace a pilot monitoring program to study groundwater/surface-water interactions (see section 4.1 of 2022 Annual Report, West Yost, 2023). At the time, only four PBHSP monitoring wells were equipped with transducers that were able to measure the high-frequency EC data in addition to temperature and water level. As transducers have been replaced, they have been upgraded to models that measure and record high-frequency EC data along with temperature and groundwater levels. As of WY 2025, 17 PBHSP monitoring wells are equipped with upgraded transducers that measure EC.

During WY 2025, the high-frequency temperature and EC data at the PBHSP monitoring sites were downloaded, processed, checked for QA/QC, and uploaded to Watermaster's relational database on a quarterly basis.

2.2.2 Surface-Water Monitoring Program

Surface-water discharge in the Prado Basin is another factor that can influence the extent and quality of riparian habitat and can influence groundwater levels. Surface-water discharge data are evaluated for the PBHSP to characterize historical and current trends in the discharge of the SAR and its tributaries in the Prado Basin, and to explore the relationship(s) to any observed changes that occur in the extent and quality of the riparian habitat. Surface-water quality data is compared to groundwater-quality data to characterize groundwater/surface-water interactions in the Prado Basin and the importance of those interactions to the extent and quality of the riparian habitat. Figure 2-3 shows the location of the surface-water monitoring sites used in the PBHSP. Surface-water discharge data are also used as input to the Chino Basin groundwater-flow model to evaluate past and future conditions in the Chino Basin, which for the PBHSP, supports the analysis of prospective losses of riparian habitat (see Section 2.3).

The surface-water monitoring program for the PBHSP involves collecting existing, publicly available surface-water discharge and quality data from sites within or tributary to the Prado Basin. These sites

include discharge locations for publicly owned treatment works (POTWs), USGS stream gaging stations, Watermaster and the IEUA Maximum-Benefit Monitoring Program surface-water-quality monitoring sites, and ACOE's storage levels and inflow to Prado Dam. All surface-water discharge and quality data were collected for WY 2025, checked for QA/QC, and uploaded to Watermaster's relational database.

In WY 2023, Watermaster also began collecting surface-water field measurements of temperature and EC at four sites located near PBHSP monitoring wells along Chino Creek and Mill Creek. This monitoring was a recommendation from the WY 2022 Annual Report based on a pilot program to study groundwater/surface-water interactions (see section 4.1 of 2022 Annual Report, West Yost, 2023) and is done in coordination with high-frequency groundwater measurements of temperature and EC described above in the Groundwater Quality Section. In WY 2025, Watermaster collected quarterly surface-water field measurements at the four sites. Data were checked for QA/QC and uploaded to Watermaster's relational database.

2.2.3 Climatic Monitoring Program

Climate is another factor that can influence the extent and quality of riparian habitat and can influence groundwater levels. Climatic data are evaluated for the PBHSP to characterize how the climate has changed over time in the study area and to explore the relationship(s) to any observed changes that occurred in the extent and quality of the riparian habitat. Climatic data are also used for the Chino Basin groundwater-flow model to evaluate past and future conditions in the Chino Basin, which for the PBHSP, supports the analysis of prospective losses of riparian habitat (see Section 2.3).

The climatic monitoring program for the PBHSP involves collecting existing, publicly available spatially gridded climate datasets for precipitation and temperature in the vicinity of the Prado Basin. These climate datasets include Next-Generation Radar (NEXRAD)[7] and the PRISM Climate Group[8]. Figure 2-3 shows the location of the areas where the grided climate data is extracted from PRISM and NEXRAD to estimate a spatial average for precipitation and temperature for the PBHSP. The Chino Basin boundary is used to extract the spatially gridded data for precipitation, and the Prado Basin boundary is used to extract the spatially gridded data for maximum and minimum temperature. Climatic data are collected annually and uploaded to Watermaster's relational database.

2.2.4 Other Factors That Can Affect Riparian Habitat

The AMP recognizes that there are potential factors other than groundwater, surface-water, and climate that can affect riparian habitat in the Prado Basin. These factors include, but are not limited to, wildfire, disease, pests, and/or invasive species. To the extent necessary and possible, data and information on these factors are collected and analyzed to explore relationships to changes in the extent and quality of the riparian habitat.

[7] Cooperative Distributed Interactive Atmospheric Catalog System/Earth Observing Laboratory/National Center for Atmospheric Research/University Corporation for Atmospheric Research, and Climate Prediction Center/National Centers for Environmental Prediction/National Weather Service/NOAA/U.S. Department of Commerce. 2000, updated quarterly. NCEP/CPC Four Kilometer Precipitation Set, Gauge and Radar. NSF National Center for Atmospheric Research. https://doi.org/10.5065/D69Z93M3. Accessed November 25, 2025.

[8] PRISM Climate Group. (2025). PRISM Gridded Climate Data (PRISM monthly mean daily maximum temperature data (800 m resolution), PRISM monthly mean daily minimum temperature (800 m resolution), PRISM daily precipitation data (800 m resolution), 2024). Oregon State University. https://prism.oregonstate.edu

In WY 2016, during the analysis for the first Annual Report, two specific factors were identified as potential impacts to the riparian habitat in the Prado Basin: wildfires and an invasive pest known as the Polyphagous Shot-Hole Borer (Euwallacea fornicates; PSHB hereafter). In WY 2018, the removal of the non-native invasive weed Arundo donax (Arundo) was identified as another factor that could potentially impact the riparian vegetation in the Prado Basin. The following describes the information that was collected for these three factors and how they are used to explore relationships to changes that have occurred in the extent and quality of riparian habitat.

2.2.4.1 Wildfires

Wildfires occur periodically in the Prado Basin and can reduce the extent and quality of riparian habitat. For the PBHSP, the occurrence and locations of wildfires are used to help understand and explain the trends observed in the extent and quality of the riparian vegetation.

To map the extent of any wildfires that have occurred in the study area, fire-perimeter data were collected from the Fire and Resource Assessment Program (FRAP) of the California Department of Forestry and Fire Protection (CAL FIRE).[9]

For the current reporting period, wildfire data were obtained from the FRAP database for the Prado Basin region for calendar year 2024.[10]

2.2.4.2 Polyphagous Shot-Hole Borer (PSHB)

The PSHB is a beetle that burrows into trees, introducing a fungus (*Fusarium euwallacea*) into the tree bark that spreads the disease Fusarium Dieback (FD).[11,12] FD destroys the food and water conducting systems of the tree, eventually causing stress and tree mortality. The PSHB was first discovered in Southern California in 2003 and has been recorded to have caused branch die-back and tree mortality for various tree specimens throughout the Southern California region (USDA, 2013). Since 2016, the PSHB has been an identified pest within the Prado Basin that has the potential to negatively impact riparian habitat vegetation health (USBR, 2016; Palenscar, K., personal communication, 2016; McPherson, D., personal communication, 2016).

Information on the PSHB occurrence in the Prado Basin has been obtained during the USBR and ECORP vegetation surveys of riparian habitat in the Prado Basin for the PBHSP during 2016, 2019, 2022, and 2025; from the University of California, United States Department of Agriculture (USDA) and Natural Resources' online PSHB/FD Distribution Map[13]; and from the OCWD's PSHB trap deployment and monitoring. For the PBHSP, the occurrences of the PSHB in the Prado Basin are used to help understand and explain the trends observed in the extent and quality of the riparian vegetation.

For the current reporting period, data were collected on the PSHB occurrence in Prado Basin during the ECORP vegetation surveys conducted in October 2025.

[9] Frap.fire.ca.gov

[10] There are no 2025 data available yet. Data for the previous year is available each year in April.

[11] UCANR.edu

[12] Cisr.Ucr.Edu

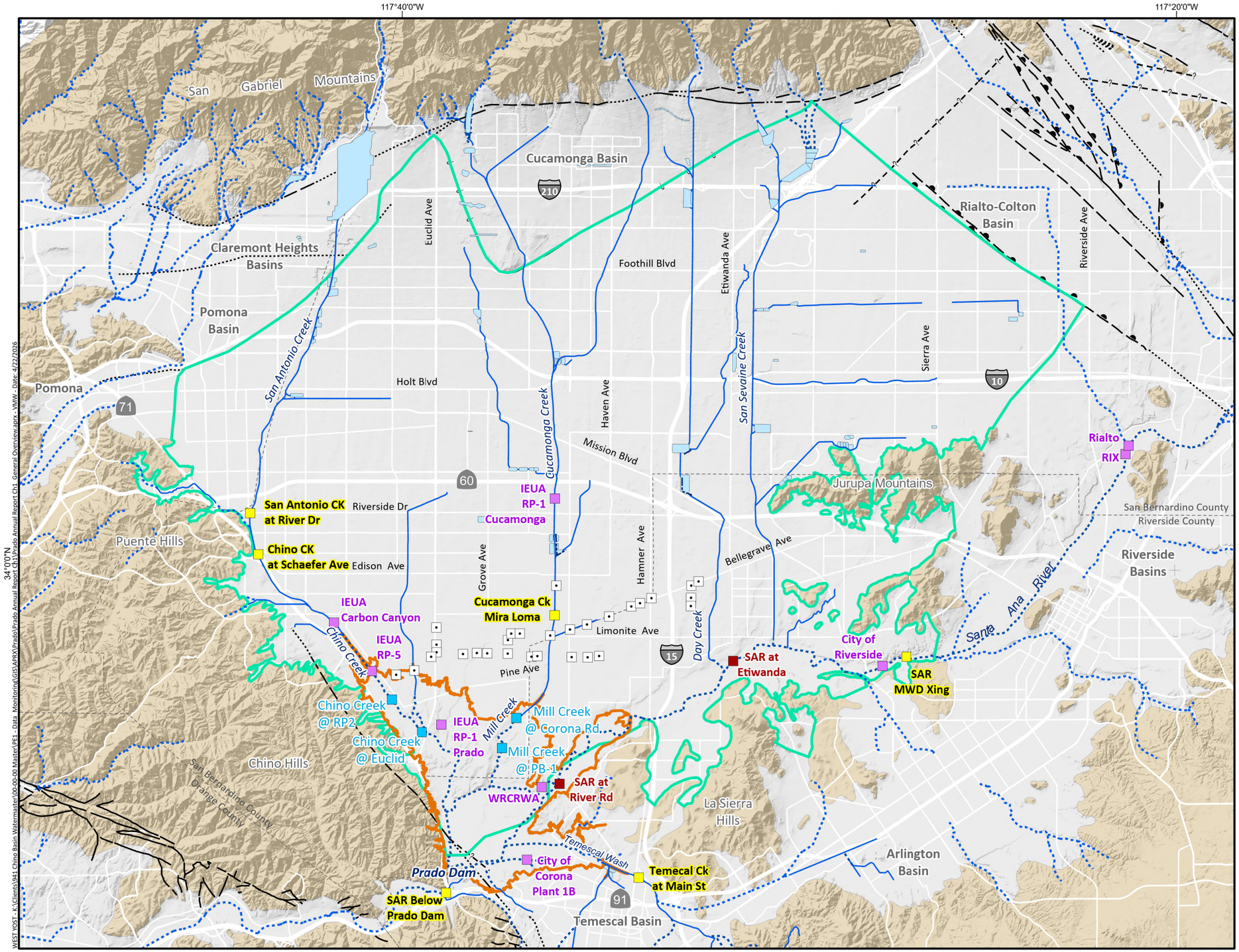
[13] Ucanr.edu

2.2.4.3 Arundo Removal

Non-native Arundo is prominent throughout riparian habitat in the Prado Basin. Arundo consumes significantly more water than native plants, can out-compete native vegetation, and is flammable in nature increasing the risk of wildfire. Several stakeholders in the SAR watershed are actively removing Arundo from the riparian habitat to restore native habitat and support the recovery of the threatened and endangered species, such as the Least Bell's Vireo and Santa Ana Sucker. For the PBHSP, tracking the occurrence and locations of these habitat restoration activities that include the removal of Arundo can help understand and explain trends in the extent and quality of the riparian habitat. The OCWD, Santa Ana Watershed Association (SAWA), and Santa Ana Watershed Project Authority (SAWPA), in coordination with others, are the main entities in the watershed that implement habitat restoration programs that include removing Arundo.

In WY 2025, information on recent Arundo removal and management activities in the Prado Basin were collected to track these programs and explore potential connections between these activities and any observed trends in the extent and quality of riparian habitat. This effort involved coordinating with the OCWD and SAWA to obtain information on the location and timing of these programs.

DRAFT



Surface-Water Monitoring Program

- POTW Discharge Outfall
- USGS Stream Gage Station
- Maximum-Benefit Monitoring Program Site
- PBHSP Site

Climate Monitoring Program

- Chino Basin - Area to Extract Gridded Data from PRISM and NEXRAD Data Sets (Precipitation)
- Prado Basin - Area to Extract Gridded Data from PRISM and NEXRAD Data Sets (Temperature)
- Chino Basin Desalter Well
- Concrete-Lined Channels
- Unlined Rivers and Streams
- Flood Control & Conservation Basins

Surface Geology

Water-Bearing Sediments

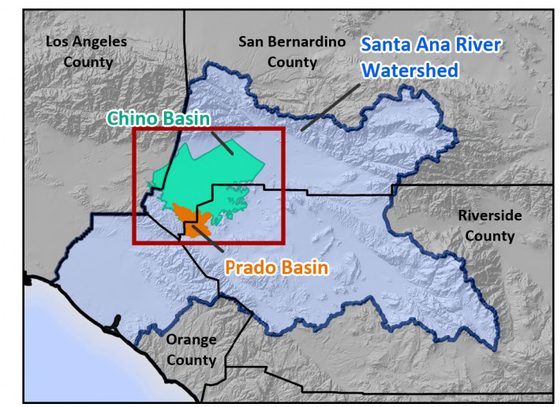
- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

0 2 4 Miles
0 2 4 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Surface Water and Climate
Monitoring Programs

Figure 2-3

2.3 Prospective Loss of Riparian Habitat

Monitoring and mitigation requirement 4.4-3 in the Peace II SEIR calls for annual reporting for the PBHSP, that will include recommendations for ongoing monitoring and any adaptive management actions required to mitigate any measured loss or **prospective loss** of riparian habitat that may be attributable to the Peace II Agreement (emphasis added). The meaning of "prospective loss" in this context is "future potential losses" of riparian habitat. Predictive modeling of groundwater levels can be used to answer Question 8 from the AMP:

- Are there areas of prospective loss of riparian habitat that may be attributable to the Peace II Agreement?

Watermaster's most recent groundwater-modeling results are used to evaluate forecasted groundwater-level changes within the Prado Basin under current and projected conditions in the Basin, including, but not limited to, plans for pumping, storm-water recharge, and supplemental water recharge. To perform this evaluation, the predictive model results of groundwater levels are mapped and analyzed to identify areas (if any) where groundwater levels are projected to decline to depths that may negatively impact riparian habitat in the Prado Basin.

Watermaster's most recent groundwater model projections are from the simulation of planning scenario "2020 SYR1" for the 2020 recalculation of Safe Yield using the updated Chino Basin groundwater-flow model (WEI, 2020). Section 3.7 of this Annual Report uses this most recent projection to characterize future groundwater-level conditions in the GMP study area and analyze prospective loss. The Chino Basin groundwater-flow model is currently being updated and used to project conditions for the 2025 Safe Yield Reset, and new model projections will be included in the WY 2026 Annual Report.

DRAFT

3.0 RESULTS AND INTERPRETATIONS

This section describes the analysis and interpretation of the monitoring data and groundwater-modeling results for the PBHSP. Analyzed data span various historical periods, based on data availability, and include both pre- and post-Peace II Agreement implementation (2007).

More specifically, this section describes the trends in the extent and quality of the riparian habitat, describes the trends in factors that can impact the riparian habitat, and evaluates potential cause-and-effect relationships—particularly any cause-and-effect relationships that may be associated with Peace II implementation. The factors that can potentially impact the extent and quality of the riparian habitat include changes in groundwater levels, surface-water discharge, climate, and other factors. Declining groundwater levels is the primary factor that is potentially related to Peace II implementation and could adversely impact the riparian habitat.

This section also includes a review of Watermaster's most recent predictive Chino Basin groundwater modeling results to identify areas of potential future declines in groundwater levels that could impact the riparian habitat.

3.1 Trends in Riparian Habitat Extent and Quality

This section analyzes the extent and quality of the riparian habitat in the Prado Basin using air photos, NDVI, and vegetation surveys.

3.1.1 Extent of the Riparian Habitat

The annual reports for the first four years of the PBHSP included an analysis of the riparian vegetation using historical air photos to map vegetation density and extent in Prado Basin over time (WEI, 2017; 2018; 2019; 2020). In general, these analyses concluded that from 1960 to 1999 the mapped extent of the riparian habitat increased from about 1.8 to 6.7 square miles (mi^2) and its vegetated density increased. The 1999 mapped extent is considered the maximum extent of the riparian habitat in the Prado Basin and has since remained relatively constant in the Prado Basin along the Chino Creek, Mill Creek, and SAR reaches in the Prado Basin.[14] The maximum extent of the riparian vegetation in Prado Basin is shown on Figure 3-1a which compares the air photos that were acquired for the PBHSP in July 2024 and June 2025. Both air photos are high-resolution (3-inch pixels) which allow for a side-by-side visual comparison of riparian vegetation extent and quality in 2024 and 2025. There are no significant differences in these photos that show a change to the extent of the riparian habitat in the Prado Basin along the Chino Creek, Mill Creek, and SAR reaches of the Prado Basin. The maximum extent of the riparian habitat in the Prado Basin is the area used to evaluate the NDVI spatially and temporally in Sections 3.1.2.1 and 3.1.2.2.

[14] Since 1999 there has been a decrease to the extent and density of the riparian vegetation along the Temescal Wash in the southeastern portion of Prado Basin. This area is outside the Chino Basin hydrologic boundary and is not an area of influence of potential impacts of Peace II implementation on groundwater levels.

2024 Air Photo
(July 1, 2024)



Maximum Riparian Vegetation Extent

2025 Air Photo
(June 26, 2025)



Maximum Riparian Vegetation Extent

Prepared by:
WEST YOST

0 1 2 Miles
0 1 2 Km

Prepared for:
Prado Basin Sustainability Committee
2025 Annual Report

Air Photos and Extent of the Riparian Vegetation
2024 and 2025

Figure 3-1a

Figure 3-1b compares the 2025 air photo and the mapped extent of the riparian habitat to the NDVI estimates for the Prado Basin area on a date that corresponds to the maximum spatial average of NDVI during the growing season for 2025.[15] Generally, the following ranges in NDVI during the growing season correspond to these land cover types:

- < 0: Water
- 0 - 0.29: Non-vegetated surfaces, such as urbanized land cover and barren land
- 0.3 - 1.0: Vegetated land cover— higher NDVI values indicate greener vegetation, and therefore greater photosynthetic activity

Three main observations and interpretations are derived from this figure:

- The majority of the Prado Basin riparian vegetation areas have NDVI estimates of about 0.3 to 0.9 during the growing season. Active agricultural lands in the Prado Basin region can also have NDVI values of a similar range during the growing season.
- The NDVI estimates support the delineation of the extent of the riparian habitat as drawn from the air photos.
- The consistency of NDVI values to land cover observed in the air photo indicates that the processing of NDVI estimates for this study were performed accurately, which supports subsequent analyses and interpretations.

3.1.2 Quality of the Riparian Habitat

As discussed, and referenced in Section 2.0, NDVI is an indicator of the photosynthetic activity of vegetation and therefore can be used to interpret the health or "quality" of the riparian vegetation. In this section, NDVI is spatially and temporally analyzed in maps and time-series charts for defined areas throughout Prado Basin to characterize changes in the quality of riparian habitat over the period 1984 to 2025.

3.1.2.1 Spatial Analysis of NDVI

Figure 3-2 compares maps of NDVI across the entire Prado Basin area for 2024 and 2025 on the dates that correspond to the maximum growing-season NDVI for the year as a spatial average across the entire extent of the riparian vegetation. Figure 3-3 is a map of change in NDVI from 2024 to 2025 that was prepared by subtracting the 2024 NDVI map from the 2025 NDVI map in Figure 3-2. These figures identify areas that may have experienced a change in the quality of riparian habitat from 2024 to 2025:

- Throughout the majority of the riparian vegetation extent in Prado Basin, NDVI showed no change from 2024 to 2025.
- NDVI both increased and decreased in scattered patches throughout the riparian vegetation in the Prado Basin.
  - The notable patches of NDVI increase are along the SAR, and along and adjacent to the lower reach of Chino Creek.

[15] The growing season for the Prado Basin riparian vegetation is from March through October (Merkel, 2007; USBR, 2008). The maximum NDVI for the 2025 growing season occurred on September 20, 2025.

- The notable patches of NDVI decrease are located in the lower portion of Prado Basin, below the OCWD wetlands and the lower reach of Chino Creek.[16]

These spatial changes in NDVI will be analyzed along with the factors that can impact riparian habitat in Sections 3.2 through 3.6 of this report.

DRAFT

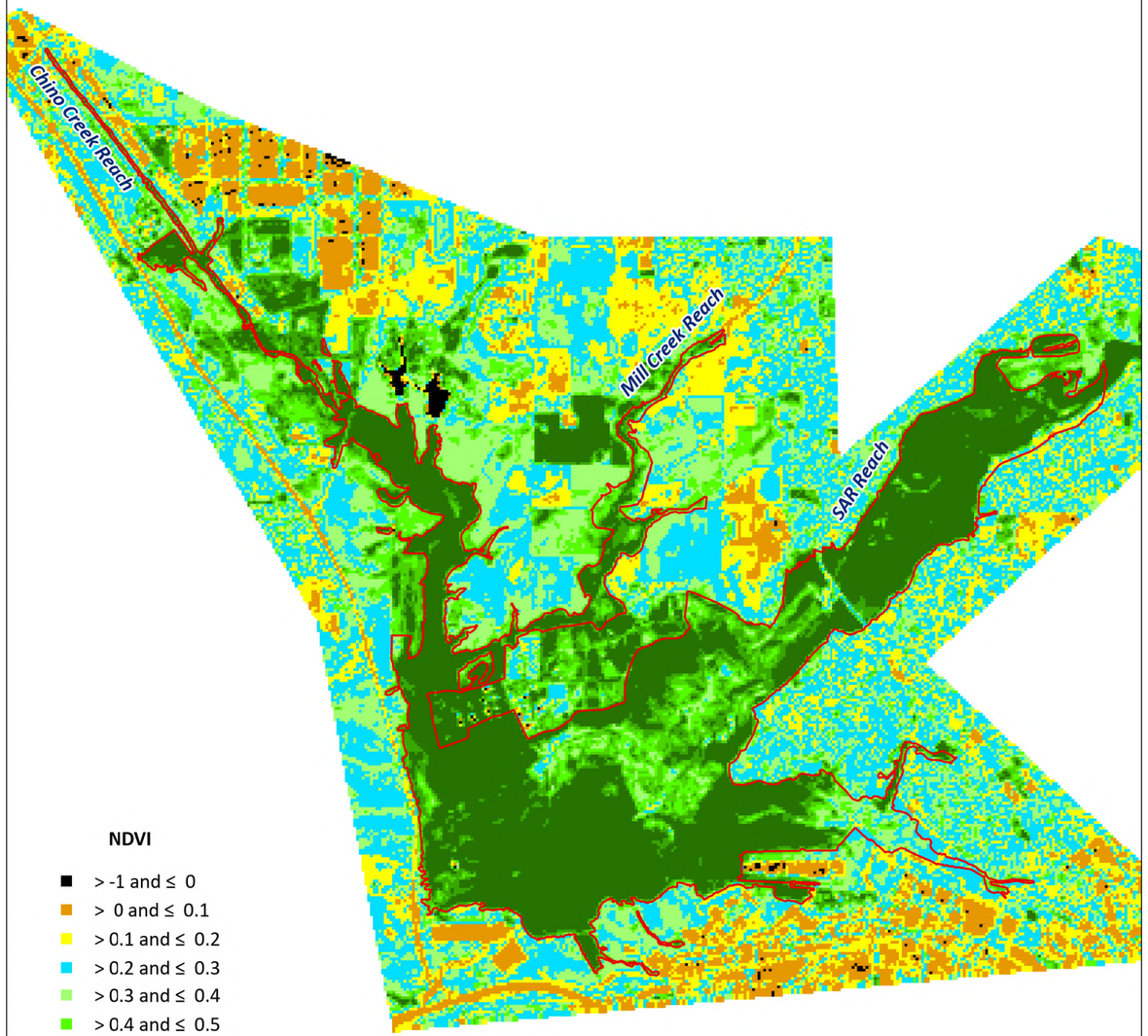
[16] There has continued to be decreasing NDVI within the riparian vegetation along the Temescal Wash in the southeastern portion of Prado Basin. This area is outside the Chino Basin hydrologic boundary and is not an area of influence of potential impacts of Peace II implementation on groundwater levels and is excluded from further analyses in this report.

2025 Air Photo (June 26, 2025)



Maximum Riparian Vegetation Extent

2025 NDVI (September 20, 2025)*



NDVI

- > -1 and ≤ 0
- > 0 and ≤ 0.1
- > 0.1 and ≤ 0.2
- > 0.2 and ≤ 0.3
- > 0.3 and ≤ 0.4
- > 0.4 and ≤ 0.5
- > 0.5 and ≤ 0.6
- > 0.6 and ≤ 0.7
- > 0.7 and ≤ 1

*Maximum growing-season NDVI for 2025

Maximum Riparian Vegetation Extent

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch2\MASTER_Prado Annual Report Ch2_NDVI_Air Photos.aprx - LH - Date: 4/21/2026

Prepared by: WEST YOST

N

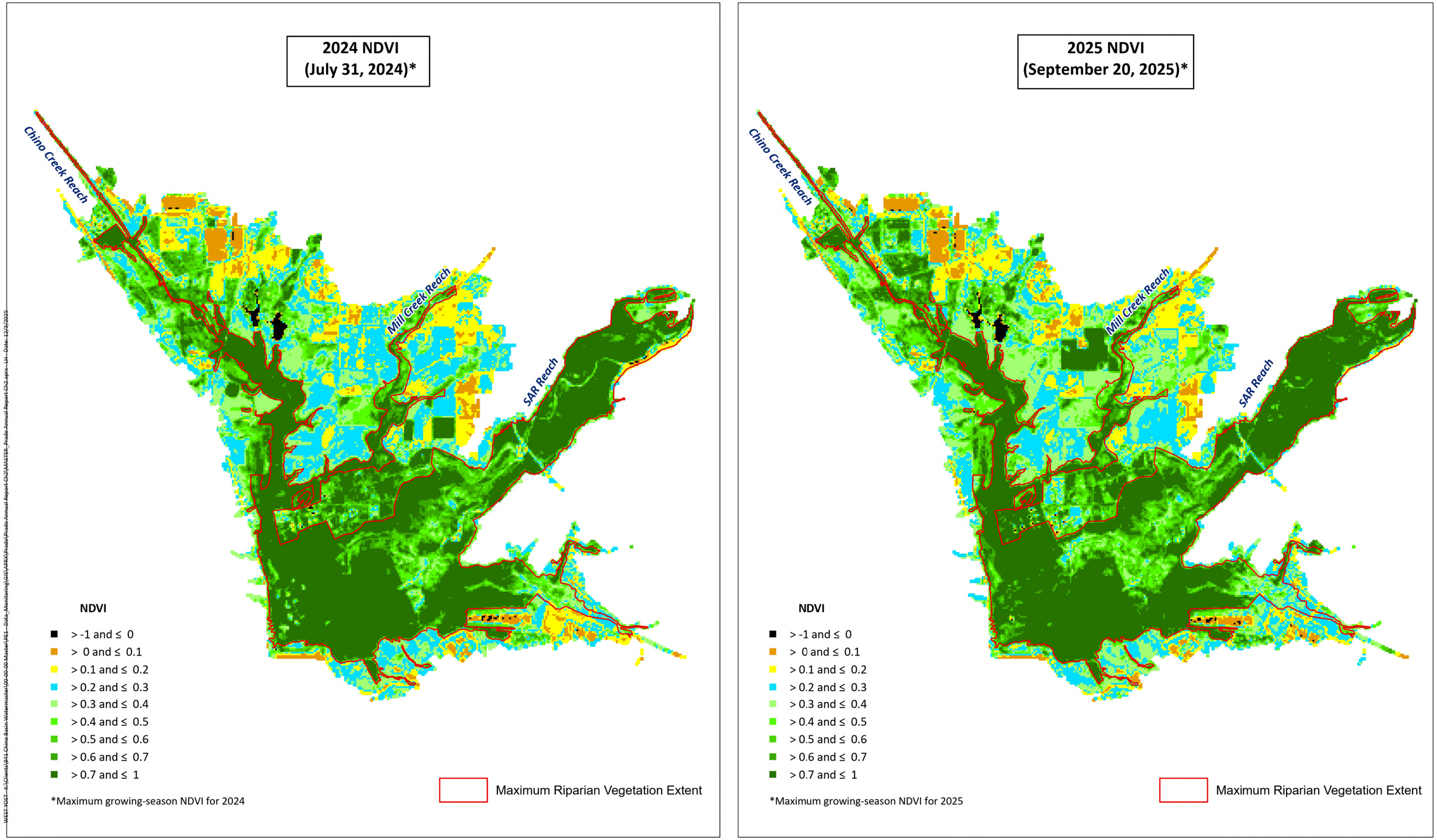
0 1 2 Miles

0 1 2 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Air Photo and Spatial NDVI for the Prado Basin
2025

Figure 3-1b



Prepared by:

WEST YOST

0 1 2 Miles

0 1 2 Km

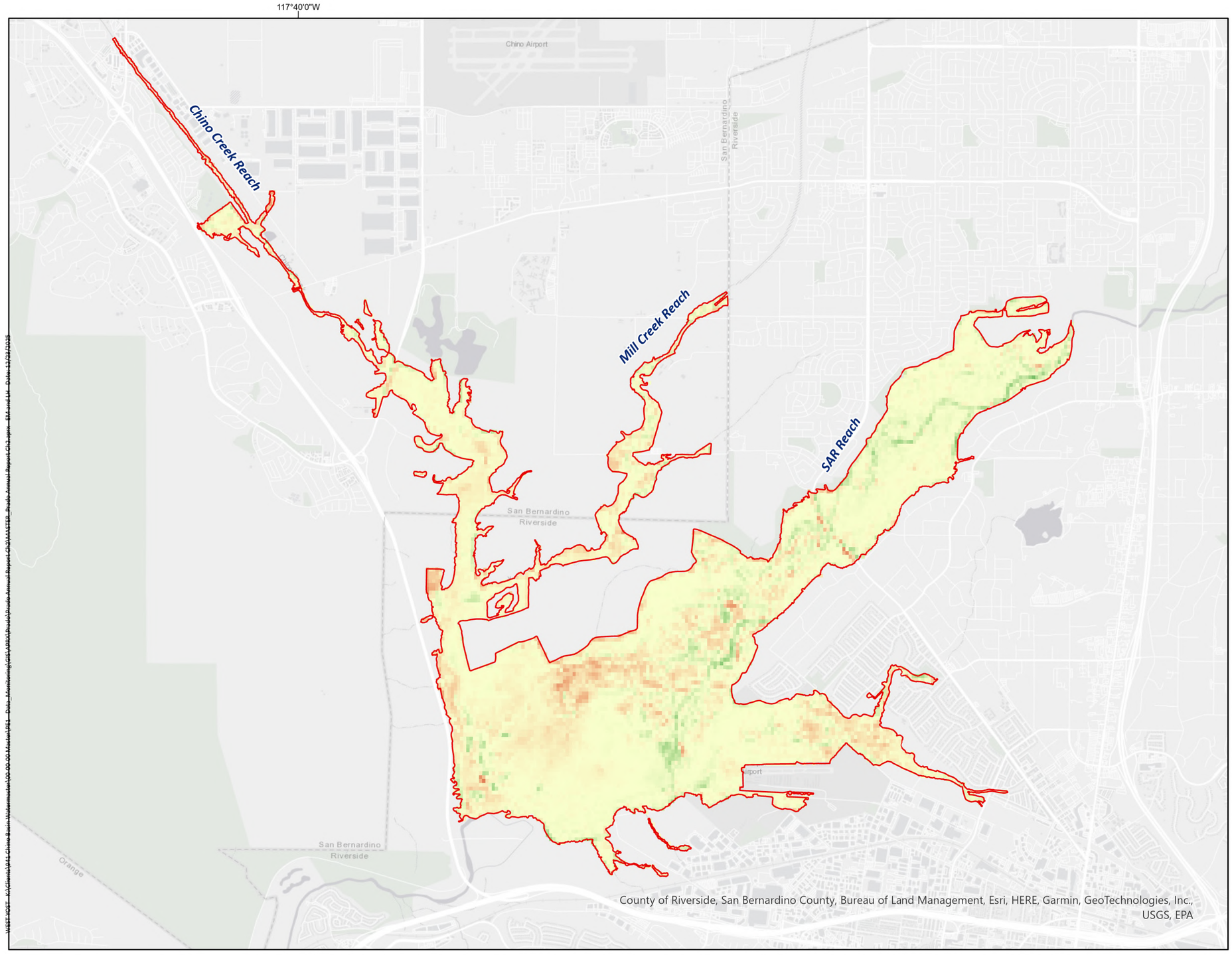
N

Prepared for:

Prado Basin Sustainability Committee
2025 Annual Report

Spatial NDVI for the Prado Basin
2024 and 2025

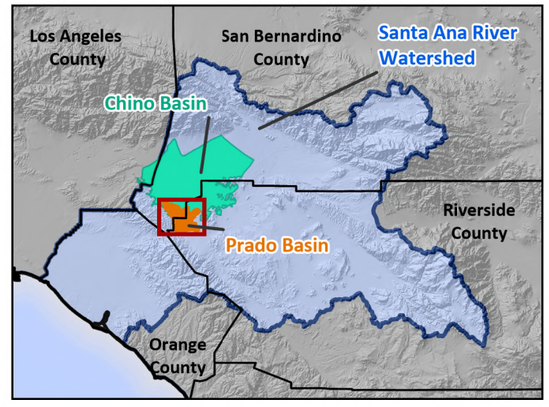
Figure 3-2



Change in Maximum Growing-Season NDVI Values
2024 to 2025

1.0
-1.0
Increase
Decrease

Maximum Riparian Vegetation Extent in Prado Basin



Prepared by:
WEST YOST

0 1 2 Miles
0 1 2 Km

Prepared for:
Prado Basin Sustainability Committee
2025 Annual Report

Spatial Change in NDVI for the Prado Basin
2024 to 2025

Figure 3-3

3.1.2.2 Temporal Analysis of NDVI

NDVI pixels[17] within defined areas throughout the Prado Basin were spatially averaged and temporally analyzed in time-series charts. The defined areas include four large and 13 small areas within Prado Basin and are shown in Figure 3-4. The large areas include: i) the extent of the riparian habitat in the entire Prado Basin (6.8 mi^2 – which is 19,520 NDVI pixels); ii) the upper portion of Chino Creek (0.74 mi^2 – which is 2,134 NDVI pixels); iii) the entire Mill Creek reach (0.26 mi^2 – which is 759 NDVI pixels); and iv) the upper portion of the Mill Creek reach (0.03 mi^2 – which is 92 NDVI pixels). The small areas are located along the northern reaches of the Prado Basin riparian habitat near the PBHSP monitoring wells and a vegetation survey site (10-meter radius plot). All the small areas are one NDVI pixel (30 x 30 meters).[18]

Figures 3-5, 3-6, 3-7a, 3-7b, and 3-8a through 3-8m are time-series charts of the NDVI for each defined area, illustrating changes in the riparian habitat quality over time. These figures characterize long- and short-term changes in NDVI in specific areas, providing context for interpreting trends and changes during Peace II implementation. Each figure shows two datasets that illustrate trends in the NDVI estimates:

- **Spatial Average NDVI (green dots)**. Spatial Average NDVI is the spatial average of the NDVI pixels within the defined area. These data characterize the seasonal and long-term trends in NDVI for each defined area. The NDVI exhibits an oscillatory pattern caused by seasonal changes in the riparian habitat. This pattern is typical for a deciduous forest, where NDVI values are higher in the growing season from around March through October and lower in the dormant season from around November through February when plants and trees shed their leaves.
- **Average Growing-Season NDVI (black dots and black curve).** The Average Growing-Season NDVI is the annual average of the Spatial Average NDVI for April through October during the growing season.[19] This curve shows the annual changes and long-term trends in the NDVI for the growing season. This metric is used to analyze year-to-year changes and long-term trends in NDVI.

NDVI maps or air photos are included on the time-series charts for spatial reference and as a visual check on the interpretations derived from the time-series charts. The air photos are for 2022, 2023, 2024, and 2025, showing the last four years using the high-resolution air photos collected for the PBHSP.

To statistically characterize long-term trends in NDVI, the Mann-Kendall statistical trend test (Mann-Kendall test) was performed on the Average Growing-Season NDVI for all defined areas over the following three periods:

- 1984 to 2025: the entire period of record
- 1984 to 2006: period prior to Peace II Agreement implementation
- 2007 to 2025: period subsequent to Peace II Agreement implementation

[17] Each NDVI pixel is approximately 30 x 30 meters.

[18] In early annual reports, these small areas were four NDVI pixels in this same general area. During WY 2020, these areas were modified to one NDVI pixel that aligned with the USBR vegetation survey so that the field vegetation survey data better correlates with the NDVI time-series data.

[19] In previous reports, the Average Growing Season NDVI was the average for March through October. During WY 2025, this metric was revised to April through October to exclude the early to mid-March period where vegetation is still dormant and then beginning to transition to active growth.

The Mann-Kendall test utilizes a ranking formula to statistically analyze if there is an increasing trend, decreasing trend, or no trend in the NDVI. Appendix B describes the Mann-Kendall test methods and results. The final Mann-Kendall test results for the Average Growing-Season NDVI are shown on each time-series chart and are summarized in Table 3-1 below.

Table 3-1. Mann-Kendall Test Results of the Average Growing-Season NDVI Trends for Defined Areas in the Prado Basin

Defined Area	Figure Number	Mann-Kendall Test Result[(a)]		
		Period of Record 1984-2025	Prior to Peace II 1984-2006	Post-Peace II 2007-2025
Riparian Vegetation Extent	3-5	No Trend	No Trend	No Trend
Chino Creek	3-6	Increasing	Increasing	Increasing
Mill Creek	3-7a	No Trend	Decreasing	Increasing
Upper Mill Creek	3-7b	Increasing	No Trend	Increasing
CC-1	3-8a	Increasing	Increasing	Increasing
CC-2	3-8b	Increasing	Increasing	Increasing
CC-3	3-8c	Increasing	Increasing	Increasing
CC-4	3-8d	Increasing	No Trend	Increasing
MC-1	3-8e	Increasing	Increasing	Increasing
MC-2	3-8f	No Trend	No Trend	Increasing
MC-3	3-8g	Increasing	No Trend	Increasing
MC-4	3-8h	Increasing	No Trend	No Trend
MC-5	3-8i	No Trend	No Trend	Increasing
MC-6	3-8j	Increasing	Decreasing	Increasing
SAR-2	3-8k	Increasing	Decreasing	Increasing
SAR-3	3-8l	Increasing	No Trend	Increasing
SAR-4	3-8m	Increasing	No Trend	Increasing

(a) See Appendix B for a description of the Mann-Kendall statistical trend test and results.

To characterize the short-term trends in NDVI, Table 3-2 summarizes the one-year change in the Average Growing-Season NDVI from 2024 to 2025 at the 17 defined areas and compares it to the changes and variability in Average Growing-Season NDVI over the historical period of 1984 to 2024 at each area. From WY 2024 to WY 2025, NDVI at most of the defined areas increased or did not change— 12 areas increased, three areas showed no change, and two areas decreased. These one-year changes in the Average Growing-Season NDVI are all minor and within the range of long-term annual variability of the NDVI at each area.

DRAFT

Table 3-2. Characterization of Variability in the Average-Growing Season NDVI for Defined Areas in the Prado Basin

Defined Area	Figure Number	Historical NDVI Statistics 1984-2024		One-Year Change in NDVI from 2024-2025
		Average One-Year Change in NDVI (Absolute Value)	Maximum One-Year Change in NDVI (Absolute Value)	
Riparian Vegetation Extent	3-5	0.03	0.08	0.00
Chino Creek	3-6	0.02	0.07	0.01
Mill Creek	3-7a	0.03	0.10	0.00
Upper Mill Creek	3-7b	0.03	0.12	0.02
CC-1	3-8a	0.03	0.08	0.01
CC-2	3-8b	0.03	0.12	0.02
CC-3	3-8c	0.03	0.12	0.01
CC-4	3-8d	0.03	0.11	0.01
MC-1	3-8e	0.04	0.12	0.00
MC-2	3-8f	0.06	0.17	0.06
MC-3	3-8g	0.03	0.12	0.01
MC-4	3-8h	0.03	0.12	-0.01
MC-5	3-8i	0.04	0.11	-0.02
MC-6	3-8j	0.05	0.22	0.04
SAR-2	3-8k	0.04	0.13	0.02
SAR-3	3-8l	0.02	0.10	0.03
SAR-4	3-8m	0.05	0.15	0.02

3.1.2.3 Temporal Analysis of NDVI in Prado Basin

Figure 3-5 is a time-series chart from 1984 to 2025 of the spatial average of all 19,520 NDVI pixels within the maximum extent of the riparian habitat in the Prado Basin.[20] The intent of this time series is to characterize trends in NDVI for the Prado Basin as a whole, which is used as a basis of comparison to the trends in NDVI for each of the smaller defined areas shown in subsequent figures. Instead of air photos like the time series charts in Figures 3-6, 3-7a, 3-7b, and 3-8a through 3-8m, Figure 3-5 includes NDVI maps from 2022, 2023, 2024 and 2025, to visually compare to the NDVI time series.

Figure 3-5 and Tables 3-1 and 3-2 show that the Average Growing-Season NDVI for the entire Prado Basin varies from year-to-year by no more than 0.08 with no apparent long-term trends. The Mann-Kendall test result on the Average Growing-Season NDVI indicates "no trend" over the 1984 to 2025 period, the 1984 to 2006 period, and the 2007 to 2025 period.

From 2024 to 2025, the Average Growing-Season NDVI remained the same. This time-series analysis of NDVI suggests that the riparian habitat in Prado Basin, analyzed as a whole, has not experienced

[20] The maximum extent of the riparian habitat in the Prado Basin is based on 1999 conditions and has been relatively stable since in the Chino Creek, Mill Creek, and SAR reaches, and has been verified by inspection of the 2017 to 2025 high-resolution air photos.

statistically significant declines in NDVI in the recent water year, nor during the post-Peace II Agreement period from 2007 to 2025.

3.1.2.4 Temporal Analysis of NDVI within Large Areas along Chino Creek and Mill Creek

Figures 3-6, 3-7a, and 3-7b are time-series charts from 1984 to 2025 of the spatial average for NDVI pixels within large areas of riparian habitat located along the reaches of Chino Creek, Mill Creek, and Upper Mill Creek, respectively. These charts characterize trends and changes in NDVI for these northern reaches of the riparian habitat in the Prado Basin and provide a basis for comparison to the NDVI trends and changes for each of the smaller defined areas.

Chino Creek

Figure 3-6 is an NDVI time-series chart for 1984 to 2025 of the spatial average of all 2,134 NDVI pixels along the upper portion of Chino Creek in the Prado Basin. This reach of Chino Creek may be susceptible to impacts from declining groundwater levels associated with Peace II implementation.

Figure 3-6 and Tables 3-1 and 3-2 show that over the period of record, the Average Growing-Season NDVI varied from year-to-year by no more than 0.07 with a long-term increasing trend. The Mann-Kendall test result on the Average Growing-Season NDVI indicates an "increasing trend" over the 1984 to 2025 period, the 1984 to 2006 period, and the 2007 to 2025 period.

From 2024 to 2025, the Average Growing-Season NDVI increased by 0.01, which is minor and within the historical range of variability of the annual Average Growing-Season NDVI. Visual inspection of the 2024 and 2025 air photos do not show significant changes in the riparian vegetation along Chino Creek.

Mill Creek

Figure 3-7a and Figure 3-7b are NDVI time-series charts for 1984-2025 of the spatial average for two areas of Mill Creek: the entire reach of Mill Creek (759 NDVI pixels) and the upper portion of Mill Creek (92 NDVI pixels). The Upper Mill Creek area is more susceptible to impacts from declining groundwater levels associated with Peace II implementation and was added for the analysis of NDVI time-series in the 2022 Annual Report.

Figure 3-7a and Tables 3-1 and 3-2 show that for the entire Mill Creek extent, the Average Growing-Season NDVI varied from year-to-year by no more than 0.10 over the period of record. The Mann-Kendall test result on the Average Growing-Season NDVI indicates "no trend" over the 1984 to 2025 period, "decreasing trend" over the 1984 to 2006 period, and "increasing" over the 2007 to 2025 period. From 2024 to 2025, the Average Growing-Season NDVI remained the same. Review of the 2024 and 2025 air photos show a slight increase in green vegetation throughout this area.

Figure 3-7b and Tables 3-1 and 3-2 show that for the Upper Mill Creek reach, the Average Growing-Season NDVI varied from year-to-year by no more than 0.12 over the period of record. The Mann-Kendall test result on the Average Growing-Season NDVI indicates an "increasing trend" over the 1984 to 2025 period, "no trend" over the 1984 to 2006 period, and an "increasing trend" over the 2007 to 2025 period. From 2024 to 2025, the Average Growing-Season NDVI increased by 0.02 which is within the historical range of the annual Average Growing-Season NDVI variability for the Upper Mill Creek area. Comparison of the 2024 and 2025 air photos show a slight increase in green vegetation throughout this area.

DRAFT

117°40'0"W

34°0'0"N

Defined Area Analyzed for NDVI Temporally in Time-Series Chart

6.8 square-mile area (19,520 NDVI pixels) Riparian Vegetation Extent (Figure 3-5)

0.74 square-mile area (2,134 NDVI pixels) in Chino Creek (Figure 3-6)

0.26 square-mile area (759 NDVI pixels) in Mill Creek, inclusive of 0.03 square-mile area (92 NDVI pixels) in Upper Mill Creek area in purple (Figures 3-7a and 3-7b)

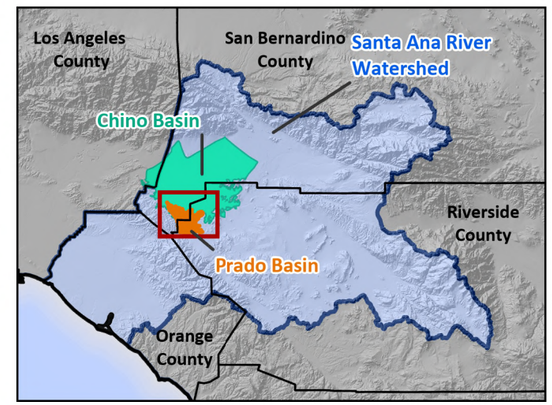
30 x 30-meter area (one NDVI pixel) (Figures 3-8a through 3-8n)

PBHSP Monitoring Well Site

Chino Desalter Well

Concrete-Lined Channels

Unlined Rivers and Streams



Prepared by:

WEST YOST

0 1 2 Miles

0 1 2 Km

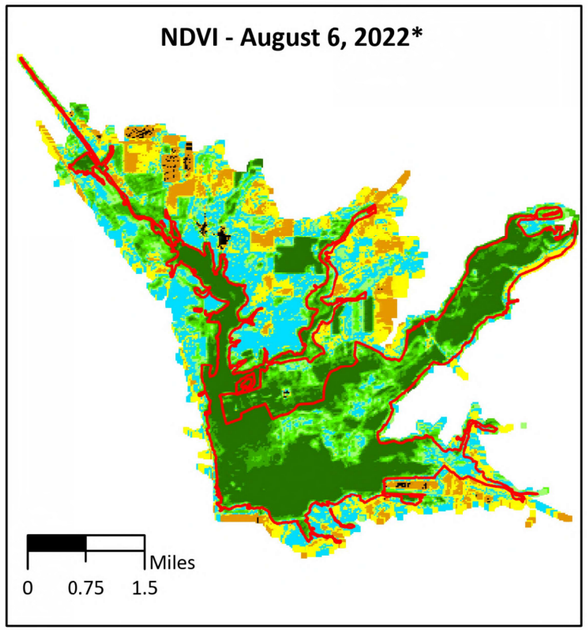
Prepared for:

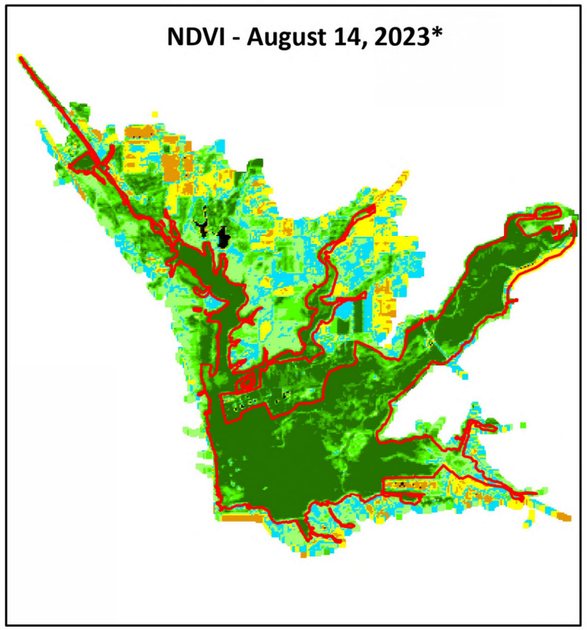
Prado Basin Habitat Sustainability Committee
2025 Annual Report

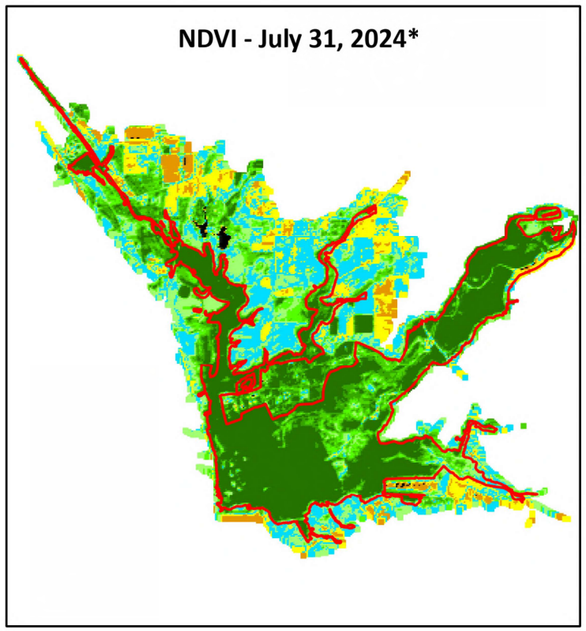
Areas for Analysis of NDVI Time Series

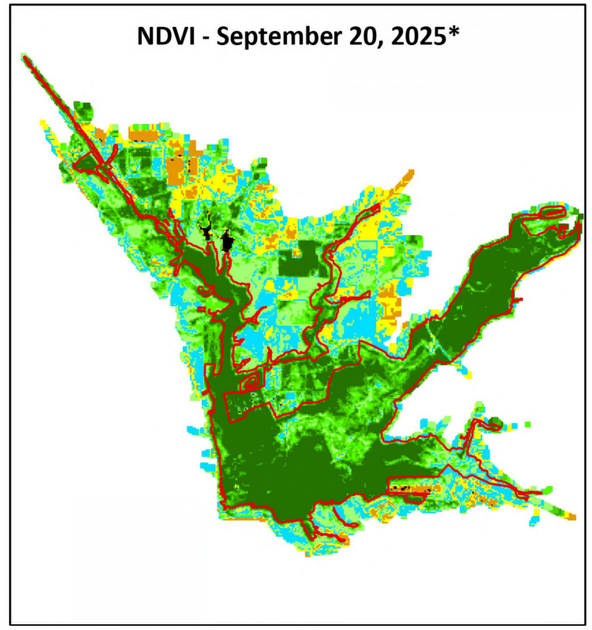
Figure 3-4

WEST YOST - K:\Clients\1941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1 General Overview.aprx - VMW - Date: 4/20/2026









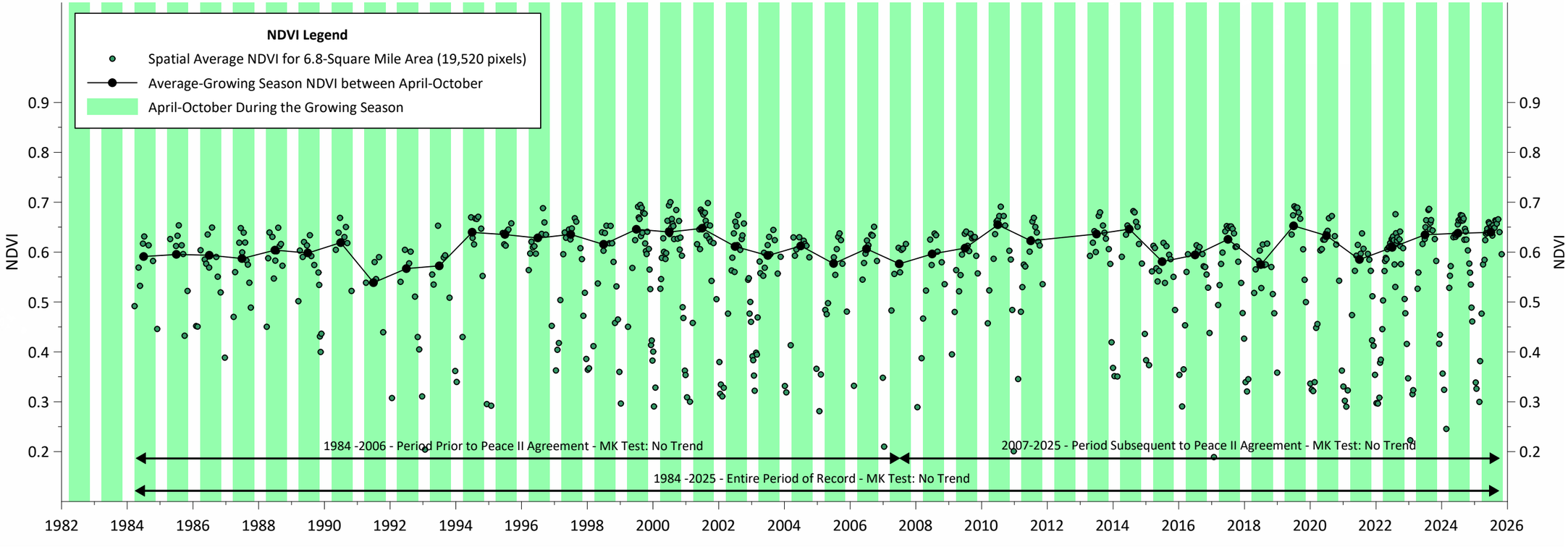
* Maximum Growing-Season NDVI

Map Legend:

NDVI

- > -1 and ≤ 0
- > 0 and ≤ 0.1
- > 0.1 and ≤ 0.2
- > 0.2 and ≤ 0.3
- > 0.3 and ≤ 0.4
- > 0.4 and ≤ 0.5
- > 0.5 and ≤ 0.6
- > 0.6 and ≤ 0.7
- > 0.7 and ≤ 1

Maximum Riparian Vegetation Extent



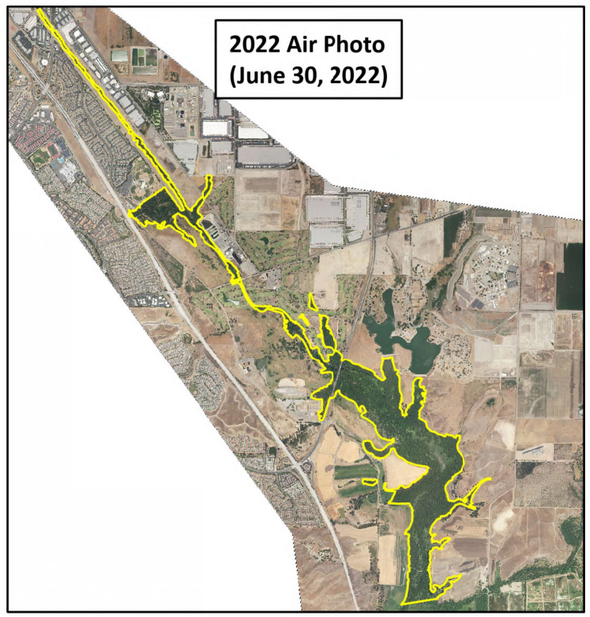
Prepared by: WEST YOST Water. Engineered

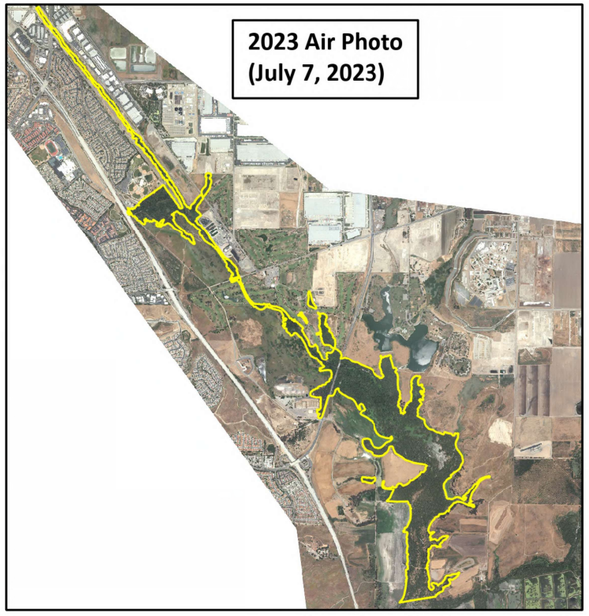
Prepared for: Prado Basin Habitat Sustainability Committee

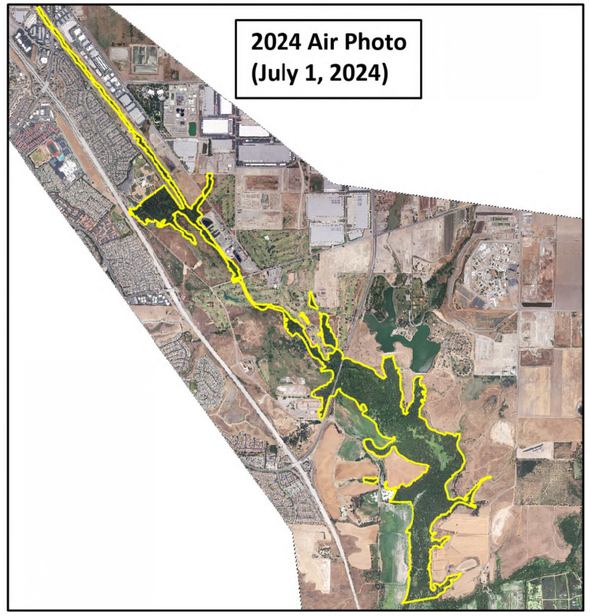
Time Series of NDVI for the Riparian Vegetation Extent

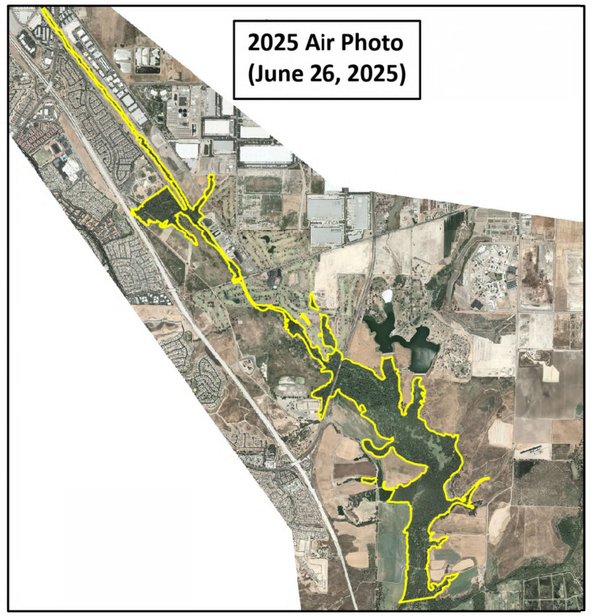
1984 to 2025

Figure 3-5





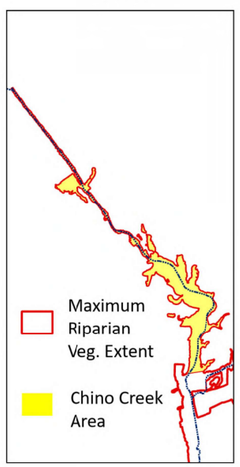


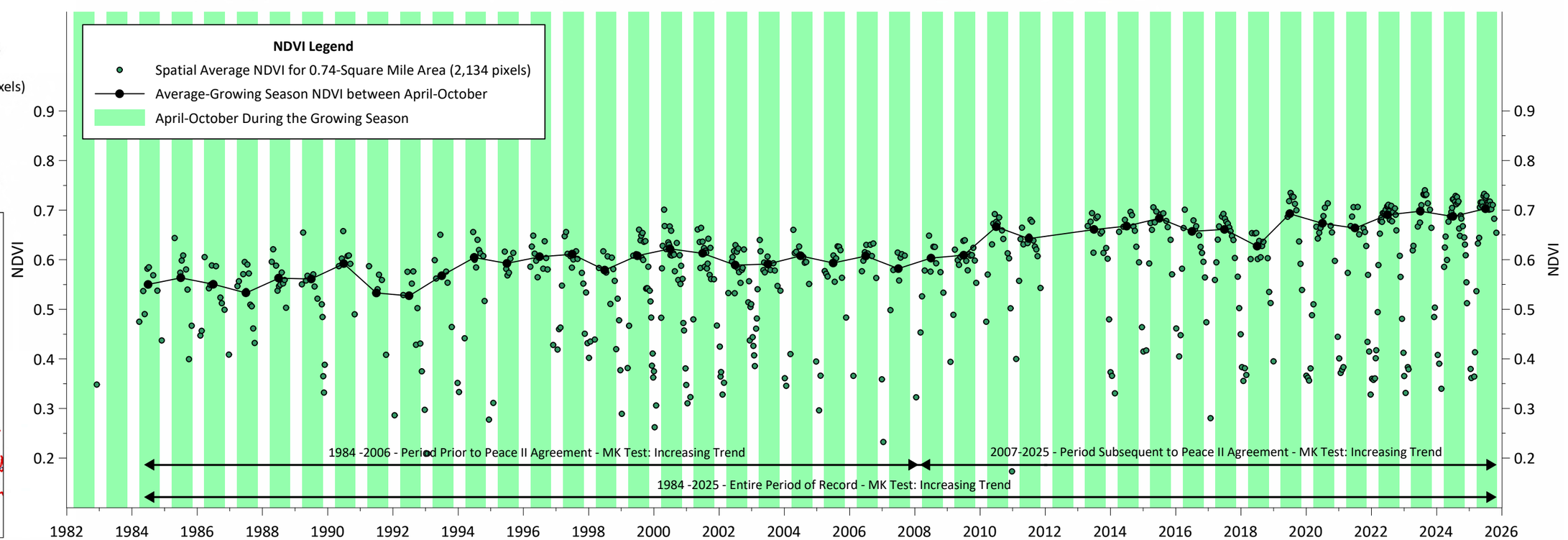


Miles
0 0.5 1

0.74 Square Mile Area (2,134 30 x 30-meter pixels)

Location of Chino Creek Area



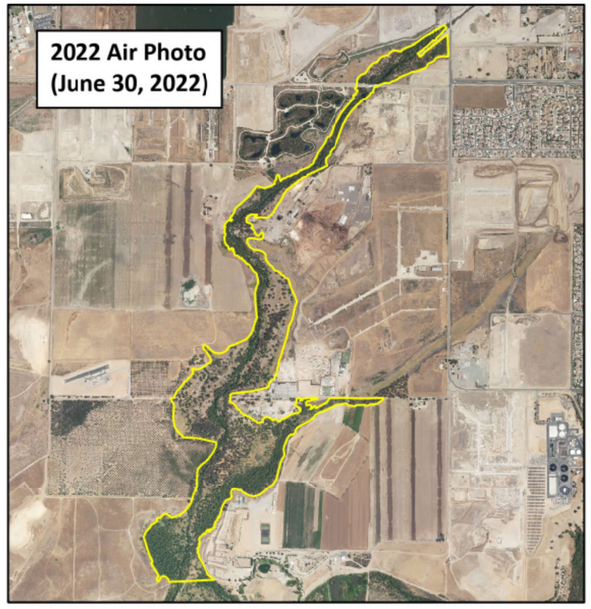


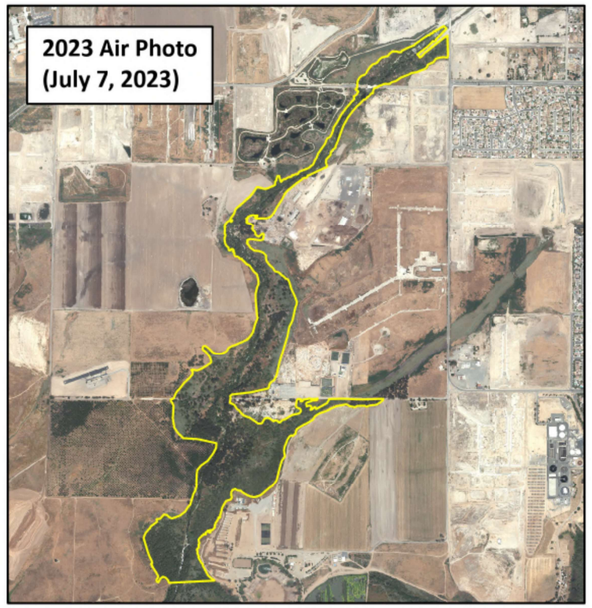
Prepared by:
WEST YOST
Water. Engineered

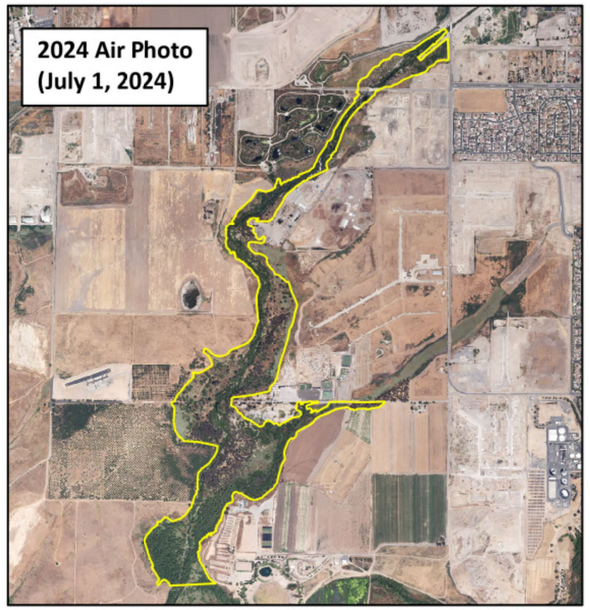
Prepared for:
Prado Basin Habitat Sustainability Committee
2025 Annual Report

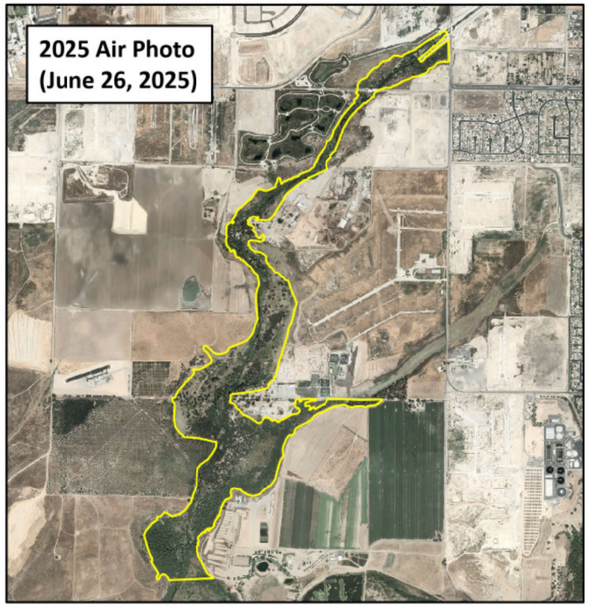
Time Series of NDVI and Air Photos
Along Chino Creek Area for 1984 to 2025

Figure 3-6





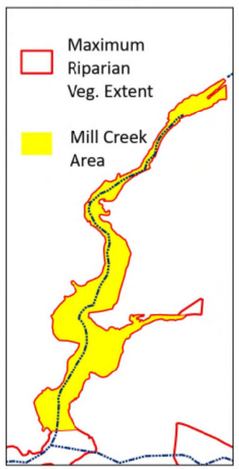


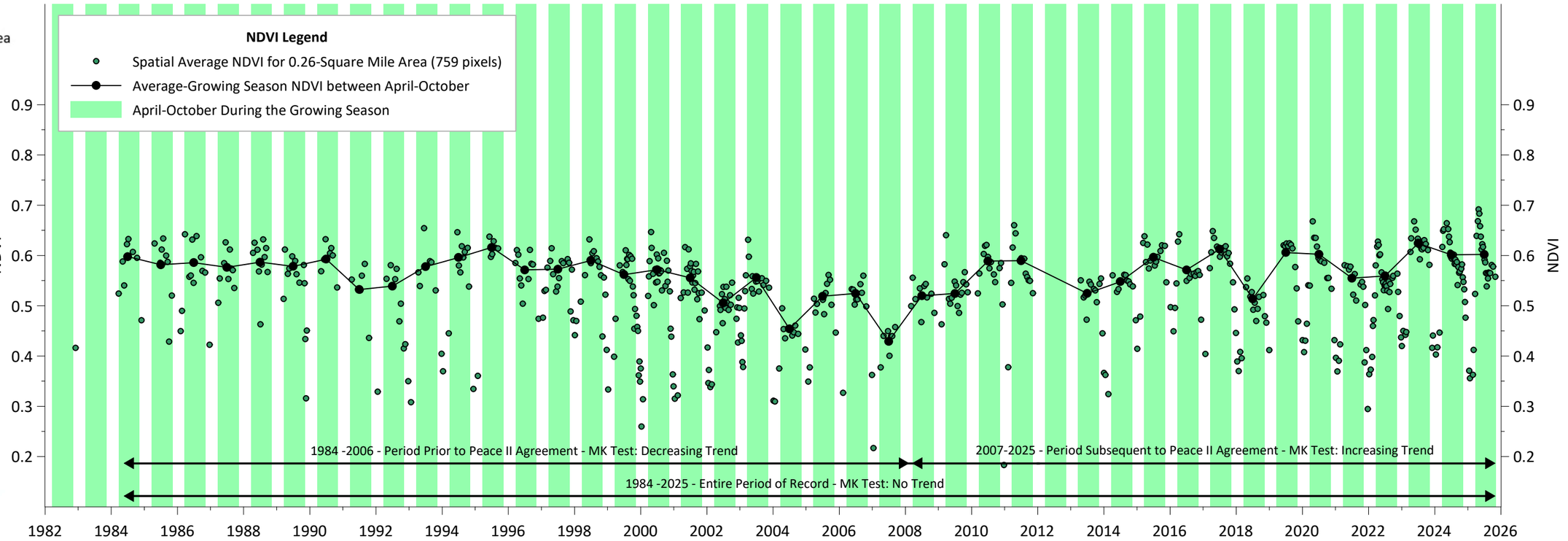


Miles
0 0.5 1

0.26 Square Mile Area (759 30 x 30-meter pixels)

Location of Mill Creek Area



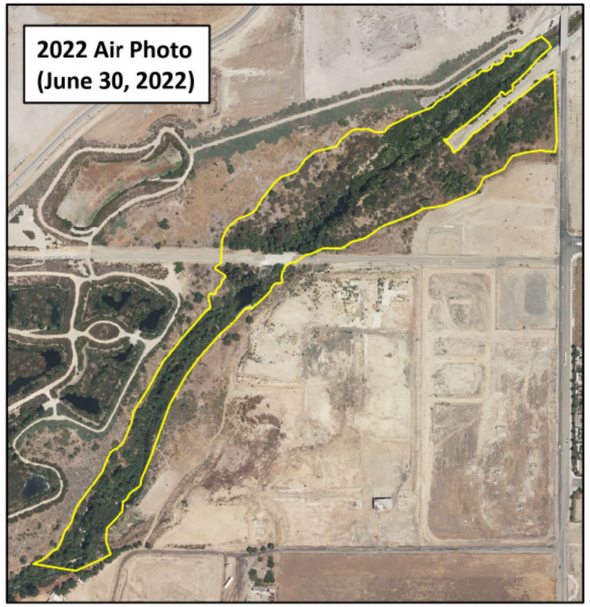


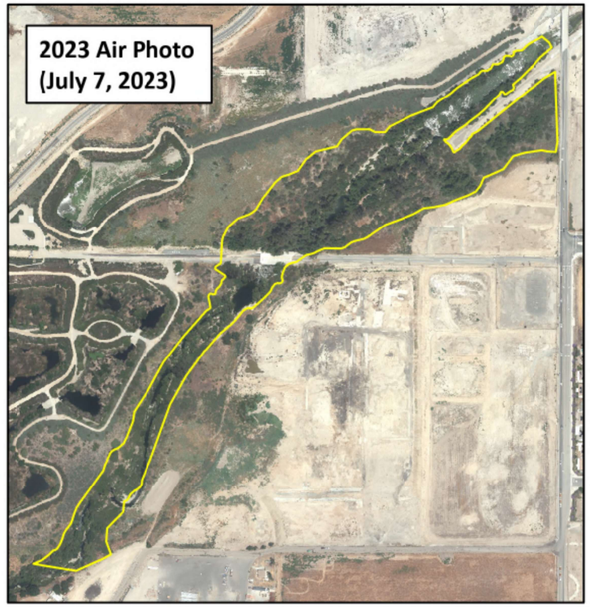
Prepared by:
WEST YOST
Water. Engineered

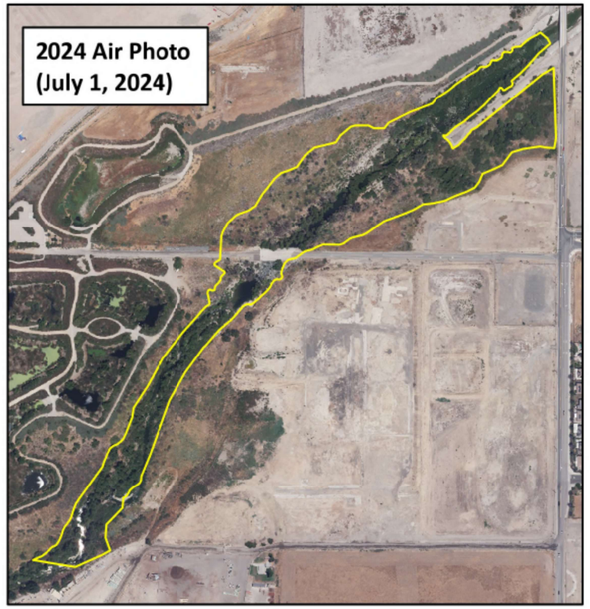
Prepared for:

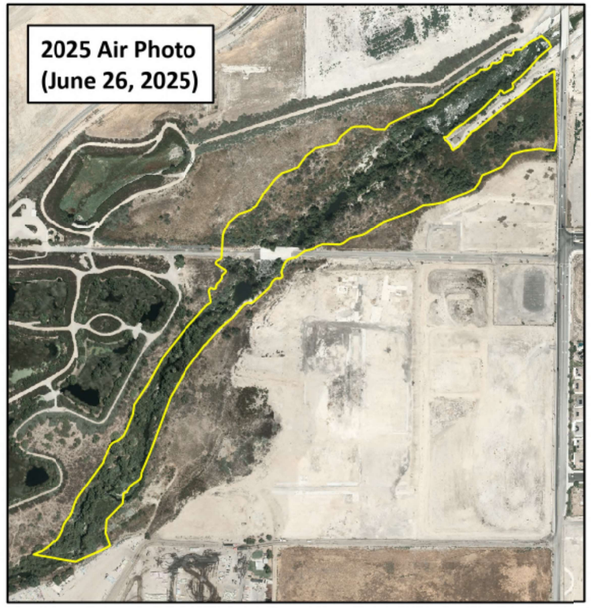
Time Series of NDVI and Air Photos
Along Mill Creek Area for 1984 to 2025

Figure 3-7a





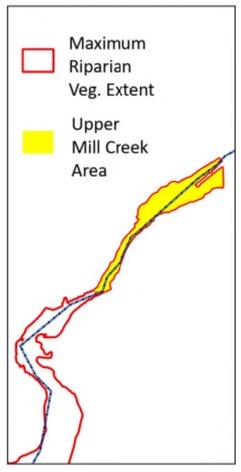


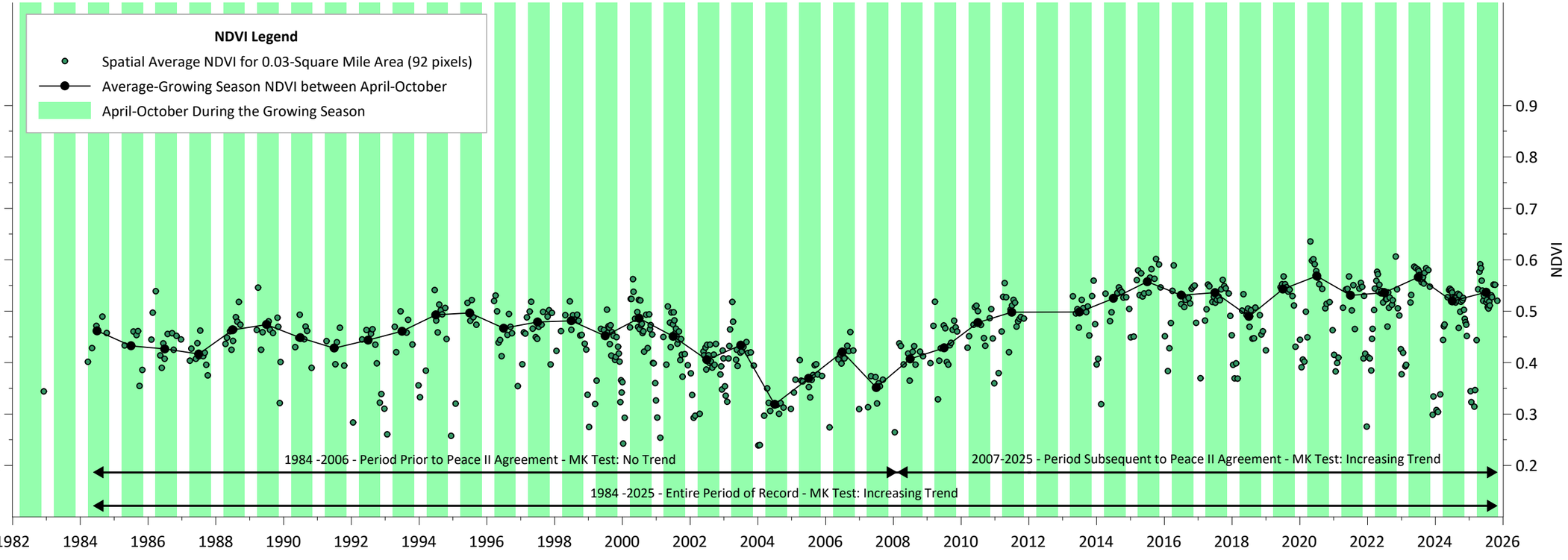


Miles
0 0.5 1

0.03 Square Mile Area (92 30 x 30-meter pixels)

Location of Upper Mill Creek Area





Prepared by: WEST YOST Water. Engineered.

Prepared for: Chino Basin Watermaster — Partners in Basin Management

Time Series of NDVI and Air Photos
Along Upper Mill Creek Area for 1984 to 2025

Figure 3-7b

3.1.2.5 Temporal Analysis of NDVI within Small Areas along Chino Creek, Mill Creek, and the Santa Ana River

Figures 3-8a through 3-8m are time-series charts of the NDVI for one NDVI pixel for the small defined areas located along Chino Creek, Mill Creek, and the SAR near the PBHSP monitoring wells from 1984 to 2025. These areas are located near a PBHSP monitoring well site to facilitate the comparison of changes in groundwater levels versus changes in the riparian habitat. Additionally, these small areas align with a 10-meter radius plot where vegetation surveys are conducted every three years allowing comparison of the field measurements with the NDVI. The measurements of percent canopy cover from the periodic vegetation surveys are included on these time series, and discussed further in Section 3.1.3

The purpose of these charts is to characterize long-term trends and short-term changes in NDVI for smaller areas primarily located along the northern stream reaches of the Prado Basin riparian habitat—areas that are most susceptible to potential impacts from declining groundwater levels associated with Peace II implementation and provide a basis for comparison to the NDVI trends and changes for each of the larger defined areas.

Chino Creek **(Figures 3-8a to 3-8d)**. Four vegetated areas were analyzed along Chino Creek: CC-1, CC-2, CC-3, and CC-4 (see Figure 3-4 for locations). These figures, and Tables 3-1 and 3-2, show that over the period of record the Average Growing-Season NDVI varied from year-to-year by up to 0.12 with no long-term declining trends. For all four areas, the Mann-Kendall test result on the Average Growing-Season NDVI indicates an "increasing trend" over the 1984 to 2025 period, "no trend" or "increasing trend" over the 1984 to 2006 period, and an "increasing trend" over the 2007 to 2025 period.

For these four areas along Chino Creek, the Average Growing-Season NDVI from 2024 to 2025 increased slightly at all areas. At all the areas, these one-year changes in the Average Growing-Season NDVI are relatively minor (0.01 or 0.02) and within the historical ranges of one-year NDVI variability (see Table 3-2). Visual inspection of the 2024 and 2025 air photos do not show notable changes in the riparian vegetation at these four areas.

Mill Creek **(Figures 3-8e to 3-8j).** Six vegetated areas were analyzed along Mill Creek : MC-1, MC-2, MC-3, MC-4, MC-5, and MC-6 (see Figure 3-4 for locations). The MC-5 and MC-6 areas were incorporated starting with the 2022 Annual Report and correspond to 10-meter radius plots added during the 2022 field vegetation surveys. This addition aimed to enhance monitoring in a region where there has been observed drawdown of groundwater levels since the commencement of PBHSP monitoring. These figures, and Tables 3-1 and 3-2, show that over the period of record the Average Growing-Season NDVI varied year-to-year by up to 0.22 with no long-term declining trends. For all six areas, the Mann-Kendall test result on the Average Growing-Season NDVI indicates: an "increasing trend" or "no trend" for the 1984 to 2025 period; an "increasing trend", "no trend", or "decreasing trend" for the 1984 to 2006 period; and an "increasing trend" or "no trend" for the 2007 to 2025 period.

The Average Growing-Season NDVI from 2024 to 2025 decreased in two of the six areas (MC-4 and MC-5), remained unchanged for one area (MC-1), and increased in three areas (MC-2, MC-3, and MC-6). All the changes in NDVI were minor and remained within the historical ranges of one-year NDVI variability (see Table 3-2). Visual inspection of the 2024 and 2025 air photos show: for the MC-2 and MC-5 areas, there are notable changes in the riparian vegetation, including increases in vegetation coverage and reduction in brown vegetation; and at the other areas (MC-1, MC-3, MC-4, and MC-6) there are no notable changes.

DRAFT

***Santa Ana River* (Figures 3-8k to 3-8m).** Three vegetated areas were analyzed along the floodplain of the SAR: SAR-2, SAR-3, and SAR-4 (see Figure 3-4 for locations). The SAR-4 area was incorporated starting with this 2025 Annual Report and corresponds to a new 10-meter radius plots added during the 2025 field vegetation surveys. These figures, and Tables 3-1 and 3-2, show that over the period of record the Average Growing-Season NDVI varied by up to 0.15 from year-to-year. For all three areas, the Mann-Kendall test result on the Average Growing-Season NDVI indicates an "increasing trend" for the 1984 to 2025 period, "no trend" or a "decreasing trend" for the 1984 to 2006 period, and an "increasing trend" for the 2007 to 2025 period.

The Average Growing-Season NDVI from 2024 to 2025 increased at all three sites. These one-year changes in the Average Growing-Season NDVI are all relatively minor and within the historical ranges of one-year NDVI variability (see Table 3-2), except at SAR-3 the increase was slightly greater than the average one-year change in NDVI over the historical period. Visual inspection of the 2024 and 2025 air photos do not show notable changes in the riparian vegetation at these areas.

DRAFT







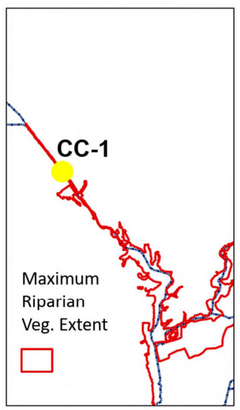


Meters
0 5 10

CC-1 Area for NDVI Analysis 30x30 meter pixel

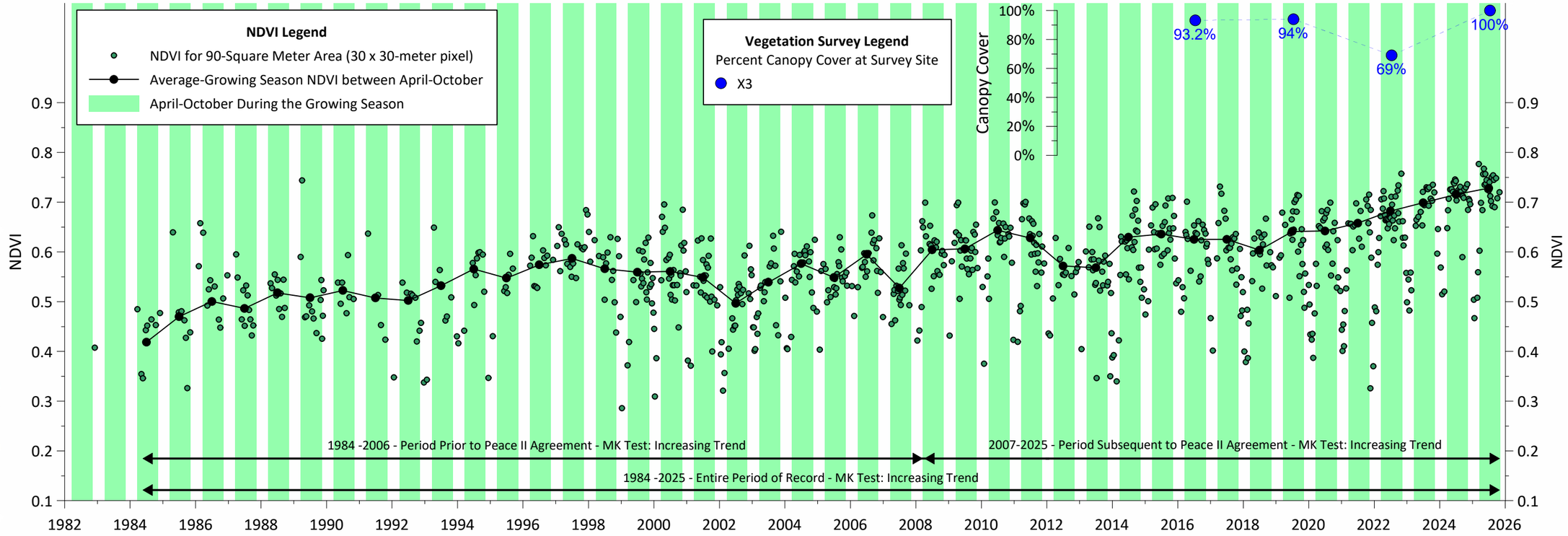
Vegetation Survey Plot Location 10-meter radius

Location Along Chino Creek

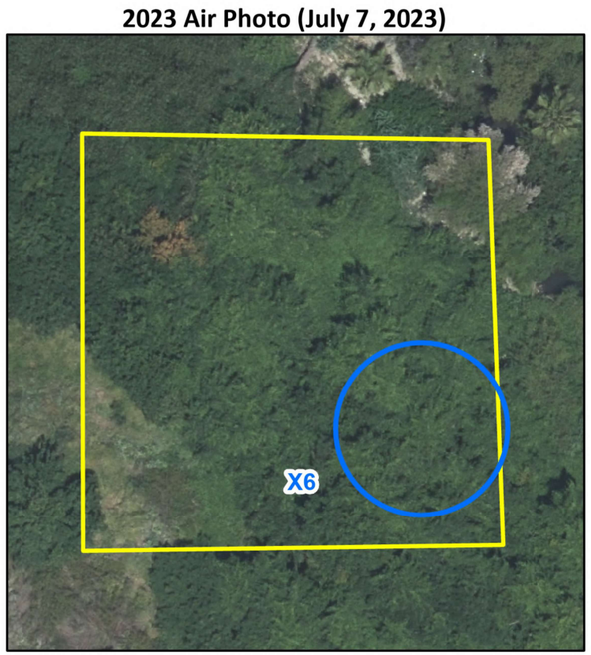


NDVI Legend
- NDVI for 90-Square Meter Area (30 x 30-meter pixel)
- Average-Growing Season NDVI between April-October
- April-October During the Growing Season

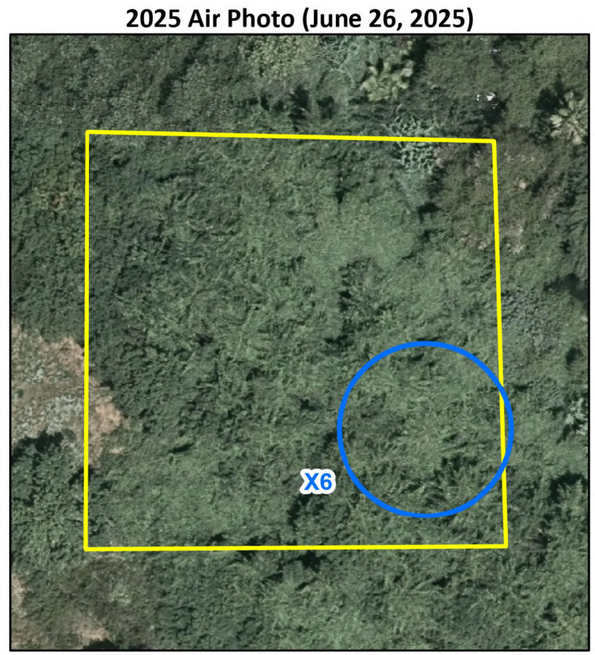
Vegetation Survey Legend
Percent Canopy Cover at Survey Site
- X3









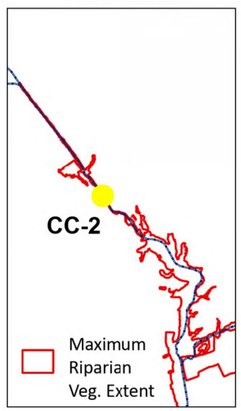


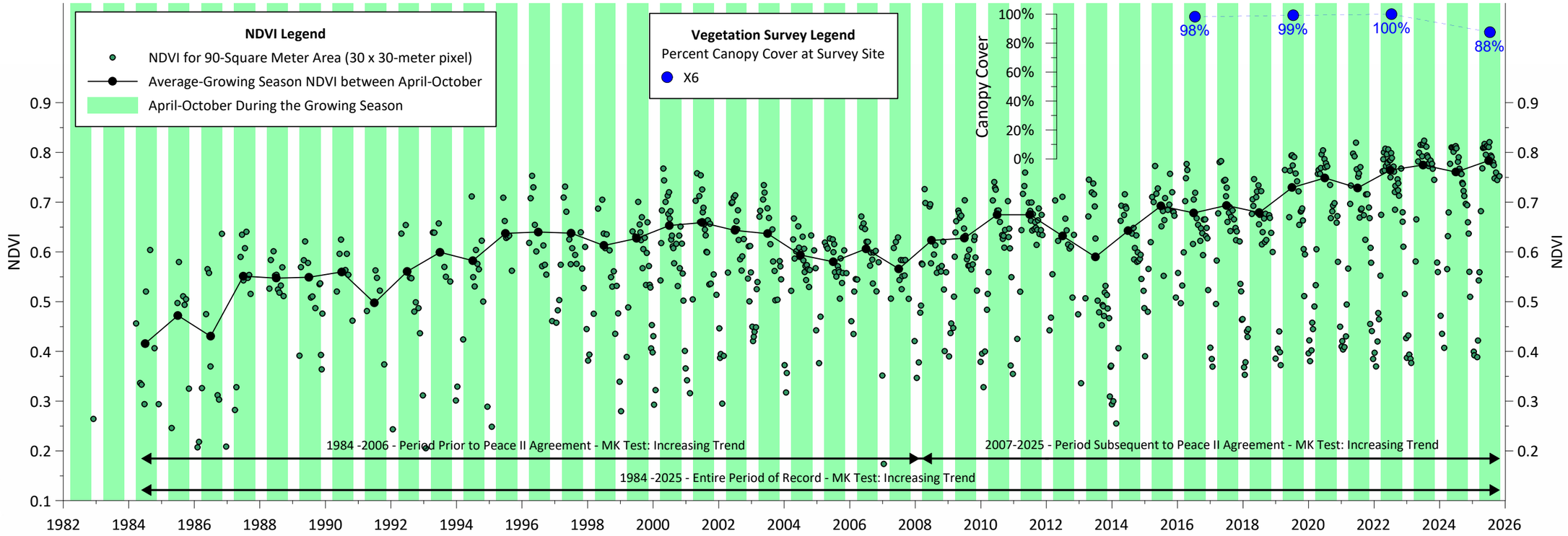
Meters
0 5 10

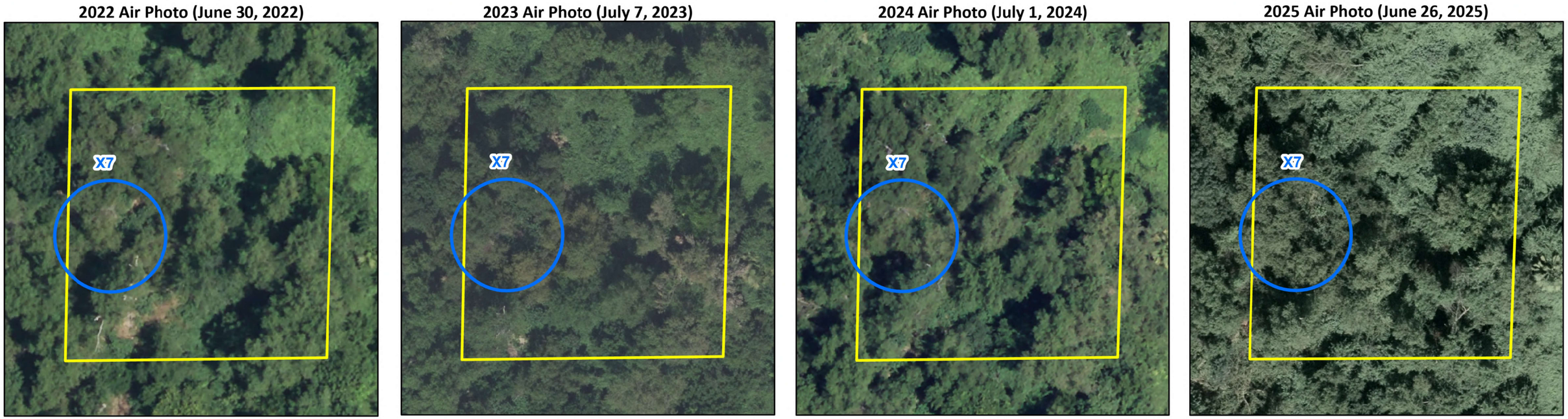
CC-2 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Chino Creek






2022 Air Photo (June 30, 2022)
2023 Air Photo (July 7, 2023)
2024 Air Photo (July 1, 2024)
2025 Air Photo (June 26, 2025)
X7
Meters
0 5 10
CC-3 Area for NDVI Analysis 30x30 meter pixel
Vegetation Survey Plot Location 10-meter radius
Location Along Chino Creek
CC-3
Maximum Riparian Veg. Extent
NDVI Legend
NDVI for 90-Square Meter Area (30 x 30-meter pixel)
Average-Growing Season NDVI between April-October
April-October During the Growing Season
Vegetation Survey Legend
Percent Canopy Cover at Survey Site
X7
Canopy Cover
100%
80%
60%
40%
20%
0%
88%
66%
84%
81%
NDVI
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1984 -2006 - Period Prior to Peace II Agreement - MK Test: Increasing Trend
2007-2025 - Period Subsequent to Peace II Agreement - MK Test: Increasing Trend
1984 -2025 - Entire Period of Record - MK Test: Increasing Trend
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026

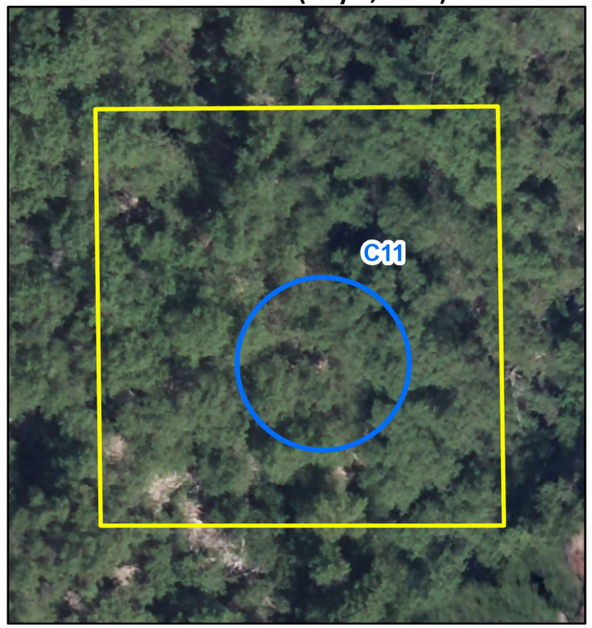
2022 Air Photo (June 30, 2022)



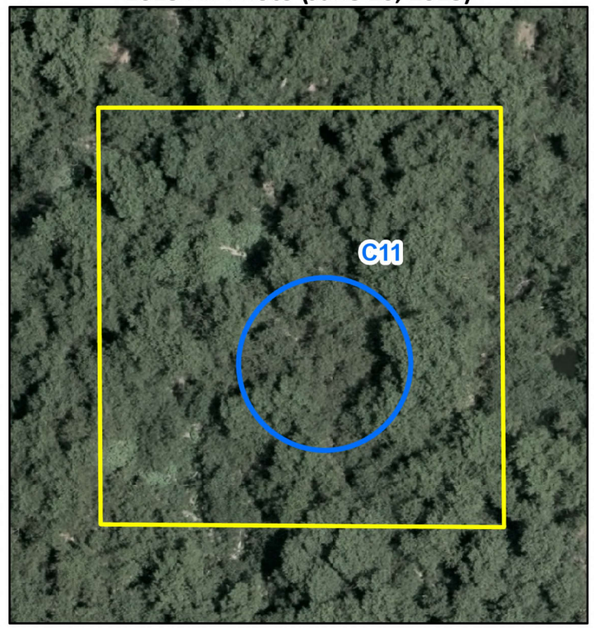
2023 Air Photo (July 7, 2023)



2024 Air Photo (July 1, 2024)



2025 Air Photo (June 26, 2025)

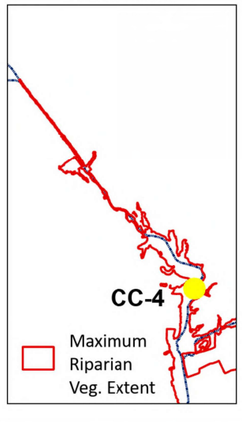


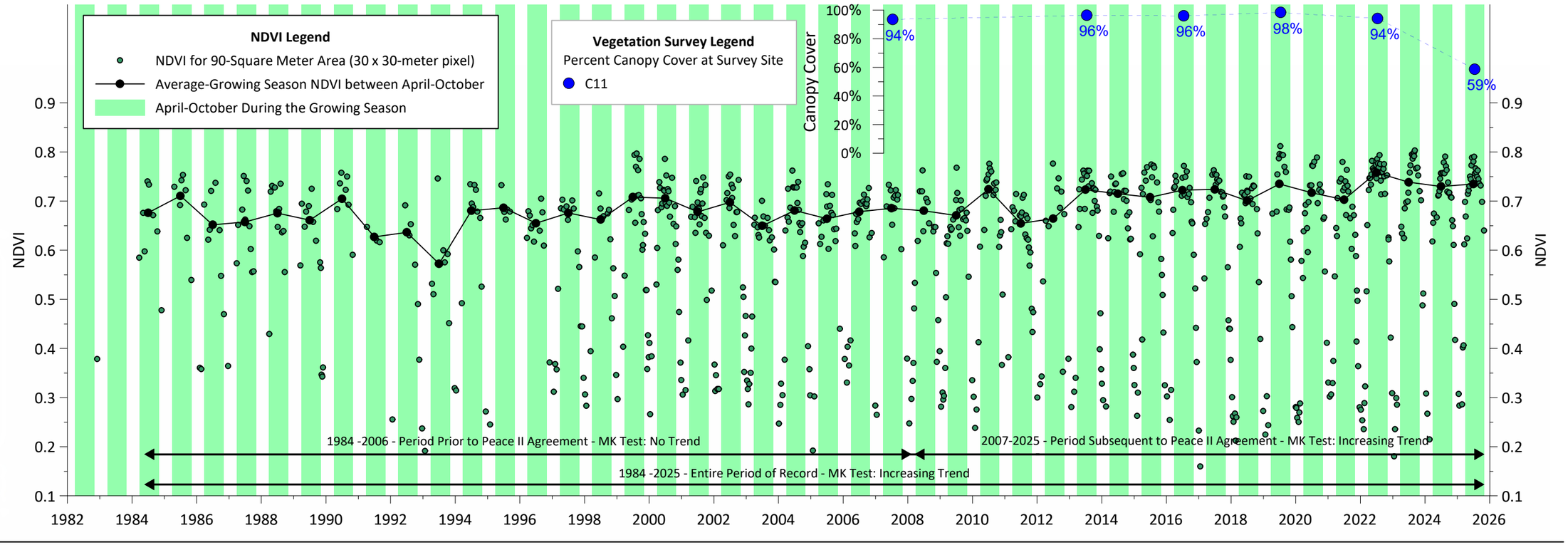
Meters
0 5 10

CC-4 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Chino Creek



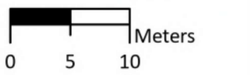








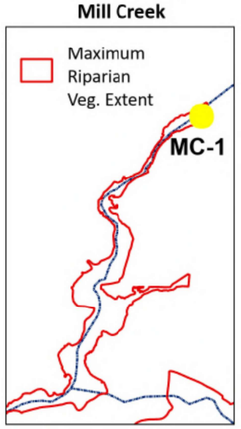


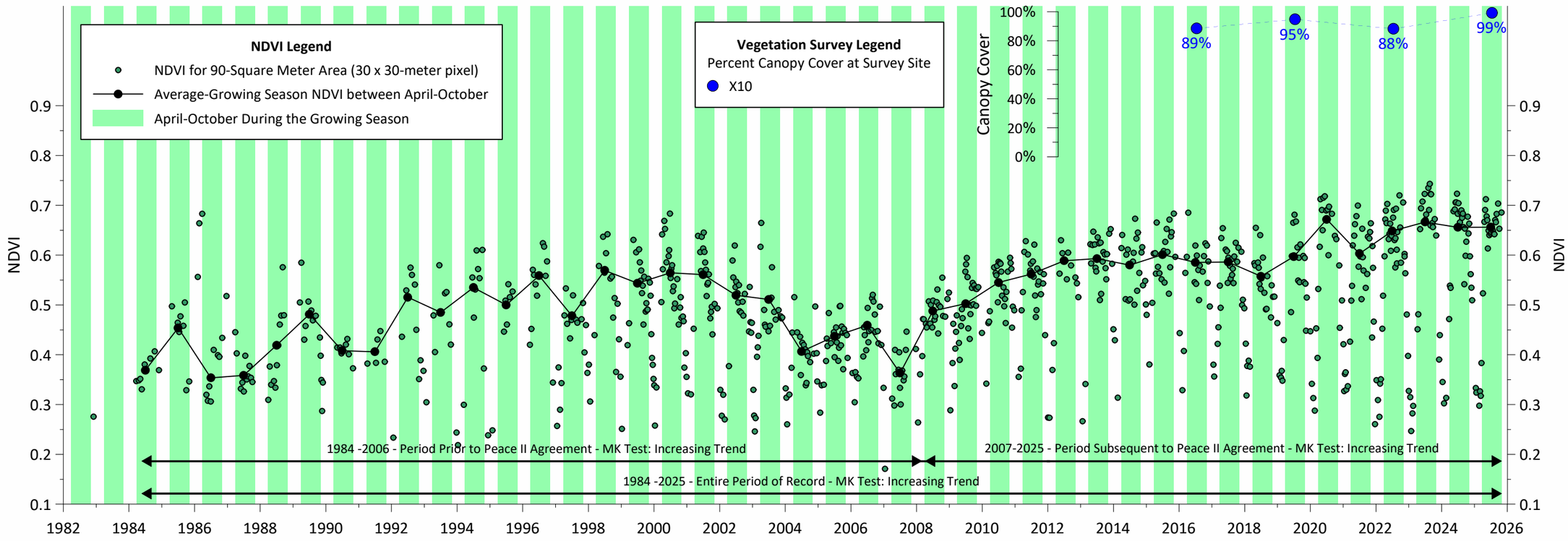


MC-1 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Mill Creek



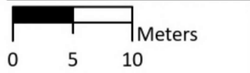








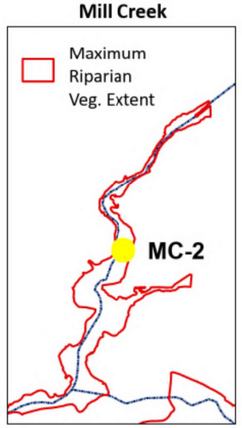




MC-2 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Mill Creek



NDVI Legend

NDVI for 90-Square Meter Area (30 x 30-meter pixel)

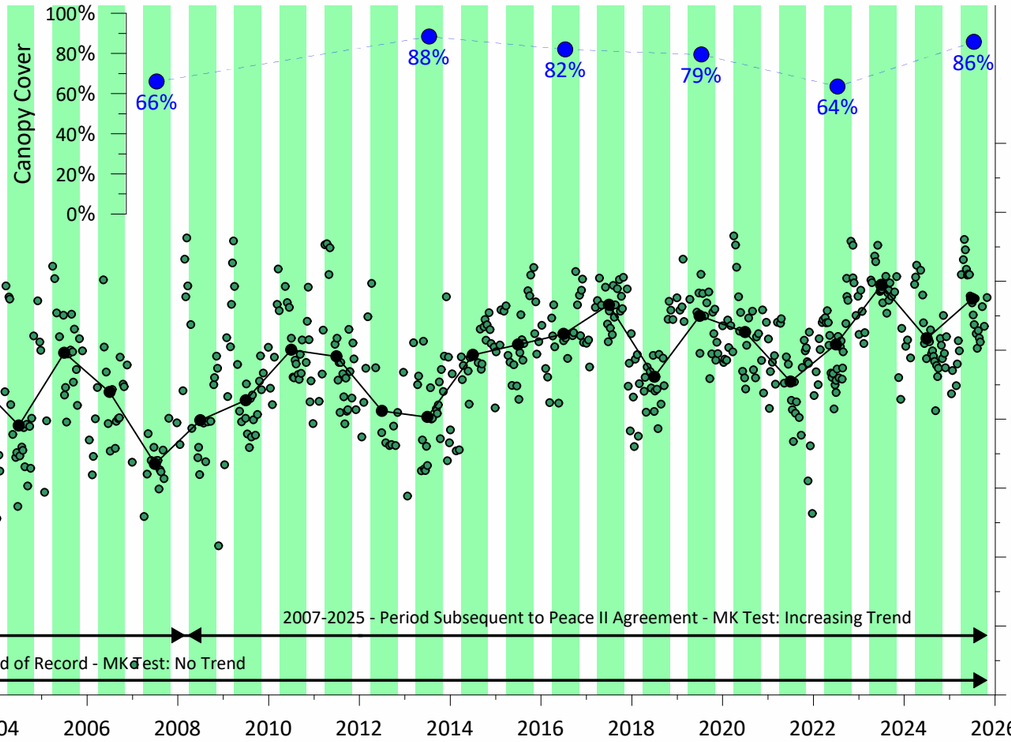
Average-Growing Season NDVI betweeen April-October

April-October During the Growing Season

Vegetation Survey Legend

Percent Canopy Cover at Survey Site

M8









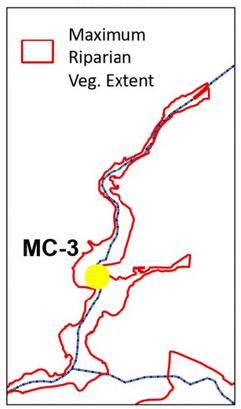


Meters
0 5 10

MC-3 Area for NDVI Analysis 30x30 meter pixel

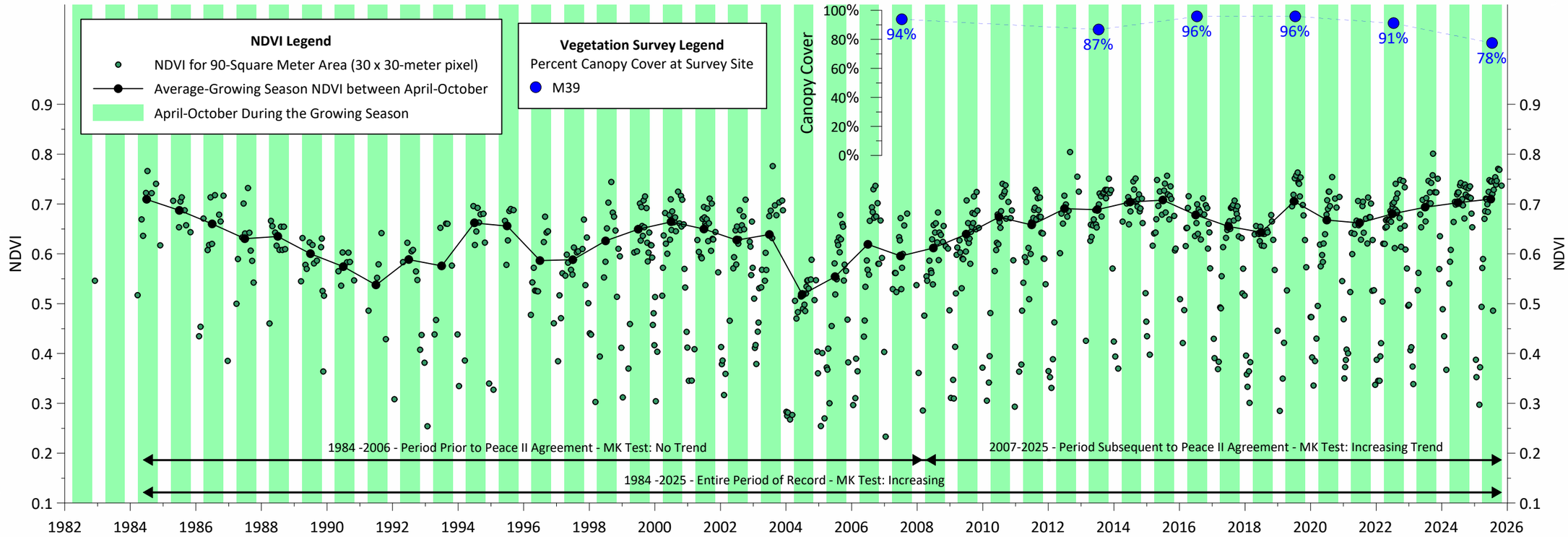
Vegetation Survey Plot Location 10-meter radius

Location Along Mill Creek



NDVI Legend
- NDVI for 90-Square Meter Area (30 x 30-meter pixel)
- Average-Growing Season NDVI between April-October
- April-October During the Growing Season

Vegetation Survey Legend
Percent Canopy Cover at Survey Site
- M39

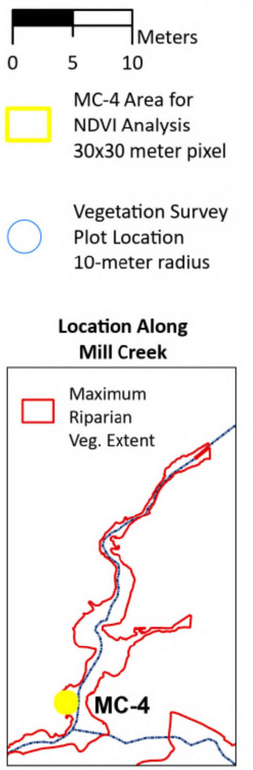


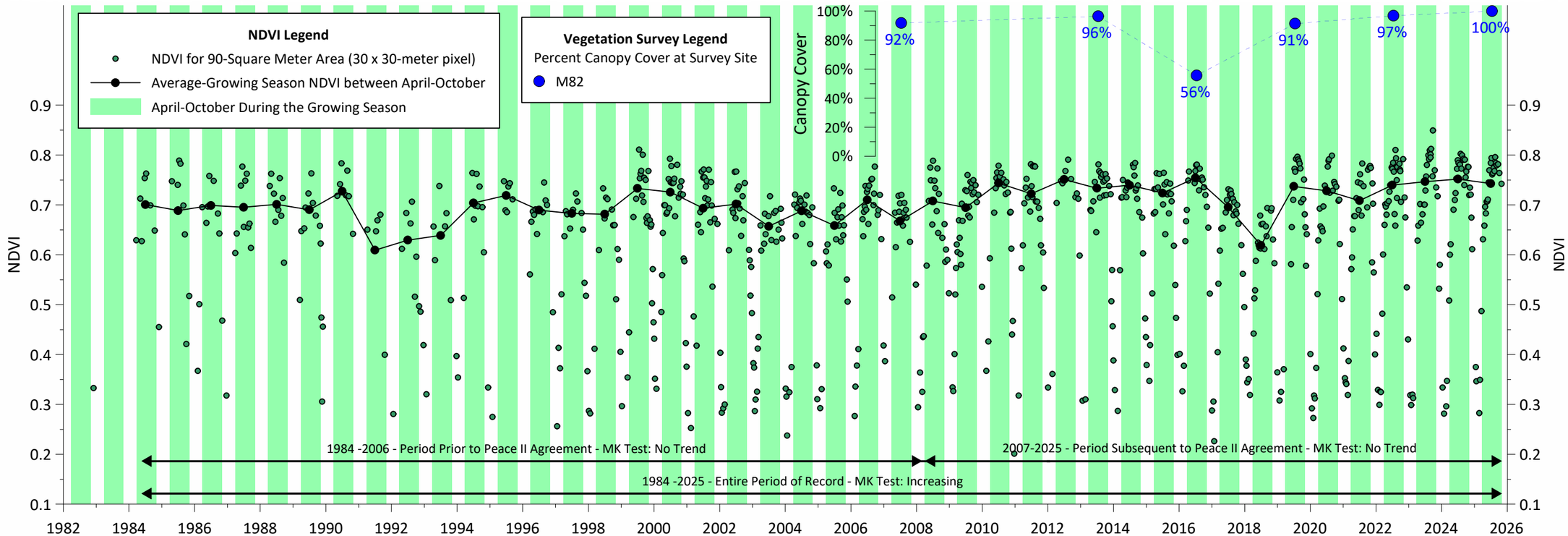

2022 Air Photo (June 30, 2022)
M82


2023 Air Photo (July 7, 2023)
M82

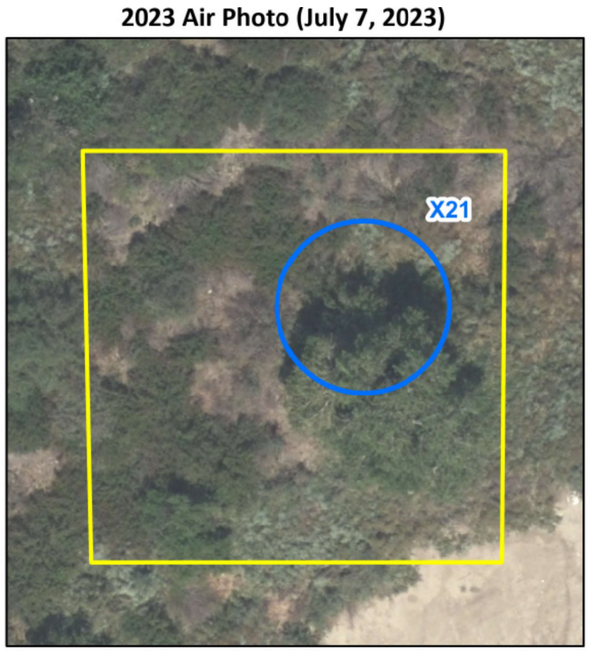

2024 Air Photo (July 1, 2024)
M82


2025 Air Photo (June 26, 2025)
M82


Meters
0
5
10
MC-4 Area for NDVI Analysis 30x30 meter pixel
Vegetation Survey Plot Location 10-meter radius
Location Along Mill Creek
Maximum Riparian Veg. Extent
MC-4

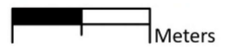

NDVI Legend
NDVI for 90-Square Meter Area (30 x 30-meter pixel)
Average-Growing Season NDVI between April-October
April-October During the Growing Season
Vegetation Survey Legend
Percent Canopy Cover at Survey Site
M82
Canopy Cover
100%
80%
60%
40%
20%
0%
92%
96%
56%
91%
97%
100%
NDVI
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
1984 -2006 - Period Prior to Peace II Agreement - MK Test: No Trend
2007-2025 - Period Subsequent to Peace II Agreement - MK Test: No Trend
1984 -2025 - Entire Period of Record - MK Test: Increasing







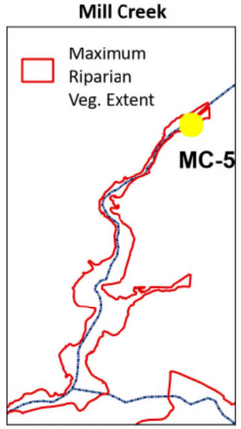


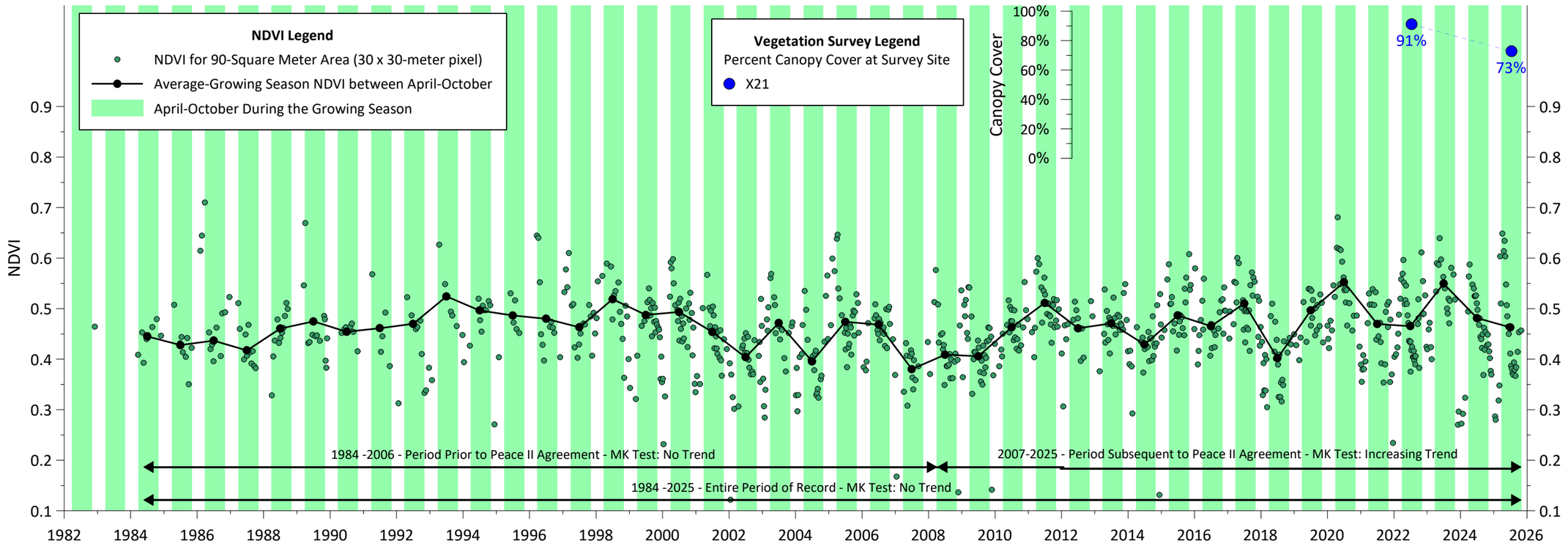


MC-5 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Mill Creek











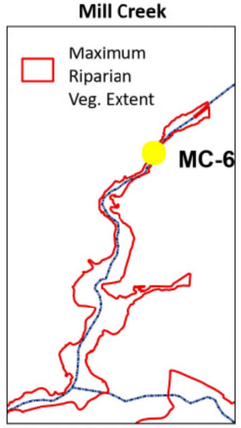


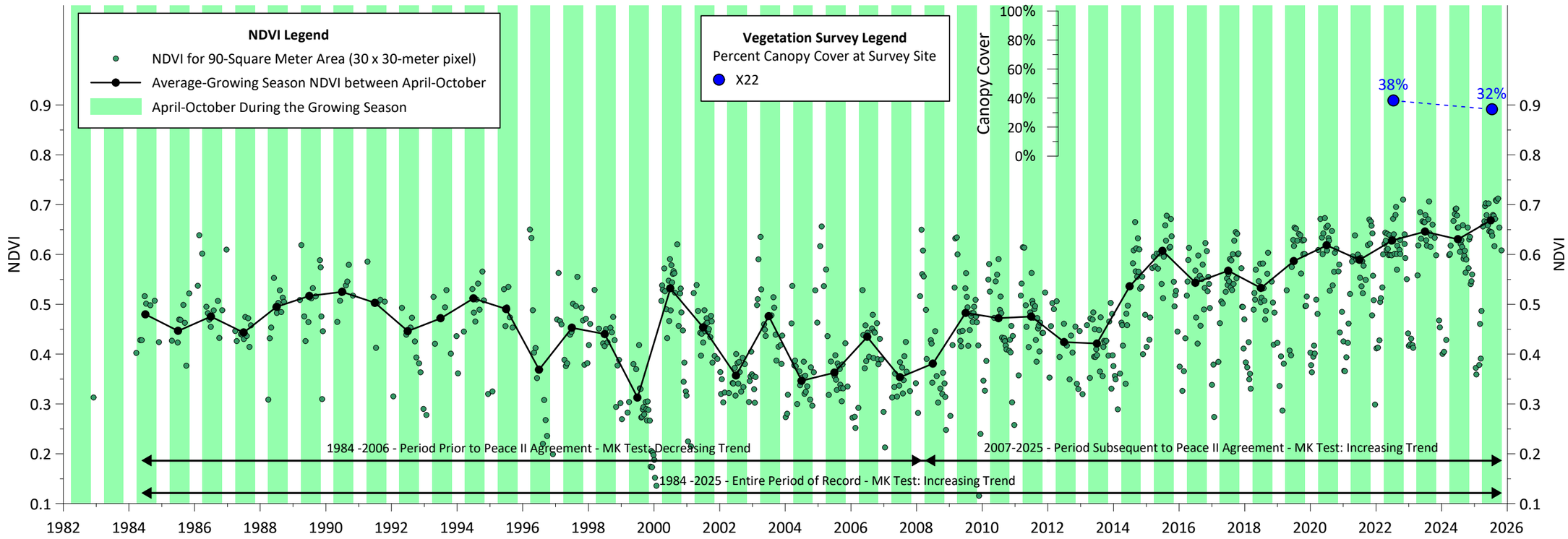
Meters
0 5 10

MC-6 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Mill Creek











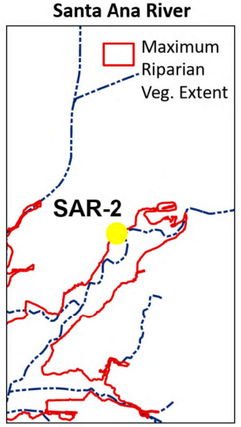


Meters
0 5 10

SAR-2 Area for NDVI Analysis 30x30 meter pixel

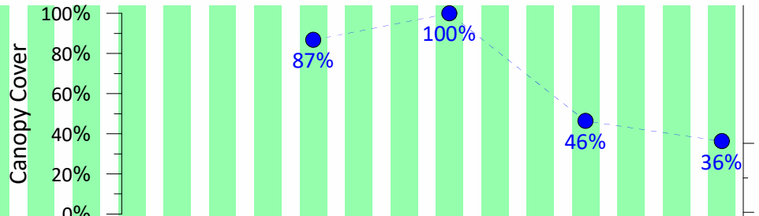
Vegetation Survey Plot Location 10-meter radius

Location Along Santa Ana River



NDVI Legend
- NDVI for 90-Square Meter Area (30 x 30-meter pixel)
- Average-Growing Season NDVI between April-October
- April-October During the Growing Season

Vegetation Survey Legend
Percent Canopy at Survey Site
- X13









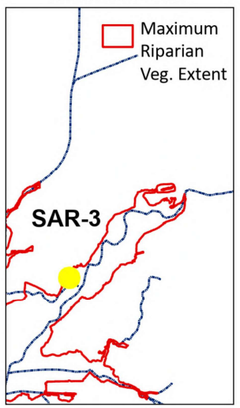


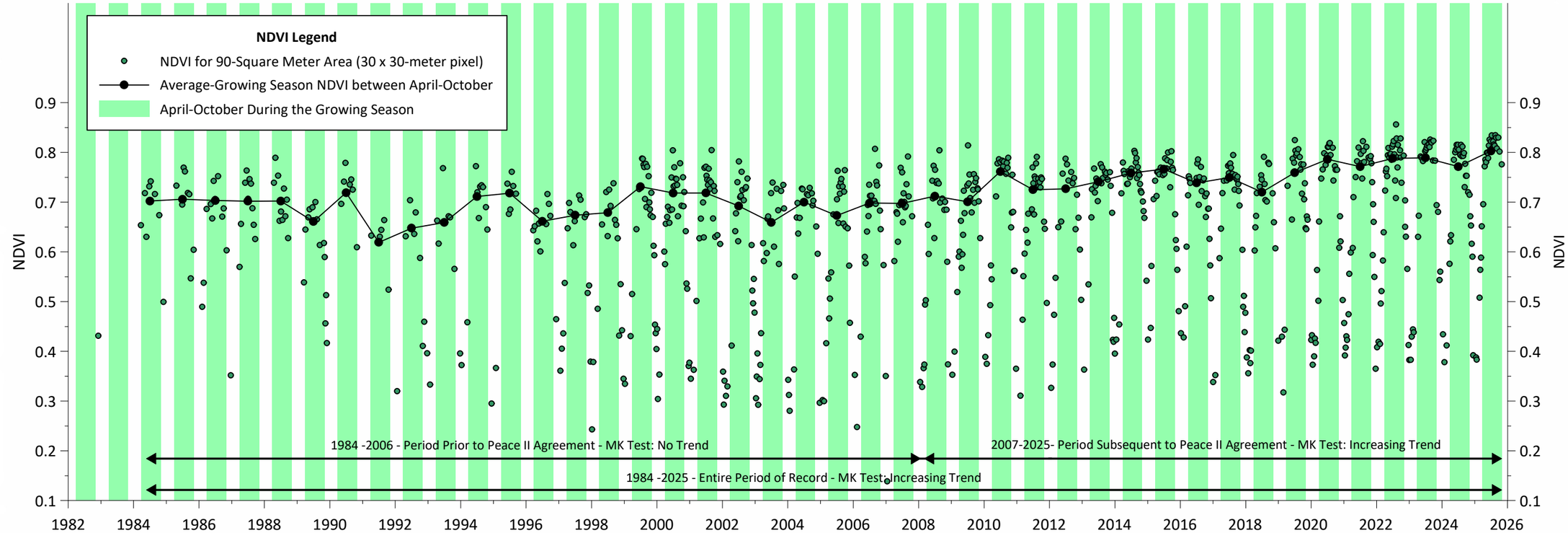
Meters
0 5 10

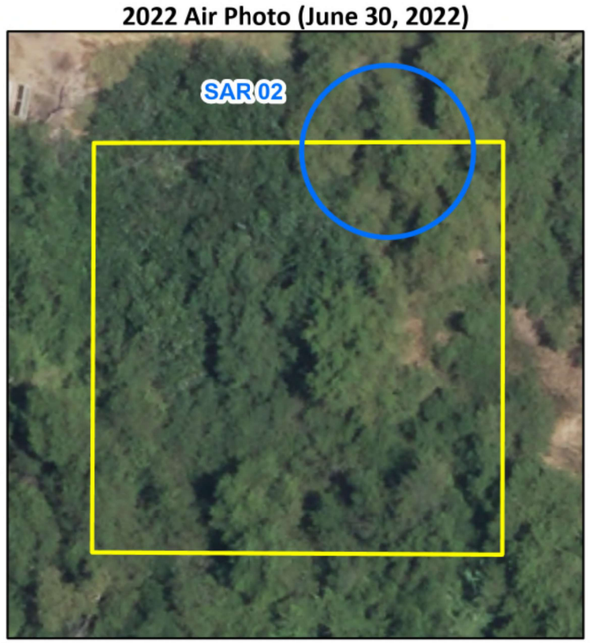
SAR-3 Area for NDVI Analysis 30x30 meter pixel

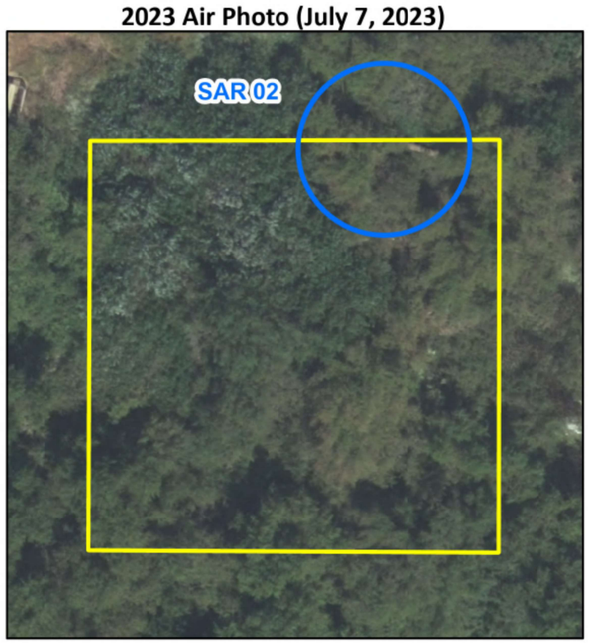
Vegetation Survey Plot Location 10-meter radius

Location Along Santa Ana River

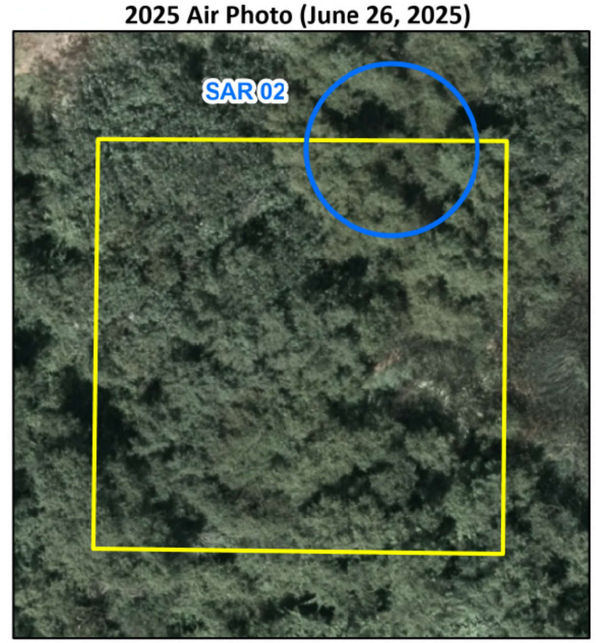










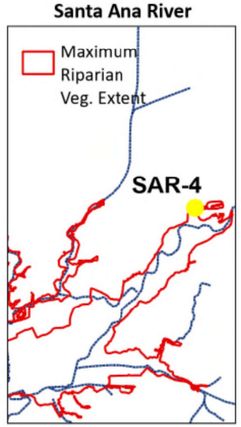


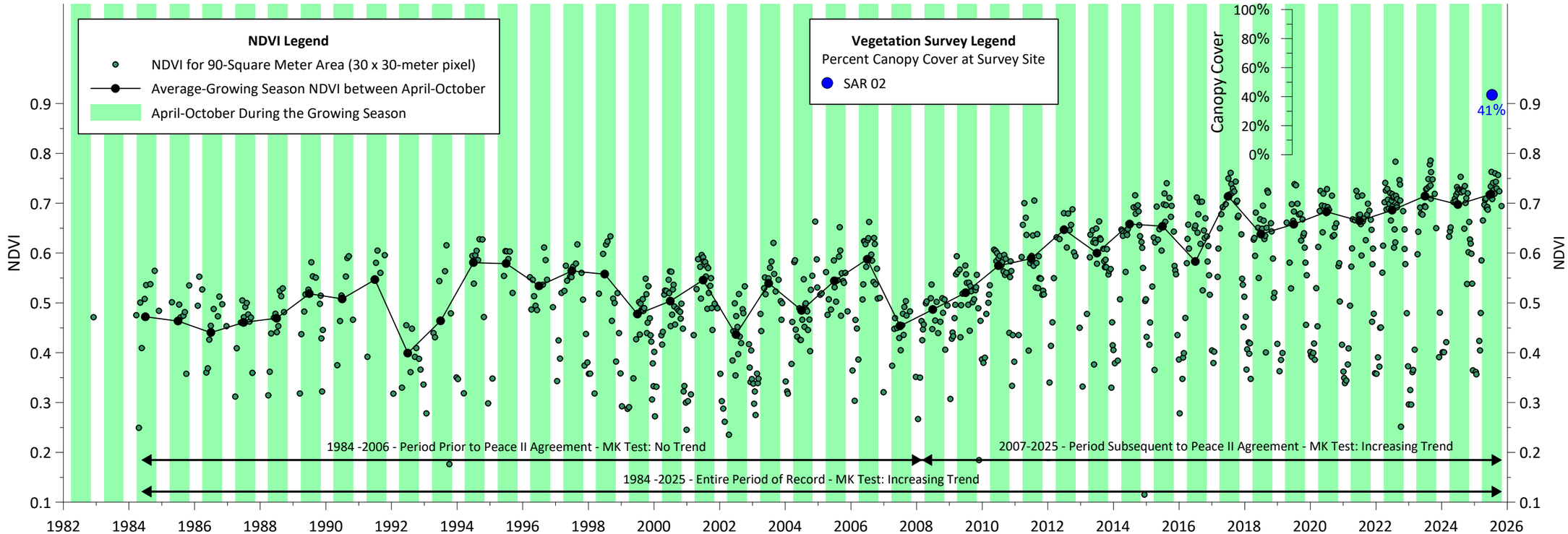
Meters
0 5 10

SAR-4 Area for NDVI Analysis 30x30 meter pixel

Vegetation Survey Plot Location 10-meter radius

Location Along Santa Ana River





3.1.3 Analysis of Vegetation Surveys

Vegetation surveys are performed for the PBHSP once every three years. The most recent vegetation survey was performed in 2025 by ECORP and was a continuation of the surveys performed in 2007, 2013, 2016, and 2019 by the USBR. During the 2025 vegetation surveys, 20 sites were monitored, including 16 previously monitored sites, and four new sites— two sites in the central portion of Mill Creek and two sites along the SAR reach. Monitoring is conducted at 5 to 10-meter radius plots established at each site containing variable number of riparian trees (termed "monitoring site plot" or "sites"). Methods and preliminary results from the 2025 vegetation surveys were published in a draft 2025 Vegetation Survey Report in April 2026, which is included as Appendix C to this Annual Report.

Table 3-3 provides a summary of the monitoring results for the 20 sites surveyed in 2025, along with results from the previous surveys. Results for the following are shown for each site, and for each reach (Chino Creek, Mill Creek, and SAR): precent percent canopy cover; percent live, dead, and stressed trees; and the percent trees with evidence of the presence of the invasive pest PSHB. Observations of non-native and nuisance plant species documented at each site in 2025 are also included.

3.1.3.1 Overstory Canopy Cover

Percent canopy cover is a measurement of the percentage of the ground surface area that is directly covered by the vertical projections of tree crowns (USDA, 1999). The percent canopy cover at the monitoring site plots are shown in Table 3-3 for the 20 sites monitored in 2025:

- Overall, the percent canopy cover measurements at individual monitoring site plots show variability over the years with no clear increasing or decreasing trends.
- From 2022 to 2025 the percent canopy cover increased at seven of sites and decreased at nine.
- From 2022 to 2025 the average percent canopy cover for all sites along Chino Creek decreased from 82 to 80 percent.
- From 2022 to 2025, the average percent canopy cover for all sites along Mill Creek decreased from 76 to 69 percent.
- From 2022 to 2025, the average percent canopy cover for all sites along the SAR decreased from 73 to 52 percent.

Despite the overall decrease in average percent canopy cover, the 2025 Vegetation Survey Report concludes that the changes observed in mean canopy cover between survey years are likely attributed to natural and climatic changes and represent short-term changes that are within the normal fluctuation of canopy cover. Specifically, the report states that: "The drop in mean canopy cover could be a result of 1) lower-than-average precipitation levels during the 2025 rainy season, 2) scouring from heavy rainfall during the 2023 and 2024 rainy seasons, and/or 3) competition with non-native and invasive species such as perennial pepperweed, poison hemlock, golden crownbeard, and eucalyptus."

The percent canopy cover measurements are charted with the NDVI time-series in Figures 3-8a through 3-8m for the monitoring site plots located within the small area of NDVI analysis (30x30-meter pixel) in Section 3.1.2.5. The names of the corresponding NDVI analysis area are included in Table 3-3. Although percent canopy cover is a metric of the areal density of the vegetation and therefore can be used for comparison with the NDVI analysis, the year-to-year variability in percent canopy cover at the plot level makes it hard to discern any notable overall trends with the NDVI data. However, there are a few monitoring site plots where notable changes in percent canopy cover may be correlated with changes in NDVI.

DRAFT

3.1.3.2 Overstory Tree Condition

Another measurement of overall riparian habitat health is the measurement of tree condition: alive, stressed, and dead. Table 3-3 shows the percent of alive, stressed, and dead trees in each of the monitoring sites:

- The proportion of alive, stressed, and dead trees in each site vary considerably over the years.
- From 2022 to 2025, the percentage of healthy trees increased at the sites along Chino Creek, Mill Creek, and the SAR by 11, 22, and 18 percent, respectively.
- From 2022 to 2025, the percentage of dead trees decreased at the sites along Chino Creek, Mill Creek, and the SAR by 14, 16, and 19 percent, respectively.
- From 2022 to 2025, the percentage of stressed trees decreased by 6 percent along Mill Creek, increased by 3 percent along Chino Creek, and increased by 1 percent along SAR. Despite these minor changes, the percentage of stressed trees in all three areas is less than 30 percent, which is indicative of overall sustained vegetation health.

3.1.3.3 Understory Monitoring

In 2025, riparian sapling species were observed at three of the 20 monitoring site plots, and were all alive. Based on the results presented in the monitoring report for the 2022 vegetation surveys and the data collected during the 2025 vegetation survey, sapling recruitment decreased. This decrease could be the result of lower-than-average precipitation levels and/or competition with non-native and invasive weeds discussed further in Section 3.1.3.5. Additionally, in 2025 only saplings for native riparian species were recorded, while sapling counts conducted in 2022 also included non-native species.

Despite a decline in sapling recruitment, in 2025 there was a notable increase in native shrubs, indicating that the riparian vegetation remains healthy overall. A total of 58 individual shrubs were observed and documented in 2025 at monitoring site plots along Mill Creek and SAR, which is a significant increase from five shrubs documented during 2022. Two primary shrub species were observed: mulefat (Baccharis salicifolia) and blue elderberry (Sambucus mexicana), both of which provide habitat for endangered species such as the Least Bell's Vireo. Furthermore, 68 percent of the shrubs in the Mill Creek monitoring site plots were alive and healthy and 70 percent of the shrubs in the SAR monitoring site plots were alive and healthy. Because riparian shrub species rely on shallow groundwater (<10 ft-bgs), the increase in the number of healthy shrubs observed suggests that groundwater levels are not negatively impacting riparian vegetation health.

3.1.3.4 Presence of the Polyphagous Shot Hole Borer (PSHB)

The vegetation surveys in 2016, 2019, 2022, and 2025, included documentation of evidence of the presence of the invasive pest—the PSHB. Table 3-3 shows the percent of trees with evidence of the PSHB:

- Overall, the number of sites with evidence of the PSHB noted in 2016 (30) decreased in 2019 (7) and then increased in 2022 (12).
- In 2025, evidence of the PSHB was noted at six of the 20 sites surveyed, including three sites that had previously had evidence of the PSHB, one site that previously had no evidence of the PSHB, and the two new sites along the SAR (SAR 01 and SAR 02).
- From 2022 to 2025, the percent of trees with evidence of the PSHB increased at sites along Chino Creek and SAR by 16 and 34 percent, respectively, and decreased at sites along Mill Creek by 2 percent.

DRAFT

Section 3.6.2 includes a more detailed discussion on the PSHB and the potential impact to riparian vegetation health.

3.1.3.5 Presence of Non-native and Nuisance Plant Species

During the 2025 vegetation surveys, non-native and nuisance plant species were documented at the monitoring site plot if they were present. Non-native and nuisance plant species are invasive and can be problematic for riparian habitat, often following periods of disturbance. These species can outcompete native shrub and tree species for water, sunlight, and nutrients causing significant stress and dieback. Table 3-3 lists the sites where non-native and nuisance plant species were documented in 2025, and the species.

Non-native and invasive tree species observed within and adjacent to the monitoring site plots included tree of heaven (Ailanthus altissima), eucalyptus (Eucalyptus spp.), Chinese flame (Koelreuteria bipinnata), Chinese elm (Ulmus parvifolia), and Mexican fan palm (Washingtonia robusta). Site X3 along Chino Creek is the only monitoring site plot observed to have significant growth of non-native and invasive tree species during the 2025 monitoring event. Non-native and invasive saplings were observed within this site, covering approximately 15 percent of the site.

Non-native and invasive shrub and herbaceous species observed within and adjacent to the monitoring site plots included: Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), perennial pepperweed (*Lepidium latifolium*), hairy beggarticks (*Bidens pilosa*), and golden crownbeard (*Verbesina encelioides*). Perennial pepperweed is of particular concern as it has a California Invasive Plant Council (Cal-IPC) rating of “high” and can produce both asexually and through seed production. Perennial pepperweed was observed at sites 82, X9, X10, and X21 along Mill Creek, and SAR 01 and SAR 02 along SAR. The perennial pepperweed was observed to cover approximately 25 to 50 percent across the sites.

Two nuisance species were also observed within and adjacent to the monitoring site plots: Rough cocklebur (*Xanthium strumarium*) and wild grape (*Vitis* sp.). While both of these species are native, they can proliferate quickly in riparian habitat and compete with other species for resources. Additionally, wild grape can add significant weight to tree limbs which can lead to limb failure. Rough cocklebur was observed at site 21 along Chino Creek, and wild grape was observed at sites X13 and SAR 01 along SAR. The presence of wild grape was also observed at X13 during the 2022 vegetation surveys in correlation with a decrease in percent canopy cover from 100 percent in 2019 to 46 percent in 2022. In 2025, percent canopy cover was measured at 36 percent.

Section 3.6.4 includes a more detailed discussion on the potential impact of non-native and nuisance plant species on riparian vegetation health.

DRAFT

Table 3-3. Summary of Vegetation Surveys in the Prado Basin[1] - Canopy Cover, Tree Condition, Occurrence of Polyphagous Shot-Hole Borer, and Other Non-Native and Nuisance Species

Site	Number of Trees in 2025	Associated NDVI Area[2]	Canopy Cover (%)[3]							Tree Condition (% trees surveyed per plot)[4]																			Presence of Polyphagous Shot-Hole Borer (% of Trees with Evidence)[5]					Non-Native and Nuisance Species Observed in 2025
										Not Stressed (Alive)							Stressed							Dead											
			2007	2013	2016	2019	2022	2025	Change 2022-2025	2007	2013	2016	2019	2022	2025	Change 2022-2025	2007	2013	2016	2019	2022	2025	Change 2022-2025	2007	2013	2016	2019	2022	2025	Change 2022-2025	2016	2019	2022	2025	Change 2022-2025	
Chino Creek Sites																																		
Chino 11	5	CC-4	94%	96%	96%	98%	94%	59%	-36%	NM	100%	50%	69%	73%	63%	-10%	NM	0%	42%	0%	9%	38%	29%	NM	0%	8%	31%	18%	0%	-18%	0%	0%	0%	0%	0%	
Chino 18	2	--	38%	87%	90%	77%	81%	100%	19%	NM	100%	7%	15%	100%	100%	0%	NM	0%	67%	69%	0%	0%	0%	NM	0%	27%	15%	0%	0%	0%	40%	0%	0%	0%	0%	
Chino 21	7	--	98%	94%	88%	17%	4%	55%	51%	NM	100%	0%	73%	75%	100%	25%	NM	0%	100%	0%	0%	0%	0%	NM	0%	0%	27%	25%	0%	-25%	17%	0%	0%	0%	0%	rough cocklebur
Chino X3	3	CC-1	NM	NM	93%	94%	69%	100%	31%	NM	NM	25%	83%	100%	0%	-100%	NM	NM	75%	17%	0%	67%	67%	NM	NM	0%	0%	0%	33%	33%	0%	0%	0%	67%	67%	various tree species
Chino X6	10	CC-2	NM	NM	98%	99%	100%	88%	-13%	NM	NM	87%	47%	50%	60%	10%	NM	NM	13%	47%	29%	40%	11%	NM	NM	0%	7%	21%	0%	-21%	13%	0%	0%	0%	0%	
Chino X7	6	CC-3	NM	NM	88%	66%	84%	81%	-2%	NM	NM	0%	43%	33%	100%	67%	NM	NM	70%	43%	67%	0%	-67%	NM	NM	30%	14%	0%	0%	0%	70%	0%	33%	75%	42%	
Average for Chino Creek[6]			**75%**	**75%**	**92%**	**84%**	**82%**	**80%**	**-1%**	**--**	**100%**	**16%**	**42%**	**58%**	**69%**	**11%**	**--**	**0%**	**71%**	**42%**	**25%**	**28%**	**3%**	**--**	**0%**	**12%**	**15%**	**17%**	**3%**	**-14%**	**28%**	**3%**	**3%**	**19%**	**16%**	
Mill Creek Sites																																		
Mill 8	11	MC-2	66%	88%	82%	79%	64%	86%	22%	NM	33%	33%	0%	0%	100%	100%	NM	67%	0%	50%	100%	0%	-100%	NM	0%	67%	50%	0%	0%	0%	33%	0%	0%	0%	0%	
Mill 22	7	--	89%	93%	96%	93%	94%	100%	6%	NM	86%	0%	43%	0%	86%	86%	NM	0%	79%	43%	67%	14%	-53%	NM	14%	21%	14%	33%	0%	-33%	64%	0%	50%	0%	-50%	
Mill 39	4	MC-3	94%	87%	96%	96%	91%	78%	-14%	NM	92%	0%	13%	33%	100%	67%	NM	0%	67%	63%	33%	0%	-33%	NM	8%	33%	25%	33%	0%	-33%	44%	38%	0%	0%	0%	
Mill 60	5	--	76%	90%	83%	51%	45%	11%	-34%	NM	86%	0%	0%	11%	20%	9%	NM	0%	93%	69%	67%	80%	13%	NM	14%	7%	31%	22%	0%	-22%	29%	0%	0%	0%	0%	
Mill 82	11	MC-4	92%	96%	56%	91%	97%	100%	3%	NM	100%	0%	69%	55%	73%	18%	NM	0%	75%	15%	27%	18%	-9%	NM	0%	25%	15%	18%	9%	-9%	25%	8%	0%	27%	27%	perennial pepperweed
Mill X9	4	--	NM	NM	94%	94%	94%	58%	-37%	NM	NM	70%	42%	50%	0%	-50%	NM	NM	30%	58%	50%	100%	50%	NM	NM	0%	0%	0%	0%	0%	10%	0%	8%	0%	-8%	perennial pepperweed
Mill X10	1	MC-1	NM	NM	89%	95%	88%	99%	11%	NM	NM	0%	70%	73%	0%	-73%	NM	NM	50%	30%	18%	100%	82%	NM	NM	50%	0%	9%	0%	-9%	50%	0%	18%	100%	82%	perennial pepperweed
Mill X21	1	MC-5	NM	NM	NM	NM	91%	73%	-18%	NM	NM	NM	NM	80%	100%	20%	NM	NM	NM	NM	20%	0%	-20%	NM	NM	NM	NM	0%	0%	0%	NM	NM	0%	0%	0%	perennial pepperweed
Mill X22	5	MC-6	NM	NM	NM	NM	38%	32%	-6%	NM	NM	NM	NM	78%	60%	-18%	NM	NM	NM	NM	22%	20%	-2%	NM	NM	NM	NM	0%	20%	20%	NM	NM	0%	0%	0%	
Mill Creek 01	9	--	NM	NM	NM	NM	NM	49%	--	NM	NM	NM	NM	NM	67%	--	NM	NM	NM	NM	NM	33%	--	NM	NM	NM	NM	NM	0%	--	NM	NM	NM	0%	--	
Mill Creek 02	11	--	NM	NM	NM	NM	NM	80%	--	NM	NM	NM	NM	NM	100%	--	NM	NM	NM	NM	NM	0%	--	NM	NM	NM	NM	NM	0%	--	NM	NM	NM	0%	--	
Average for Mill Creek[6]			**69%**	**73%**	**72%**	**76%**	**76%**	**69%**	**-7%**	**--**	**84%**	**8%**	**31%**	**48%**	**70%**	**22%**	**--**	**0%**	**71%**	**40%**	**33%**	**27%**	**-7%**	**--**	**8%**	**22%**	**30%**	**19%**	**3%**	**-16%**	**57%**	**9%**	**9%**	**7%**	**-2%**	
Santa Ana River Sites																																		
SAR X13	3	SAR-2	NM	NM	87%	100%	46%	36%	-10%	NM	NM	0%	17%	20%	0%	-20%	NM	NM	67%	67%	0%	100%	100%	NM	NM	33%	17%	80%	0%	-80%	67%	0%	0%	0%	0%	wild grape
New SAR 01	5	--	NM	NM	NM	NM	NM	79%	--	NM	NM	NM	NM	NM	80%	--	NM	NM	NM	NM	NM	20%	--	NM	NM	NM	NM	NM	0%	--	NM	NM	NM	40%	--	perennial pepperweed; wild grape
New SAR 02	6	SAR-4	NM	NM	NM	NM	NM	41%	--	NM	NM	NM	NM	NM	83%	--	NM	NM	NM	NM	NM	0%	--	NM	NM	NM	NM	NM	17%	--	NM	NM	NM	50%	--	perennial pepperweed
Average for SAR[6]			**--**	**--**	**85%**	**93%**	**73%**	**52%**	**-21%**	**--**	**--**	**34%**	**54%**	**46%**	**64%**	**18%**	**--**	**--**	**56%**	**31%**	**27%**	**29%**	**1%**	**--**	**--**	**11%**	**15%**	**27%**	**7%**	**-19%**	**44%**	**0%**	**2%**	**36%**	**34%**	
Average for All Reaches[7]			**75%**	**76%**	**86%**	**82%**	**78%**	**70%**	**-8%**	**--**	**91%**	**15%**	**43%**	**48%**	**65%**	**16%**	**--**	**5%**	**68%**	**37%**	**30%**	**32%**	**2%**	**--**	**4%**	**17%**	**19%**	**22%**	**4%**	**-18%**	**40%**	**5%**	**7%**	**18%**	**11%**	

Notes:

NM - Not Measured

1 - Table only includes the 20 monitoring sites surveyed in 2025. In past years, the number and location of monitoring sites surveyed has varied.

2 - This is the defined area with time-series data analyzed in Section 3.1.2.5, that aligns with the monitoring site plot. Shown in Figures 3-8a through 3-8m.

3- Canopy cover is a measurement of the percentage of a ground area directly covered by vertical projections of tree crowns. In the field, canopy cover is measured using a spherical densiometer standing five meters from the center of the plot in the four cardinal directions (north, south, east, west). Canopy Cover percent herein is the average of the four measurements.

4- Tree condition is a qualitative measurement of the health of the tree. Trees were assessed and classified as "alive," "stressed," or "dead". The percentage of each classification per plot is shown here.

5- From 2016 to 2025, trees were assessed for evidence of the polyphagous shot-hole borers (PSHB). If a tree showed signs of the beetle it was noted. The percent of trees in each plot that showed signs of beetle infestation was then calculated.

6- Average values for each year represent the average of all sites monitored that year some of which were not surveyed in 2025 and not included in this table. Calculated as the percent of the total number of trees at all monitoring sites.

7- The average for all reaches across the Prado Basin. Calculated as the average of all sites surveyed that year.

3.1.4 Summary

The extent of the riparian habitat in the Prado Basin has been delineated from air photos and maps of NDVI. The extent increased from about 1.85 mi^2 in 1960 to about 6.7 mi^2 by 1999 and has remained relatively constant through 2025 along the Chino Creek, Mill Creek, and SAR reaches.

The quality of riparian habitat has been characterized through the analysis of air photos, maps of NDVI, and time-series charts of NDVI for large and small areas located throughout the Prado Basin:

- The NDVI change map shows that spatial NDVI remained mostly unchanged from 2024 to 2025 across riparian vegetation in the Prado Basin, with localized patches of NDVI increases and decreases. Notable increases in the NDVI are observed in patches along the SAR, and along and adjacent to the lower reach of Chino Creek. Notable decreases in the NDVI are observed in patches in the lower portion of Prado Basin—below the OCWD wetlands and the lower reach of Chino Creek.
- The analyses of NDVI time series indicate that over the last year from 2024 to 2025: there was no change in the riparian vegetation greenness across the Prado Basin and Mill Creek reach when analyzed as a whole; and there was an increase in the riparian vegetation greenness along the Chino Creek reach and Upper Mill Creek reach when analyzed as a whole. These increases were minor and within the historical ranges of one-year NDVI variability for these areas.
- The NDVI time series at the 13 small defined areas indicate that over the last year from 2024 to 2025, most areas experienced an increase in vegetation greenness, with one area showing no change, and two areas showing slight decreases. At all areas, these one-year changes in the Average Growing-Season NDVI are within the historical ranges of one-year NDVI variability presented in Table 3-2. Additionally, all the changes were less than the average one-year change in NDVI, with the exception of one site along the SAR (SAR-3), which increased slightly more than the average one-year change in NDVI.
- The visual inspection of the 2024 and 2025 air photos reveals no significant changes in the riparian vegetation along Chino Creek, Mill Creek and the SAR reaches Additionally, areas that showed reductions in coverage and browning in 2024, exhibited an overall increase in vegetation greenness in the 2025 air photo.
- The Mann-Kendall test result on the Average Growing-Season NDVI for the post-Peace II Agreement period from 2007 to 2025 indicates “no trend” for the Prado Basin riparian vegetation as a whole and either "no trend” or an “increasing trend” at all the other areas analyzed in the Prado Basin.

Site-specific monitoring of riparian habitat is performed approximately every three years to collect data that can be used to ground-truth the interpretations derived from the regional monitoring and assessment of riparian habitat quality. The most recent site-specific monitoring was performed at 20 monitoring site plots in the Mill Creek, Chino Creek and SAR reaches in October 2025. Results of the survey showed that overall, the riparian vegetation at the monitoring site plots appears to be healthy and that the riparian system is functioning properly. The primary driver of observed variability and year-to-year changes is climate, which also impacts the composition of vegetation species, including native and non-native species. All the changes observed in the riparian vegetation from 2022 to 2025 appear to be within the normal range of variability related to climatic changes and it is unlikely that any observable decline in the riparian system for the monitoring site plots could be linked to groundwater pumping.

DRAFT

The remainder of Section 3.0 describes the factors that can affect the riparian habitat, how these factors have changed over time, and how the changes in these factors may explain the changes that are being observed in the riparian habitat described above.

3.2 Groundwater and Its Relationship to Riparian Habitat

Peace II Agreement implementation was projected to change groundwater pumping patterns and reduce groundwater replenishment through 2030, both of which would change groundwater levels in the Chino Basin. These groundwater level changes caused by Peace II Agreement implementation and other unrelated water management activities[21] have the potential to impact the extent and quality of Prado Basin riparian habitat.

This section characterizes the history of groundwater pumping and changes in groundwater levels in the GMP study area and compares this history to the trends in the extent and quality of the riparian habitat described in Section 3.1.

3.2.1 Groundwater Pumping

Table 3-4 lists the groundwater pumping estimates for the GMP study area for WY 1961 to 2025.[22] Figure 3-9 is a map that illustrates the spatial distribution of groundwater pumping from wells within the GMP study area for WY 2025. This figure includes a bar chart of the annual groundwater pumping in the GMP study area (from Table 3-4 below). Figure 3-9 illustrates the following history of groundwater pumping within the GMP study area:

- From 1961 to 1990, groundwater pumping averaged about 45,900 afy. Pumping mainly occurred at private domestic and agricultural wells distributed throughout the area.
- From 1991 to 1999, groundwater pumping steadily declined, primarily due to conversions of agricultural land uses to urban. By WY 1999, groundwater pumping was estimated to be about 23,600 afy, about 49 percent less than average annual pumping from 1961 to 1990.
- From 2000 to 2025, CDA pumping commenced and increased to replace the declining agricultural groundwater pumping, as envisioned in the OBMP/Peace Agreement and Peace II Agreement. In WY 2025, total groundwater pumping in the GMP study area was about 40,100 afy—an increase of about 70 percent from 1999.
- In WY 2020 the CDA pumping reached its intended pumping rate of 40,000 afy to maintain hydraulic control of the Chino Basin, to replace agricultural pumping, and has maintained this pumping through this WY 2025.
- Total CDA pumping in WY 2025 was 40,425 afy, while CDA pumping within the GMP study area totaled 37,413 afy. The difference reflects CDA Well II-12, which began operating in August 2021 and is situated outside the GMP study area.

[21] Other water management activities unrelated to Peace II Agreement implementation include changes in wastewater discharge to the SAR due to conservation, recycling, and drought response; increases in storm water diverted and recharged; increases in recycled water recharge; management of groundwater in storage; and the implementation of the Dry-Year Yield Program with MWD.

[22] Production for years prior to WY 2001 were estimated in the calibration of the 2013 Chino Basin groundwater model (WEI, 2015). Production estimates for WY 2001 and thereafter are based on metered production data and water-duty estimates compiled by Watermaster.

- Since the PBHSP monitoring began in 2016, the highest annual pumping occurred in WY 2020, 2021, and 2022 in the GMP study area.

Table 3-4. Annual Groundwater Pumping in the Groundwater Monitoring Program Study Area

Water Year	Non-CDA Pumping, afy[(a)]	CDA Pumping, afy	Total Pumping, afy[(a)]
1961	48,577	0	48,577
1962	43,811	0	43,811
1963	43,293	0	43,293
1964	45,170	0	45,170
1965	43,294	0	43,294
1966	46,891	0	46,891
1967	42,709	0	42,709
1968	47,180	0	47,180
1969	37,754	0	37,754
1970	45,849	0	45,849
1971	45,492	0	45,492
1972	47,541	0	47,541
1973	38,427	0	38,427
1974	47,014	0	47,014
1975	44,606	0	44,606
1976	44,847	0	44,847
1977	45,710	0	45,710
1978	46,881	0	46,881
1979	48,829	0	48,829
1980	46,402	0	46,402
1981	53,326	0	53,326
1982	41,719	0	41,719
1983	42,200	0	42,200
1984	52,877	0	52,877
1985	46,876	0	46,876
1986	54,501	0	54,501
1987	46,875	0	46,875
1988	46,277	0	46,277
1989	46,835	0	46,835
1990	45,732	0	45,732
1991	42,266	0	42,266
1992	44,617	0	44,617
1993	43,186	0	43,186
1994	37,390	0	37,390
1995	32,604	0	32,604
1996	35,200	0	35,200

DRAFT

Table 3-4. Annual Groundwater Pumping in the Groundwater Monitoring Program Study Area

Water Year	Non-CDA Pumping, afy[(a)]	CDA Pumping, afy	Total Pumping, afy[(a)]
1997	33,340	0	33,340
1998	22,366	0	22,366
1999	23,632	0	23,632
2000	24,299	523	24,822
2001	21,249	9,470	30,719
2002	20,271	10,173	30,445
2003	18,600	10,322	28,922
2004	18,606	10,480	29,086
2005	13,695	10,595	24,290
2006	14,261	19,819	34,079
2007	12,988	28,529	41,517
2008	12,293	30,116	42,409
2009	11,694	28,456	40,150
2010	10,452	28,964	39,416
2011	10,460	28,941	39,401
2012	11,193	28,230	39,423
2013	11,433	27,380	38,813
2014	9,059	29,626	38,685
2015	6,985	29,877	36,862
2016	5,900	28,249	34,148
2017	5,899	28,351	34,250
2018	7,504	29,191	36,695
2019	5,348	32,004	37,352
2020	5,875	37,973	43,848
2021	6,155	40,501[(b)]	46,656
2022	6,066	38,277[(c)]	44,342
2023	4,462	36,687[(d)]	41,149
2024	3,597	37,002[(e)]	40,598
2025	2,697	37,413[(f)]	40,110
Average: 1961-1990	45,917	0	45,917
Average: 1991-1999	34,956	0	34,956
Average: 2000-2025	10,809	26,044	36,853

(a) Prior to WY 2001 production is estimated with the calibrated 2013 Chino Basin groundwater model (WEI, 2015).

(b) Total CDA production in WY 2021 was 40,649 af; active CDA Well II-12 is outside of the GMP study area and not included in the total annual pumping for the GMP study area.

(c) Total CDA production in WY 2022 was 40,684 af; active CDA Well II-12 is outside of the GMP study area and not included in the total annual pumping for the GMP study area.

(d) Total CDA production in WY 2023 was 39,814 af; active CDA Well II-12 is outside of the GMP study area and not included in the total annual pumping for the GMP study area.

(e) Total CDA production in WY 2024 was 40,396 af; active CDA Well II-12 is outside of the GMP study area and not included in the total annual pumping for the GMP study area.

(f) Total CDA production in WY 2025 was 40,425 af; active CDA Well II-12 is outside of the GMP study area and not included in the total annual pumping for the GMP study area.

DRAFT

117°40'0"W

34°0'0"N

Edison Ave

San Antonio Creek (upstream)

Euclid Ave

Grove Ave

Hamner Ave

Bellegrave Ave

Cypress Channel

71

El Prado Rd

Kimball Ave

Chino Airport

Limonite Ave

Day Creek

Cucamonga Creek

Archibald Ave

Pine Ave

Schleisman Rd

15

Chino Creek

Mill Creek

Hellman Ave

Chandler St

6th St

5th St

4th St

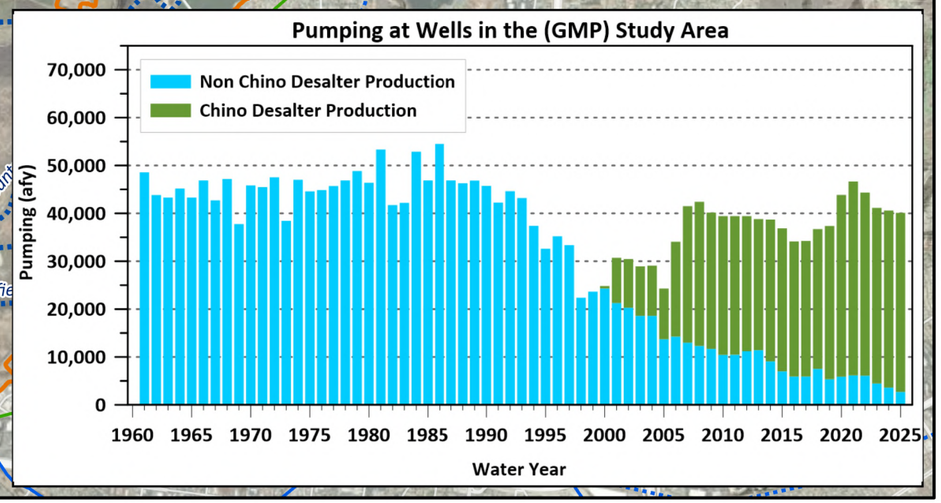
Chino Hills

Prado Dam

91

I-1 I-2 I-3 I-4 I-5 I-6 I-7 I-8 I-9 I-10 I-11 I-13 I-14 I-15 I-16 I-17 I-18 I-20 I-21

II-1 II-2 II-3 II-4 II-6 II-7 II-8 II-9 II-10 II-11 II-12



Groundwater Pumping in the GMP Study Area
Water Year 2025 (af)

- 0
- > 0.1 - 10
- > 10 - 100
- > 100 - 500
- > 500 - 1,000
- > 1,000 - 2,500
- > 2,500 - 5,000

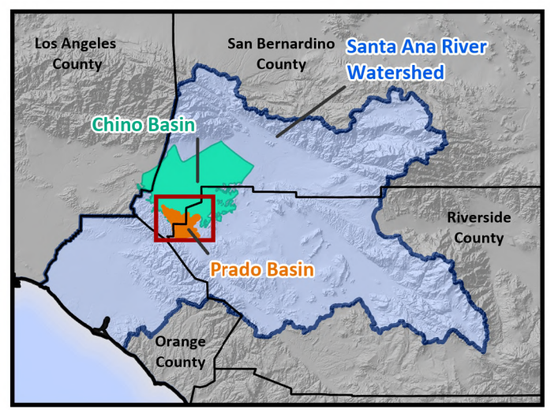
Chino Basin Desalter Well

Groundwater Monitoring Program (GMP) Study Area

Prado Basin Management Zone (Prado Basin)

Concrete-Lined Channels

Unlined Rivers and Streams



WEST YOST - K:\Clients\3941 Chino Basin Watermaster\09-00-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch1\Prado Annual Report Ch1_General Overview.aprx - VMW - Date: 4/20/2026

Prepared by:

WEST YOST

N

0 1 2 Miles

0 1 2 Km

Prepared for:

Prado Basin Habitat Sustainability Committee
2025 Annual Report

Groundwater Pumping
Water Year 2025
Figure 3-9

3.2.2 Groundwater Levels

Figures 3-10a and 3-10b are groundwater-elevation contour maps of the GMP study area for the shallow aquifer system in September 2016 (first Annual Report condition) and September 2025 (current condition). The contours were created from rasterized surfaces of groundwater elevations that were created from measured groundwater elevations at wells. The raster of groundwater elevation for September 2016 was subtracted from the raster of groundwater elevation for September 2025 to create a raster of change in groundwater elevation from 2016 to 2025 (Figure 3-11).

Figure 3-11 shows that with an exception to the northwest portion of the GMP study area, groundwater levels changed by about +/- 5 feet across most of the GMP study area from 2016 to 2025. The greatest areas of change occurred in the northern portion of the GMP study area near the Chino Basin Desalter well field. Groundwater levels increased up to 20 feet near to the northeast of Chino Creek, near Chino Basin Desalter wells I-16 and I-17.

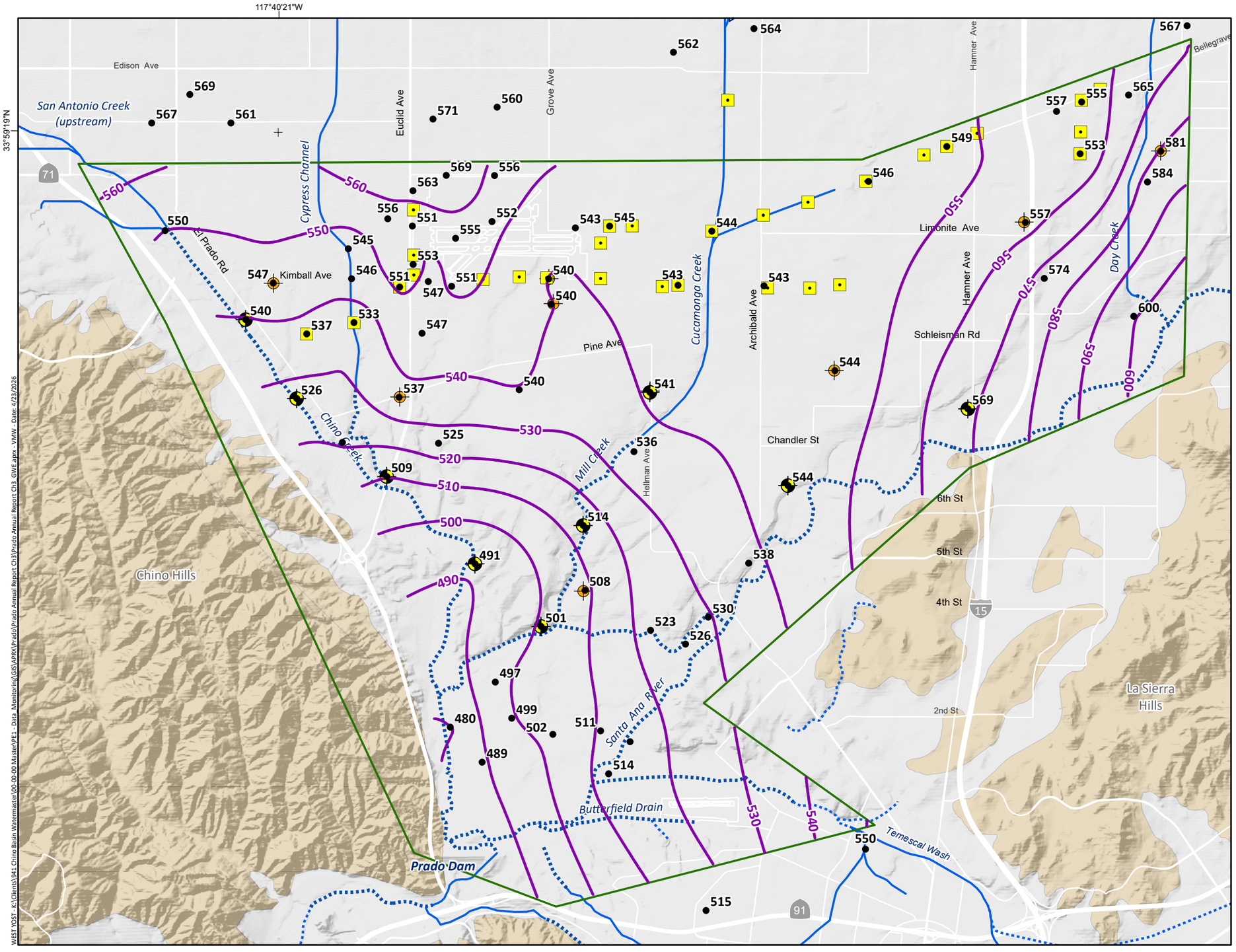
Since the PBHSP began in 2016, the largest groundwater level declines within the riparian vegetation areas have occurred in the northern reach of Mill Creek (just south of PB-2). From 2016 to 2025 groundwater levels declined about three feet in this area, and at well PB-2 just to the north, groundwater levels declined by about five feet. This northern portion of Mill Creek has consistently shown the greatest groundwater level declines, and were the lowest in WY 2022, as documented in previous Annual Reports (West Yost 2022; 2023; 2024). This area is part of the regional pumping depression expanding around the Chino Basin Desalter well field to the north. Over this last year, groundwater levels decreased about 0.25 feet in this area.

Since 2016, the largest groundwater level increases within the riparian vegetation extent occurred along northern Chino Creek. From 2016 to 2025, groundwater levels increased by up to 10 feet in this area. Section 3.2.3 describes a decrease in pumping in the area near Chino Creek.

Figure 3-12 is a map of depth-to-groundwater in September 2025. It was created by subtracting a one-meter horizontal resolution 2020 digital-elevation model (DEM)[23] of the ground surface from the raster of groundwater elevation for September 2025. An outline of the Prado Basin riparian habitat extent is superimposed on the depth-to-groundwater raster. With few exceptions, the riparian habitat generally overlies areas where the depth-to-groundwater is less than 15 feet below the ground surface (ft-bgs). The shallow groundwater could exit the Prado Basin via rising groundwater discharge to the SAR and its tributaries and/or evapotranspiration by the riparian vegetation.

DRAFT

[23] The 2020 DEM is from LiDAR data collected of the Prado Basin and along the SAR during July 2020 when Watermaster, IEUA, OCWD, and San Bernadino Valley Water District collaborated and cost-shared the collection of the 2022 air photo of the Prado Basin.



Equal Elevation Contour of Groundwater Elevation (feet above mean sea level)

505 — Measured Groundwater Elevation in September 2016 used to draw contours (feet above mean sea level)

PBHSP Monitoring Well

HCMP Monitoring Well

Other Well

Chino Basin Desalter Well

Groundwater Monitoring Program (GMP) Study Area

Concrete-Lined Channels

Unlined Rivers and Streams

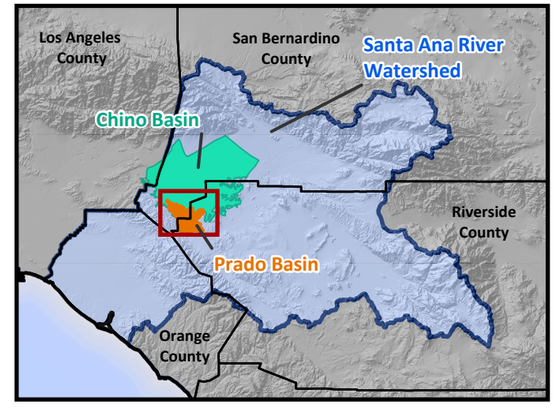
Surface Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks



Prepared by: WEST YOST

N

0 1 2 Miles

0 1 2 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Map of Groundwater Elevation
September 2016 - Shallow Aquifer System

Figure 3-10a

117°40'0"W

34°0'0"N

Edison Ave

San Antonio Creek (upstream)

Cypress Channel

Euclid Ave

Grove Ave

Hamner Ave

Limonite Ave

Schleisman Rd

Pine Ave

Chandler St

6th St

5th St

4th St

2nd St

Chino Creek

El Prado Rd

Cucamonga Creek

Archibald Ave

Mill Creek

Hellman Ave

Santa Ana River

Butterfield Drain

Temescal Wash

Day Creek

Prado Dam

Chino Hills

La Sierra Hills

71

15

91

559 562 569 593 588 583 577 563 557 558 560 553 557 545 580 582 571 570 558 567 560 554 561 558 560 553 551 552 537 537 536 537 535 563 573 598 558 556 554 548 536 533 535 540 569 529 519 523 534 510 543 513 536 489 508 501 521 526 522 495 497 499 507 480 487 513 510 542 519

500 510 520 530 540 550 560 570 580 590 600 490 480

Equal Elevation Contour of Groundwater Elevation (feet above mean sea level)

505 Measured Groundwater Elevation in September 2025 used to draw contours (feet above mean sea level)

PBHSP Monitoring Well

HCMP Monitoring Well

Other Well

Chino Basin Desalter Well

Groundwater Monitoring Program (GMP) Study Area

Concrete-Lined Channels

Unlined Rivers and Streams

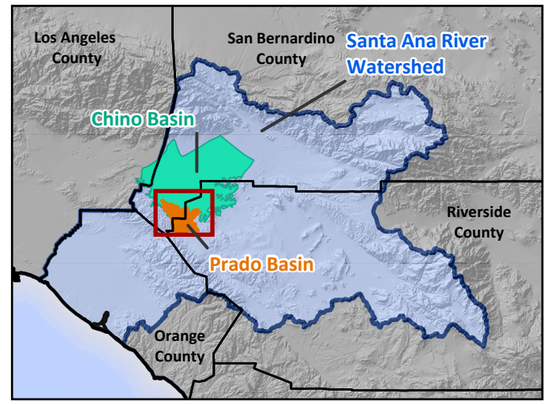
Surface Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch3\Prado Annual Report Ch3_GWE.aprx - VMW - Date: 4/23/2026

Prepared by: WEST YOST

N

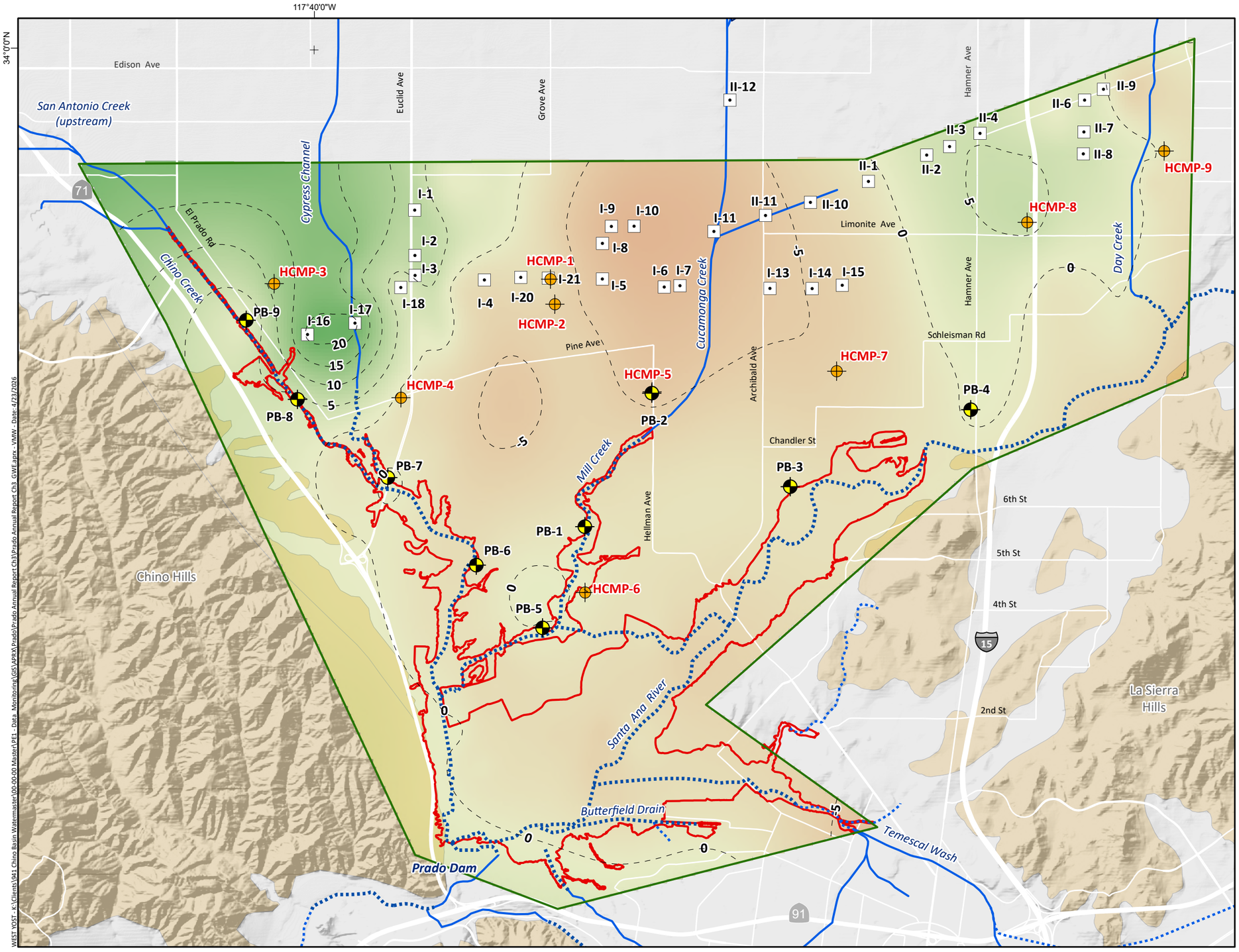
0 1 2 Miles

0 1 2 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Map of Groundwater Elevation
September 2025 - Shallow Aquifer System

Figure 3-10b



+ 25
0
- 25

Change in Groundwater Elevation from September 2016 to September 2025

Contour of Change in Groundwater Elevation from September 2016 to September 2025 (feet)

Chino Basin Desalter Well

HCMP Monitoring Well

PBHSP Monitoring Well

Groundwater Monitoring Program (GMP) Study Area

Maximum Extent of the Riparian Vegetation in Prado Basin

Concrete-Lined Channels

Unlined Rivers and Streams

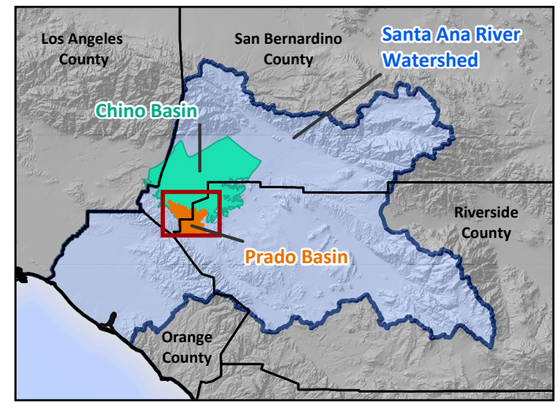
Surface Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks



WEST / YOST - K:\Clients\941 Chino Basin Watermaster\00-00.00 Master\PE1 - Data Monitoring\GIS\APRX Prado\Prado Annual Report Ch3\Prado Annual Report Ch3 GWE.aprx - VMW - Date: 4/23/2026

Prepared by: WEST YOST

N

0 1 2 Miles

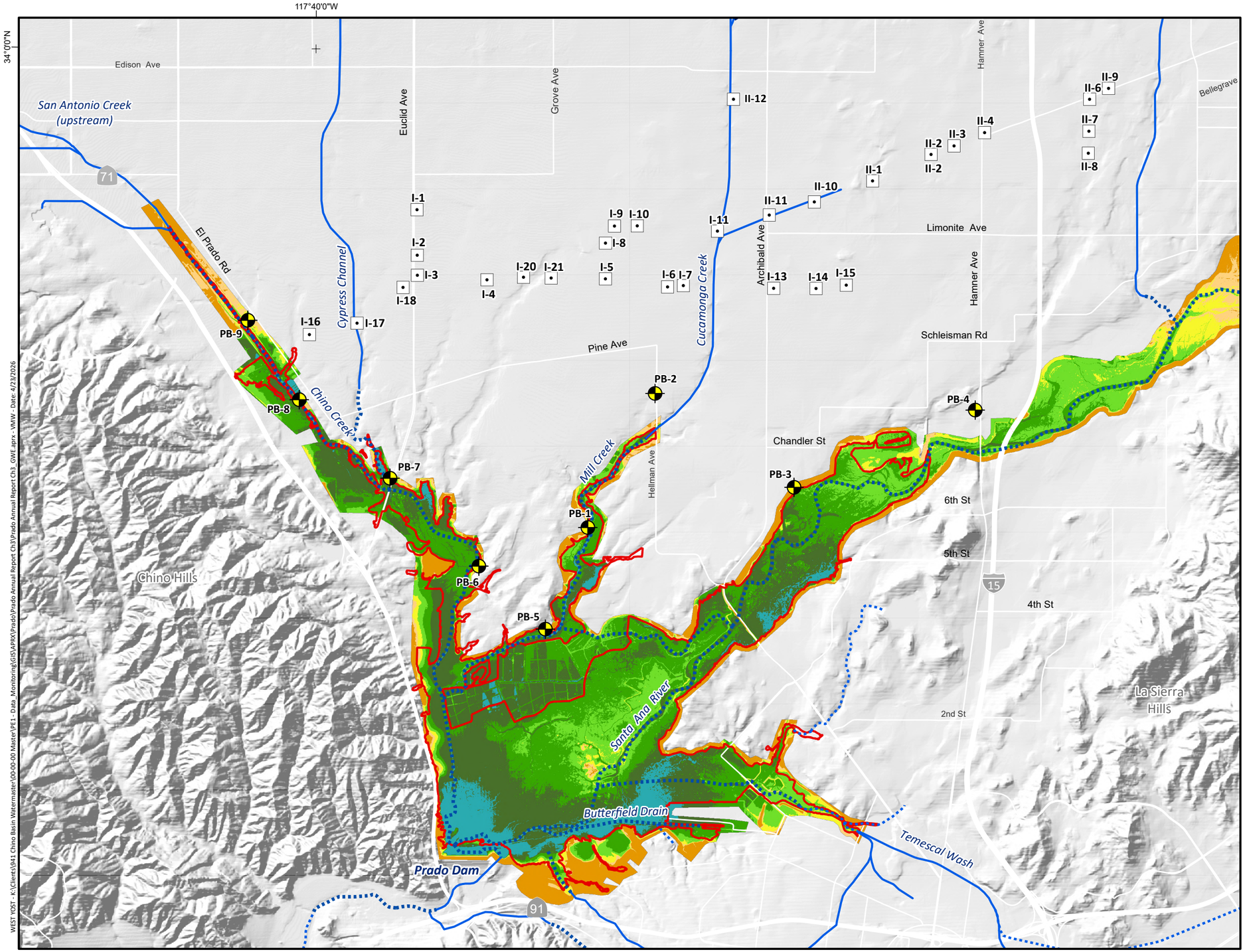
0 1 2 Km

Prepared for:

Prado Basin Habitat Sustainability Committee
2025 Annual Report

Change in Groundwater Elevation
September 2016 to September 2025

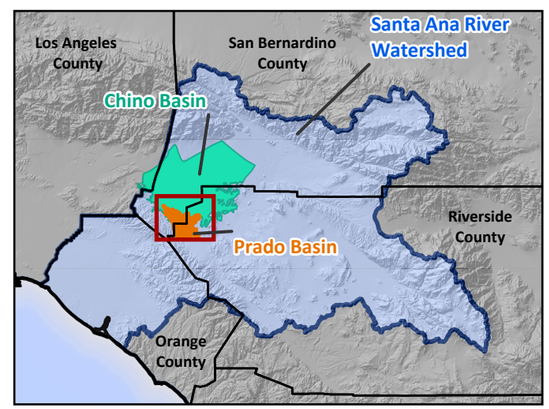
Figure 3-11



Depth to Groundwater (feet below ground surface)

- Area of Groundwater at the Ground Surface
- > 0 and ≤ 5
- > 5 and ≤ 10
- > 10 and ≤ 15
- > 15 and ≤ 20
- > 20 and ≤ 25
- > 25

- Maximum Extent of the Riparian Vegetation in Prado Basin
- Chino Basin Desalter Well
- PBHSP Monitoring Well
- Concrete-Lined Channels
- Unlined Rivers and Streams



WEST YOST - K:\Clients\1041 Chino Basin Watermaster\000-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch3\Prado Annual Report Ch3_GWE.aprx - VMW - Date: 4/23/2026

Prepared by: WEST YOST

0 1 2 Miles
0 1 2 Km

Prepared for: Prado Basin Habitat Sustainability Committee
2025 Annual Report

Depth to Groundwater
September 2025

Figure 3-12

3.2.3 Groundwater Levels Compared to NDVI

Figures 3-13a through 3-13c are time-series charts that compare long-term trends in groundwater pumping and groundwater elevations to the trends in the quality of the riparian vegetation as indicated by the NDVI for three reaches in the Prado Basin: Chino Creek, Mill Creek, and the SAR. The period of analysis for these charts is 1984 to 2025—the period of NDVI availability. The upper chart in these figures compares changes in groundwater levels for each respective area to long-term trends in groundwater pumping within the respective regions of the GMP study area (Chino Creek, Mill Creek, and SAR). The annual groundwater pumping for wells within the respective regions is presented as a stacked bar chart, differentiating between Chino Basin Desalter wells and non-Chino Basin Desalter wells. Model-generated groundwater-elevation estimates for 1984 to 2018 were extracted from Watermaster's 2020 calibration of its groundwater-flow model at the monitoring well locations (WEI, 2020). The more recent groundwater-elevation data shown on these charts were measured at monitoring wells constructed by Watermaster and the IEUA to support the Hydraulic Control Monitoring Program (HCMP) (beginning in 2005) and the PBHSP (beginning in 2015). Where the measured and model-estimated groundwater elevations overlap in time, the model-estimated elevations mimic the seasonal fluctuations and longer-term trends of the measured elevations, typically differing by no more than 10 feet. This alignment supports the use of these model-estimated groundwater elevations in this analysis to evaluate historic trends prior to the availability of actual water level measurements.

The lower chart in Figures 3-13a through 3-13c displays the time series of the Average Growing-Season NDVI for the defined areas (discussed in Section 3.1) along Chino Creek, Mill Creek, and the SAR. For reference, the Mann-Kendall test results for trends in the Average Growing-Season NDVI for 1984 to 2025, 1984 to 2006, and 2007 to 2025 are shown in the legend.

The NDVI observations and interpretations below focus on recent changes in Average Growing-Season NDVI (Section 3.1) and whether observed groundwater level trends may be contributing to recent NDVI changes.

Chino Creek (Figure 3-13a). During the late 1990s, groundwater levels in the riparian habitat along Chino Creek increased, particularly along the north reach of Chino Creek, where groundwater levels increased by over 30 feet. The increase in groundwater levels was most likely due to reduced pumping in the area. Since 2000, groundwater levels have remained relatively stable, even as Chino Basin Desalter pumping commenced and increased at CDA wells I-I, I-2, I-3, I-4, I-16, I-17, and I-18 to the north of Chino Creek (see inset map on Figure 3-13a). From 2017 to 2023, pumping at these Chino Basin Desalter wells was at historically low volumes, contributing to reduced pumping in this area. Since WY 2024, pumping returned to normal operational levels at the Chino Basin Desalter wells and, in 2025, reached a historic high. However, total WY 2025 pumping in this Chino Creek region did not exceed historical higher levels since pumping at the non-Chino Basin Desalter wells is reduced.

From 2015-2025, the measured groundwater levels at the PBHSP monitoring wells along Chino Creek in the riparian habitat show a stable trend along the very northern reach at well PB-9/1 and central reach at wells PB-7/1 and PB-6/1; and a decreasing trend along the north reach at well RP2-MW3. Groundwater levels fluctuate seasonally, in some cases by more than 15 feet, under the seasonal stresses of pumping and recharge. During the winter months of WY 2017, 2019, 2023, and 2024, groundwater levels at the PBHSP monitoring wells increased to their highest recorded levels, in response to the recharge of stormwater discharge in unlined creeks and the associated surface-water reservoir that ponds behind Prado Dam. Over the last year (fall 2024 to fall 2025) groundwater levels stayed about the same along the upper northern reach of Chino Creek (PB-9/1), decreased by about 1 foot along the lower northern reach (RP2-MW3), stayed about the same (PB-7/1) or decreased by about 1 foot (PB-6/1) along the central reach of Chino Creek.

DRAFT

The Average Growing-Season NDVI and the air photo analyses along Chino Creek show that changes in the vegetation were relatively minor during 2024 to 2025 (discussed in Section 3.1), and the NDVI slightly increased at all areas (CC-1, CC-2, CC-3, CC-4). Hence, the main observations and conclusions for the period of 2024 to 2025 for the Chino Creek reach are that overall, groundwater levels remained stable or slightly decreased, and the riparian vegetation did not change significantly.

Mill Creek. ***(Figure 3-13b).*** During the 1990s, groundwater levels along Mill Creek in the riparian habitat increased, particularly along the north reach of Mill Creek where groundwater levels increased by about 10 feet, most likely due to reduced agricultural pumping in the area. Since 2000, groundwater levels along the north reach of Mill Creek have declined by up to 13 feet. The decline in groundwater levels was most likely due to the onset and progressive increase in Chino Basin Desalter pumping at CDA wells I-5, I-6, I-7, I-8, I-9, I-10, I-11, I-13, I-14, I-20, I-21, and II-11 to the north of Mill Creek (see inset map on Figure 3-13b). Since 2017, total pumping at these Chino Basin Desalter wells has progressively increased, reaching a historically high volume in 2021 and slightly declining after, contributing to the overall increase in the total pumping in this region.

From 2015 to 2025, the measured groundwater levels at the PBHSP monitoring wells along Mill Creek show an overall declining trend in the northern and central portion of Mill Creek (PB-2, HCMP-5/1, and PB-1/2). Groundwater levels decreased from 2015 to 2022 by about eight feet at the wells in the northern portion (PB-2 and HCMP-5/1), and 1.5 feet at wells in the central portion (PB-1/2), then increased and leveled out from 2022 to 2025. These changes in groundwater levels follow the same trends as groundwater pumping observed in this area. From 2015 to 2025, the measured groundwater levels in the southern reach of Mill Creek show a slight decreasing trend of about 1 foot (HCMP-6/1 and PB-5/1).

Groundwater levels fluctuate seasonally, in some cases up to 10 feet, under the seasonal stresses of pumping and recharge. During the winter months in WY 2017, WY 2019, WY 2023, and WY 2024, groundwater levels at most of the PBHSP monitoring wells increased to their highest recorded levels, in response to the recharge of stormwater discharge in unlined creeks. Over this past year from fall 2024 to fall 2025, groundwater levels decreased about one foot in the northern portion of Mill Creek (PB-2 and HCMP-5/1), decreased about one foot in the central portion (PB-1/2) and decreased about one foot or remained stable at the southern portion (HCMP-6/1 and PB-5/1).

The Average Growing-Season NDVI and air photo analyses along Mill Creek show that changes in the vegetation were relatively minor during 2024 to 2025 (discussed in Section 3.1), with NDVI increasing or showing no change at four of the areas (MC-1, MC-2, MC-3, and MC-6), and slightly declining at two sites (MC-4 and MC-5). Hence, the main observations and conclusions for the period of 2024 to 2025 for the Mill Creek reach are that groundwater levels slightly decreased, and riparian vegetation did not change significantly.

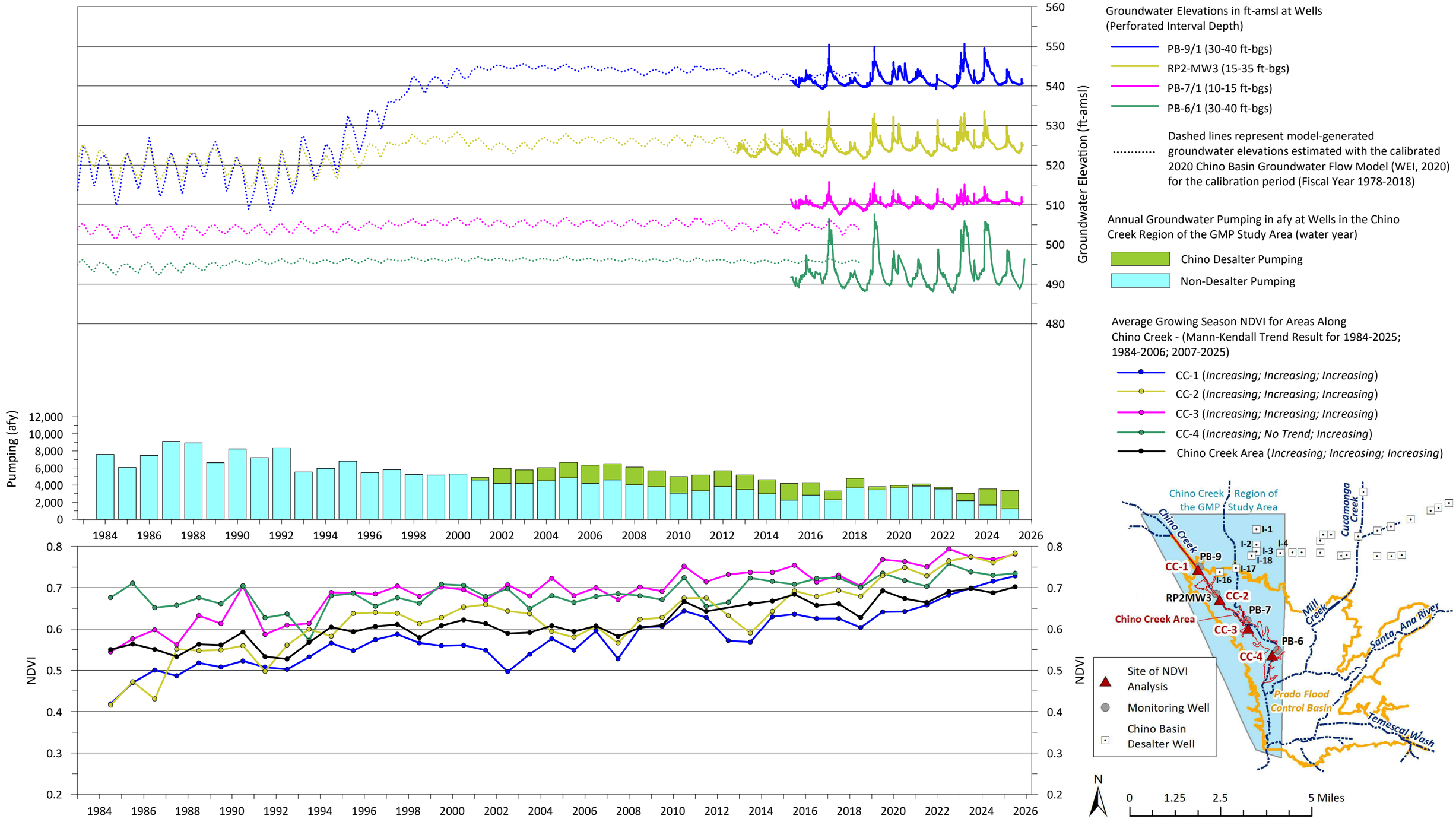
Santa Ana River (***Figure 3-13c***). During the 1990s, the groundwater levels along SAR increased in response to a decline in pumping from 1990 to 2000. These responses were greatest along the eastern portion of SAR where they increased up to five feet. Since 2000, groundwater levels have declined by a similar magnitude along the eastern portion of the SAR due to the onset and progressive increase in Chino Basin Desalter pumping at CDA wells I-13, I-14, I-15, and II-1 through II-11 to the north of the SAR (see inset map on Figure 3-13c), while groundwater levels slightly increased along the western portion of the SAR near the Archibald well. Since 2018, total pumping at these Chino Basin Desalter wells progressively increased to a historically high volume in 2021, declining slightly since, contributing to the increase in the total pumping observed in this area.

DRAFT

From 2015 to 2025, the measured groundwater levels at the PBHSP monitoring wells in the riparian habitat show a slight decreasing trend through 2022 along the northeastern portion near PB-4/1 and the northern portion near PB-3/1, and then increasing and stable trend between 2023 and 2025. These decreases in groundwater levels are likely due to the pumping in this area. The increase between 2023 and 2025 is likely due to a combination of reduced pumping and increased stormwater recharge. Along the southwestern portion near the Archibald 1 groundwater levels show a stable and slight increasing trend through 2023, and then a declining trend from 2023 through 2025. Groundwater levels fluctuate seasonally, in some cases by up to seven feet under the seasonal stresses of pumping and recharge. Over the last year, from fall 2024 to fall 2025, groundwater levels at the monitoring wells along the SAR remained stable along the northeastern and northern portions (PB-4/1 and PB-3/1) and decreased by about 1 foot along the western portion (Archibald 1).

The Average Growing-Season NDVI and air photo analyses along the SAR show that changes in the vegetation were relatively minor from 2024 to 2025 (discussed in Section 3.1) and the NDVI increased at all SAR areas (SAR-2, SAR-3, and SAR-4). Hence, the main observations and conclusions for the period of 2024 to 2025 for the SAR reach, are that groundwater levels remained stable or slightly decreased, and the riparian vegetation did not change significantly.

DRAFT



Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

Groundwater Levels and Production versus NDVI
Chino Creek Area for 1984-2025

Figure 3-13a

Groundwater Elevations in ft-amsl at Wells (Perforated Interval Depth)

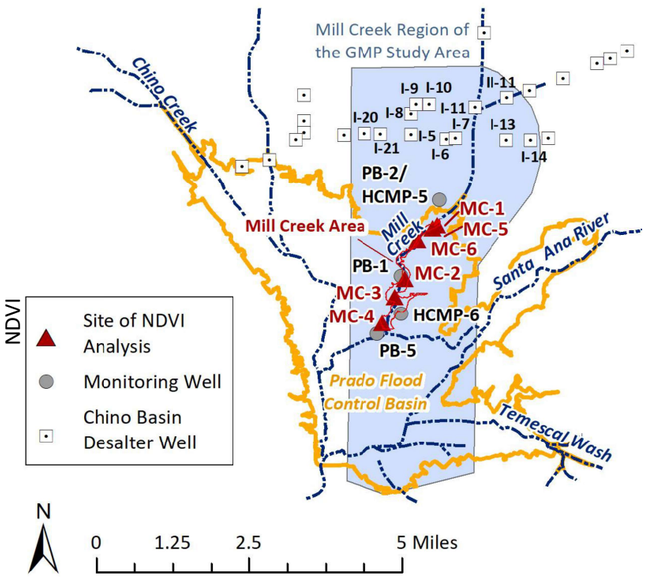
- PB-2 (42-62 ft-bgs)
- HCMP-5/1 (90-130 ft-bgs)
- PB-1/2 (75-95 ft-bgs)
- HCMP-6/1 (60-100 ft-bgs)
- PB-5/1 (30-50 ft-bgs)
- Dashed lines represent model-generated groundwater elevations estimated with the calibrated 2020 Chino Basin Groundwater Flow Model (WEI, 2020) for the calibration period (Fiscal Year 1978-2018)

Annual Groundwater Pumping in afy at Wells in the Mill Creek Region of the GMP Study Area (water year)

- Chino Desalter Pumping
- Non-Desalter Pumping

Average Growing Season NDVI for Areas Along Mill Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- MC-1 (*Increasing; Increasing; Increasing*)
- MC-2 (*No Trend; No Trend; Increasing*)
- MC-3 (*Increasing; No Trend; Increasing*)
- MC-4 (*Increasing; No Trend; No Trend*)
- MC-5 (*No Trend; No Trend; Increasing*)
- MC-6 (*Increasing; Decreasing Trend; Increasing*)
- Upper Mill Creek Area (*Increasing; No Trend; Increasing*)
- Mill Creek Area (*No Trend; Decreasing; Increasing*)



Groundwater Elevation (ft amsl)

580
570
560
550
540
530
520

Groundwater Elevations in ft-amsl at Wells
(Perforated Interval Depth)

- PB-4/1 (15-25 ft-bgs)
- PB-3/1 (44.5-54.5 ft-bgs)
- Archibald (75-85 ft-bgs)

Dashed lines represent model-generated groundwater elevations estimated with the calibrated 2020 Chino Basin Groundwater Flow Model (WEI, 2020) for the calibration period (Fiscal Year 1978-2018)

Annual Groundwater Pumping in afy at Wells in the Santa Ana River Region of the GMP Study Area (water year)

- Chino Desalter Pumping
- Non-Desalter Pumping

Pumping (afy)

34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0

1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026

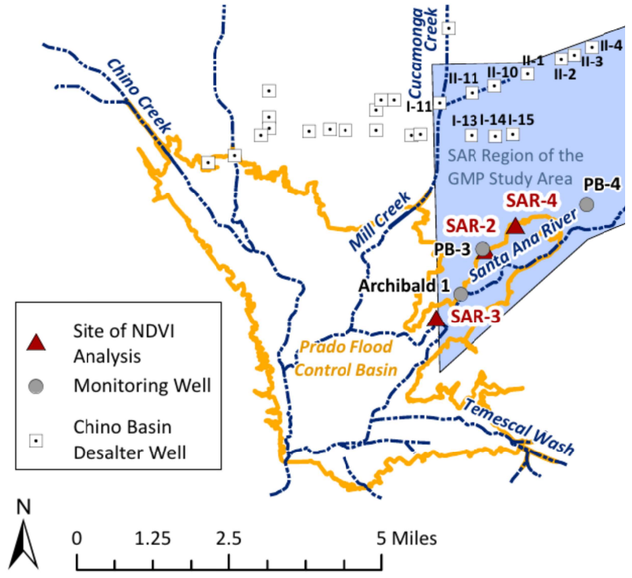
Average Growing Season NDVI for Areas Along Santa Ana River - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- SAR-2 (*Increasing; Decreasing; Increasing*)
- SAR-3 (*Increasing; No Trend; Increasing*)
- SAR-4 (*Increasing; No trend; Increasing*)

NDVI

0.8
0.7
0.6
0.5
0.4
0.3
0.2

1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026



3.2.4 Summary

The following observations and interpretations were derived from the analysis of groundwater pumping, groundwater levels, and NDVI:

- From 1961 to 1990, groundwater pumping from private domestic and agricultural wells in the study area averaged about 45,900 afy. From 1991 to 1999, groundwater pumping steadily declined to about 23,600 afy primarily due to conversions from agricultural to urban land uses. In 2000, Chino Basin Desalter pumping commenced to replace the lost agricultural pumping, and by 2018, pumping in the study area was about 37,000 afy. In WY 2020, the CDA reached its intended pumping rate of 40,000 afy at the Chino Basin Desalters. In WY 2025, there was 40,110 af total groundwater pumping in the GMP study area; 37,413 af of this was CDA pumping. This is just slightly less pumping than the previous year (40, 598 af).
- Since groundwater-level measurements commenced at the PBHSP monitoring wells in 2015, there have been some increasing and decreasing trends in groundwater levels observed in the riparian vegetation area along the reaches of Chino Creek, Mill Creek, and SAR. From September 2016 to September 2025, groundwater levels have changed less than +/-5 feet throughout most of the extent. Historically, groundwater levels in the riparian vegetation have declined the most along the northern portion of Mill Creek, just south of the PB-2 monitoring well, where levels decreased by eight feet between 2015 to 2022, likely due to increased pumping at the Chino Desalter wells to the north. By 2024 groundwater levels had increased in this area by about four feet, and in 2025, groundwater levels slightly declined by about one foot. From 2015 to 2025, groundwater levels increased the most in the northern reach of Chino Creek where groundwater levels have increased about 10 feet due to decreased pumping.
- Over the past year from 2024 to 2025 groundwater levels generally remained stable with groundwater levels changing up to +/- one foot at most of the PBHSP wells near the riparian vegetation along the reaches of Chino Creek, Mill Creek, and SAR. In Section 3.1, the analysis of air photos and NDVI for the riparian habitat indicates that the riparian vegetation did not change significantly in any of the areas, and there was a slight increase in NDVI at most of the areas as groundwater levels remained stable or slightly decreased.

3.3 Analysis of Groundwater/Surface-Water Interactions

One of the objectives of the PBHSP is to identify factors that contribute to the long-term sustainability of Prado Basin riparian habitat. The depth to groundwater analysis in Figure 3-12 indicates the riparian vegetation exists in areas of shallow groundwater, typically 15 ft-bgs or less, and is dependent, at least in part, upon the shallow groundwater. There have been multiple studies for the PBHSP on the groundwater/surface-water interactions in the Prado Basin to determine the source of shallow groundwater that is available for consumptive use by the riparian vegetation, and that may be important to the long-term sustainability of the riparian habitat.

DRAFT

3.3.1 Past Monitoring of Groundwater/Surface-Water Interactions:

Historical monitoring of groundwater/surface-water interactions for the PBHSP include:

- From FY 2015 to FY 2018 quarterly groundwater samples were collected from the 18 PBHSP monitoring wells and analyzed at a minimum for general minerals. The general mineral chemistry was to be analyzed along with other data to help characterize groundwater/surface-water interactions in the Prado Basin and determine the source of the shallow groundwater, as described in the following bullet.
- The Annual Reports for WY 2017 and WY 2018 (Section 3.3) included a comprehensive analysis to understand the sources of the shallow groundwater in the Prado Basin (WEI, 2018; 2019). The analysis used the groundwater-quality data, along with surface-water discharge, surface water quality, groundwater levels, and groundwater modeling, as multiple lines of evidence to analyze the groundwater/surface-water interactions at the nine PBHSP well locations—along the fringes of the riparian habitat. In general, the analysis concluded that the SAR and northern portion of Mill Creek are losing reaches, characterized by streambed recharge. Most other areas along Chino and Mill Creeks are gaining reaches, characterized by groundwater discharge. That said, at most locations in the Prado Basin, there appear to be multiple and transient sources that feed the shallow groundwater, and the groundwater/surface-water interactions are complex. Additional monitoring was recommended to better characterize the sources of shallow groundwater and groundwater/surface-water interactions.
- From FY 2018 to FY 2023 a pilot monitoring program was conducted to evaluate whether high-frequency data could improve the interpretation of groundwater/surface-water interactions previously studied for the PBHSP. The pilot monitoring program included the use of transducers that record EC, temperature, and water levels at 15-minute intervals at two locations in Chino Creek and the same high-frequency monitoring at four nearby monitoring wells (PB-7 and PB-8 clusters). Additionally, during the first two years of the pilot monitoring program, surface-water and groundwater-quality samples were collected to support the high-frequency data.
- The Annual Report for WY 2022 included an analysis of data from the pilot monitoring program (West Yost, 2023). The analysis concluded that the high-frequency monitoring of EC and temperature at shallow monitoring wells can reveal the source waters that recharge shallow groundwater. Additionally, the high-frequency monitoring of groundwater-level elevations, surface-water stage, and thalweg elevations can help identify the source waters that recharge shallow groundwater. We also learned from the pilot monitoring program that it is difficult to collect high-frequency data in the surface-water because the transducers consistently become clogged with mud compromising the accuracy of the data and can be lost during large storm events. The WY 2022 report included recommendations to discontinue the pilot monitoring program and replace it with high-frequency monitoring of EC, temperature, and water levels for each pair of PBHSP monitoring wells, most of which was already being collected, along with quarterly surface-water field measurements for EC and temperature in the adjacent streams.

DRAFT

3.3.2 Current Monitoring for Groundwater/Surface-Water Interactions

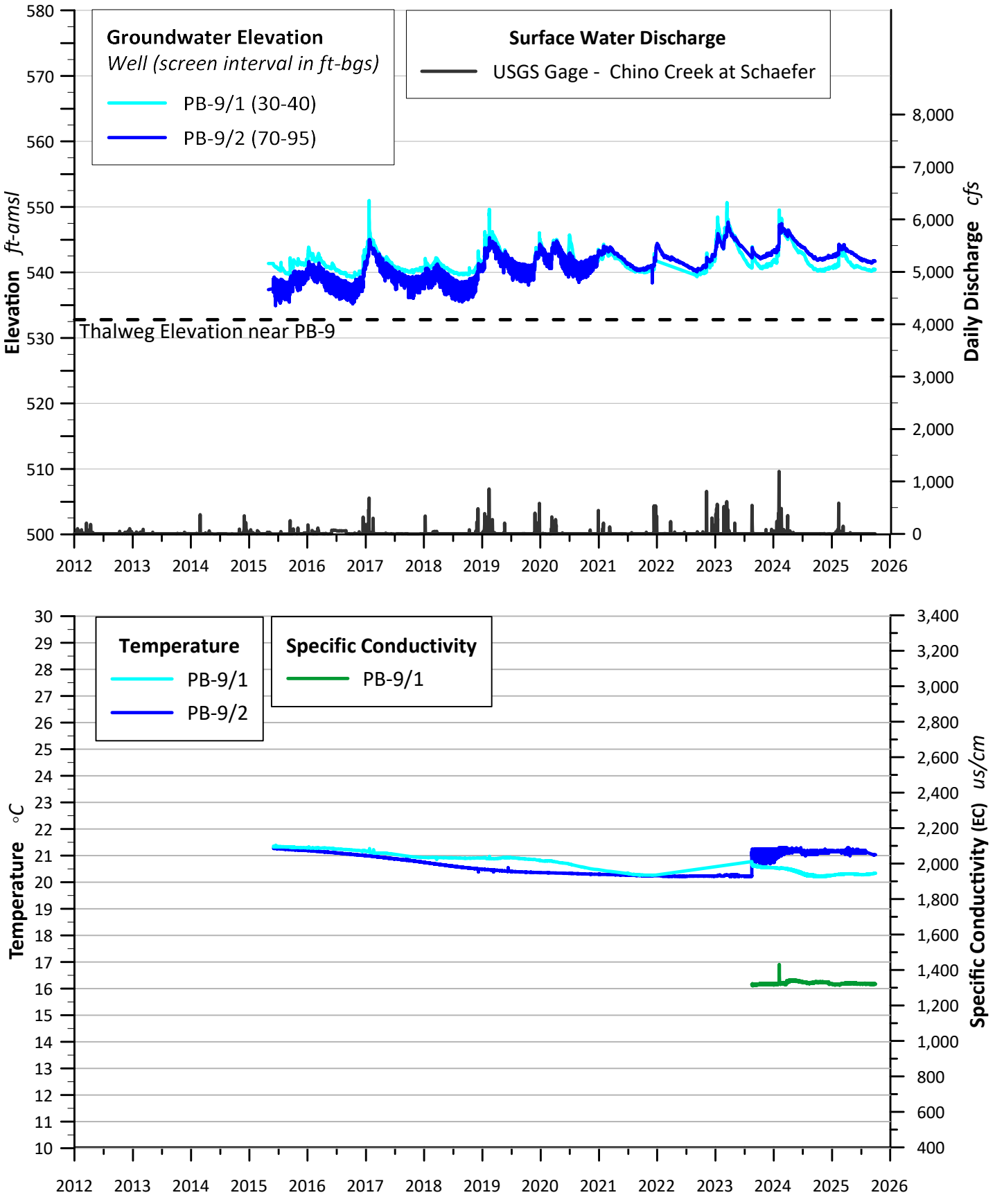
In 2023, monitoring of groundwater/surface-water interactions was initiated based on recommendations in the WY 2022 Annual Report following the analysis of the pilot monitoring program. This monitoring included: (i) compiling, processing, and uploading to the database, the high-frequency temperature data which was already being collected at the PBSHP monitoring wells since 2015; (ii) establishing the locations of surface-water sites near the PBHSP monitoring wells to collect field measurements of EC and temperature, and initiating quarterly measurements; and (iii) replacing transducers at the PBHSP monitoring wells as needed with transducers that measure EC in addition to temperature and level readings (now 17 wells have transducers that measure EC). As described in Section 3.2, this monitoring continued through 2025.

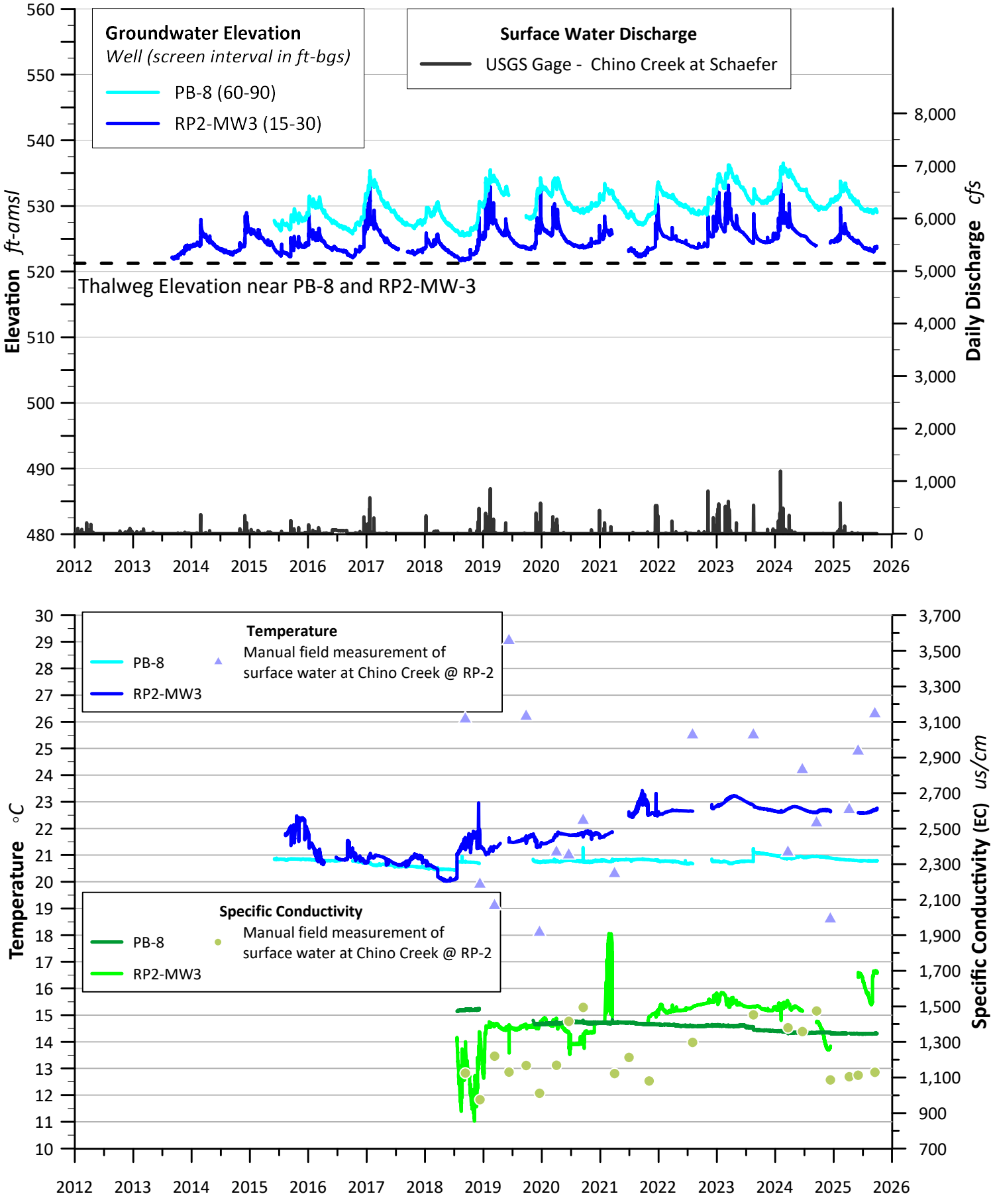
In June 2024, professional elevation surveys were conducted of the thalweg elevations of the adjacent water bodies to all PBHSP monitoring wells. The thalweg elevation can be compared to the groundwater elevations in PBHSP monitoring wells to help characterize groundwater/surface-water interactions within the GMP study area and determine if the shallow groundwater supporting the riparian vegetation is supported primarily by the groundwater and/or the surface-water. Figures 3-14a through 3-14i are time series charts that display the high-frequency monitoring data at each PBHSP monitoring well location in the riparian habitat along Chino Creek, Mill Creek, and the SAR. Each figure contains the following:

- The upper chart is a time series of the high-frequency groundwater elevations at the shallow and deeper PBHSP monitoring well at each location and the surface-water discharge in the adjacent stream to the monitoring wells. The groundwater-elevation time series are charted with the surveyed thalweg elevation of the adjacent creek or river. Thalweg elevations are compared to the groundwater elevations to determine the potential for groundwater discharge or streambed recharge along the specific stream reaches, and daily surface-water discharge data are charted and compared with groundwater elevations to characterize the relationship between surface-water discharge and groundwater levels.
- The lower chart is a time series of high-frequency temperature and EC at the shallow and deeper PBHSP monitoring wells at each location, with the surface-water field measurements of EC and temperature if available.

The high-frequency monitoring data and the surveyed thalweg elevations in Figures 3-14a through 3-14i was intended to better reveal the interpretation of groundwater/surface-water interactions previously studied for the PBHSP that used the general mineral chemistry data collected at the PBHSP wells. Table 3-5 summarizes the analysis of groundwater/surface-water interactions based on this data presented in Figures 3-14a through 3-14i. Table 3-5 also includes the interpretation from the original groundwater/surface-water interactions analysis presented in the Annual Reports for WY 2017 and WY 2018 (Section 3.3) that used multiple lines of evidence, including the general mineral chemistry data to analyze the groundwater/surface-water interactions at the PBHSP well locations (WEI, 2018; 2019). In general, the analysis of the high-frequency data concludes a similar analysis from the 2017 to 2018 Annual Reports that the SAR from PB-4 to PB-3 and Mill Creek near PB-2 are losing reaches, characterized by streambed recharge. And most other areas along Chino Creek and Mill Creek are overall gaining reaches, characterized by groundwater discharge, and some locations additionally influenced by surface water recharge.

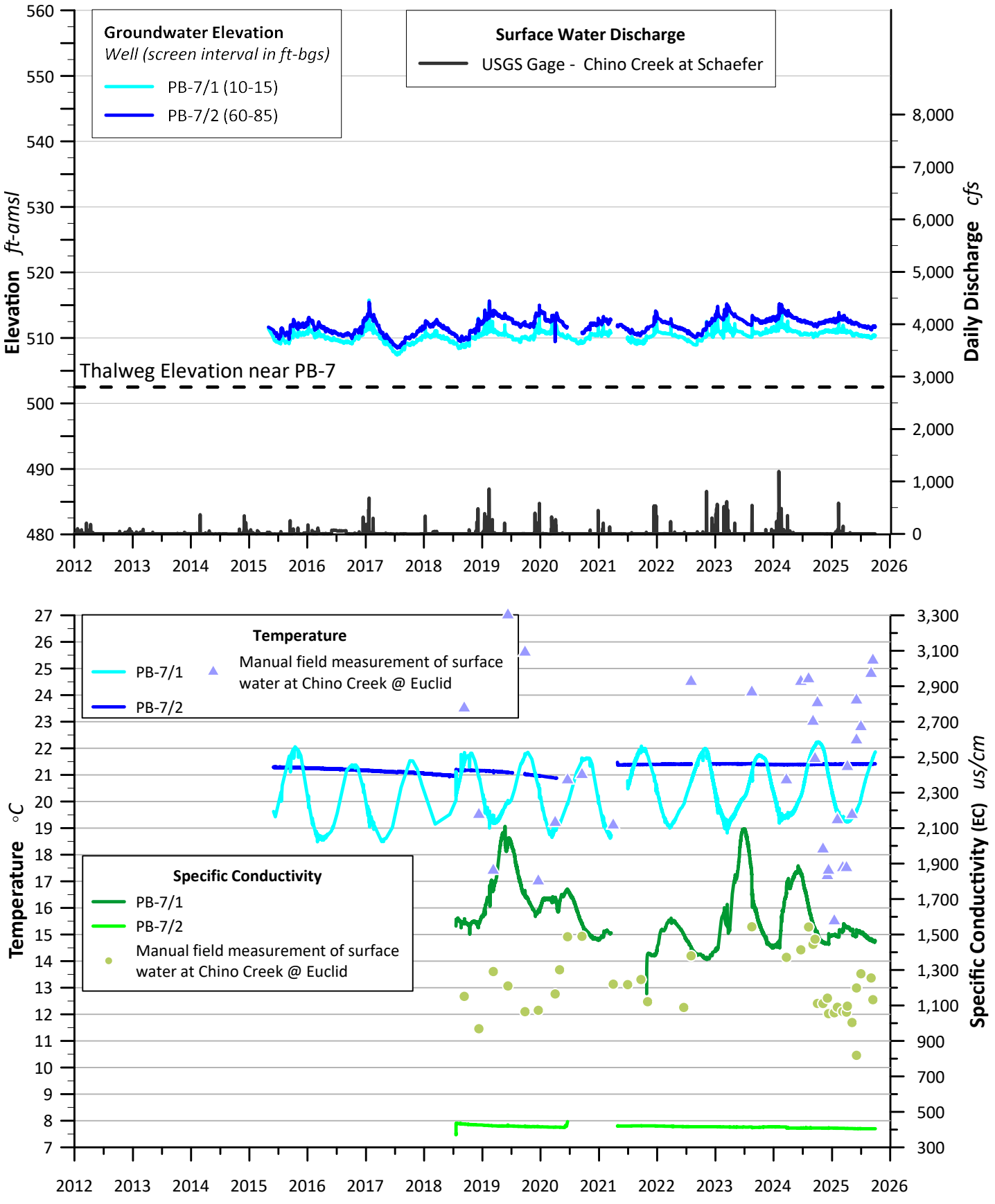
DRAFT

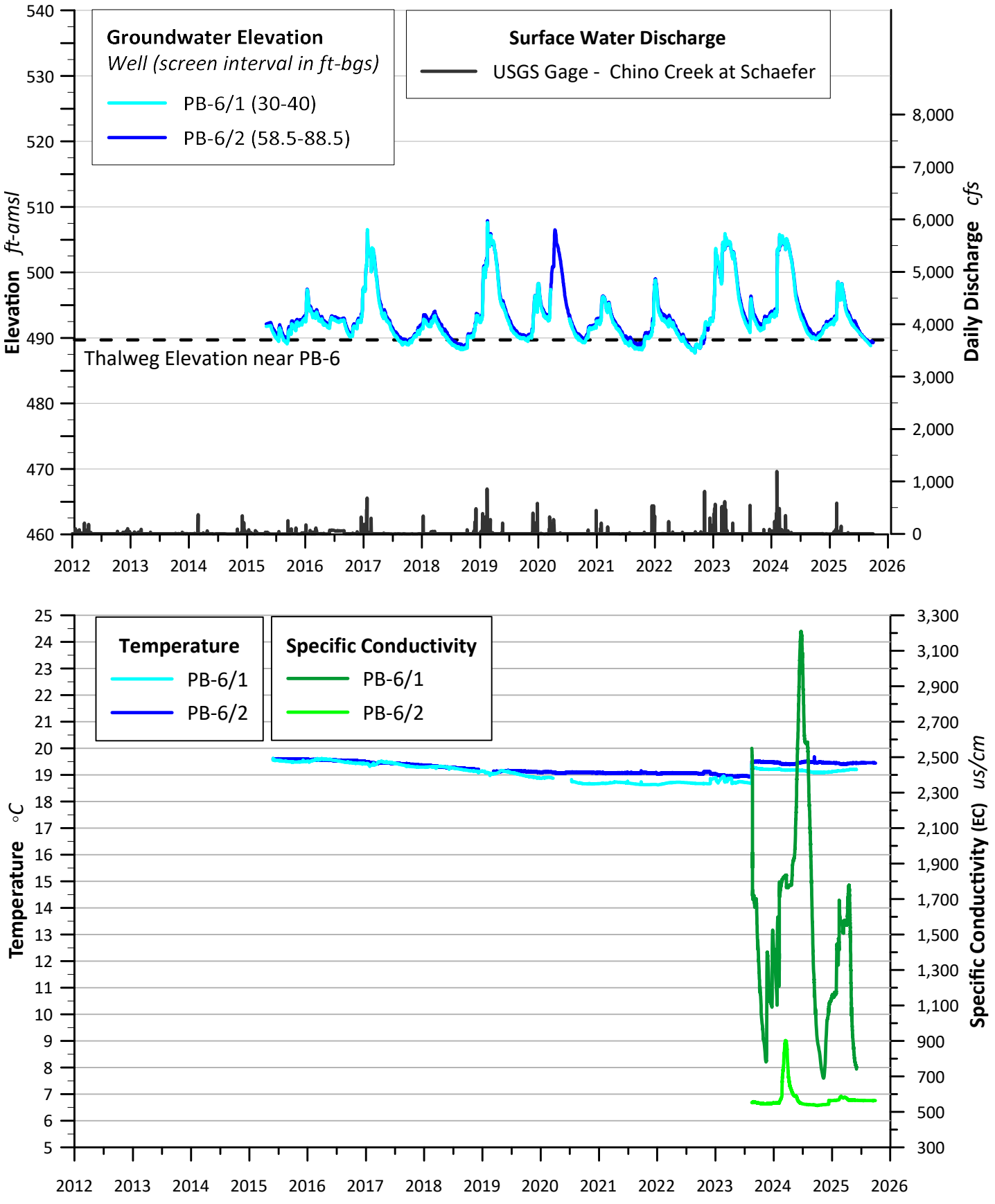

Groundwater Elevation
Well (screen interval in ft-bgs)
PB-9/1 (30-40)
PB-9/2 (70-95)
Surface Water Discharge
USGS Gage - Chino Creek at Schaefer
Thalweg Elevation near PB-9
Elevation ft-amsl
Daily Discharge cfs
Temperature
PB-9/1
PB-9/2
Specific Conductivity
PB-9/1
Temperature °C
Specific Conductivity (EC) us/cm

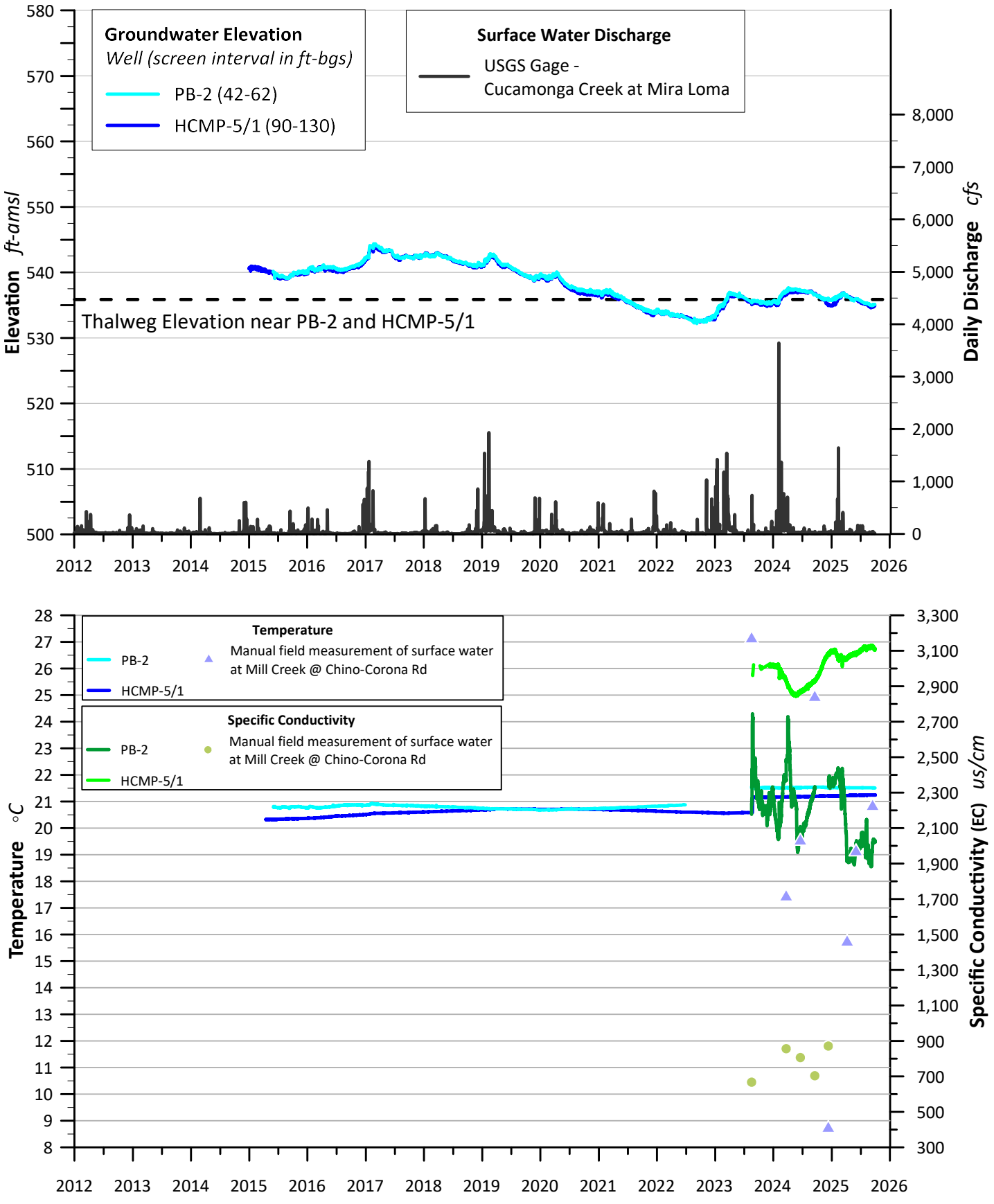


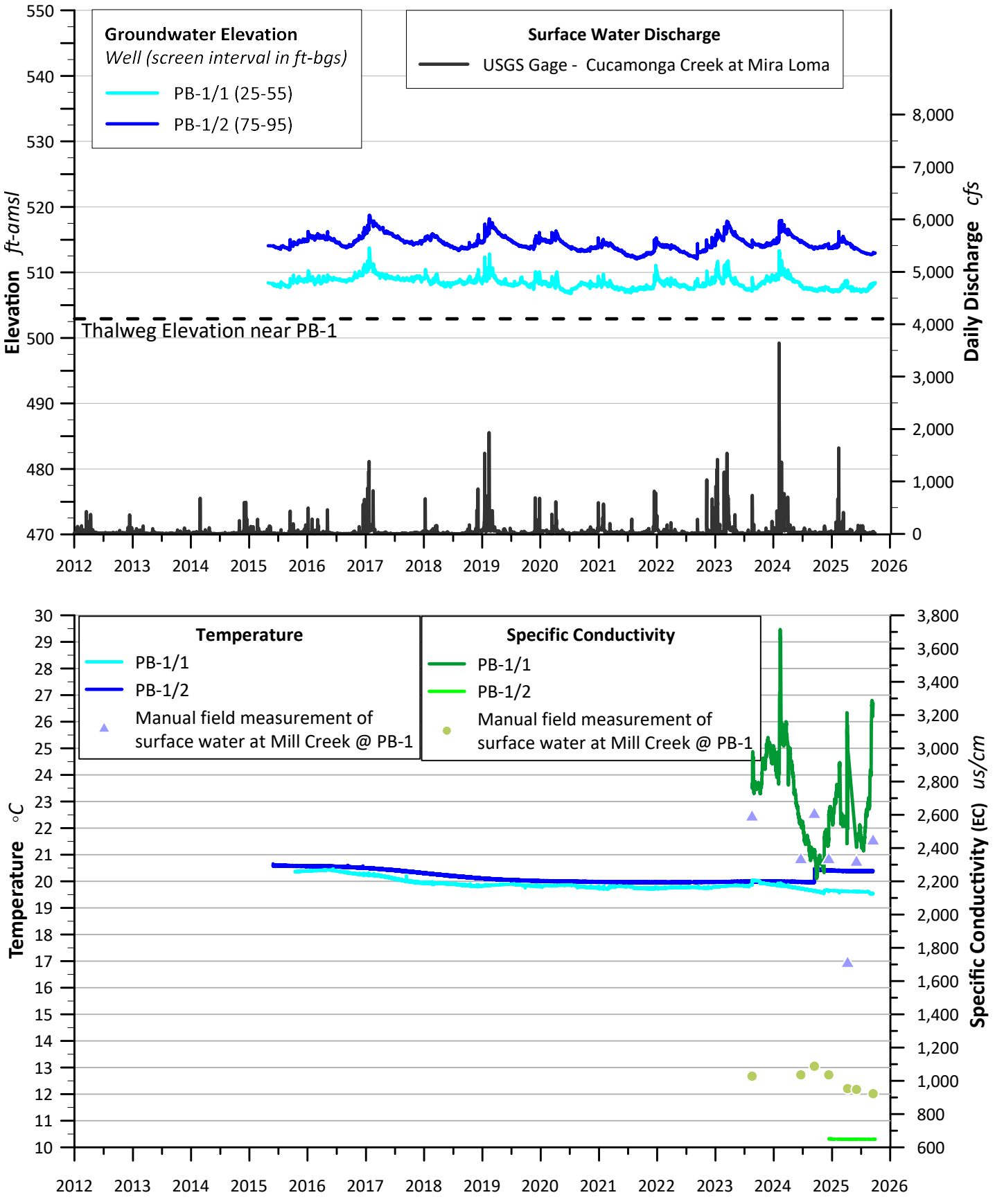
Monitoring to Characterize Groundwater and Surface-Water Interactions
PB-8 and RP2-MW3 Near Chino Creek

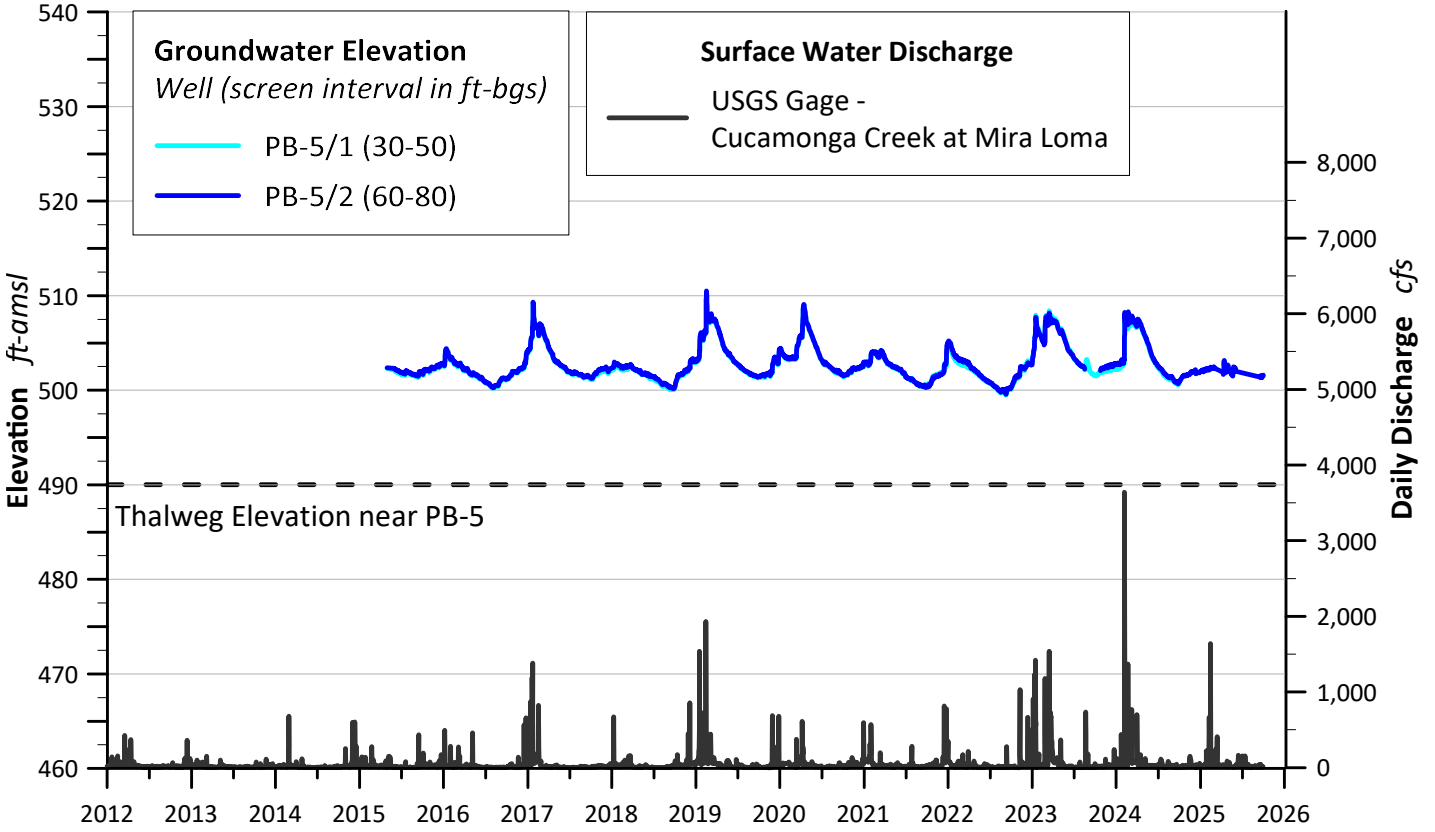
Figure 3-14b

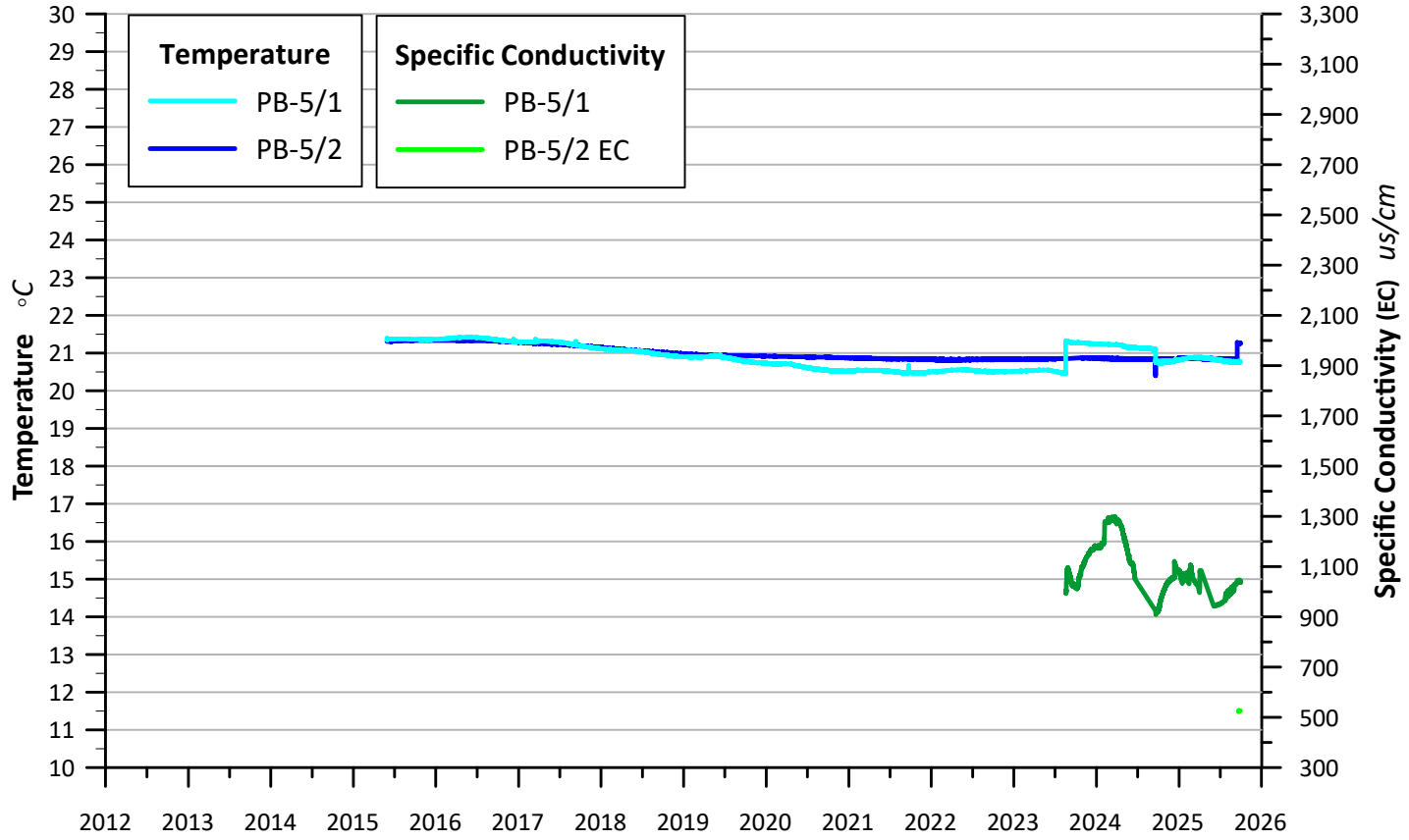

Groundwater Elevation
Well (screen interval in ft-bgs)
PB-7/1 (10-15)
PB-7/2 (60-85)
Surface Water Discharge
USGS Gage - Chino Creek at Schaefer
Elevation ft-amsl
Daily Discharge cfs
Thalweg Elevation near PB-7
Temperature
PB-7/1
PB-7/2
Manual field measurement of surface water at Chino Creek @ Euclid
Specific Conductivity
PB-7/1
PB-7/2
Manual field measurement of surface water at Chino Creek @ Euclid
Temperature °C
Specific Conductivity (EC) us/cm

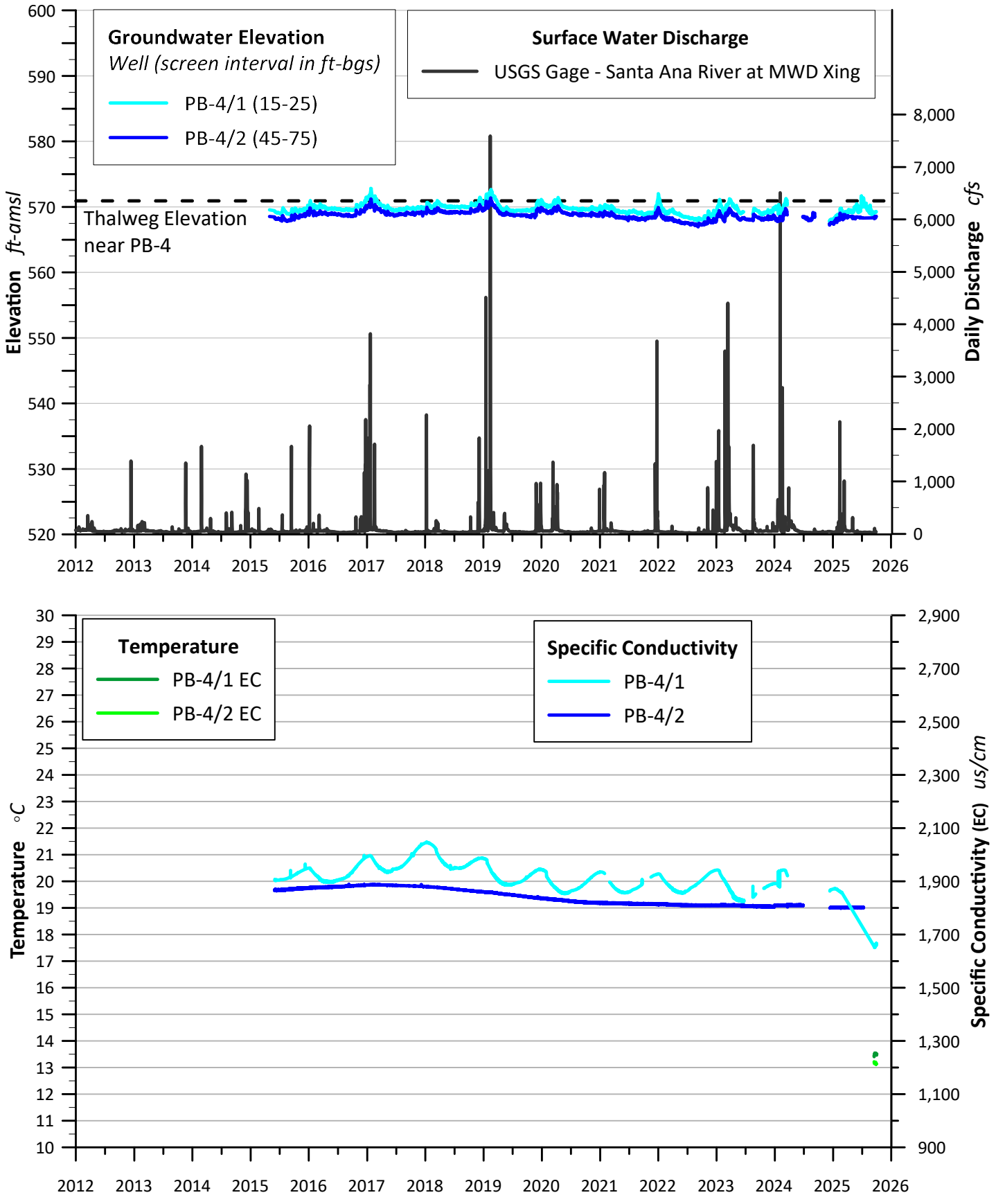

Groundwater Elevation
Well (screen interval in ft-bgs)
PB-6/1 (30-40)
PB-6/2 (58.5-88.5)
Surface Water Discharge
USGS Gage - Chino Creek at Schaefer
Thalweg Elevation near PB-6
Elevation ft-amsl
Daily Discharge cfs
Temperature
PB-6/1
PB-6/2
Specific Conductivity
PB-6/1
PB-6/2
Temperature °C
Specific Conductivity (EC) us/cm


Groundwater Elevation
Well (screen interval in ft-bgs)
PB-2 (42-62)
HCMP-5/1 (90-130)
Surface Water Discharge
USGS Gage - Cucamonga Creek at Mira Loma
Thalweg Elevation near PB-2 and HCMP-5/1
Elevation ft-amsl
Daily Discharge cfs
Temperature
PB-2
HCMP-5/1
Manual field measurement of surface water at Mill Creek @ Chino-Corona Rd
Specific Conductivity
PB-2
HCMP-5/1
Manual field measurement of surface water at Mill Creek @ Chino-Corona Rd
Temperature °C
Specific Conductivity (EC) us/cm


Groundwater Elevation
Well (screen interval in ft-bgs)
PB-1/1 (25-55)
PB-1/2 (75-95)
Surface Water Discharge
USGS Gage - Cucamonga Creek at Mira Loma
Thalweg Elevation near PB-1
Elevation ft-amsl
Daily Discharge cfs
Temperature
PB-1/1
PB-1/2
Manual field measurement of surface water at Mill Creek @ PB-1
Specific Conductivity
PB-1/1
PB-1/2
Manual field measurement of surface water at Mill Creek @ PB-1
Temperature °C
Specific Conductivity (EC) us/cm


Groundwater Elevation
Well (screen interval in ft-bgs)
PB-5/1 (30-50)
PB-5/2 (60-80)
Surface Water Discharge
USGS Gage -
Cucamonga Creek at Mira Loma
Thalweg Elevation near PB-5
Elevation ft-amsl
Daily Discharge cfs
540
530
520
510
500
490
480
470
460
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026


Temperature
PB-5/1
PB-5/2
Specific Conductivity
PB-5/1
PB-5/2 EC
Temperature °C
Specific Conductivity (EC) us/cm
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
3,300
3,100
2,900
2,700
2,500
2,300
2,100
1,900
1,700
1,500
1,300
1,100
900
700
500
300
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026


Groundwater Elevation
Well (screen interval in ft-bgs)
PB-4/1 (15-25)
PB-4/2 (45-75)
Surface Water Discharge
USGS Gage - Santa Ana River at MWD Xing
Thalweg Elevation near PB-4
Elevation ft-amsl
Daily Discharge cfs
Temperature
PB-4/1 EC
PB-4/2 EC
Specific Conductivity
PB-4/1
PB-4/2
Temperature °C
Specific Conductivity (EC) us/cm

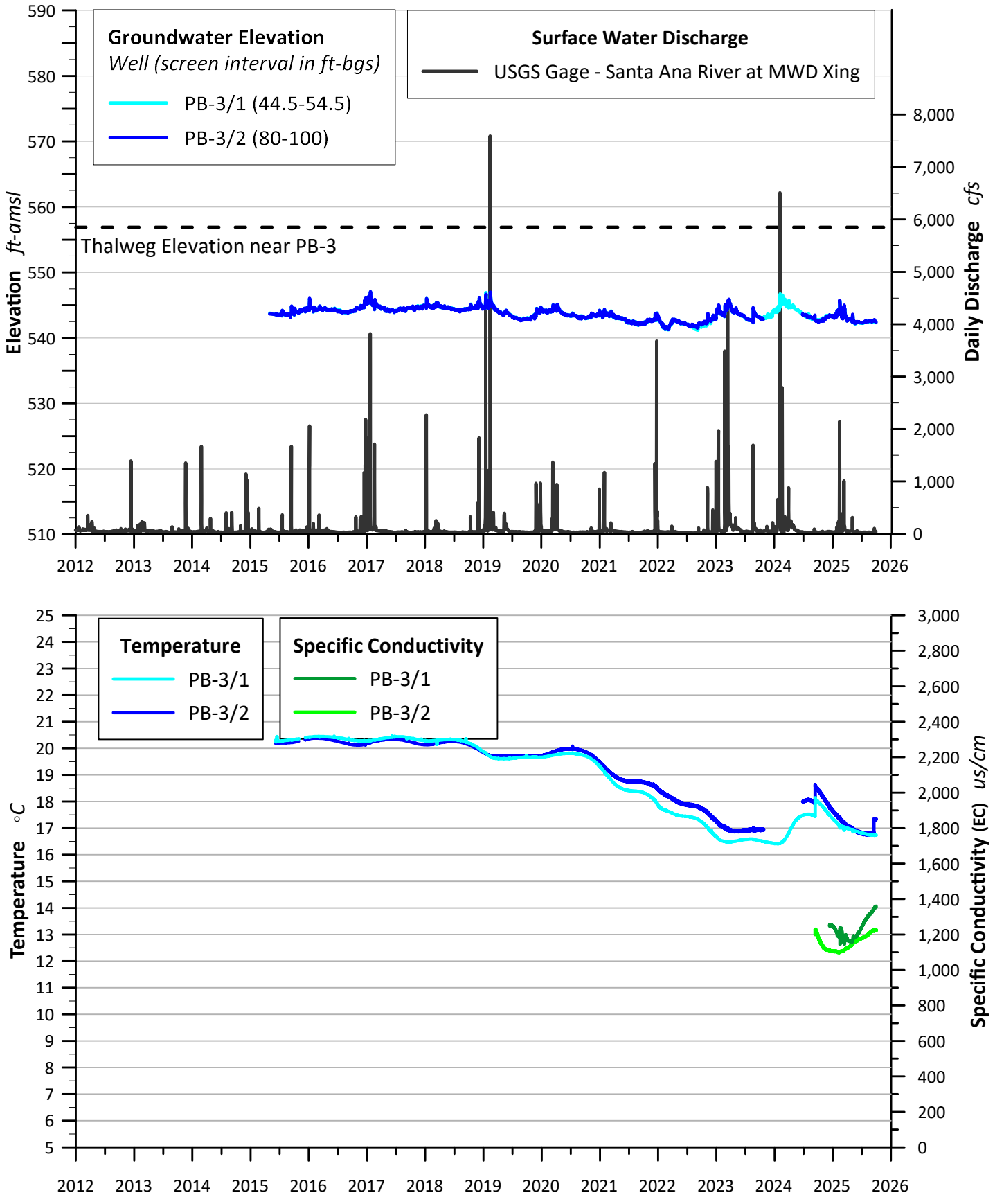

Groundwater Elevation
Well (screen interval in ft-bgs)
PB-3/1 (44.5-54.5)
PB-3/2 (80-100)
Surface Water Discharge
USGS Gage - Santa Ana River at MWD Xing
Thalweg Elevation near PB-3
Elevation ft-amsl
Daily Discharge cfs
590
580
570
560
550
540
530
520
510
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
Temperature
PB-3/1
PB-3/2
Specific Conductivity
PB-3/1
PB-3/2
Temperature °C
Specific Conductivity (EC) us/cm
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0

Table 3-5. Analysis of Groundwater/Surface-Water Interactions in the Prado Basin

Location Figure No.	Overall Interpretation	Interpretation from the 2017 and 2018 Annual Reports	Lines of Evidence in Figures 3-14a through 3-14i			
			Groundwater Levels vs. Thalweg Elevations	Groundwater Levels vs. Surface Water Discharge	High-Frequency Temperature Data	High-Frequency EC Data
PB-9 @Chino Creek Figure 3-14a	**Rising Groundwater (Gaining Reach)**	Chino Creek at PB-9 appears to be an area of groundwater discharge with instances of streambed recharge when groundwater levels decline below the thalweg. The likely primary sources of shallow groundwater in this area are a perched aquifer, the shallow regional aquifer system, and local return flows from precipitation and applied water. There are indications that streambed recharge contributes to shallow groundwater, especially during stormwater discharge events and when groundwater levels rise up to ten feet.	From 2015-2021 groundwater elevations at the deeper screened well PB-9/2 are higher than then the groundwater elevation of the shallow screened well (PB-9/1), indicating an upward hydraulic gradient. This reverses after 2021 when what appears to be nearby pumping that impacts PB-9/2 appears to stop. The groundwater elevations at both wells always remain above thalweg elevation. Both of these conditions indicate that this is an area of rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Chino Creek, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	Both monitoring wells show a long-term, slight gradual decline in temperature of about 1 degree C, but with slightly different patterns. The shallow well (PB-9/1) exhibits an overall decreasing trend with bi-annual variability, while the deeper well (PB-9/2) shows a slight decline through 2023 followed by an abrupt slight increase and relative stabilization since, aside from daily fluctuations. The abrupt increase coincides with the installation of a new transduce. These changes are minor and likely indicative of the regional groundwater as the primary source of water at this location.	EC data has only been collected in the shallow well (PB-9/1) since mid-2023. The EC data in the shallow well shows a stable trend, indicating that regional groundwater is the primary source of water at this location.
PB-8 @ Chino Creek Figure 3-14b	**Rising Groundwater (Gaining Reach)**	Chino Creek at PB-8 appears to be an area of groundwater discharge. The likely primary sources of the shallow groundwater in this area are the shallow regional aquifer system and local return flows from precipitation and applied water. There are some indications that streambed recharge contributes to the shallow groundwater, especially during stormwater discharge events.	Groundwater elevations at the deeper screened well PB-8 are higher than the groundwater elevation of the shallow screened well (RP2-MW3), indicating an upward hydraulic gradient, and the groundwater elevations at both wells always remain above thalweg elevation— both of these conditions indicate that this is an area of rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Chino Creek, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	The shallow monitoring well (RP2-MW3) exhibits temperature data with gradual declining trend then upward trend, with irregular fluctuations. This may indicate that the groundwater is likely being recharged by some surface water in addition to shallow groundwater. The deeper well (PB-8) exhibits a relatively constant time series of temperature data, indicating that regional groundwater is the primary source of water at this location.	EC data at the shallow monitoring well (RP2-MW3) and deeper well (PB-8) exhibit similar trends as the temperature data, also indicating that the shallow well is likely being recharged by some surface water in addition to shallow groundwater; and the deeper well is primarily regional groundwater influenced.
PB-7 @ Chino Creek Figure 3-14c	**Rising Groundwater (Gaining Reach)**	Chino Creek at PB-7 appears to be an area of groundwater discharge. The likely primary source of the shallow groundwater in this area is the shallow regional aquifer system. However, the groundwater/surface-water interactions in this area appear to be complex with multiple and transient sources of water that are tributary to the PB-7 wells.	Groundwater elevations at the deeper screened well (PB-7/2) are slightly higher than the groundwater elevation of the shallow screened well (PB-7/1), indicating an upward hydraulic gradient, and the groundwater elevations at both wells always remain above thalweg elevation—both of which indicate that this is an area of rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Chino Creek and the formation of a reservoir behind Prado Dam, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	The temperature data for the shallow well (PB-7/1) shows a seasonal sinusoidal pattern between 18 and 22 degrees C, which indicates that the shallow well is under the influence of surface water recharge. The temperature at the deeper well (PB-7/2) remains relatively constant, which indicates that it is not under the influence of surface water recharge.	The EC at the shallow well (PB-7/1) and deeper well (PB-7/2) exhibit similar trends as the temperature data, also indicating that the shallow well is under the influence of surface water recharge, and the deeper well is not.
PB-6 @ Chino Creek Figure 3-14d	**Rising Groundwater (Gaining Reach)**	Chino Creek at PB-6 appears to be an area of both groundwater discharge and streambed recharge. The likely sources of the shallow groundwater in this area are the shallow regional aquifer system and streambed recharge. However, the groundwater/surface-water interactions in this area appear to be complex with multiple and transient sources of water that are tributary to the PB-6 wells.	Groundwater elevations at the both PB-6 wells are similar. The groundwater elevations are typically above the thalweg elevation, indicating this is an area of rising groundwater. However, in some years there are brief periods in late summer to early fall when levels fall below the thalweg. This indicates that there are short periods where the surface water is likely recharging the shallow groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Chino Creek and the formation of a reservoir behind Prado Dam, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	Both monitoring wells exhibit a relatively constant time series of temperature data with a slow declining trend of about 1 degree C through 2023, followed by an abrupt slight increase and stabilization since. The abrupt increase coincides with the installation of a new transducer. This indicates that likely the groundwater is the primary source of water at this location.	Since monitoring for EC began in 2023, the EC data at both wells show a different pattern than temperature. EC in the shallow well (PB-6/1) greatly fluctuates by up to 2,500 µs/cm whereas in the deeper well (PB-6/2) EC shows a brief rise of about 400 µs/cm in 2024 followed by stable conditions. These patterns suggest that the shallow well is affected by water sources distinct from those influencing the deeper well. At this time, it cannot be determined whether surface-water recharge is among those sources, and further analysis is required.
PB-2 @ Mill Creek Figure 3-14e	**Streambed Infiltration (Losing Reach)**	Mill Creek to the south of PB-2 appears to be an area of streambed recharge. However, the primary source of the shallow groundwater near PB-2 appears to be return flows from precipitation and applied water.	Groundwater elevations at the shallow screened well (PB-2) and deeper screened well (HCMP-5/1) are the same. From 2015 to 2021 the groundwater elevations at the wells are above the thalweg elevation, indicating this is an area of rising groundwater. After 2021, groundwater levels declined and fluctuated around the thalweg, indicating a indicating a transitional reach where conditions shifted between surface water recharge and rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Mill Creek, suggesting that stormwater discharge in Mill Creek is a source of recharge to shallow groundwater.	Both monitoring wells exhibit a relatively constant time series of temperature data followed with an abrupt slight increase in 2023 and stabilization since. The abrupt increase coincides with the installation of a new transducer. This indicates that likely the groundwater is the primary source of water at this location.	Since monitoring for EC began in 2023, the EC data at both wells show a different pattern than temperature. In the shallow well (PB-2), EC fluctuates by roughly 800 µS/cm and is higher than EC in the deeper well (HCMP-5/1), where EC also varies but does so more steadily, with a total range of about 200 µS/cm. These patterns suggest that the shallow well is affected by water sources distinct from those influencing the deeper well. At this time, it cannot be determined whether surface-water recharge is among those sources, and further analysis is required.
PB-1 @ Mill Creek Figure 3-14f	**Rising Groundwater (Gaining Reach)**	Mill Creek at PB-1 appears to be an area of groundwater discharge. The primary source of the shallow groundwater at PB-1 appears to be a complex mixture of the shallow regional aquifer system that is fed, in part, by streambed recharge in upstream areas of Mill Creek. The groundwater/surface-water interactions in this area appear to be complex with multiple sources of water that are tributary to the PB-1 wells.	Groundwater elevations at the deeper screened well (PB-1/2) are higher than the groundwater elevation of the shallow screened well (PB-1/1), indicating an upward hydraulic gradient, and the groundwater elevations at both wells always remain above thalweg elevation—both of which indicate that this is an area of rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Mill Creek, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	Both monitoring wells exhibit a relatively constant time series of temperature data with a slow declining trend. This indicates that likely the groundwater is the primary source of water at this location. The same slight abrupt increase in 2023 as seen in other wells, coincides with the installation of a new transducer.	Since monitoring for EC began in 2023 at the shallow well (PB-1/1), the EC data show a different pattern than temperature. EC fluctuates by roughly 1,200 µS/cm and is much higher than EC in the deeper well (PB-1/2). EC data recently began to be collected in the deeper well in December 2025 and thus far shows a stable flat trend. These patterns suggest that the shallow well is affected by water sources distinct from those influencing the deeper well. At this time, it cannot be determined whether surface-water recharge is among those sources, and further analysis is required.
PB-5 @ Mill Creek Figure 3-14g	**Rising Groundwater (Gaining Reach)**	Mill Creek at PB-5 appears to be an area of groundwater discharge. The likely source of shallow groundwater at PB-5 is a complex mixture of: (i) streambed recharge of effluent discharge in upstream areas of Mill Creek, the SAR, and the diversion channel that conveys WRCRWA effluent to the OCWD Wetlands, and (ii) rising groundwater discharge.	Groundwater elevations at the shallow screened well (PB-5/1) and deeper screened well (PB-5/2) are the same. The groundwater elevations at the wells are typically above the thalweg elevation, indicating this is an area of rising groundwater.	Water levels in both monitoring wells increase during and immediately after periods of stormwater discharge in Mill Creek, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	Both monitoring wells exhibit a relatively constant time series of temperature data with a slow declining trend. This indicates that likely the groundwater is the primary source of water at this location. The same slight abrupt increase in 2023 occurs in PB-5/1 as that seen in other wells, and coincides with the installation of a new transducer.	Since monitoring for EC began in 2023 at the shallow well (PB-5/1), the EC data show a different pattern than temperature. EC fluctuates by roughly 400 µS/cm, and is higher than EC in the deeper well (PB-1/2). EC data recently began to be collected in the deeper well in December 2025 and will be evaluated at another time. The EC data will be evaluated at another time.
PB-4 @ SAR Figure 3-14h	**Streambed Infiltration (Losing Reach)**	The SAR at PB-4 is primarily an area of streambed recharge. The primary source of shallow groundwater at PB-4 is streambed recharge of the SAR, and at times, there appears to be some influence of the shallow regional aquifer system and/or local return flows of precipitation and applied water.	Groundwater elevations at the deeper screened well (PB-4/2) are slightly lower than the groundwater elevation of the shallow screened well (PB-4/1). Groundwater elevations at both PB-4 wells are mostly below the thalweg elevation, which indicates that this is an area of streambed recharge.	Water levels in both monitoring wells increase slightly during and immediately after periods of stormwater discharge in the SAR, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	The temperature data for the shallow well (PB-4/1) shows a seasonal sinusoidal pattern between 19 and 22 degrees C, which indicates that the shallow well is under the influence of surface water recharge. The temperature at the deeper well (PB-4/2) remains relatively constant with a slow declining trend of about 1 degree C, which indicates that it is not under the influence of surface water recharge, and groundwater is likely being recharged by the regional groundwater.	EC monitoring at the shallow (PB-4/1) and deep (PB-4/2) wells commenced in September 2025. The EC data will be evaluated at another time.
PB-3 @ SAR Figure 3-14i	**Streambed Infiltration (Losing Reach)**	The SAR at PB-3 is an area of streambed recharge. The primary source of shallow groundwater at PB-3 is SAR streambed recharge.	Groundwater elevations at the both PB-3 wells are always below the thalweg elevation, indicating that this is an area of streambed recharge.	Water levels in both monitoring wells increase slightly during and immediately after periods of stormwater discharge in the SAR, suggesting that stormwater discharge is a source of recharge to shallow groundwater.	The temperature data for both wells shows a seasonal sinusoidal pattern with a long term declining trend between 2021 to 2024, which indicates that the shallow well is under the influence of surface water recharge and some other changing condition after 2021.	Since EC monitoring began in mid-2024, both wells show similar EC patterns characterized by an initial decrease followed by an increase. This pattern may indicate that both wells are influenced by surface-water recharge.

3.4 Climate and Its Relationship to the Riparian Habitat

Precipitation and temperature are climatic factors that can affect the extent and quality of riparian habitat. Precipitation can provide a source of water for consumptive use by the riparian vegetation via the direct infiltration of precipitation and runoff, which increases soil moisture that can be directly used by the vegetation, or by maintaining groundwater levels underlying the vegetation for its subsequent use. Temperatures affect the rate of plant growth and productivity. Both factors are unrelated to the implementation of the Peace II Agreement. This section characterizes the time series of precipitation and temperature in the Prado Basin area and compares them to time series trends in the quality of the riparian habitat, as indicated by NDVI, to help determine if these factors have influenced the riparian habitat in the Prado Basin.

3.4.1 Precipitation

Figure 3-15 is a time-series chart that shows annual precipitation estimates within the Chino Basin for WY 1896 to 2025. These estimates were computed as a spatial average across the Chino Basin using rasterized data from the PRISM Climatic Group (an 800-meter by 800-meter grid). The long-term average annual precipitation in the Chino Basin is 16.3 inches per year (in/yr). The chart includes a cumulative departure from mean (CDFM) precipitation curve, which characterizes the occurrence and magnitude of wet and dry periods: positive sloping segments (trending upward to the right) indicate wet periods, and negative sloping segments (trending downward to the right) indicate dry periods.

Review of the CDFM precipitation curve indicates that the Chino Basin experienced several prolonged wet and dry periods from WY 1896 to 2025. Typically, the dry periods are longer in duration than the wet periods. The longest dry period occurred between 1946 through 1977 (32 years). The current dry period is a 27-year period, starting in WY 1999, and includes the Peace/Peace II Agreement period (2001 through 2025). Over the 130-year record, about 41 percent of the years had precipitation greater than the average, and 59 percent had below-average precipitation. In the 25-year period since the Peace Agreement was implemented, about 32 percent of the years had precipitation greater than the average, and 68 percent had below-average precipitation. Precipitation in WY 2025 was 7.91 inches, which is:

- 8.35 inches below the long-term average
- About 42 percent less than the previous WY 2024 (19.01 inches)
- The 10th driest year over the 130-year record

3.4.2 Temperature

Maximum and minimum temperatures during the growing season are the temperature metrics used in this analysis because plant growth and development are dependent upon the temperatures surrounding the plant (Hatfield and Prueger, 2015). Maximum temperatures during the growing season directly influence photosynthesis, evapotranspiration, and breaking of the dormancy of vegetation (Pettorelli, 2015). Minimum temperatures affect nighttime plant respiration rates and can potentially have an effect on plant growth that occurs during the day (Hatfiled et al., 2011). Hence, both temperature metrics can influence NDVI. All species of plants have a range of maximum and minimum temperatures necessary for growth (Hatfield and Prueger, 2015). Climate change is more likely to increase minimum temperatures while maximum temperatures are affected more by local conditions (Knowles et al., 2006; Alfaro et al., 2006).

Figure 3-16 is a time-series chart that shows the average maximum and minimum Prado Basin temperatures for the growing-season months of March through October from 1896 to 2025 (growing-season maximum and minimum temperatures). These temperature estimates were computed as a spatial average across the

DRAFT

Prado Basin using rasterized data from the PRISM Climatic Group (an 800-meter by 800-meter grid) of monthly maximum and minimum temperature estimates through 2024 and from data extrapolated through October 2025 using daily minimum and maximum temperature data from the U.C. Riverside CIMIS station[24]. This chart also shows the five-year moving average of the growing-season maximum and minimum temperatures for the Prado Basin. The five-year moving average is a smoothing technique used to reveal trends over time.

This chart also shows a complete record of atmospheric carbon dioxide (CO_2) concentrations assembled from multiple sources:

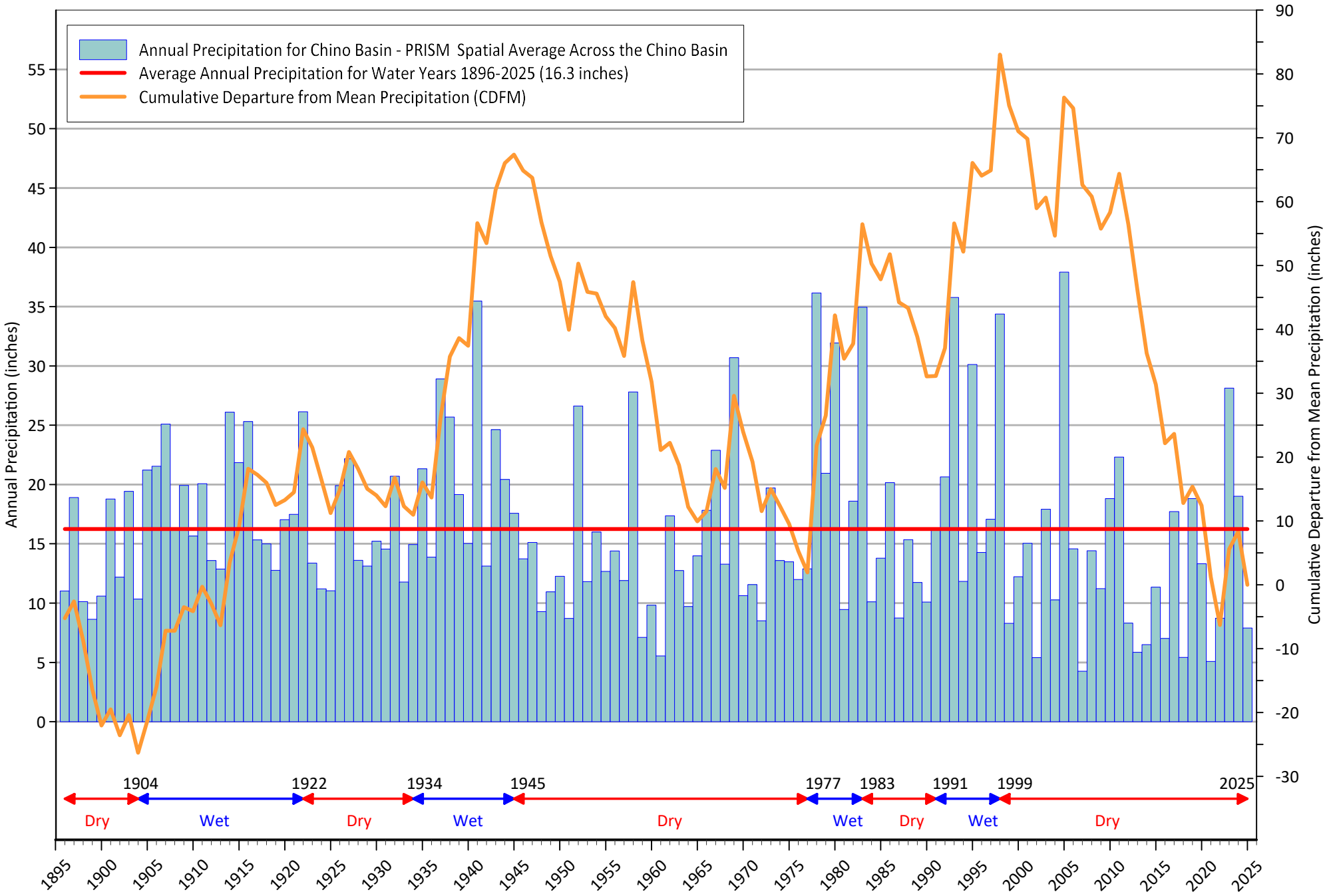
- Values prior to 1959 were estimated from an analysis of the Law Dome DE08 and DE08-2 ice cores in Antarctica. (Acquired from the Carbon Dioxide Information Analysis Center, http://cdiac.ornl.gov/trends/co2/lawdome.html. Accessed on June 6, 2017).
- Values after 1959 are from measured CO_2 concentration data at the Mauna Loa Observatory in Hawaii. (Acquired from the National Oceanic and Atmospheric Association's Earth Systems Research Laboratory, https://www.esrl.noaa.gov/gmd/ ccgg/trends/full.html. Accessed on January 9, 2026.

The time history of atmospheric CO_2 concentrations shows a slight increasing trend from about 290 parts per million (ppm) in the late 1890s to about 310 ppm in 1950. After 1950, the CO_2 concentration shows an amplified consistent increasing trend and exceeds 400 ppm by 2015.

From 1896 to 2025, the growing-season maximum temperature fluctuates between 80 degrees Fahrenheit (°F) to 87°F and has a slight increasing trend. From 1896 to 2025, the growing-season minimum temperature fluctuates between 49°F to 59°F and has a prominent increasing trend starting in 1950 of about 5°F through 2025. This increasing trend in the growing-season minimum temperature beginning in 1950 appears to correlate with the increase in atmospheric CO_2 concentrations. The five-year moving averages of both the growing-season minimum and maximum temperatures display a decreasing trend over the last seven-year period since 2018 when it had the highest values over the entire period of record. In 2025, the growing-season minimum and maximum temperatures increased from the previous year and the five-year moving averages all decreased. The Average Growing-Season minimum temperature was 56°F and the Average Growing-Season maximum temperature was 84°F.

DRAFT

[24] California Department of Water Resources (DWR). (2025). *California Irrigation Management Information System (CIMIS) minimum and maximum temperature data* [Station 044, U.C. Riverside; 1985-2025]. https://cimis.water.ca.gov/



Prepared by:

WEST YOST
Water. Engineered

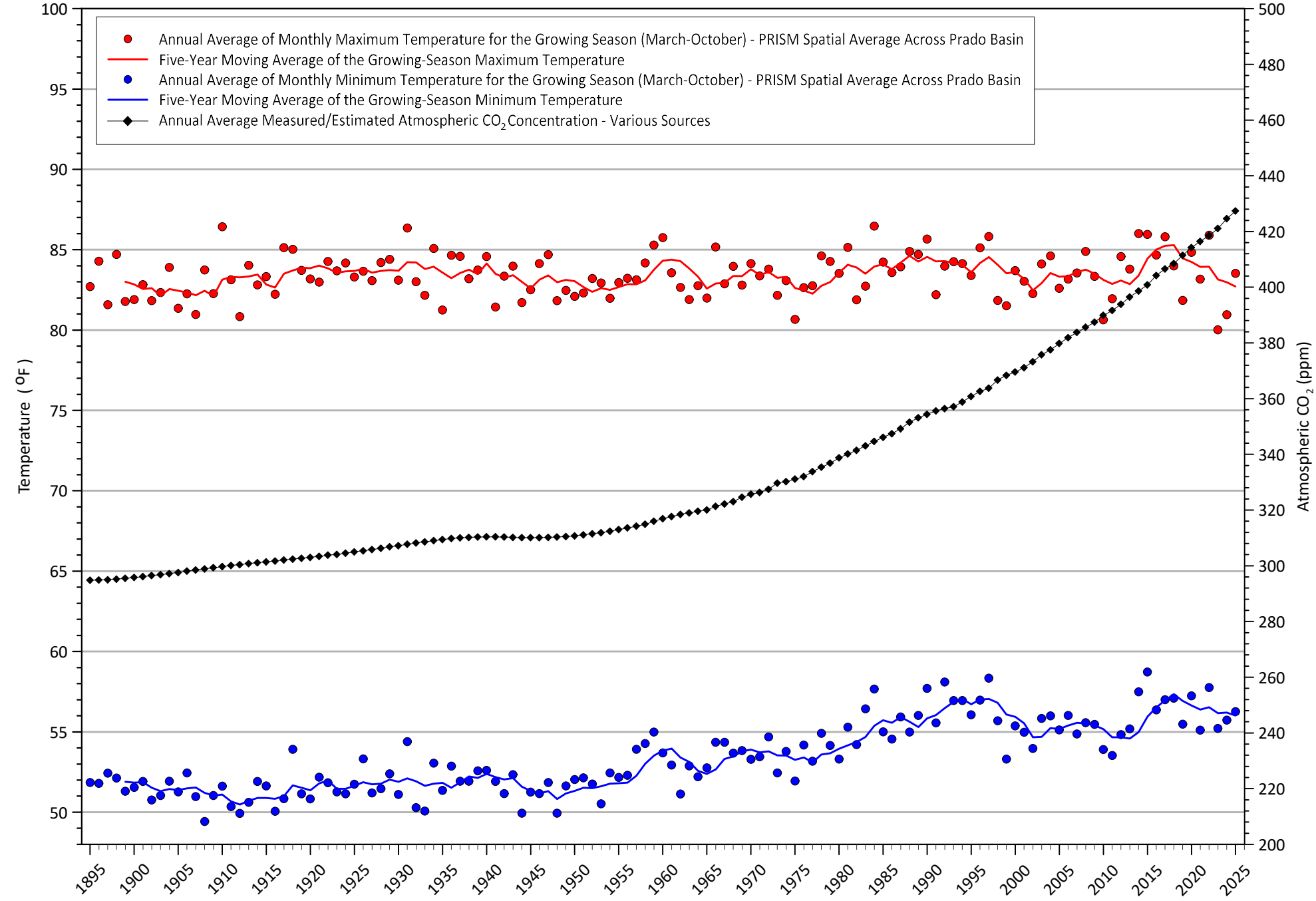
Prepared for:

Prado Basin Habitat Sustainability Committee

Annual Precipitation in the Chino Basin

Water Year 1986 - 2025

Figure 3-15



Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Prado Basin Habitat Sustainability Committee

Maximum and Minimum Temperature in Prado Basin

1895-2025

Figure 3-16

3.4.3 Climate Compared to NDVI

Figures 3-17a through 3-17c are time-series charts that compare long-term trends in precipitation and temperature to trends in the quality of the riparian vegetation, as indicated by NDVI, for three reaches in the Prado Basin: Chino Creek, Mill Creek, and SAR. The period of analysis is 1984-2025—the period of NDVI availability. The upper chart on the figures displays the time series of annual precipitation in Chino Basin, the CDFM precipitation curve, and the five-year moving average for the growing-season maximum and minimum temperatures in the Prado Basin. The lower chart displays the time series of the Average Growing-Season NDVI for the defined areas discussed in Section 3.1 along Chino Creek, Mill Creek, and SAR. For reference, the Mann-Kendall test results for trends in the Average Growing-Season NDVI for 1984-2025, 1984-2006, and 2007-2025 are shown in the legend.

The observations and interpretations below are focused on recent changes in Average Growing-Season NDVI during 2025 described in Section 3.1, and whether observed trends in temperature and precipitation may be contributing to recent changes in NDVI.

Chino Creek (Figure 3-17a). From 2024 to 2025, the Average Growing-Season NDVI slightly increased for the whole Chino Creek area and the four small areas along Chino Creek (CC-1, CC-2, CC-3, and CC-4). For all these areas, the one-year change in NDVI was relatively minor and within the historical range of one-year NDVI variability (see Table 3-2). These recent increases in NDVI and vegetation greenness occurred during a slightly warmer year, and significantly drier year following two consecutive wet years. Although the drier and slightly warmer conditions in 2025 may have contributed to some vegetation re-growth along Chino Creek previously scoured or inundated, contributing to a slight NDVI increase. The main observations and conclusions for 2024 to 2025 indicate no significant riparian vegetation changes along Chino Creek attributable to these climatic conditions.

Mill Creek (Figure 3-17b). From 2024 to 2025, the Average Growing-Season NDVI did not change across the entire Mill Creek area and slightly increased for the Upper Mill Creek area. For the small defined areas, NDVI increased at three areas (MC-2, MC-3, and MC-6), decreased at two areas (MC-4 and MC-5), and remained the same at one area (MC-1). At all the areas, the one-year NDVI changes are within the historical ranges of their one-year NDVI variability (see Table 3-2). These recent changes in NDVI occurred during a warmer and drier year following two wet years. Hence, the main observations and conclusions for the 2024 to 2025 period indicate warmer and drier conditions, with no notable changes in the riparian vegetation along Mill Creek.

Santa Ana River (Figure 3-17c). From 2024 to 2025, the Average Growing-Season NDVI increased at all three of the sites along the SAR (SAR-2, SAR-3 and SAR-4). These one-year NDVI changes were all relatively minor and within the historical ranges of their one-year NDVI variability (see Table 3-2). These changes in NDVI occurred during a slightly warmer and significantly drier year following two consecutive wet years. The drier conditions in 2025 following above average wet years, likely contributed to the increase in NDVI observed along the SAR as a result of vegetation re-growth in areas that were previously scoured or inundated. Despite these minor changes, overall, the main observations and conclusions for the 2024 to 2025 period indicate warmer and drier conditions, with no significant changes in the riparian vegetation along the SAR.

DRAFT

Precipitation and CDFM (inches)

Temperature (°F)

Dry Period

Wet Period

Dry Period

Precipitation

Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Annual Precipitation (Water Year) - PRISM Spatial Average Across Chino Basin

Temperature

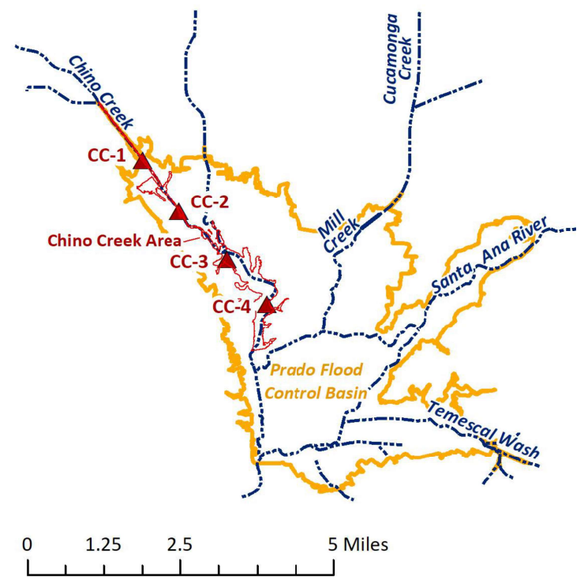
Five-Year Moving Average of the Growing-Season Maximum Temperature for Prado Basin

Five-Year Moving Average of the Growing-Season Minimum Temperature for Prado Basin

Average Growing Season NDVI for Areas Along Chino Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

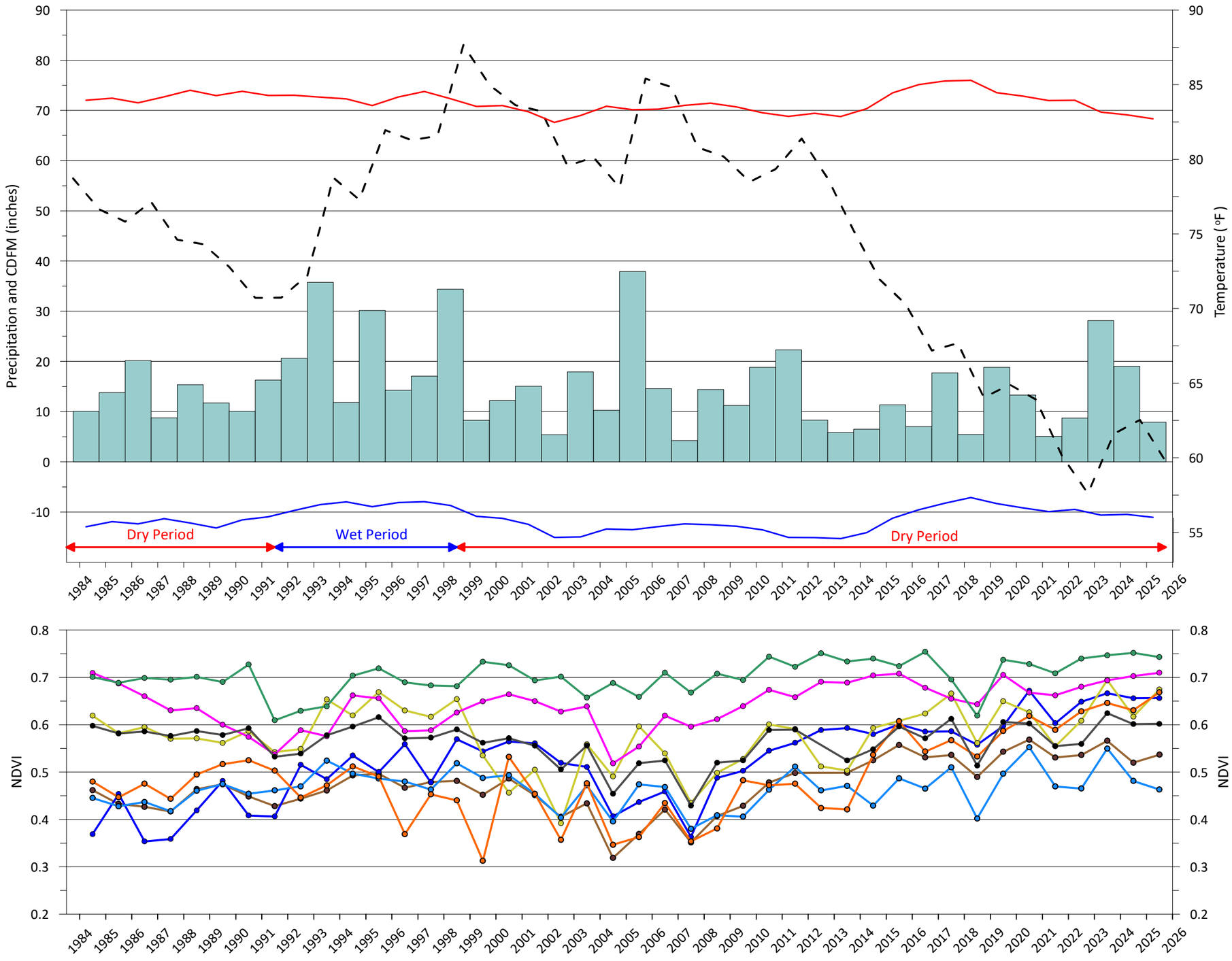
- CC-1 (*Increasing; Increasing; Increasing*)
- CC-2 (*Increasing; Increasing; Increasing*)
- CC-3 (*Increasing; Increasing; Increasing*)
- CC-4 (*Increasing; No Trend; Increasing*)
- Chino Creek Area (*Increasing; Increasing; Increasing*)

NDVI



Climate verus NDVI
Chino Creek Area for 1984-2025

Figure 3-17a



Precipitation

Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Annual Precipitation (Water Year) - PRISM Spatial Average Across Chino Basin

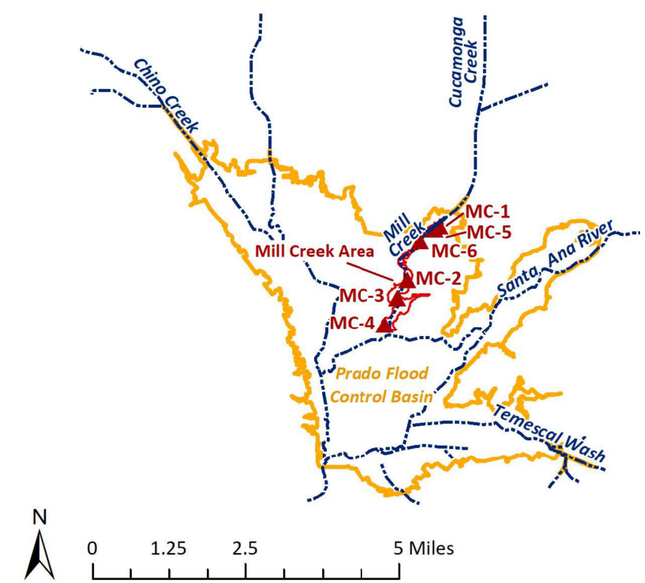
Temperature

Five-Year Moving Average of the Growing-Season Maximum Temperature for Prado Basin

Five-Year Moving Average of the Growing-Season Minimum Temperature for Prado Basin

Average Growing Season NDVI for Areas Along Mill Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- MC-1 (*Increasing; Increasing; Increasing*)
- MC-2 (*No Trend; No Trend; Increasing*)
- MC-3 (*Increasing; No Trend; Increasing*)
- MC-4 (*Increasing; No Trend; No Trend*)
- MC-5 (*No Trend; No Trend; Increasing*)
- MC-6 (*Increasing; Decreasing Trend; Increasing*)
- Upper Mill Creek Area (*Increasing; No Trend; Increasing*)
- Mill Creek Area (*No Trend; Decreasing; Increasing*)



Precipitation and CDFM (inches)

Temperature (F°)

Dry Period

Wet Period

Dry Period

NDVI

NDVI

Precipitation

Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Annual Precipitation (Water Year) - PRISM Spatial Average Across Chino Basin

Temperature

Five-Year Moving Average of the Growing-Season Maximum Temperature for Prado Basin

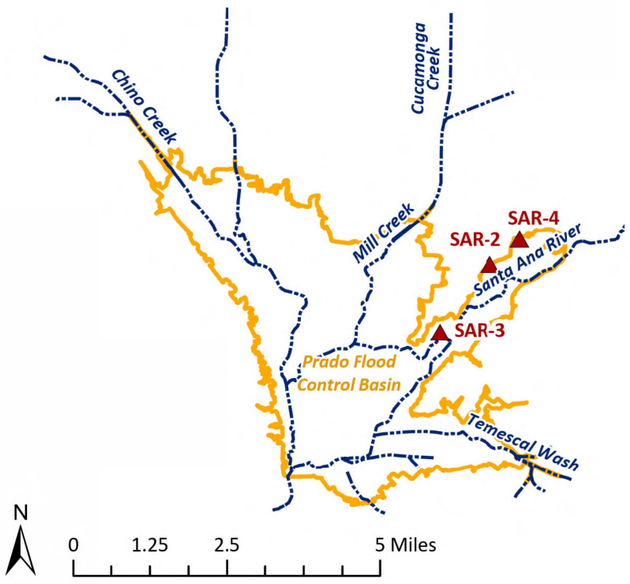
Five-Year Moving Average of the Growing-Season Minimum Temperature for Prado Basin

Average Growing Season NDVI for Areas Along Santa Ana River - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

SAR-2 (*Increasing; Decreasing; Increasing*)

SAR-3 (*Increasing; No Trend; Increasing*)

SAR-4 (Increasing*; No Trend; Increasing*)



3.5 Stream Discharge and Its Relationship to the Riparian Habitat

Stream discharge in the SAR and its tributaries that flow through the Prado Basin is a factor that can affect the extent and quality of Prado Basin riparian habitat. Stream discharge can recharge the groundwater system along losing stream reaches and supply water through the groundwater system to riparian vegetation. Stream discharge is also important to fauna living within the stream system. Flooding events and flood-control/water-conservation operations at Prado Dam can scour and inundate areas of the riparian habitat and potentially cause adverse impacts.

This section characterizes the time series of stream discharge within the Prado Basin and compares to trends in the extent and quality of the riparian habitat, as indicated by NDVI, to help determine whether changes in stream discharge have influenced the riparian habitat in the Prado Basin.

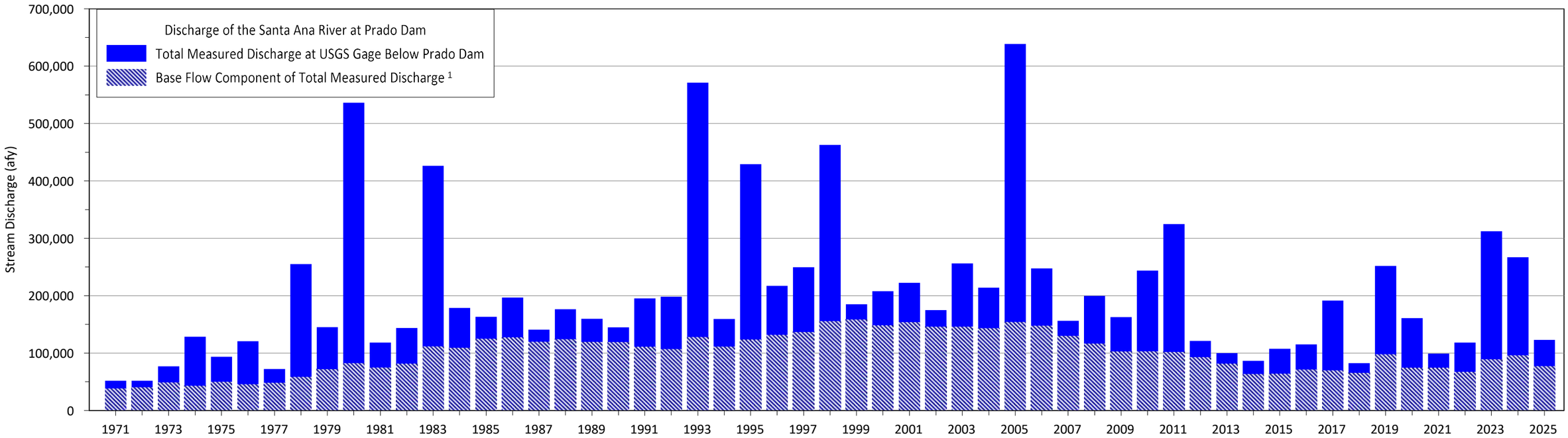
3.5.1 Stream Discharge

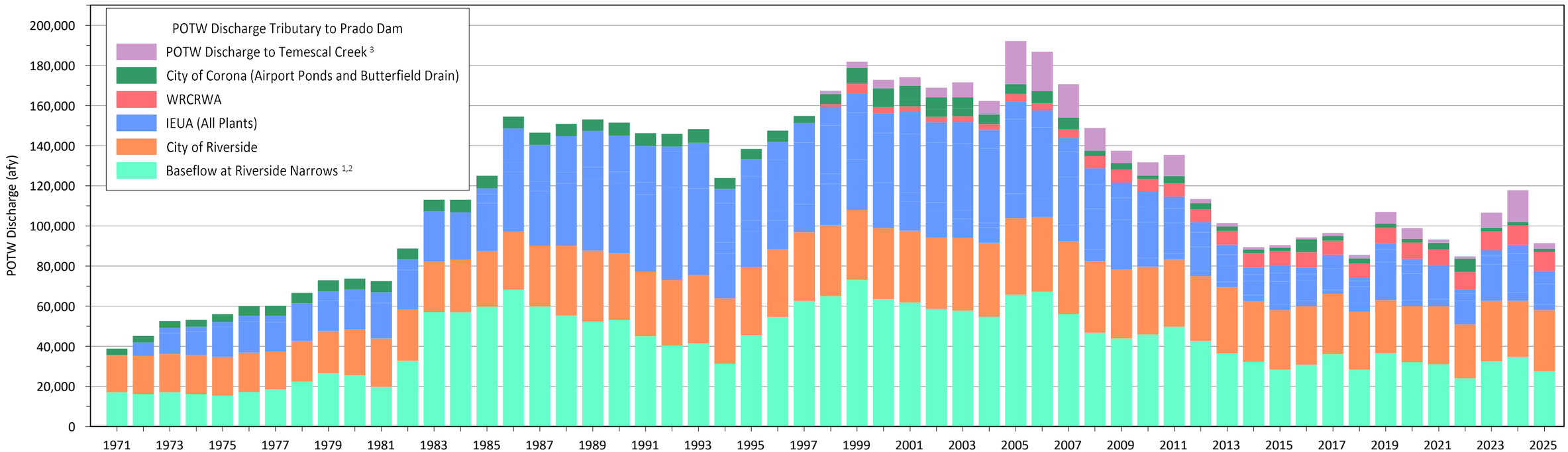
There are three primary components of stream discharge in the SAR and its tributaries: stormwater discharge, non-tributary discharge, and base-flow discharge. Stormwater discharge is rainfall runoff. Non-tributary originates outside of the watershed; and a major non-tributary discharge that occurred historically is imported water discharged at the OC-59 turnout on San Antonio Creek. Base-flow discharge, as used herein and by the Santa Ana River Watermaster (SARWM), includes tertiary-treated wastewater discharge from POTWs, rising groundwater, and dry-weather runoff. Figure 3-18 includes time-series charts that summarize important annual discharges within the upper SAR watershed that are tributary to Prado Dam from water years 1971 to 2025 (SARWM, 2025). The upper chart on Figure 3-18 characterizes the annual outflow from the Prado Basin as total measured SAR discharge at USGS gage *SAR at below Prado Dam* and shows the base-flow component of the total measured discharge as estimated by the SARWM. This chart shows that base-flow discharge declined from about 154,000 afy in 2005 to an average of about 80,800 afy over the recent five-year period 2021-2025. The decline in base-flow discharge is primarily related to declines in POTW effluent discharges that are tributary to Prado Basin. In WY 2025, both the total discharge at below Prado Dam and the total baseflow discharge decreased from the previous year:

- **Total Discharge at below Prado Dam in WY 2025**. Total discharge in WY 2025 was about 122,890 af, which is about 47,770 afy less than the average over the previous ten years (2015 to 2024), and a 144,260 afy (53 percent) decrease from WY 2024, which was a notably wet year. This below-average discharge occurred during a year in which precipitation was also below-average.
- **Base-Flow Discharge at below Prado Dam in WY 2025**. Base-flow discharge was about 77,080 afy, which is about the same as the average over the previous ten years (2015 to 2024) of 77,020 afy, and about 18,980 afy less than WY 2024.

The lower chart on Figure 3-18 shows the combined POTW discharges that are tributary, at least in part, to Prado Dam. The POTW discharges are the primary component of the baseflow discharge. The POTW discharges declined from a high of about 192,200 afy in 2005 to an average of about 98,780 afy for the last five years (2021-2025). The reduction in POTW effluent discharge since 2005 can be attributed to several factors: the increased use of recycled-water, a decline in water use due to the economic recession that began in 2008, and the implementation of emergency water-conservation measures during the 2012 drought and thereafter. In WY 2025, POTW discharge was about 91,450 afy, which is about 6,070 afy less than the average POTW discharge over the previous ten years (2015-2024), and about 26,370 afy less than POTW discharge in WY 2024.

DRAFT





[1] Data are interpretations of the Santa Ana River Watermaster as published in thier Annual Reports.

[2] Baseflow at Riverside Narrows primarily includes POTW discharge from RIX and Rialto Plants; and can also include rising groundwater, dry weather flow

[3] Includes discharge from EVMWD, EMWD, and LLWD plants

3.5.2 Stream Discharge Compared to NDVI

Figures 3-19a through 3-19c are time-series charts that compare long-term trends in stream discharge to trends in the quality of the riparian vegetation, as indicated by NDVI, for three reaches in Prado Basin: Chino Creek, Mill Creek, and the SAR. The period of analysis for these charts is 1984 to 2025, the period of NDVI availability. The upper chart on the figures displays the annual volumes of measured discharge to each stream during the water year, including measurements at USGS gaging stations located upstream of the Prado Basin, and POTW discharges.[25] The lower chart displays the time series of the Average Growing-Season NDVI for defined areas, as discussed in Section 3.1, along Chino Creek, Mill Creek, and the SAR. For reference, the Mann-Kendall test results for trends in the Average Growing-Season NDVI for 1984 to 2025, 1984 to 2006, and 2007 to 2025 are shown in the legend.

The observations and interpretations below are focused on the recent (2025) changes in Average Growing-Season NDVI, as described in Section 3.1, and whether observed trends in surface-water discharge may be contributing to recent changes in NDVI.

Chino Creek (Figure 3-19a). Chino Creek is a concrete-lined, flood-control channel that transitions into an unlined stream channel at the Prado Basin boundary and flows south into the SAR behind Prado Dam (see Figure 2-3). The upper chart on Figure 3-19a shows discharge in Chino Creek during the growing season, including: measured discharge at USGS gage *Chino Creek at Schaefer* and the POTW discharges downstream of the USGS gage, including discharges from the IEUA Carbon Canyon, RP-2, RP-5, and RP-1 plants. Measured discharge at *Chino Creek at Schaefer*[26] includes stormwater and dry-weather runoff in the concrete-lined channel upstream of the IEUA discharge locations. Discharges not characterized in this figure are stormwater runoff, dry-weather runoff, and rising-groundwater discharge downstream of the *Chino Creek at Schaefer* gage. From 1984 to 2025, discharge in Chino Creek during the water year progressively increased through 1997 and then decreased. The decreasing trend in growing-season discharge since about 1997 was caused by dry climatic conditions, water conservation in response to drought, and decreases in effluent discharge from the IEUA plants. During the previous ten-year period (2015-2024), annual discharge in Chino Creek averaged about 17,900 afy. In WY2025, discharge was about 12,010 afy, which is about 5,890 af less than the average discharge for the previous ten water years and about 10,500 af less than discharge in WY 2024 which was a notably wetter year.

From 2024 to 2025, the Average Growing-Season NDVI for the whole Chino Creek area as well as all four small areas along Chino Creek increased. For all these areas, the one-year changes in NDVI were relatively minor and within the historical range of their one-year NDVI variability (see Table 3-2). These recent changes in NDVI occurred during a year of below-average discharge in Chino Creek. Therefore, the main observations and conclusions for the 2025 period are that there were below-average discharge conditions in Chino Creek and the riparian vegetation along Chino Creek did not change significantly.

Mill Creek (Figure 3-19b). Cucamonga Creek is a concrete-lined flood-control channel that transitions into an unlined stream channel at the Prado Basin boundary, where its name changes to Mill Creek (see Figure 2-3). The upper chart on Figure 3-19b shows annual discharge in Mill Creek during the water year, including: POTW effluent discharge from the IEUA RP-1 plant to Cucamonga Creek, and measured discharge downstream at the USGS gage *Cucamonga Creek near Mira Loma* (less the RP-1 discharge). The

[25] These charts do not describe other hydrologic processes that affect surface-water discharge within the Prado Basin, including evaporation, evapotranspiration, the infiltration of water along unlined stream segments, and rising groundwater discharge.

[26] Historically until 2016 this also included imported water discharge from the OC-59 turnout.

measured discharge at *Cucamonga Creek near Mira Loma* (less the RP-1 discharge) is representative of stormwater and dry-weather runoff in Cucamonga Creek upstream of this gaging station. Discharges not characterized on this figure are stormwater runoff, dry-weather runoff, and rising-groundwater discharge downstream of the *Cucamonga Creek near Mira Loma* gage.

Also shown on the upper chart is the annual volume of flow that is estimated to be in the upper portion of Mill Creek excluding the surface-water diverted to the Mill Creek Wetlands. The Mill Creek Wetlands began diverting water from Mill Creek just north of where Mill Creek begins in 2016 (see inset map for location of Mill Creek Wetlands). Water from the Mill Creek Wetlands re-enters Mill Creek just downstream of the MC-6 area; hence the volume of water in the upper portion of Mill Creek near the MC-1, MC-5, and MC-6 areas is less than the total flow represented in the bar chart. Since 2016, water diverted to the Mill Creek Wetlands on an annual basis has ranged from 5 percent to 30 percent of the total flow, and the annual discharge in the northernmost region of Mill Creek near the MC-1, MC-5, and MC-6 areas is on average about 18 percent less than the discharge in Mill Creek south of the Mill Creek Wetlands.

From WY 1984 to 2025, annual discharge in Mill Creek progressively increased through 2005, then decreased through 2014, and has shown an overall increasing trend since. The decreasing trend in annual discharge since about 2005 was caused by dry climatic conditions, water conservation in response to drought conditions after 2012, and the decrease in effluent discharge from the IEUA RP-1 plant. The increasing trend since 2014 is a result of an increase in base-flow discharge, as effluent discharge from the IEUA RP-1 plant has continued to decrease. In WY 2025, annual discharge was about 28,670 afy, which is about 2,360 af less than the average annual discharge for the previous ten water years (2015-2024) and about 18,360 af less than the annual discharge in WY 2024, which was a notably wetter year. The below-average annual discharge is attributed to decreased stormwater discharge from below-average precipitation in WY 2025. In WY 2025 discharge in the upper portion of Mill Creek between the diversion and the outlet for the Mill Creek Wetlands was about 26,360 afy which is about 9 percent less than the total discharge in Mill Creek.[27]

From 2024 to 2025, the Average Growing-Season NDVI remained unchanged across the entire Mill Creek area, increased across the Upper Mill Creek area, increased in three of the small areas (MC-2, MC-3, MC-6), remained unchanged in one area (MC-1), and decreased in two areas (MC-4 and MC-5). All of these one-year NDVI changes are within the historical range of their one-year NDVI variability (see Table 3-2) and air photos show no significant reduction in vegetation. Moreover, vegetation browning that was observed at MC-2 and MC-5 in 2024 has since returned to green. These recent changes in NDVI occurred during a year of below-average discharge in Mill Creek. Hence, the main observations and conclusions for the 2025 period are that there were below-average discharge conditions in Mill Creek and there were no notable changes in the riparian vegetation along Mill Creek.

Santa Ana River (Figure 3-19c). The SAR is an unlined stream channel from the Riverside Narrows to Prado Dam—its entire reach across the Chino Basin (see Figure 2-3). The upper chart on Figure 3-19c shows the annual discharge at the USGS gage *SAR at MWD Crossing* (Riverside Narrows) and the annual discharges to the SAR downstream of the Riverside Narrows, including POTW effluent from the City of Riverside's Regional Water Quality Control Plant, and the Western Riverside County Regional Wastewater

[27] The City of Ontario measures the water diverted to the Mill Creek Wetlands every month using flow meters located at the two culverts where water is diverted. Due to equipment malfunction no monthly flow data was available from July 2023 to August 2024. During these months, flow was estimated as 28% (average historical percentage diverted during the growing season from 2016 to 2022) of the total monthly discharge measured at the USGS gage *Cucamonga Creek near Mira Loma*.

Authority (WRCRWA) plant that is conveyed in an unlined channel (along with a portion of SAR discharge) to the OCWD Wetlands. The measured discharge at the *SAR at MWD Crossing* gage represents stormwater runoff and base flow discharge in the SAR upstream of the gaging station at the Riverside Narrows. The base flow discharge upstream of the Riverside Narrows includes POTW discharge from the RIX and Rialto treatment plants, dry-weather runoff, and rising groundwater. Discharges not characterized on this figure are stormwater runoff, dry-weather runoff, and rising-groundwater discharge downstream of the *SAR at MWD Crossing* gage.

From 1984 to 2011, discharge in the SAR averaged about 146,200 afy with episodic increases in storm water discharge during wet years. Since 2011, discharge in the SAR has been lower overall and averaged about 94,500 afy from 2013 to 2025 with episodic increases during wet years. The decreasing trend in discharge was caused by dry climatic conditions, water conservation in response to drought, and decreasing base flow at the Riverside Narrows. In WY 2025, the discharge in the SAR was about 81,500 af, which is about 13,000 af less than the average annual discharge from 2013 to 2025, and about 18,090 af less than the previous ten-year average from 2015 to 2024. The below-average annual discharge in WY 2025 is attributed to decreased stormwater discharge from below-average precipitation in WY 2025 and follows two consecutive wet years with high-discharge conditions.

From 2024 to 2025, the Average Growing-Season NDVI increased at all three areas along SAR (SAR-2, SAR-3, and SAR-4). For all these areas, the one-year NDVI changes were relatively minor and within the historical range of their one-year NDVI variability (see Table 3-2). The increase in NDVI observed along the edges of the SAR over this past year are likely a result of the below-average discharge conditions in the SAR, which contributed to an increase in vegetation growth in areas that were previously scoured or inundated in the previous two wet years. Despite these minor increases in NDVI, the main observations and conclusions for the 2025 period are that there were lower discharge conditions in the SAR and the riparian vegetation did not change significantly along the SAR.

DRAFT

Annual (Water Year) Discharge Along Chino Creek - acre-feet (af)

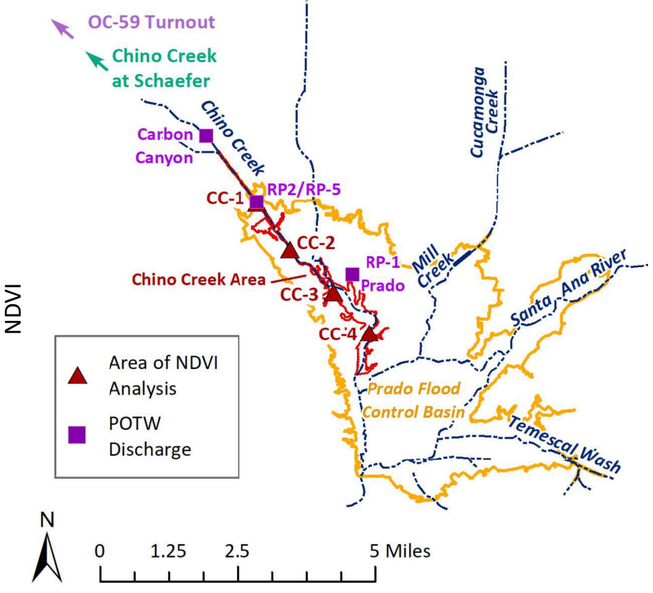
- USGS Gage - Chino Creek at Schaefer
- IEUA Carbon Canyon Effluent Discharge
- IEUA RP-2 Effluent Discharge
- IEUA RP-5 Effluent Discharge
- IEUA RP-1 Prado Effluent Discharge

Precipitation

- Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Average Growing Season NDVI for Areas Along Chino Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- CC-1 (*Increasing; Increasing; Increasing*)
- CC-2 (*Increasing; Increasing; Increasing*)
- CC-3 (*Increasing; Increasing; Increasing*)
- CC-4 (*Increasing; No Trend; Increasing*)
- Chino Creek Area (*Increasing; Increasing; Increasing*)



Discharge (af)

CDFM (inches)

Annual (Water Year) Discharge Along Mill Creek - acre-feet (af)

IEUA RP-1 Cucamonga Effluent

USGS Gage - Cucamonga Creek near Mira Loma less RP-1 Cucamonga Effluent

Volume of Flow in the North Portion of Mill Creek After the Mill Creek Wetland Diversion* - Representative of Flow Near MC-1, MC-5, MC-6, and Upper Mill Creek Area

*2023 and 2024 are estimates due to limited available data

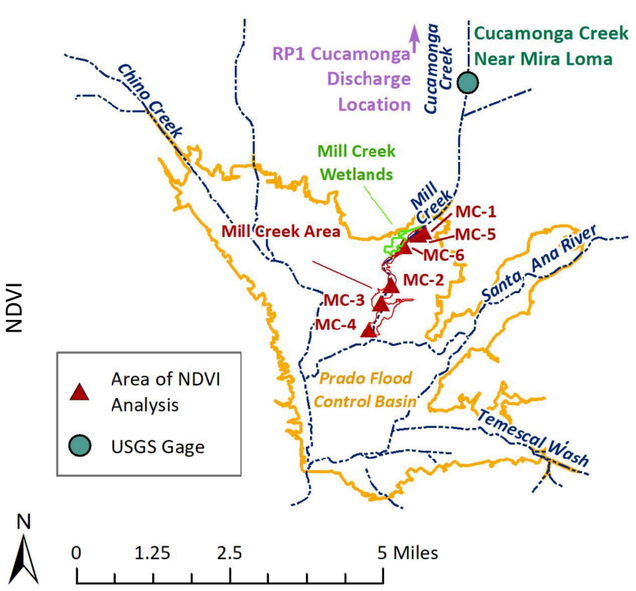
Precipitation

Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Average Growing Season NDVI for Areas Along Mill Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- MC-1 (*Increasing; Increasing; Increasing*)
- MC-2 (*No Trend; No Trend; Increasing*)
- MC-3 (*Increasing; No Trend; Increasing*)
- MC-4 (*No Trend; No Trend; No Trend*)
- MC-5 (*No Trend; No Trend; Increasing*)
- MC-6 (*Increasing; Decreasing Trend; Increasing*)
- Upper Mill Creek Area (*Increasing; No Trend; Increasing*)
- Mill Creek Area (*No Trend; Decreasing; Increasing*)

NDVI



Annual (Water Year) Discharge Along the Santa Ana River - acre-feet (af)

USGS Gage - Santa Ana River at MWD Crossing

City of Riverside Effluent

WRCRWA Effluent

Precipitation

Cumulative Departure from Mean Precipitation (CDFM) (PRISM Spatial Average Acoss Chino Basin)

Discharge (af)

CDFM (inches)

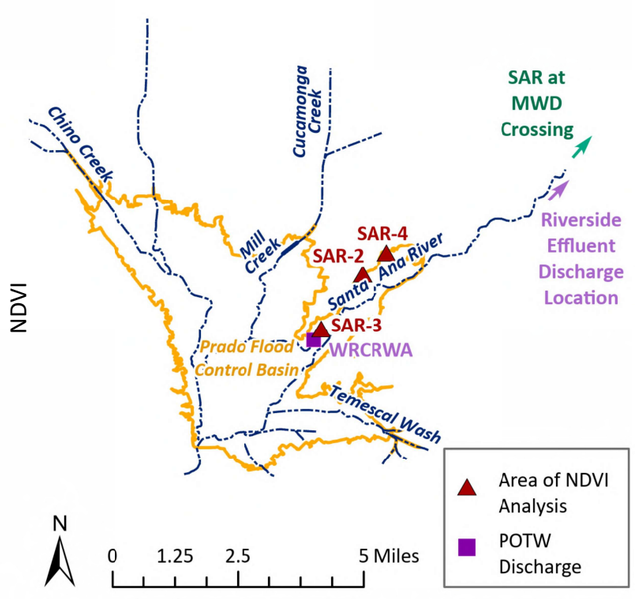
Average Growing Season NDVI for Areas Along Santa Ana River - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

SAR-2 (*Increasing; Decreasing; Increasing*)

SAR-3 (*Increasing; No Trend; Increasing*)

SAR-4 (*Increasing; No Trend; Increasing*)

NDVI



3.6 Other Factors and Their Relationships to Riparian Habitat

Other factors that can affect the extent and quality of riparian habitat in the Prado Basin analyzed in this Annual Report include wildfire, Arundo management, pests, non-native plant species, and development/construction. These factors are unrelated to Peace II Agreement implementation.

This section characterizes what is known about these factors and compares them to trends in the extent and quality of the riparian habitat to determine their impacts, as characterized by the NDVI.

3.6.1 Wildfire

Available wildfire perimeter data from the FRAP database[28] were compiled within the Prado Basin extent for the period of 1950-2024.[29] The FRAP database shows that wildfires occurred in the Prado Basin in 1985, 1989, 2007, 2015, 2018, and 2020. During 2025, there was a wildfire that occurred in the very west margin of the Prado Basin adjacent to Chino Creek, that was reported and delineated in the OCWD's *Prado Basin Water Conservation and Habitat Assessment 2024-2025* report (OCWD, 2026). Figure 3-20a shows the spatial extent of these wildfires, mapped over the 2025 air photo. The most recent wildfire in July 2025, termed the Euclid fire, started west of CA-71 and jumped the freeway to the west side of Prado Basin, and burned riparian vegetation adjacent to Chino Creek. The Euclid fire burned 120 acres in total, about half in the Prado Basin, affecting mostly shrub-dominated landscape and some Eucalyptus (OCWD, 2026).

Figure 3-20b shows the spatial extent of the most recent wildfires in 2015, 2018, 2020, and 2025, overlying a side-by-side of the change map of NDVI for 2024 to 2025 and the 2025 air photo. The locations of the wildfires in 2015 and 2020 align with several of the notable patches of NDVI decreases shown on the NDVI change map, and areas of less vegetated land cover along the SAR in the air photo. The recent NDVI decreases are likely not caused by these historic fires since there has been observed vegetation regrowth in these areas documented in previous Annual Reports (WEI, 2020; West Yost, 2022). The location of the 2025 wildfire, however, aligns with the notable NDVI decrease adjacent to Chino Creek, just to the northwest of the OCWD wetlands— this is likely the cause of the NDVI decreases in this area.

Figures 3-21a through 3-21c are time-series charts that explore the relationship between other factors that can impact riparian vegetation and NDVI for the three reaches in the Prado Basin: Chino Creek, Mill Creek, and the SAR. The figures show the Average Growing-Season NDVI for 15 of the defined areas of riparian habitat discussed in Section 3.1 and shown in Figures 3-6, 3-7a, 3-7b, and 3-8a through 3-8m. Wildfire occurrences, annotated by year, are shown on the charts if their extent intersects with the extent of the defined area of NDVI analysis. Previous Annual Reports have described that the NDVI time series for the entire riparian vegetation extent (Figure 3-5) and other impacted defined areas indicated NDVI declines after the 2015, 2018, and 2020 fires, followed by increases in some of these areas as the vegetation started to regrow (WEI, 2019; 2020; West Yost, 2021; 2022).

[28] Link (Website for California Department of Forestry and Fire Protection's Fire and Resource Assessment Program).

[29] Data is updated in late April for the previous year; 2025 data were not available for this annual report.

3.6.2 Polyphagous Shot Hole Borer

The PSHB, from the group known as ambrosia beetles, is a pest in Southern California that burrows into trees and introduces fungi that assists in establishing colonies. Infection caused by the fungi can cause a dark stain surrounding the entry holes, discolored bark, leaf discoloration and wilting, and die-off of entire branches or trees.

The first notable die-off in the Prado Basin confirmed to be caused by the PSHB, was in spring 2016 by OCWD biologists who observed die-off of riparian trees in patches, especially arroyo and black willows (ACOE and OCWD, 2017; OCWD 2020). Since 2016, OCWD biologists continued to note the presence of PSHB throughout the Prado Basin, which reduced tree canopy cover, but tree mortality remained confined to small local patches (Zembal, R., personal communication, 2018). OCWD biologists observed that the affected trees that had not died were showing signs of severe infestation, exhibiting branch failure, significant staining, and crown sprouting after the upper branches had died back. (ACOE and OCWD, 2017). The die back and crown sprouting was noted to reduce canopy coverage in many areas (OCWD, 2020).

In 2016 and 2017, OCWD biologists in the Prado Basin worked with the University of California, Riverside, the USFWS, and SAWA to actively monitor the occurrence and impact of PSHB within Prado Basin riparian habitat. These agencies conducted studies on how to potentially protect certain areas of the Prado Basin from PSHB using attractants and deterrents; however, there were too many trees to effectively protect the entire forest (Zembal, R., personal communication, 2018). Traps were placed throughout the lower portion of Prado Basin and along the SAR by the OCWD and SAWA. The total number of PSHB beetles trapped at each location between August 2016 and April 2017 ranged from seven to 2,092.

Since the first confirmed impact of the PSHB in 2016, the presence of the PSHB was included as part of the vegetation surveys performed for the PBHSP. Section 3.1.3.3 of this report describes the number of monitoring site plots with evidence of PSHB in 2025 and the total percentage of trees in the Chino Creek, Mill Creek, and SAR areas with evidence of the PSHB in 2022 and 2025. Table 3-3 summarizes the presence of the PSHB during the 2016, 2019, 2022, and 2025 vegetation surveys at all the sites surveyed. Primary observations from these four surveys include:

- In 2016, the presence of the PSHB was identified at 30 of the 37 survey sites. At these sites, all the trees identified with the presence of PSHB were noted as “stressed,” except one which was noted as “dead.”
- In 2019, the presence of the PSHB was identified at seven of the 30 sites where the presence was identified in 2016, and were only at sites along Chino and Mill Creeks. The reduced presence of the PSHB from 2016 to 2019 correlated to less stressed trees at each of the survey sites; however, the PSHB had an adverse impact from 2016 to 2019, as evidenced by the increased percentage of dead trees and some reductions in percent canopy cover at the monitoring site plots.
- In 2022, the presence of the PSHB was identified in 12 of the 30 sites that were identified with PSHB presence in 2016 and/or 2019. The increase in the presence of the PSHB did not, however, correlate to a trend in the increase of stressed or dead trees at the affected sites.
- In the recent 2025 vegetation surveys, evidence of the PSHB was identified in three of the 30 sites where the PSHB was noted in one or more years of the previous surveys, and in the two new sites along the SAR. Although the percentage of trees with evidence of the PSHB infestation showed an overall increase during 2025, many of the trees with PBHSB evidence were recovering and appeared healthy, and there was no correlation to an increase in stressed or dead trees. Therefore, the presence of PSHB does not appear to impact vegetation health.

DRAFT

Figure 3-22a shows the locations where the presence of PSHB has been documented within the Prado Basin from 2016 to 2025 by: PSHB traps deployed by the OCWD and SAWA between August 2016 and April 2017; and the PBHSP vegetation surveys performed in 2016, 2019, 2022, and 2025.

Figures 3-21a through 3-21c present time-series charts that explore the relationship between PSHB occurrence and NDVI for the three reaches in Prado Basin: Chino Creek, Mill Creek, and the SAR. These figures show the Average Growing-Season NDVI for the defined areas of riparian habitat that are discussed in Section 3.1 and shown in Figures 3-6, 3-7a, 3-7 b, and 3-8a through 3-8m. For each defined area, the percentage of infected trees within each survey site that is within the area are plotted on the charts. As described above, the number of survey sites noting the PSHB presence has decreased over the years. With few exceptions, sites surveyed across multiple years show an overall pattern of the percentage of impacted trees: they decreased or stayed the same from 2016 to 2019; remained stable or decreased from 2019 to 2022; and remained stable or increased from 2022 to 2025. Many of these observed decreases in the earlier years declined to zero percent.

Overall, the increases in the percentage of infected trees at the survey sites do not correlate with a decrease in NDVI at the defined areas. Therefore, the presence of the PSHB does not appear to be causing a notable negative impact on riparian vegetation in these areas.

3.6.3 Arundo Removal and Maintenance

The OCWD and SAWA[30] are the main entities that implement habitat restoration programs, including the removal and management of the non-native Arundo in the SAR watershed for the promotion of native habitat for endangered or threatened species. The OCWD and SAWA sometimes work collaboratively with each other on these programs and with other stakeholders in the watershed, such as the SAWPA, the USFWS, California Department of Fish and Wildlife (CDFW), and the ACOE. There are many ongoing programs throughout the Prado Basin for the management and maintenance of riparian habitat that include the management of Arundo. SAWA publishes an annual report on the status of all habitat restoration projects they are involved with in the watershed (SAWA, 2025).

Figures 3-22a and 3-22b show the locations of known areas where habitat restoration activities have occurred recently in the Prado Basin. These locations and activities may not be inclusive of all current activities in the Prado Basin, but are the known locations where the information has been collected for the PBHSP:

- Various locations where SAWA has led the removal, treatment, and management of Arundo growth along the SAR between 2016 and 2024 (areas outlined in cyan, pink, navy, coral, yellow, and bright green in Figure 3-22a and in purple in Figure 3-22b).
- 400 acres where the OCWD has been controlling the regrowth of Arundo within the perimeter of the 2015 wildfire (area outlined in dark red).
- 287-acres ACOE Arundo mitigation site (outlined in orange) where the ACOE has historically removed and managed Arundo growth. Between May 2022 and June 2023, Arundo was removed from a small, 26.5-acre area in the western most part of the mitigation site.

[30] SAWA is a non-profit agency with a five-member board, consisting of one member from the OCWD and the remaining from four resource conservation districts (RCDs) in the watershed, including the Riverside-Corona RCD, Temecula-Elsinore-Anza RCD, San Jacinto RCD, and Inland Empire RCD.

- Approximately 34 acres where SAWA has been removing and treating Arundo in 2025 (area outlined in light blue).

Figure 3-22b shows the locations of these known areas where habitat restoration activities have occurred, overlying a side-by-side of the change map of NDVI from 2024 to 2025, and the 2025 air photo. The locations of these habitat restoration activities generally align with areas of NDVI decreases or increases in the change map, indicating that these habitat restoration activities are likely related to the changes observed in NDVI in these areas. NDVI may decrease in areas where Arundo is removed or treated and increase in areas that are experiencing vegetation regrowth following historical Arundo removal. Just south of the OCWD wetlands, in one of the larger areas where SAWA and OCWD were performing Arundo treatment and removal in 2025, NDVI generally decreased from 2024 to 2025. In the area where SAWA and OCWD have been controlling the regrowth of Arundo since the 2015 wildfire, there are patches of both NDVI decreases and increases, which likely reflect the combination of Arundo removal/treatment and vegetation regrowth. In the western most area of the ACOE Arundo mitigation site where Arundo had been removed in 2023, NDVI decreased from 2023 to 2024, but notably increased from 2024 to 2025 likely due to vegetation regrowth following the 2023 Arundo removal. In the northern reach of the SAR, where there has been limited Arundo management activities since 2021, there are no notable changes in NDVI from 2024 to 2025.

3.6.4 Non-native and Nuisance Plant Species

Section 3.1.3 describes the non-native and nuisance plant species observed this last year during the 2025 vegetation surveys throughout the Prado Basin. These species include rough cocklebur, perennial pepper weed, wild grape, and various trees. The perennial pepperweed is the most abundant non-native species observed, and is of particular concern because it is perennial, difficult to control, and capable of proliferating rapidly and causing significant damage in riparian habitat systems. Table 3-3 summarizes the results of the 2025 vegetation surveys and includes non-native and nuisance plant species documented at each site if observed.

Figures 3-21a through 3-21c are time-series charts that explore the relationship between other factors that can impact riparian vegetation and NDVI for the three reaches in the Prado Basin: Chino Creek, Mill Creek, and the SAR. The figures show the Average Growing-Season NDVI for 15 of the defined areas of riparian habitat discussed in Section 3.1 and shown in Figures 3-6, 3-7a, 3-7b, and 3-8a through 3-8m. Non-native and nuisance plant species occurrences in 2025, annotated by species, are plotted with the NDVI time series if they were noted in the monitoring site plot that is within the defined area of NDVI analysis.

Perennial pepperweed was observed at monitoring site plots along Mill Creek and SAR during the 2025 vegetation surveys. The bullets below summarize the 2025 occurrences of perennial pepperweed, as well as associated trends in overstory health indicators and NDVI time-series results:

- Pepperweed was observed at monitoring site plots X9, X10, and X21, all of which are located below the Mill Creek Wetlands diversion, and site 82.
  - At X9, the percent of alive trees and canopy coverage decreased from 2022 to 2025, and the percent of stressed trees increased. Site X9 does not align with an area of NDVI time series analysis.
  - At X10, the percent of alive trees decreased from 2022 to 2025, and the percent of stressed trees increased. At MC-1, NDVI remained the same from 2024 to 2025.
  - At X21, the percent canopy cover decreased from 91 percent in 2022 to 73 percent in 2025, indicating that perennial pepperweed in this area may be outcompeting native

riparian vegetation. At the MC-5 area, there has been a notable decrease in NDVI over the last two years, along with a change in timing of growing season NDVI values. These changes could be related to a decrease or stressing of the native riparian vegetation species caused by the perennial pepperweed.

  - At 82, the percent canopy cover and percent of alive trees both increased from 2022 to 2025. In contrast, 82 is within the MC-4 area, where NDVI decreased from 2023 to 2025, and is one of the only areas where NDVI has decreased over this least year along Mill Creek. This may be reflective of an impact of the perennial pepperweed at this site.

- Perennial pepperweed was observed at both of the new monitoring site plots along the SAR— SAR 01 and SAR 02. Scouring of the riparian habitat during high-precipitation and high-discharge events in 2023 and 2024, may have removed or knocked down larger riparian vegetation, creating open areas for the perennial pepperweed to proliferate.
  - At SAR 01, 20 percent of the trees observed were stressed. Site SAR 01 does not align with an area of NDVI time series analysis.
  - At SAR 02, 17 percent of the trees observed were dead. At the SAR-4 area, NDVI decreased from 2024 to 2025.

Overall, the NDVI time-series results suggest that perennial pepperweed is not having a significant, notable effect on the condition of riparian vegetation health.

In 2025, various species of non-native tree species were observed at monitoring site plot X3 along Chino Creek, and the NDVI is showing an increasing trend at the CC-1 area from 2024 to 2025. Additionally, the nuisance species, wild grape, was observed at monitoring site plot X13 along SAR, and the NDVI is showing an increasing trend at the SAR-2 area from 2024 to 2025.

3.6.5 Miscellaneous Factors

Figure 3-3 shows notable patches of NDVI increases and decreases from 2024 to 2025 below the OCWD wetlands, along and adjacent to the lower reach of Chino Creek, and along the SAR. The causes of these changes in NDVI have not been correlated with groundwater levels, surface-water discharge, or climate impacts. However, the area below the OCWD wetlands correlates with an area where recent Arundo removal and treatment occurred; and a large patch adjacent to Chino Creek just northwest of the OCWD wetlands correlates with a recent wildfire in 2025. The remaining notable areas where NDVI changed are in the lower Prado Basin and are vegetated areas mostly dominated by perennial growth, that respond to variations in precipitation over wet and dry years. As described in Section 3.4, WY 2025 was a dry year, after two subsequent wet years in WY 2024 and WY 2023. These conditions likely impacted the amount of perennial plant growth and the observed changes in NDVI from 2024 to 2025:

- The notable patches of NDVI increases along the SAR are likely due to regrowth of vegetation following scouring along edges of the river during the significantly higher surface-water discharge conditions in WY 2023 and WY 2024. This scouring effect was described in the 2023 and 2024 Annual Reports. Observation of the 2024 and 2025 air photos show these areas as bare land in 2024 and covered with green vegetation in 2025.
- The notable patches of NDVI increases along and adjacent to the lowest portion of Chino Creek behind Prado Dam are likely due to vegetation regrowth following an extended period of seasonal inundation during water-conservation operations. The significantly wet conditions in WY 2023 and WY 2024 resulted in a prolonged conservation pool behind Prado Dam, disrupting the growth of perennial grasses and shrubs. In contrast, the drier conditions in

2025, with no conservation pool, allowed for regrowth. Comparison of the 2024 and 2025 air photos reveals these areas as bare, gray/brown land in 2024, replaced by green land cover of perennial grasses and shrubs in 2025.

- The notable patches of NDVI decrease adjacent to the lower reach of Chino Creek are likely due to less perennial grasses and shrubs growing in the area due to a drier year than the two years before. Comparison of the 2024 and 2025 air photos show these areas as green coverage in 2024, replaced by more gray/green coverage in 2025.

DRAFT

117°40'0"W

CC-1
CC-2
CC-3
CC-4
MC-1
MC-2
MC-3
MC-4
MC-5
MC-6
SAR-2
SAR-3
SAR-4

Chino Creek
Mill Creek
Cucamonga Creek
Santa Ana River
Butterfield Drain
Temescal Wash

Pine Ave
Schleisman Rd
Chandler St
Hellman Ave
5th St
4th St
2nd St

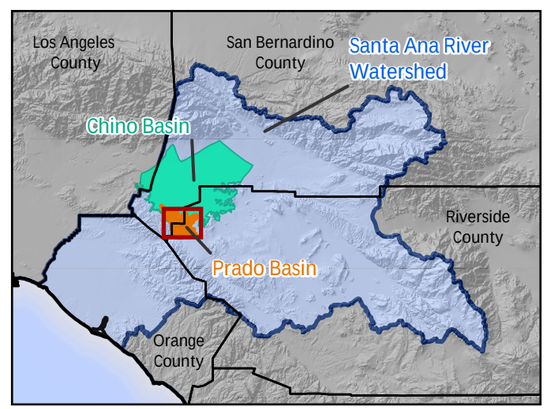
Prado Dam

County of Riverside, San Bernardino County, Bureau of Land Management, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS, EPA

Extent of Wildfire Occurrences in Prado Basin (1985-2025)

- 1985
- 1989
- 2007
- 2015
- 2018
- 2020
- 2025

Small Defined Area Analyzed for NDVI Time Series
1 NDVI pixel (30 x 30-meters)



Location Map of Other Factors That Can Affect Riparian Habitat
Wildfire

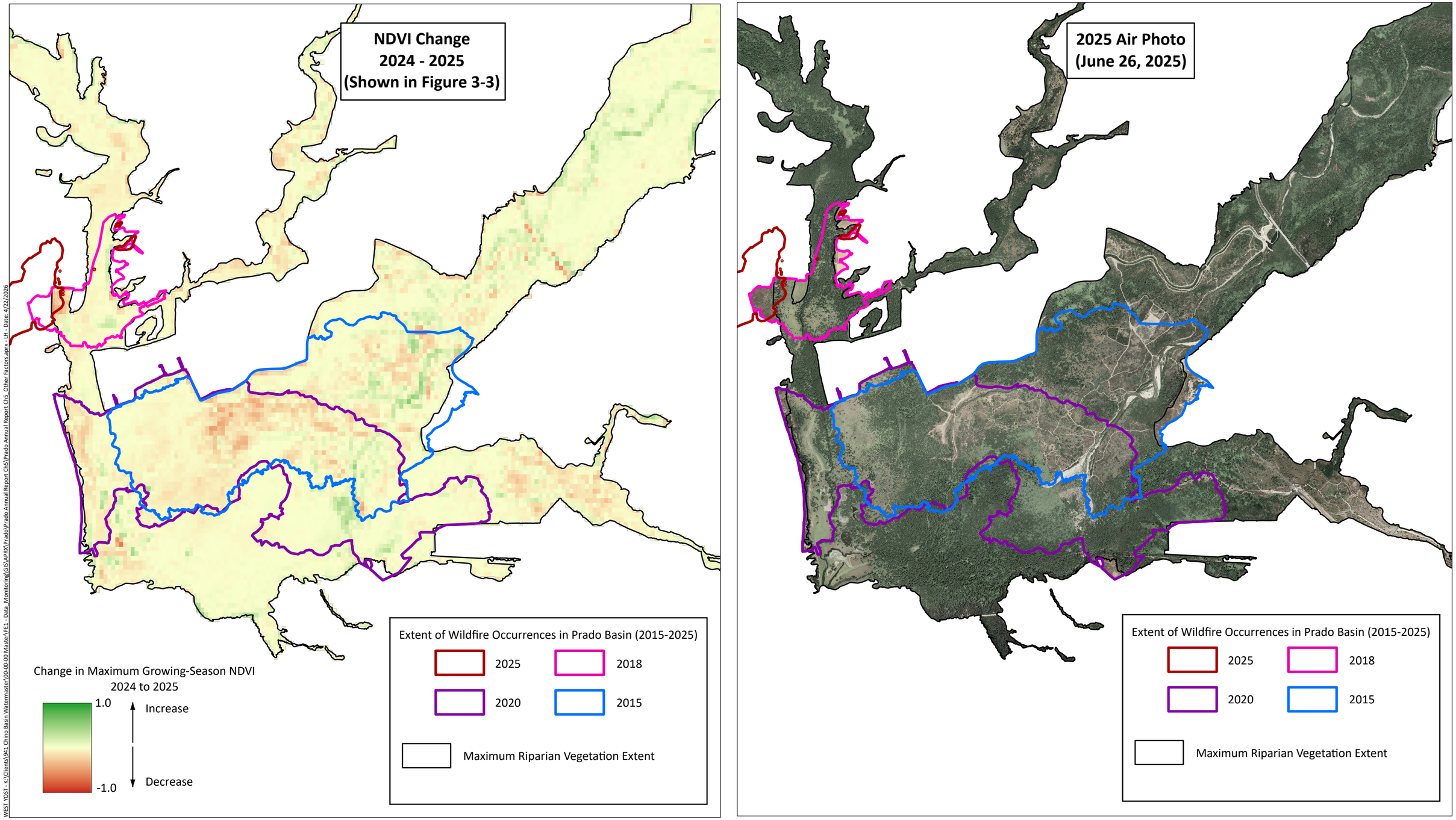
Figure 3-20a

Prepared by:
WEST YOST

N
0 0.5 1 Miles
0 1 2 Km

Prepared for:
Prado Basin Habitat Sustainability Committee
2025 Annual Report

K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data Monitoring\GIS\APRX\Prado\Prado Annual Report Ch5\Prado Annual Report Ch5 Other Factors.aprx - LH - Date: 4/21/2026
WEST YOST



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch5\Prado Annual Report Ch5_Other Factors.aprx - LH - Date: 4/22/2026

Prepared by:

WEST YOST

N

0 0.5 1 Miles

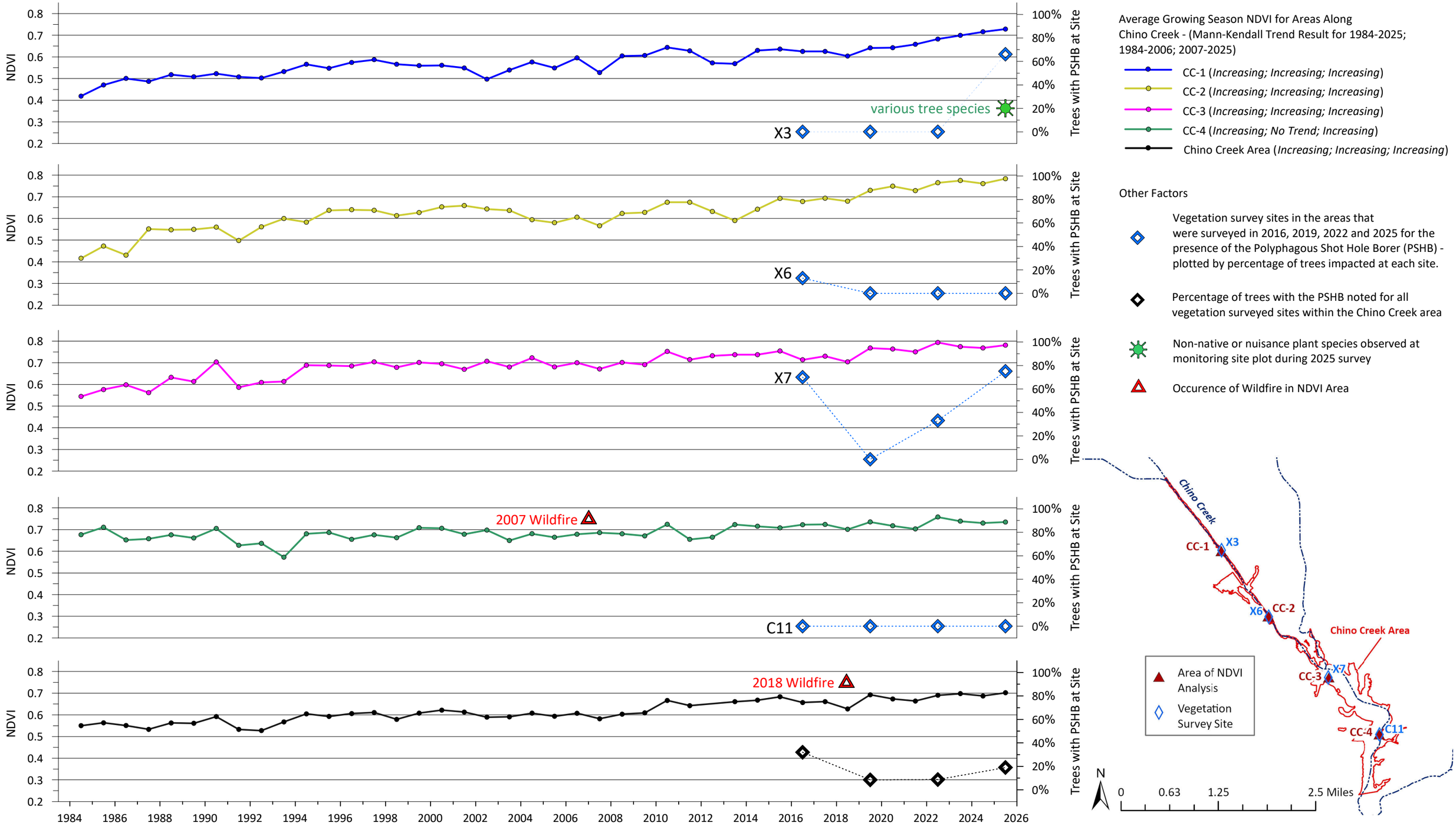
0 1 2 Km

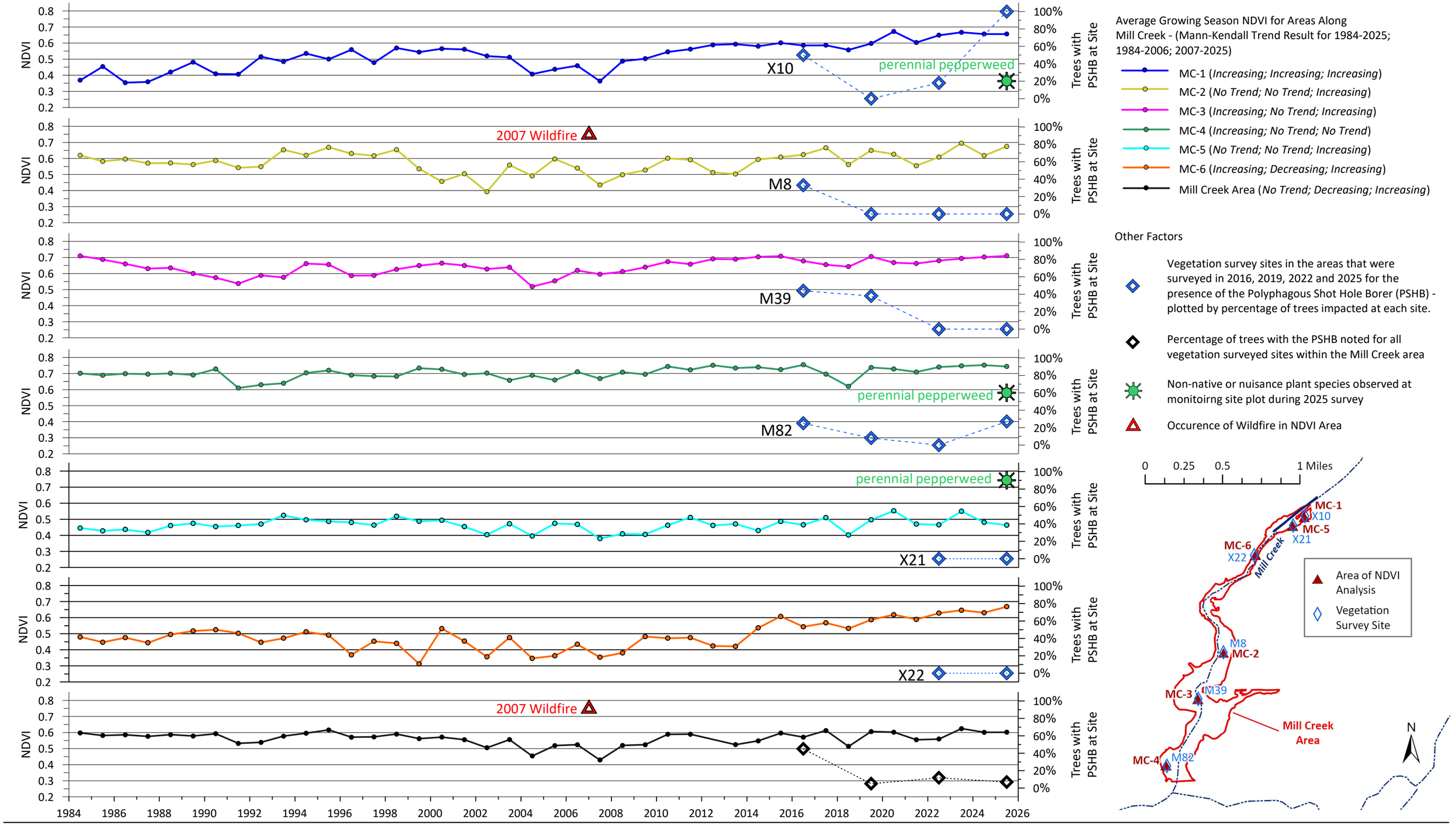
Prepared for:

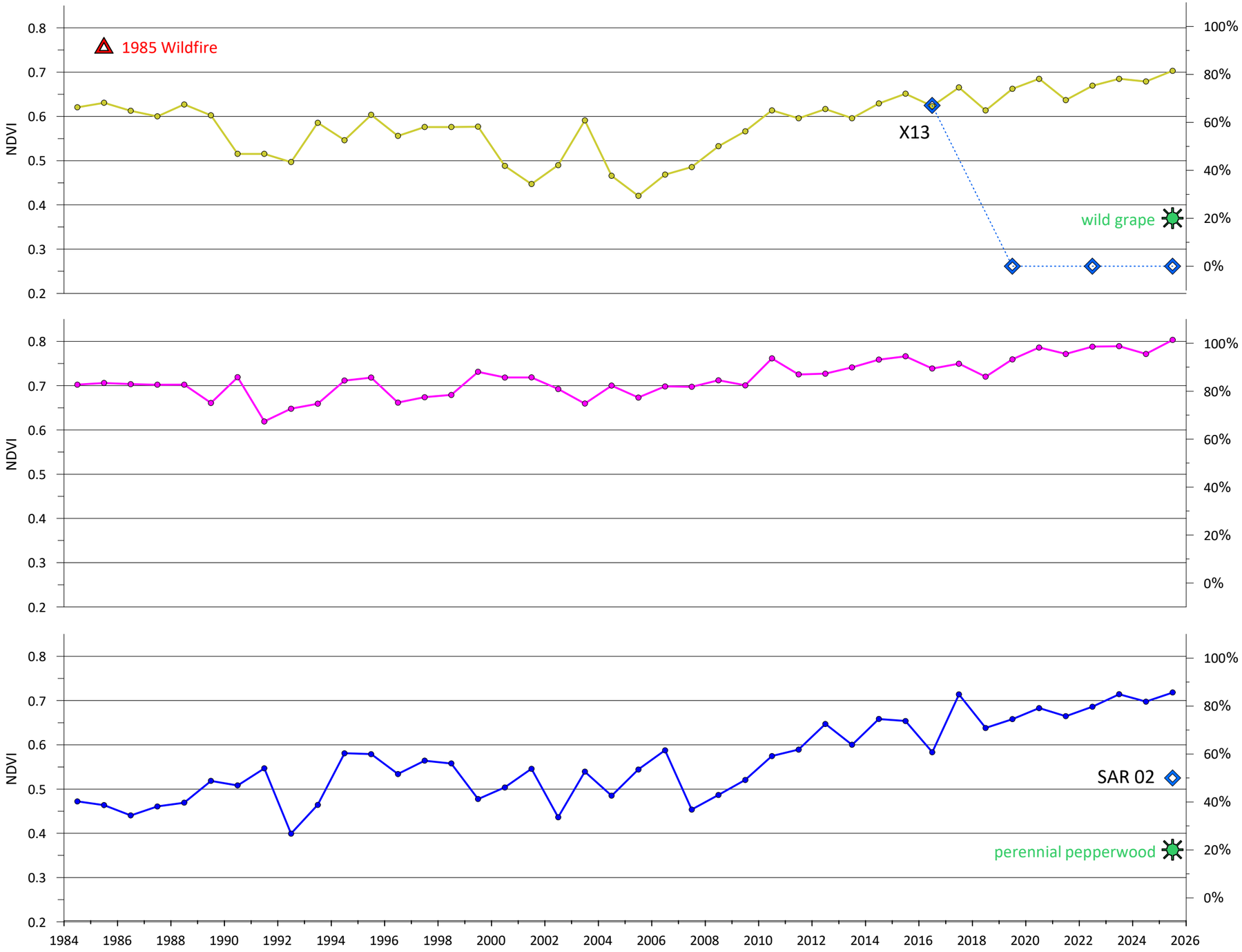
Prado Basin Habitat Sustainability Committee
2025 Annual Report

Spatial NDVI Change 2024-2025 and 2025 Air Photo with Prado Basin Wildfires

Figure 3-20b


NDVI
Trees with PSHB at Site
0.8
0.7
0.6
0.5
0.4
0.3
0.2
100%
80%
60%
40%
20%
0%
various tree species
X3
X6
X7
2007 Wildfire
C11
2018 Wildfire
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
Average Growing Season NDVI for Areas Along Chino Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)
CC-1 (Increasing; Increasing; Increasing)
CC-2 (Increasing; Increasing; Increasing)
CC-3 (Increasing; Increasing; Increasing)
CC-4 (Increasing; No Trend; Increasing)
Chino Creek Area (Increasing; Increasing; Increasing)
Other Factors
Vegetation survey sites in the areas that were surveyed in 2016, 2019, 2022 and 2025 for the presence of the Polyphagous Shot Hole Borer (PSHB) - plotted by percentage of trees impacted at each site.
Percentage of trees with the PSHB noted for all vegetation surveyed sites within the Chino Creek area
Non-native or nuisance plant species observed at monitoring site plot during 2025 survey
Occurence of Wildfire in NDVI Area
Chino Creek
CC-1
X3
X6
CC-2
Chino Creek Area
X7
CC-3
CC-4
C11
Area of NDVI Analysis
Vegetation Survey Site
N
0
0.63
1.25
2.5 Miles


NDVI
Trees with PSHB at Site
X10
perennial pepperweed
2007 Wildfire
M8
M39
M82
X21
X22
Average Growing Season NDVI for Areas Along Mill Creek - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)
MC-1 (Increasing; Increasing; Increasing)
MC-2 (No Trend; No Trend; Increasing)
MC-3 (Increasing; No Trend; Increasing)
MC-4 (Increasing; No Trend; No Trend)
MC-5 (No Trend; No Trend; Increasing)
MC-6 (Increasing; Decreasing; Increasing)
Mill Creek Area (No Trend; Decreasing; Increasing)
Other Factors
Vegetation survey sites in the areas that were surveyed in 2016, 2019, 2022 and 2025 for the presence of the Polyphagous Shot Hole Borer (PSHB) - plotted by percentage of trees impacted at each site.
Percentage of trees with the PSHB noted for all vegetation surveyed sites within the Mill Creek area
Non-native or nuisance plant species observed at monitoirng site plot during 2025 survey
Occurence of Wildfire in NDVI Area
0 0.25 0.5 1 Miles
MC-1
X10
MC-5
X21
MC-6
X22
Mill Creek
M8
MC-2
MC-3
M39
Mill Creek Area
MC-4
M82
Area of NDVI Analysis
Vegetation Survey Site
N

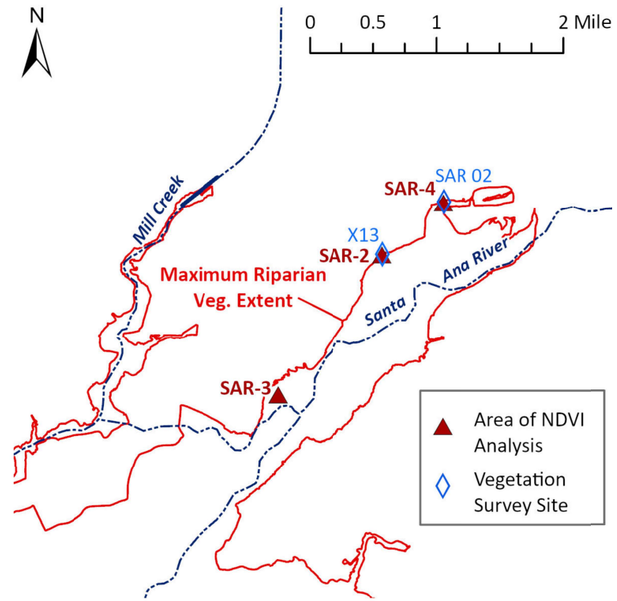


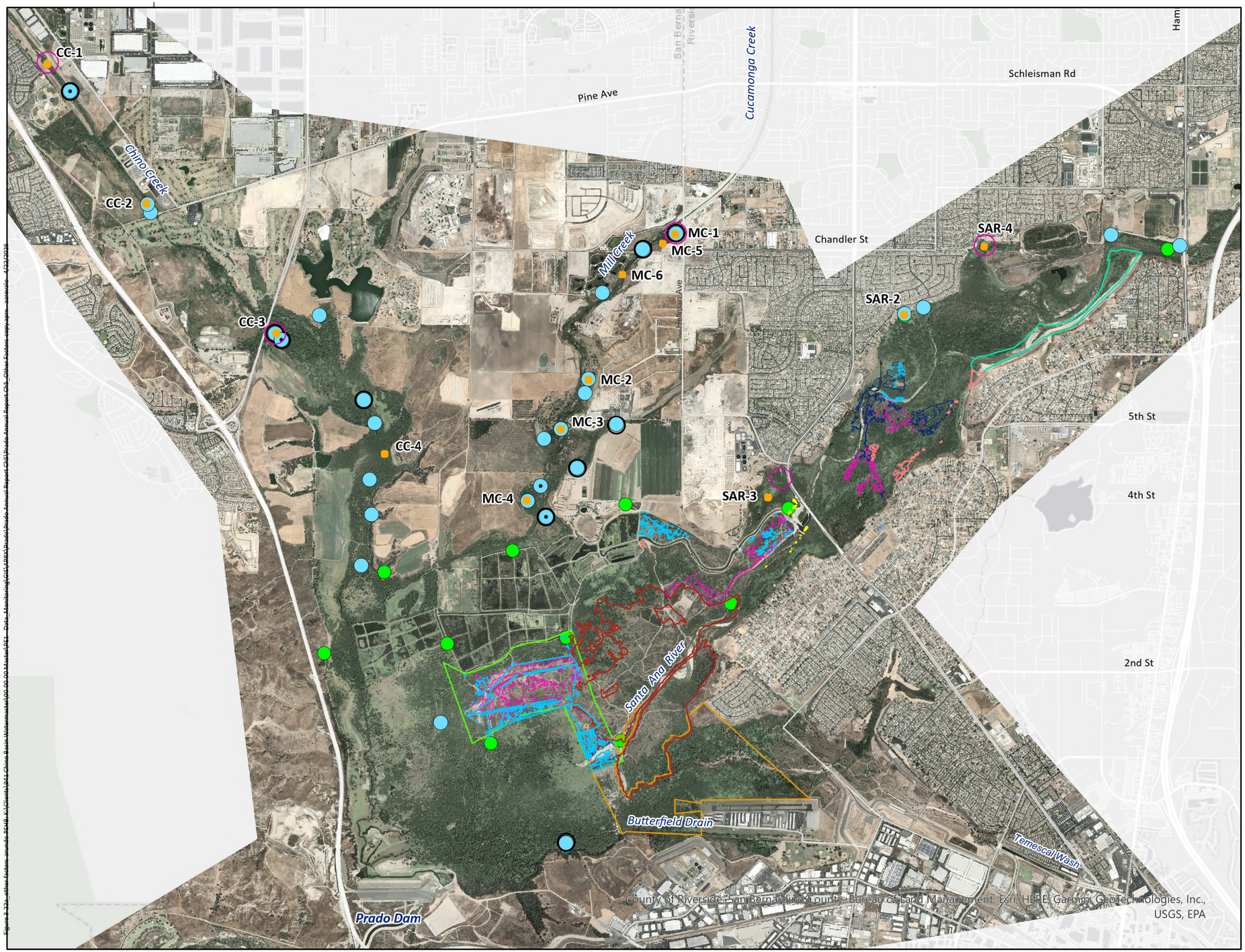
Average Growing Season NDVI for Areas Along Santa Ana River - (Mann-Kendall Trend Result for 1984-2025; 1984-2006; 2007-2025)

- SAR-2 (*Increasing; Decreasing; Increasing*)
- SAR-3 (*Increasing; No Trend; Increasing*)
- SAR-4 (*Increasing; No Trend; Increasing*)

Other Factors

- Vegetation survey sites in the areas that were surveyed in 2016, 2019, 2022 and 2025 for the presence of the Polyphagous Shot Hole Borer (PSHB) - plotted by percentage of trees impacted at each site.
- Non-native or nuisance plant species observed at monitoirng site plot during 2025 survey
- Occurence of Wildfire in NDVI Area





Documented Locations of Polyphagous Shot-Hole Borer (PSHB)

- Identified by USBR during the 2016 Vegetation Surveys
- Identified by USBR during the 2019 Vegetation Surveys
- Identified by USBR during the 2022 Vegetation Surveys
- Identified by ECORP during the 2025 Vegetation Surveys
- Traps Deployed by OCWD and SAWA from August 2016 to April 2017

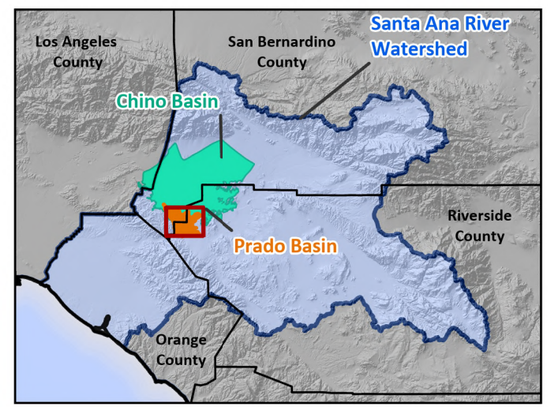
Area of SAWA Arundo Removal, Treatment, and/or Maintenance

- 2025
- 2023-2024
- 2022
- 2021
- 2020
- 2019
- 2016 - 2018

Area of Arundo Management

- Control of Arundo Regrowth by OCWD within the Perimeter of 2015 Wildfire
- ACOE Arundo Mitigation Site

Small Defined Area Analyzed for NDVI Time Series - 1 NDVI pixel (30 x 30-meters)



Location Map of Other Factors That Can Affect Riparian Habitat
Arundo and PSHB

Figure 3-22a

Prepared by: WEST YOST

N

0 0.5 1 Miles

0 1 2 Km

Prepared for:

Prado Basin Habitat Sustainability Committee
2025 Annual Report

NDVI Change
2024 - 2025
(Shown in Figure 3-3)

2025 Air Photo
(June 26, 2025)

Maximum Riparian Vegetation Extent

Change in Maximum Growing-Season NDVI
2024 to 2025

1.0 Increase

-1.0 Decrease

Area of Arundo Removal, Treatment, and Management in 2025

Area of Arundo Removal, Treatment, and Management from 2019 to 2024

Control of Arundo Regrowth by OCWD Within the Perimeter of 2015 Wildfire

ACOE Arundo Mitigation Site

0 0.5 1 Miles

0 1 2 Km

N

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE1 - Data_Monitoring\GIS\APRX\Prado\Prado Annual Report Ch5_Other Factors-copy.aprx - LH - Date: 4/22/2026

Prepared by: WEST YOST

Prepared for: Prado Basin Habitat Sustainability Committee

Spatial NDVI Change 2024-2025 and 2025 Air Photo with Prado Basin Arundo Removal and Management

2016-2025

Figure 3-22b

3.7 Analysis of Prospective Loss of Riparian Habitat

The meaning of "prospective loss" of riparian habitat in this context is the "future potential loss" of riparian habitat. Watermaster's most recent (2020) predictive modeling results[31] were used to identify areas of prospective loss of riparian habitat that may be attributable to the Peace II Agreement by projecting future groundwater-level conditions in the Prado Basin area through 2030. To perform this evaluation, the predictive model results were mapped and charted to identify areas, if any, where groundwater levels are projected to decline to depths that may adversely impact the riparian habitat in the Prado Basin.

Figure 3-23 is a map that shows the 2020 model-predicted change in groundwater levels in the Prado Basin area over the period of 2018-2030 from the planning scenario used to recalculate the Safe Yield of the Chino Basin in 2020 using Watermaster's updated groundwater-flow model (WEI, 2020). The map shows that groundwater levels are predicted to remain steady across most of the Prado Basin area through 2030. The stability in groundwater levels is explained in part by projected declines in groundwater production from private wells in the area, the IEUA's delivery of treated recycled water to this area for direct uses (such as outdoor irrigation), and the fact that most of the Chino Basin Desalter production will occur to the north and northeast. Figure 3-24 shows that the most likely area where groundwater levels are projected to decline by 2030 is the northern portions of Mill Creek and the SAR.

Figure 3-24 is a time-series chart of the 2020 model-predicted groundwater levels at the PBHSP monitoring wells for the period of 2018 to 2030. These wells are strategically located adjacent to the riparian habitat south of the Chino Desalter well field to understand the potential impacts of Peace II implementation on groundwater levels and the riparian habitat. The chart shows:

- Groundwater levels are projected to fluctuate seasonally at all PBHSP monitoring wells by about one to two feet.
- Groundwater-level trends are projected to remain stable at most of the PBHSP monitoring wells through the duration of the Peace II Agreement (through 2030).
- At two of the PBHSP monitoring wells, groundwater levels are projected to experience declines of about one to three feet from 2018 to 2030, which may represent a threat for prospective loss of riparian habitat:
  - **PB-2 above the northern reach of Mill Creek.** The 2020 model predicts a decline in groundwater levels at PB-2 of about three feet from 2018 to 2030. Figure 3-11 shows that groundwater levels declined at PB-2 by about 4.5 feet from 2018 to 2024, which is greater than the decline predicted by the model through 2030. Additionally, groundwater levels have declined by about 2.5 feet through 2024 in the riparian vegetation extent along Mill Creek just to the south. Figure 3-12 shows that the current (Fall 2024) depth-to-groundwater where the riparian vegetation is growing along the northernmost reaches of Mill Creek ranges from about 10-15 ft-bgs. Hence, if the

[31] The predicted groundwater level changes through 2030 were made with the 2020 Chino Valley Model (CVM) for Scenario 2020 SYR1 for Layer 1 of the aquifer. The results of this model scenario were used to recalculate the 2020 Safe Yield of the Chino Basin (WEI, 2020). Scenario SYR1 is based on the water demands and water supply plans provided by the Watermaster parties, Chino Basin parties' planning assumptions on pumping groundwater and conducting recharge operations, planning hydrology that incorporates climate change impacts on precipitation and ET0, and assumptions regarding cultural conditions and future replenishment.

groundwater levels continue to decline along Mill Creek, then it could result in adverse impacts to the riparian habitat in this area.

- **PB-3 along the northern portion of the SAR.** The 2020 model predicts a decline in groundwater levels at PB-3 of about one foot from 2018 to 2030. Figure 3-13c shows that groundwater levels declined at PB-3 by about 1.5 feet, from 2018 to 2024, which is slightly greater than the decline predicted by the model through 2030. Figure 3-12 shows that the current (Fall 2024) depth-to-groundwater where the riparian vegetation is growing along the northernmost reaches of the SAR ranges from 6-11 ft-bgs. If groundwater levels continue to decline at similar or higher rate through 2030, then it could result in a depth to groundwater greater than 15 ft-bgs and adverse impacts to the riparian habitat in this area. However, the groundwater-level declines in this northern reach of the SAR near PB-3 are not a concern for the riparian vegetation at this time because the depth to groundwater in this area is shallow (6 to 11 ft-bgs) and is supported by SAR recharge.

DRAFT

117°40'0"W

34°0'0"N

Edison Ave

San Antonio Creek (upstream)

Cypress Channel

El Prado Rd

Kimball Ave

Cucamonga Creek

Archibald Ave

Day Creek

Chino Creek

Mill Creek

Chino Hills

6th St

5th St

4th St

2nd St

La Sierra Hills

Santa Ana River

Butterfield Drain

Tomescal Wash

Prado Dam

71

15

91

I-1 I-2 I-3 I-4 I-5 I-6 I-7 I-8 I-9 I-10 I-11 I-12 I-13 I-14 I-15 I-16 I-17 I-18 I-20 I-21

II-1 II-2 II-3 II-4 II-6 II-7 II-8 II-9 II-10 II-11 II-12

-15 -10 -5 0 5 10

Contours of Model-Predicted Change in Groundwater Levels for Layer 1*
July 2018 to July 2030, feet

Hydraulic Head Change (ft) *July 2018 to July 2030*

30 — Increase

0

-30 — Decrease

Chino Desalter Well

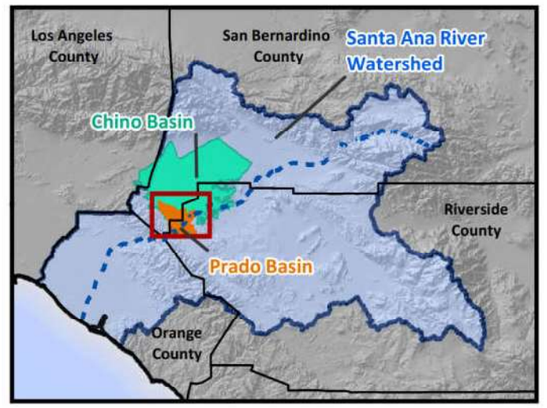
PBHSP Monitoring Well Site

Riparian Vegetation Extent in Prado Basin

Concrete-Lined Channels

Unlined Rivers and Streams

* Model Predicted Change in Groundwater Levels from the planning scenario 2020 SYR1 for the recalclation of Safe Yield using the updated Chino Valley Model (WEI, 2020)



WEST YOST - \Clients\941 Chino Basin Watermaster\100-00-00 Master\PE1 - Data_Monitoring\GIS\MXD\Prado\Annual Report\Figure 3-21_Model 2018-30.mxd - VMW - 4/26/21

Prepared by: WEST YOST Water. Engineered.

0 1 2 Miles

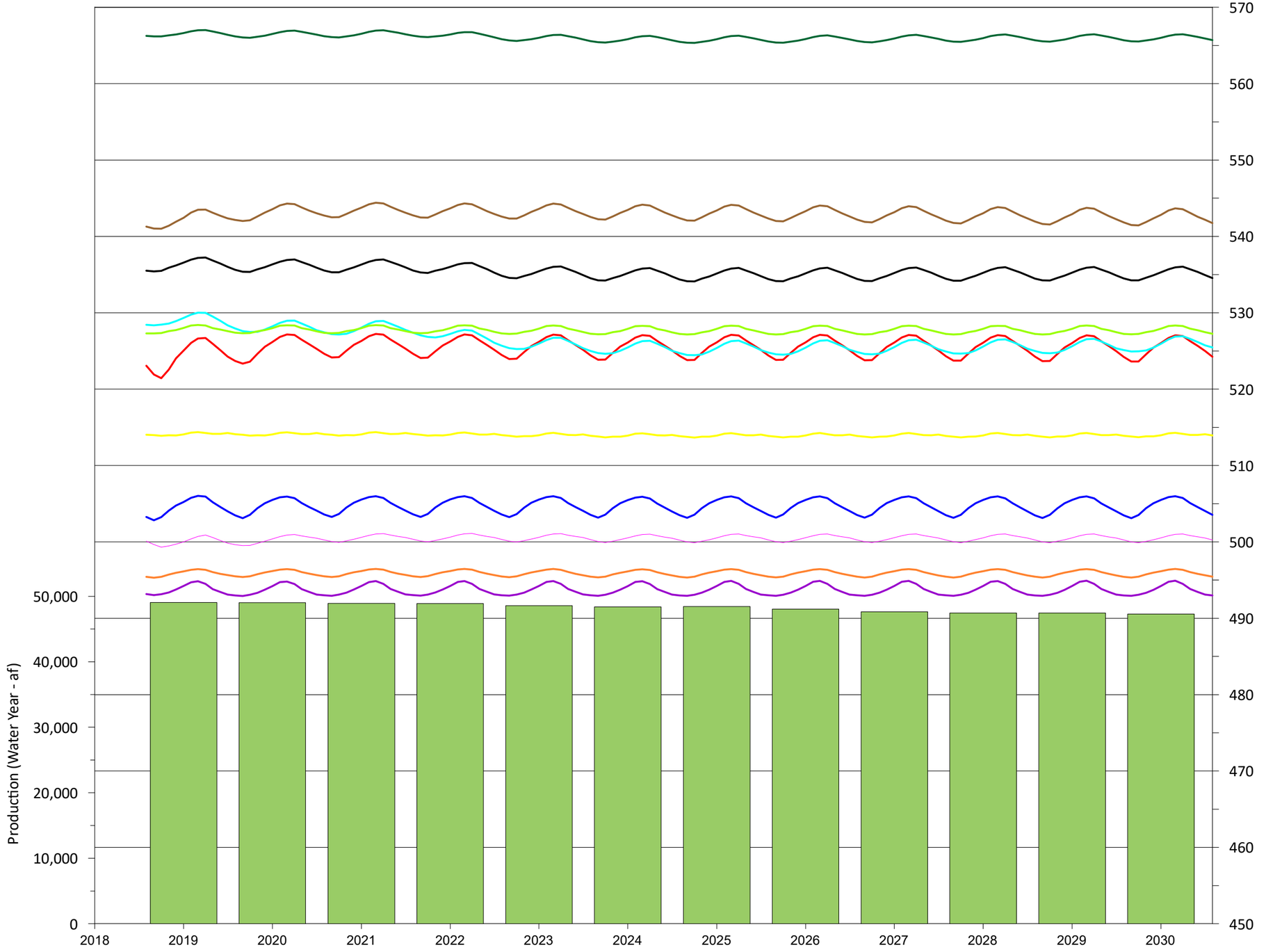
0 1 2 Km

Chino Basin Watermaster and Inland Empire Utilities Agency
2022 Annual Report of the Prado Basin Habitat Sustainability Committee

Prepared for:

Predicted Change in Groundwater Level
2018 to 2030 - Scenario 2020 SYR1

Figure 3-24



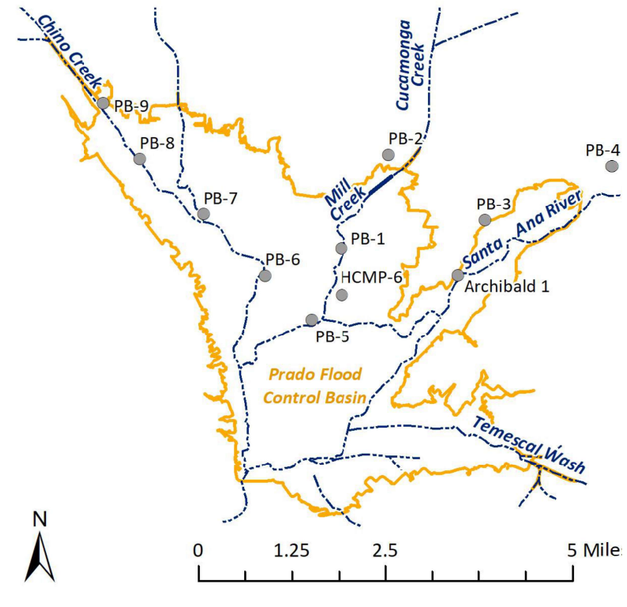
Model-Predicted Groundwater Levels*
(feet above mean sea level (ft amsl))

- PB-4
- PB-9
- PB-3
- PB-8
- PB-2
- Archibald 1
- PB-1
- PB-7
- HCMP-6
- PB-6
- PB-5

Model-Predicted Pumping at Wells in the Groundwater Monitoring Program Study Area*
(acre-feet (af))

*Model Simulated Groundwater Elevations and Pumping from the planning scenario 2020 SYR1 for the 2020 recalculation of Safe Yield using the updated Chino Basin groundwater-flow model (WEI, 2020)

Well Locations



Prepared by: WEST YOST Water. Engineered.

Prepared for: Chino Basin Watermaster

Predicted Change in Groundwater Levels
2018 to 2030 - Scenario 2020 SYR1

Figure 3-24

4.0 CONCLUSIONS AND RECOMMENDATIONS

The monitoring and mitigation requirements in the Peace II SEIR call for annual reporting for the PBHSP. Annual reports include recommendations for ongoing monitoring and any adaptive management actions required to mitigate any measured loss or prospective loss of riparian habitat that may be attributable to the Peace II Agreement.

The following describes the main conclusions of this annual report and provides recommendations for future monitoring, reporting, and mitigation, if any.

4.1 Main Conclusions and Recommendations

4.1.1 Conclusions

The main conclusions of the PBHSC Annual Report for WY 2025 are:

- Based on the analysis of NDVI time series and air photos, the quality (greenness) of the riparian habitat vegetation across most of the Prado Basin increased or remained the same from 2024 to 2025. The exception is two areas where the NDVI decreased, and those changes were minor and within the range of one-year variability observed historically. The 2024 and 2025 air photos reveal no significant changes in riparian vegetation, and areas previously noted as having reduced coverage or browning in 2024 exhibited increased greenness in 2025. These observations occurred during a slightly warmer and drier year following two consecutive wet years.
- Based on the analysis of NDVI spatial change maps and air photos, there were three notable areas of decreases and increases in greenness observed in the Prado Basin between 2024 and 2025: (i) increases and decreases along the lower reach of Chino Creek; (ii) increases along the SAR; and iii) decreases below the OCWD wetlands. The increases were likely caused by growth of perennial vegetation in a dryer year following two wet years where there was scouring along the channels, and inundation from the water conversation pool behind the dam. The potential cause of the decreases varied by area, and included a 2025 wildfire, continued maintenance of Arundo, or less perennial vegetation growth in a dry year. None of the reductions in greenness were related to declining groundwater levels during the period of Peace II Agreement implementation.
- Based on the results of the vegetation survey, overall the riparian vegetation at the monitoring sites appears to be healthy and the riparian system is functioning properly. The primary driver of observed variability and year-to-year changes is climate. All the changes observed in the riparian vegetation from 2022 to 2025 appear to be within the normal range of variability related to climatic changes and it is unlikely that any observable decline in the riparian system for the monitoring site plots could be linked to groundwater pumping.
- Over this past year from 2024 to 2025, groundwater levels at the PBHSP monitoring wells along Chino Creek, Mill Creek and the SAR in the Prado Basin remained stable or showed slight changes of +/- up to a foot. These changes were likely due to a drier year with decreased stream discharge.
- Since groundwater-level measurements commenced at the PBHSP monitoring wells in 2015, there have been some increasing and decreasing trends in groundwater levels observed along the reaches of Chino Creek, Mill Creek, and SAR. From fall 2016 to fall 2025, groundwater levels throughout most of riparian vegetation extent have changed less than +/-5 feet. There are some notable areas of change:

DRAFT

- Groundwater levels have declined the most in the northern portion of Mill Creek just south of the PB-2 monitoring well. From 2016 to 2022 groundwater levels declined by about eight feet likely due to increased pumping at the CDA wells to the north. From 2023 to 2025, groundwater levels increased and have since leveled out in this area, for a net change of -4 feet since 2016. Based on the analysis of NDVI, air photos, and the 2025 vegetation surveys, there are no notable declines in the greenness of the riparian vegetation in this northern area of Mill Creek reach where groundwater levels have declined.
- In the northern reach of Chino Creek, groundwater levels increased by about ten feet from 2016 to 2024. These increases in groundwater levels were likely due to decreased groundwater pumping in the area.

- The depth to groundwater in the northernmost reach of Mill Creek where the groundwater levels have declined the most (near PB-2) is estimated at 10-15 ft-bgs in WY 2025. Future declines in groundwater levels in this area could result in adverse impacts to the riparian habitat.

4.1.2 Recommendations

Based on the conclusions above, the PBHSP monitoring and reporting should continue to monitor and assess the extent and quality of the riparian habitat and the factors that can influence it, consistent with the approach used through WY 2025. As described earlier, groundwater levels declined from 2016 to 2022 beneath the northern portion of Mill Creek; however, levels have since recovered to roughly halfway between their 2022 lows and historical conditions, and no long-term negative impacts to the riparian vegetation have been observed in this area. Focused monitoring along Mill Creek has continued to evaluate whether the earlier groundwater declines could affect the extent or quality of riparian habitat, and results to date indicate no sustained adverse effects.

The latest triennial vegetation surveys were in the summer of 2025 and were tailored to focus on the northern portion of Mill Creek and reduced to key locations for continued representative monitoring. The biological consultant who performed the surveys recommended the surveys continue every three years.

4.2 Recommended Mitigation Measures and/or Adjustments to the AMP

This annual report has documented no trend in the degradation of the extent or quality of riparian habitat along Chino Creek, Mill Creek, or the SAR that is contemporaneous with decreasing groundwater levels during the implementation of the Peace II Agreement. As such, no mitigation measures are proposed at this time and no adjustments to the AMP are recommended.

4.3 Recommended PBHSP for Fiscal Year 2026/27

Based on preliminary analysis of the PBHSP data for WY 2025, a draft *Technical Memorandum Recommended Scope and Budget of the Prado Basin Habitat Sustainability for FY 2026/27* was submitted to the PBSHC on March 12, 2026. On March 19, 2026, Watermaster's Engineer presented the recommended scope and budget for FY 2026/27 to the PBHSC for consideration. There were no changes recommended by the PBHSC on the proposed FY 2026/27 scope of work, and a final scope of work and budget was submitted to the PBHSC and will go through the Watermaster and the IEUA FY 2026/27 budgeting process in May and June of 2026. The scope of work for the PBHSP for FY 2026/27 is shown in Table 4-1 as a line-item cost estimate.

DRAFT

The following describes the scope of work for the PBHSP for FY 2026/27:

Recommended Scope of Work and Budget

Since monitoring began in 2015, the monitoring and analysis of the riparian habitat, groundwater levels, precipitation, temperature, and surface-water discharge have been successful in identifying: (i) changes in the health and extent of the riparian habitat (ii) changes in groundwater levels in the Prado Basin and the relationship to riparian habitat health, and (iii) relationships between the riparian habitat and the factors that influence it besides groundwater levels. The monitoring of the riparian habitat and changes in groundwater levels remain the most critical components of the PBHSP.

Groundwater levels in the northern portions of Mill Creek and the SAR declined for a period of time between 2021 and 2023, reaching levels lower than the model-predicted groundwater levels for Peace II implementation that were assumed to have minimal impact on the habitat. The PBHSP monitoring during this period indicated that riparian vegetation health did not exhibit a corresponding decline attributable to the lowered groundwater levels; and slight declines in the vegetation greenness that were observed were associated with other factors.

The last PBHSP Annual Report for water year 2024 documented some notable decreases in the vegetation greenness in the Mill Creek area, shown in the remote sensing data and visible as browning in the air photos. These decreases occurred during a period of cooler-than-average temperatures, stable or increasing groundwater levels, and above average precipitation and stream discharge. Preliminary analyses for the current PBHSP Annual Report for WY 2025 do not indicate a significant decrease in the vegetation greenness in any of the areas. Furthermore, field vegetation surveys conducted in October 2025 confirmed that overall, the riparian vegetation in Prado Basin appeared healthy.

The continuation of the monitoring and analyses as done in previous fiscal years is necessary to continue to identify potential changes in the riparian habitat and groundwater levels, and the specific causes of those changes during the implementation of the Peace II Agreement. If mitigation measures are ever determined to be necessary, the PBHSP results will assist in their development. Based on the monitoring and reporting completed to date—and consistent with the scope implemented in previous years, the proposed PBHSP scope of work for FY 2026/27 includes the following tasks:

- Task 1: Groundwater Monitoring Program
- Task 2: Surface-Water Monitoring Program
- Task 3: Climate Monitoring Program
- Task 4: Riparian Habitat Monitoring Program
- Task 5: Prepare Annual Report
- Task 6: Project Management and Administration

The monitoring and analysis proposed for FY 2026/27 for the PBHSP is generally the same scope as the previous year, except it excludes the periodic field vegetation surveys that are done every three years (last conducted in 2025). As a result, the proposed budget for FY 2026/27 is less than the budget for FY 2025/26 and continues to incorporate cost savings due to efficiencies in the monitoring and reporting program developed over the years.

DRAFT

Table 1 is a line-item cost estimate for Tasks 1 through 6. The costs of the PBHSP are shared between Watermaster and IEUA per 2016 Agreement.[32] Watermaster is responsible for the costs associated with Tasks 1 and 2; IEUA and Watermaster split costs equally for Tasks 3 through 6. The OCWD is also a cost-sharing partner for sub-Task 4.1.

The proposed scope of work is described below by task.

Task 1. Groundwater Monitoring Program

The monitoring of groundwater levels in the Prado Basin is a key component of the PBHSP because declining groundwater levels could be a factor related to Peace II implementation that adversely impacts riparian vegetation. Sixteen monitoring wells were installed specifically for the PBHSP in 2015. These wells, plus monitoring wells HCMP-5/1 and RP2-MW3, are monitored for the PBHSP. Figure 1 shows these 18 PBHSP monitoring wells located at nine sites in the Prado Basin along the fringes of the riparian habitat. The 18 monitoring wells are equipped with integrated pressure transducers/data-loggers (hereafter referred to as transducers) that measure and record water level measurements and temperature readings every 15 minutes. At 15 of the 18 wells, the transducers also collect high-frequency measurements of EC. The inclusion of the high-frequency temperature and EC data was a recommendation resulting from the evaluation of a pilot monitoring program in the Annual Report for water year 2022 and is used to help evaluate groundwater/surface-water interactions. As transducers require replacements at the end of their useful life, they will be replaced with transducers that measure EC.

This task includes quarterly field visits to all 18 PBHSP monitoring wells to download the data from the transducers, and the processing, checking, and uploading of the water level, temperature, and EC data to the PBHSP database. The scope of this task is the same as the previous fiscal year.

Task 2. Surface-Water Monitoring Program

Surface-water data from the SAR and the tributaries that cross Prado Basin are used to evaluate groundwater/surface-water interactions and their importance to the impact on groundwater levels and riparian habitat, and to characterize the influence of surface-water discharge on the riparian habitat.

The surface-water monitoring program includes two components: i) collecting field surface-water measurements of EC and temperature at select locations, and ii) leveraging available surface water quality and flow data for the study area monitored by various entities.

Task 2.1 is to collect field measurements of temperature and EC at four surface-water sites in Chino Creek and Mill Creek near the PB-1, PB-2, PB-7, and PB-8 monitoring wells (see Figure 1), and to process and upload the data to the database. The collection of field surface-water measurements was another monitoring recommendation from the evaluation of the pilot monitoring program in the Annual Report for water year 2022. The collection of this data will further support the analyses of groundwater/surface-water interactions with the high-frequency EC and temperature monitoring at nearby PBHSP monitoring wells collected in Task 1. The effort to collect, process, and upload the manual measurements is minimal since it can be done during the quarterly field visits to the monitoring wells to

[32] Agreement Between Chino Basin Watermaster and Inland Empire Utilities Agency Regarding Reimbursement of the Peace II Subsequent Environmental Impact Report Mitigation Measure 4.4.5 (Prado Basin Habitat Sustainability Program). Signed September 2016.

download the transducer data. The scope of this sub-task is consistent with the work performed for the previous fiscal year.

Task 2.2 includes the annual collection and review of the surface-water data from four publicly available data sets, including: the USGS daily discharge measurements at six sites along the SAR and its tributaries; daily discharge and water-quality data from POTWs that are tributary to Prado Basin; US ACOE daily measurements of reservoir elevation and releases from the reservoir at Prado Dam; and Watermaster's quarterly surface-water quality monitoring at two sites along the SAR. The locations of these surface-water monitoring sites are shown on Figure 1. The data for water year 2026 will be compiled and reviewed. This sub-task does not include the effort to obtain, process, and upload the data to the database, which is performed under other Watermaster tasks for other monitoring programs. The scope of this sub-task is consistent with the work performed for the previous fiscal year.

Task 3. Climate Monitoring Program

Climatic data are evaluated in the vicinity of the Prado Basin to characterize trends and to determine if these trends contribute to impacts on the riparian habitat. The climate monitoring program utilizes two types of publicly available, spatially gridded datasets. Task 3 includes the annual collection of these spatially gridded datasets for water year 2026 (October 2025 – September 2026), and the checking and uploading of the data to the PBHSP database. The scope of this task is consistent with the work performed for the previous fiscal year.

Task 4. Riparian Habitat Monitoring Program

Monitoring the extent and quality of the riparian habitat in the Prado Basin is a fundamental component of the PBHSP to characterize how the riparian habitat changes over time. To characterize the impacts of Peace II implementation on the riparian habitat (if any) it is necessary to understand the long-term historical trends of its extent and quality, and the factors that have affected it. The current RHMP consists of both regional and site-specific components. The proposed RHMP for FY 2026/27 is described in the subsections below.

Regional Monitoring:

The regional monitoring of riparian habitat is performed via two independent methods that complement each other: mapping and analysis of the riparian habitat using (i) air photos and (ii) the NDVI derived from the Landsat remote sensing program. Tasks 4.1, 4.2, and 4.3 are for the collection and compilation of the regional monitoring data, including:

- Perform a custom flight (via outside professional services) to acquire a high-resolution air photo (three-inch pixel) of the Prado Basin during summer 2026. The cost for the air photo is shared with OCWD.
- Catalog and review in ArcGIS the quality and extent of the riparian vegetation in the 2026 high-resolution air photo of the Prado Basin. Commonly, a meeting is held with OCWD to review the air photo and share information on the other current monitoring efforts of Prado Basin riparian habitat.
- Collect, review, and upload the Landsat NDVI data for another year through the 2026 growing season (November 2025 through October 2026) NDVI is collected for the entire Prado Basin extent and 17 defined areas. In WY 2025 two defined areas were removed (LP and SAR-1) because the analysis in these areas was no longer needed; and a new area

DRAFT

(SAR-4) was added in the northern portion of the riparian vegetation along the Santa Ana River.

Site-Specific Monitoring:

The site-specific monitoring of the riparian habitat consists of periodic field surveys of the riparian vegetation at selected locations. These surveys provide an independent measurement of vegetation quality that can be used to "ground truth" the regional monitoring of the riparian habitat, as well as the occurrence of the PSHB, a pest that is known to increase tree mortality in the Prado Basin. The USBR along with the OCWD[33] has conducted field surveys once every three years since 2007 at 31-39 sites. The most recent triennial field survey was conducted in the summer of 2025 by ECORP at 20 sites, including two new sites along the northern portion of Mill Creek and two new sites along the SAR. The sites were reduced to 20 to focus on key representative areas where field data are important for verifying regional assessment monitoring, where there have been some observed groundwater level declines or vegetation health, and where the Peace II implementation has potential to impact riparian vegetation.

Task 5. Prepare Annual Report of the PBHSC

This task involves the analysis of all data sets collected by the PBHSP through WY 2026, including the data collected in Tasks 1 through 4 and for other as-needed factors that can impact the riparian habitat, such as wildfires, habitat mitigation programs, or construction/development in the Basin. The results and interpretations generated from the data analysis will be documented in the *Annual Report for Prado Basin Habitat Sustainability Committee for Water Year 2026*. This task includes the effort to prepare an administrative draft report for Watermaster and IEUA staff review, a draft report for the review by the PBHSC, and a final report including comments and responses document by early June. This task also includes a PBHSC meeting to review the draft report and facilitate comments on the report. The scope of this task is consistent with the work performed for the previous fiscal year.

Task 6. Project Management and Administration

This task includes the effort to prepare the PBHSP scope, schedule, and budget for the subsequent fiscal year. A draft *Technical Memorandum Recommended Scope and Budget of the Prado Basin Habitat Sustainability Program for FY 2027/28* will be submitted to the PBHSC in February/March 2027. A PBHSC meeting will be conducted in March 2027 to review the draft recommended scope and budget and facilitate comments. Also included in this task is project administration, including management of staffing and monthly financial reporting. The scope of this task is consistent with the work performed for the previous fiscal year.

DRAFT

[33] OCWD staff provides assistance to the USBR in the field as in-kind services.

Table 4-1. Work Breakdown Structure and Cost Estimate
Prado Basin Habitat Sustainability Program - Fiscal Year 2026/27

	Task Description	No. of sites	Labor Total		Other Costs, dollars				Notes	Totals, dollars			
			Person Days	Total, dollars	Travel	Equipment Rental	Outside Pro	Total		Recommended Budget 2026/27	Budget Prior FY 2025/26	IEUA Share 2026/27	CBWM Share 2026/27
Task 1. Groundwater Monitoring Program			**20.8**	**$35,818**				**$1,200**		**$37,018**	**$34,327**	-	**$37,018**
1.1	Download Transducer Data from PBHSP Wells (Quarterly)	18	11.8	$18,338	$1,000	$200		$1,200		$19,538	$17,787		
1.2	Process, Check and Upload Water Level, Temperature, and EC Transducer Data from PBHSP Wells (Quarterly)	18	9.0	$17,480				$0		$17,480	$16,539		
Task 2. Surface Water Monitoring Program			**3**	**$6,240**				**$200**		**$6,440**	**$9,402**	-	**$6,440**
2.1	Collect, Process, and Upload Field Measurements of Temperature and EC at Four Surface Water Sites (Quarterly)	4	2.5	$4,678		$200		$200		$4,878	$6,408		
2.2	Collect, Check, and Upload Surface Water Discharge and Quality Data from POTWs, USGS; and Dam Level Data from the ACOE (Annual)		0.8	$1,562				$0		$1,562	$2,994		
Task 3. Climate Monitoring Program			**1.6**	**$3,999**				**$0**		**$3,999**	**$3,203**	**$2,000**	**$2,000**
3.1	Collect, Check, and Upload Climatic Data (Annual)		1.6	$3,999				$0		$3,999	$3,203		
Task 4. Riparian Habitat Monitoring Program			**13.3**	**$28,042**				**$13,500**		**$41,542**	**$97,714**	**$20,771**	**$20,771**
4.1	Perform a Custom Flight to Acquire a High-Resolution 2026 Air Photo of the Prado Basin		1.5	$3,540			$13,500	$13,500	(a)	$17,040	$16,432		
4.2	Catalog, and Review the Extent of the Riparian Vegetation in the 2026 Air Photo of the Prado Basin		2.5	$5,772				$0		$5,772	$5,596		
4.3	Collect, Check, and Upload 2026 Landsat NDVI Data to the PBHSP Database		9.3	$18,730				$0		$18,730	$18,146		
4.4	Conduct the Field Vegetation Monitoring		0.0	$0				$0		$0	$57,540		
Task 5. Prepare Annual Report			**46.3**	**$95,706**				**$120**		**$95,826**	**$93,329**	**$47,913**	**$47,913**
5.1	Analyze Data and Prepare Admin Draft Report for CBWM/IEUA		34.3	$68,778				$0		$68,778	$68,212		
5.2	Incorporate CBWM/IEUA Comments and Prepare Draft Report: Submit Draft Report to PBHSC		3.0	$6,464				$0		$6,464	$7,271		
5.3	Meet with PBHSC to Review Draft Report		5.8	$13,182	$120			$120		$13,302	$11,810		
5.4	Incorporate PBHSC Comments and Finalize Report		3.3	$7,282				$0		$7,282	$6,036		
Task 6. Project Management and Administration			**10.5**	**$25,114**				**$120**		**$25,234**	**$24,338**	**$12,617**	**$12,617**
6.1	Prepare Scope and Budget for FY 2027/28		3.3	$7,574				$0		$7,574	$7,340		
6.2	Meet with PBHSC to Review Scope and Budget for FY 2027/28		3.3	$7,994	$120			$120		$8,114	$7,868		
6.3	Project Administration and Financial Reporting		4.0	$9,546				$0		$9,546	$9,130		
	Totals		**96**	**$194,919**	**$1,240**	**$400**	**$13,500**	**$15,140**		**$210,059**	**$262,312**	**$83,301**	**$126,758**

(a) This is half of the cost for the outside professional. OCWD will pay the other half.

5.0 REFERENCES

Achard F., and Estreguil, C. (1995). *Forest Classification of Southeast Asia using NOAA AVHRR data*. *Remote Sensing of the Environment v.* 56, pg. 198-208.

Alfaro, E.J., Gershunov, A., and Cayan, D. (2006). *Prediction of Summer Maximum and Minimum Temperatures Over the Central and Western United States: The Roles of Soil Moisture and Sea Surface Temperatures. J. Clim v. 19*, 1407-1421.

Army Corps of Engineers, Los Angeles District, with technical Assistance by the Orange County Water District. (2017). Five Year (2017 to 2022) *Planned Deviation to the Prado Dam Water Control Plan and Sediment Management Demonstration Project. Biological Assessment.* August 2017.

Associated Engineers, Inc. (2007). *Digital Elevation Model of Southern Chino Basin. Acquired by Airborne 1 Corporation via LIDAR.* March 2007.

California Regional Water Quality Control Board, Santa Ana Region. (2016). *Water Quality Control Plan Santa Ana River Basin (Region 8)* 1995. Updated February 2008, June 2011, and February 2016.

Campbell. (2007). *Introduction to Remote Sensing. Fourth edition*. Published 2007 Guilford Press.

Chino Basin Watermaster. (2000). *Peace Agreement, Chino Basin. SB 240104 v 1:08350.0001.* 29 June 2000.

Chino Basin Watermaster. (2007). *Peace II Agreement: Party Support for Watermaster's OBMP Implementation Plan, Settlement and Release of Claims Regarding Future Desalters. SB 447966 v 1:008250.0001.* 25 October 2007.

Chino Basin Municipal Water District v. City of Chino et al., San Bernardino Superior *Court, No. 164327*. (1978).

Chen, J., Jonsson, P., Tamura, M, Gu, Z., Matsushita, B., and Eklundh, L. (2004). *A Simple Method for Reconstructing a High-Quality NDVI Time-Series Data Set Based on the Savitzky-Golay filter. Remote Sensing of Environment v. 91, pg. 332-344.*

ECORP Consulting, Inc. (2026). *Prado Basin 2025 Vegetation Survey Western Riverside County, California. Draft Report.* January 2026.

Flood, N. (2014). *Continuity of Reflectance Data Between Landsat-7 ET<+ and Landsay-8 OLI, for Both Top-of Atmosphere and Surface Reflectance: A Study in the Australian Landscape. Remote Sensing v. 6, pg. 7952-7970.* August 26, 2014.

Gandhi, M., Parthiban, S., Thummalu, N., and A., C. (2015). Ndvi: *Vegetation Changes Detection Using Remote Sensing and Gis – A Case Study of Vellore District. Procedia Computer Science v. 57*, *pg. 1199-1210.*

Hatfield, J.L., and Prueger, J.H. (2015). *Temperature Extremes: Effect on Plant Growth and Development. Weather and Climate Extremes v. 10, pg. 4-10*.

Hatfiled, J.L, Boote, K.J, Kimball, B.A, Ziska, L.H, Izaurralde, R.C., Ort, D., Thomson, A.M., and Wolfe, D. (2011). *Climate Impacts on Agriculture: Implications for Plant Production. Agron J, v. 103*, *P.351-370.*

Hird, J., and McDermid, G. (2009). *Noise reduction of NDVI time series: An Empirical Comparison of Selected Techniques. Remote Sensing of Environment v. 113, pg. 248-258*.

H. T. Harvey & Associates. (2015). *Prado Basin Preliminary Riparian Habitat Health and Vigor Assessment. Memorandum to the Orange County Water District*. October 26, 2015.

James, M., and Kalluri, S. (1994). *The Pathfinder AVHARR Land Data Set; an Improved Coarse Resolution Data Set for Terrestrial Monitoring. International Journal of Remote Sensing v. 15, pg. 3347-3363.*

Jenson, J. (2007). *Remote Sensing of the Environment: An Earth Resource Perspective, Second Edition.* Published 2007 by Prentice-Hall, Upper Saddle River, N.J.

Johnson, B., at Orange County Water District. (2019). *Email Communication on* March 19, 2019.

Jones, H., and Vaughan, R. (2010). *Remote Sensing of Vegetation: Principles, Techniques and Applications*. Oxford University Press, Oxford.

Ke, Y., Im, J., Lee, J., Gong, H., and Ryu, Y. (2015). *Characteristics of Landsat 8 OLI-derived NDVI by Comparison with Multiple Sensors and In-Situ Observations. Remote Sensing of Environment v. 164, pg. 298-313.*

DRAFT

Knowles, N., Dettinger, M.D., and Canyon, D.R. (2006). *Trends in Snowfall Versus Rainfall in The Western United States. J Clim v.19, pg.4545-4599.*

Law, J. at Santa Ana Watershed Association. *Verbal Communication* on April 11, 2019.

Li, P., Jiang, L., Feng, Z. (2014). *Cross Comparison of Vegetation Indices Derived from Landsat-7 Enhanced Thematic Mapper Plus (ETM+) and Landsat-8 Operational Land Imager (OLI) Sensors. Remote Sensing v. 6, pg. 310-329.*

Lillesand, T., Kiefer, R, and Chipman, J. (2008). *Remote Sensing and Image Interpretation, sixth edition.* Published in 2008 by John Wiley & Sons, New York.

Markon, C., Fleming, M., and Binnian, E. (1995). *Characteristics of Vegetation Phenology over Alaskan Landscape using AVHRR Time-Series Data. Polar Records v. 31, pg.179-190.*

Markon, C., and Peterson, K. (2002). *The Utility of Estimating Net Primary Productivity over Alaska Using Baseline AVHRR Data. International Journal of Remote Sensing, v.23, pg. 4571-4596. v*

McPherson, D., at United States Bureau of Reclamation. (2016). *Verbal Communication on November 2, 2016*

Merkel & Associates, Inc. (2007). *Evapotranspiration Analysis of the Prado Basin Santa Anan River, California. Prepared for Wildermuth Environmental, Inc.* November 2007.

Orange County Water District. (2018). *Prado Basin Water Conservation and Habitat Assessment 2017-2018 Report to U.S. Fish and Wildlife Service.* December 2018.

Orange County Water District. (2026). *Prado Basin Water Conservation and Habitat Assessment 2024-2025 Report to U.S. Fish and Wildlife Service.* March 2026.

Palenscar, K., at United States Fish and Wildlife. (2016). *Verbal Communication* on November 2, 2016

Peters, A., Walter-Shea, E., Ji, L, Vina, A., Hayes, M., and Svoboda, M.D. (2002). *Drought Monitoring with NDVI-Based Standardized Vegetation Index. Photogrammetric Engineering & Remote Sensing v. 68, no. 1, pg. 71-75.*

Pettorelli, N. (2013). *The Normalized Difference Vegetation Index. First edition*. Published 2013 by Oxford University Press.

Pinzon, J., Brown, M., and Tucker, C. (2004). *Monitoring Seasonal and International Variations in Land-surface Vegetation from 1981-2003 Using GIMMS NDVI.*

Roy, D., Kovalskyy, V., Zhang, H., Vermote, E., Yan, L., Kumar, S, and Egorov, A. (2016). *Characterization of Landsat-7 to Landsat-8 Reflective Wavelength and Normalized Difference Vegetation Index Continuity. Remote Sensing of Environment v. 185, pg. 57-70.* January 12, 2016.

Inland Empire Utilities Agency and Chino Basin Watermaster. (2008). *Memorandum of Understanding, Cooperative Efforts for Monitoring Programs Between the Inland Empire Utilities Agency and the Chino Basin Watermaster, Bright Line Approach.* 17 December 2008

Intera Inc. (2015). *Memorandum Remote-Sensing Based Evaluation of Temporal Changes in Riparian Vegetation Health Along Temescal Creek, Prado Reservoir, Corona, California. Prepared for Orange County Water District.* January 30, 2015.

Santa Ana River Watermaster. (2025). *Fifty Third Annual Report of the Santa Ana River Watermaster for Water Year October 1, 2023 – September 30, 2024. Draft Report. Prepared for Orange County Water District v. City of Chino, et al. Case No. 117628 – County of Orange.* March 2025.

Santa Ana Watershed Association. (2025). *Annual Regulatory Report Mitigation Projects July 1, 2023* – June 30, 2024.

Schimdt, H. and Karnieli, A. (2000). *Remote Sensing of Seasonal Variability of Vegetation in a Semi-Arid Environment. Journal Of Arid Environments V.45, Pg. 43-59.*

She, X., Zhang L., Cen, Y., Wu, T., Changping, H., and Ali Baig, H. 2015. *Comparison of the Continuity of Vegetation Indices Derived from Landsat * OLI and Landsat 7 ETM+ Data Among Different Vegetation Types. Remote Sensing v.7, pg. 13485-13506.* October 16, 2015.

Siddiqui, Naeem Ahmed., at the Army Corps of Engineers. *Email communication* on April 12, 2024.

Tanre, D., Holden, B., and Kaufman, Y. (1992). *Atmospheric Correction Algorithm for NOAA_AVHRR Products; Theory and Application. IEE Journal of Geosciences and Remote Sensing, V. 30, Pg. 231-248.*

DRAFT

Tom Dodson & Associates. (2000). *Program Environmental Impact Report for the Optimum Basin Management Program (SCH#2000041047). Prepared for the Inland Empire Utilities Agency.* July 2000.

Tom Dodson & Associates. (2010). *Final Subsequent Environmental Impact Report for the Inland Empire Utilities Agency Peace II Agreement Project. Prepared for the Inland Empire Utilities Agency. 25* September 2010.

Tucker C., Justice, C., and Prince, S. (1986). *Monitoring the Grasslands of Sahel 1984-1985. International Journal of Remote Sensing, v. 71, pg. 1571-1581.*

Tucker C., Grant, D., and Dykstra, J.D. (2004). *NASA's Global Orthorectified Landsat Data Set. Photogrammetric Engineering & Remote Sensing, v. 70, pg. 313-322.*

United States Bureau of Reclamation, Lower Colorado Regional Office. (2008). *Hydraulic Control Monitoring Plan, Task 5.2: Vegetation Survey at the Prado Reservoir, Report No 2 of 5. Prepared for the Inland Empire Utilities Agency.* March 2008.United States Bureau of Reclamation, Lower Colorado Regional Office. (2015). *Riverside and San Bernardino Counties, California Inland Empire Utility Agency Hydraulic Control Monitoring Plan, Task 5.2: Report No 3 of 5. Draft Report.* April 2015.

United States Bureau of Reclamation. (2016). *Prado Basin Vegetation Survey October 2013 Riverside and San Bernardino Counties, California Inland Empire Utility Agency Hydraulic Control Monitoring Plan, Task 5.2 Report No. 3 of 5.* September 2016.

United States Bureau of Reclamation. (2017). *Prado Basin Vegetation Survey October 2016 Riverside and San Bernardino Counties, California Inland Empire Utility Agency Hydraulic Control Monitoring Plan, Task 5.2 Report No. 4 of 5.* July 2017.

United States Bureau of Reclamation. (2020). *Technical Service Center Hydraulic Investigation and Laboratory Services Ecological Research Laboratory. Prado Basin Vegetation Survey September 2019 Riverside and San Bernardino Counties, California Inland Empire Utility Agency Task 5.2 Draft Report.* March 2020.

United States Bureau of Reclamation. (2023). *Prado Basin Vegetation Survey September 2022 Riverside and San Bernardino Counties, California, Chino Basin Watermaster and Inland Empire Utility Agency, Prado Basin Habitat Sustainability Program. Final Report.* June 2023. United States Department of Agriculture. (1996). *Using NDVI to Assess Departure from Average Greenness and its Relation to Fire Business. Burgan, R.E., Hartford, R.A, and Eidenshink, J.C. General Technical Report INT-GTR-333.* April 1996.

United States Department of Agriculture. (1999). *Percent Canopy Cover and Stand Structure Statistics from the Forest Vegetation Simulator.* April 1999.

United States Department of Agriculture, Forest Service Region Pacific Southwest Region – State and Private Forestry. (2013). *Pest Alert. New Pest Complex in California: The Polyphagous Shot Hole Borer, Euwallacea sp., and Fusarium Dieback, Fusarium euwallaceae. R5-PR-032.* November 4, 2013.

United State Geological Survey. (2013). *Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) Algorithm Description. Open-File Report 2013-1057*. 2013.

United State Geological Survey. (2016). *Product Guide – Landsat Surface Reflectance-Derived Spectral Indices. Version 3.3.* December 2016.

United State Geological Survey. (2017a). *Product Guide – Landsat 4-7 Climate Data Record (CDR) Surface Reflectance. Version 7.2.* January 2017.

United State Geological Survey. (2017b). *User Guide – Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface. Version 3.7.* January 2017.

Verbesselt, J., Hyndman, R., Newnham, G., and Culvenor, D. (2010). *Detecting Trend and Seasonal Changes in Satellite Image Time-Series. Remote Sensing of Environmental, V. 17, Pg. 231-235.*

Weiss, J., Gutzler, D., Allred Coonrod, J., and Dahm, C. (2004). *Long-term vegetation monitoring with NDVI in a diverse semi-arid setting central New Mexico, USA. Journal of Arid Environments v. 58, pg. 249-272.*

West Yost (2021). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2020. June 2021*

West Yost (2022). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2021. June 2022*

West Yost (2023). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2022. June 2023*

DRAFT

Wildermuth Environmental, Inc. (1999). *Optimum Basin Management Program. Phase I Report. Prepared for the Chino Basin Watermaster.* August 19, 1999.

Wildermuth Environmental, Inc. (2007). *2007 Chino Basin Watermaster Groundwater Model Documentation and Evaluation of the Peace II Project Description. Final Report*. November 2007.

Wildermuth Environmental, Inc. (2015). *2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement (Final Report). Prepared for the Chino Basin Watermaster*. October 2015.

Wildermuth Environmental, Inc. (2016). 2016 Adaptive Management Plan for the Prado Basin Habitat Sustainability Program, Final. *Prepared for the Inland Empire Utilities Agency and Chino Basin Watermaster*. August 2016.

Wildermuth Environmental, Inc. (2017). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2016. July 2017.*

Wildermuth Environmental, Inc. (2018). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2017. June 2018.*

Wildermuth Environmental, Inc. (2019). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2018. June 2019.*

Wildermuth Environmental, Inc. (2020). *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2019. June 2020.*

Wildermuth Environmental, Inc. (2020). *2020 Safe Yield Recalculation Report*. May 2020.

Wang, J., Rich, P., Price, K., and Kettle, W. (2004). *Relations Between NDVI and Tree Productivity in The Central Great Plains. International Journal or Remote Sensing, V. 25, Pg. 3127-3138*.

Woodside, G., at Orange County Water District. *Verbal communication* on March 15, 2017.

Xie, Y., Sha, Z., and Yu, M. (2008). *Remote Sensing Imagery in Vegetation Mapping: A Review. Journal of Plant Ecology. V. 1, no.1, pg. 9-23.*

Xue, J. and Su, B. (2017). *Significant Remote Sensing Vegetation Indices a Review of Development and Applications. Journal of Sensors V. 2017, Article ID 1353691 17 pages.*

Zembal, R., at Orange County Water District. *Verbal communication* on March 14, 2017.

Zembal, R., at Orange County Water District. *Email communication* on April 5, 2018.

DRAFT

Appendix A

NDVI

DRAFT

A.1 BACKGROUND

Multi-spectral remote-sensing measurements of the Earth's surface from satellites are a verifiable means of deriving complete spatial coverage of environmental information. Remote-sensing measurements have been collected in a consistent manner over time. They are updated regularly and can be analyzed retrospectively, which has made these measurements useful in various types of ecological and environmental monitoring, including vegetation monitoring (USDA, 1996; Schidt and Karnieli, 2000; Campbell, 2007; Lillesand et al., 2008; Xie et al., 2008; Jones and Vaughnan, 2010).

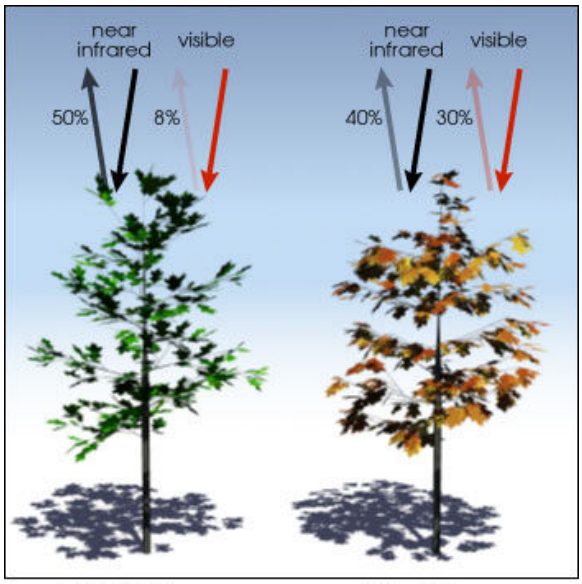
Remote sensing-based methods of vegetation monitoring commonly use vegetation indices that can be calculated from the wavelengths of light absorbed and reflected by vegetation (Jensen, 2007). NDVI, or the normalized difference vegetation index, is a widely used numerical indicator of vegetation extent and quality that is calculated from remote-sensing measurements (Ke et al., 2015; Xue,J and Su, B., 2017). Moreover, NDVI is an index of greenness correlated with photosynthesis and can be used to assess temporal and spatial changes in the distribution, productivity, and dynamics of vegetation (Pettorelli, 2013). NDVI is calculated from visible and near-infrared radiation reflected by vegetation using the following formula:

$$NDVI = \frac{(NIR - VIS)}{NIR + VIS}$$

Where: **NIR** = the spectral reflectance of near infrared radiation
VIS = the spectral reflectance of visible (red) radiation

During photosynthesis, healthy vegetation absorbs incoming visible light and reflects a large portion of near-infrared radiation. Unhealthy or dormant vegetation absorbs less visible light and reflects less near-infrared radiation. The figure[1] illustrates NDVI:

[1] Nasa.gov



Near-infrared radiation and visible light spectral reflectance are both expressed as ratios of the reflected radiation over the incoming radiation (values between 0 and 1); therefore, NDVI estimates range between -1.0 and 1.0. Negative NDVI estimates correspond to standing water, and low positive values (0 to 0.1) correspond to non-vegetated areas, such as barren rock and sand, snow, and water. NDVI estimates ranging from 0.1 to 1.0 correspond to vegetated areas, with very low-end estimates indicating sparse, unhealthy, or dormant vegetation, and increasing estimates towards 0.9 indicating higher amounts of dense, healthy green vegetation.

Advantages and Limitations.

NDVI was chosen as a method for characterizing and monitoring the riparian habitat for the PBHSP for the following reasons:

- Peace II activities could cause regional changes in groundwater levels, which potentially could result in regional impacts to the riparian habitat that is dependent on shallow groundwater. The regional scale of NDVI makes it an appropriate “first indicator” of regional changes in the extent and quality of riparian vegetation. And, it has been widely used in the past to support similar environmental monitoring and management programs (Peters et al., 2002; Pinzon et al., 2004; Wang et al., 2004; Weiss et al., 2004; Intera, 2014; Verbesselt et al, 2010; Gandhi et al., 2015).
- There is a long time-series of historical NDVI (early 1980s to present) that spatially covers the entire Prado Basin. These datasets can be used to characterize the history of the spatial extent and quality of the riparian vegetation prior to and after the implementation of Peace II activities (2007).
- In the future, it is likely that multi-spectral remote sensing will continue to collect the commonly measured spectral bands that are used to calculate NDVI (red and near-infrared) and that these data will be available for use as part of the PBHSP at a low cost.

Like most monitoring tools, NDVI has its limitations, which can reduce its reliability and usefulness. Important examples include:

- Cloud cover, water vapor, and atmospheric contaminants can lead to false decreases in NDVI estimates compared to clear days (Tanre et al., 1992; Achard and Estreguil, 1995; Chen et al., 2004; Hird and McDermid, 2009).
- Satellite degradation, sensor errors, and data transmission errors can lead to false NDVI estimates (James and Kalluri, 1994).
- Changes in soil moisture can lead to changes in NDVI estimates that are not necessarily related to changes in vegetation (Pettorelli, 2013).
- NDVI is a composite view of plant species diversity, form, structure, density, and vigor. As such, changes in NDVI may be caused by various changes in riparian habitat (Markon et al., 1995; Markon and Peterson, 2002). In other words, NDVI does not provide a complete picture of how and why vegetative changes are occurring; it simply indicates a change in vegetation.
- In densely vegetated areas, NDVI estimates have been shown to plateau during the growing season, indicating that NDVI can underestimate the green biomass in densely vegetated areas (Tucker et al., 1986).

These limitations demand that NDVI data be screened and filtered to identify or remove errors and noise. To reduce or eliminate noise, processing algorithms can be applied to "smooth" the time-series data and reveal patterns of change over time. For example, a smoothing technique applied in this report was the averaging of all NDVI from the growing season months. The average values are then plotted on time-series charts to display long-term trends in growing season vegetation quality.

The limitations also demand that NDVI not be interpreted in isolation. Interpretations of NDVI (vegetative changes) should be (i) verified with other georeferenced datasets, such as air photos and field vegetation surveys, and (ii) explained by comparison to datasets of causal factors of vegetative changes, such as water availability.

A.2 LANDSAT PROGRAM AND NDVI

The USGS and the National Aeronautics and Space Administration (NASA) jointly manage the Landsat Program[2], a series of Earth-observing satellite missions that began in 1972 with sensors that observe the Earth's surface and transmit information to ground stations that receive and process multi-spectral, remote-sensing data. Landsat satellites use technology that collects scenes of remote sensing measurements at the same time and location on the Earth's surface at a temporal frequency of about every two weeks. Landsat remote sensing measurements (Landsat imagery) is acquired in scenes that are approximately 106 by 115 miles. Landsat imagery is the only data source with more than thirty-years of continuous records of global land surface conditions at a spatial resolution of tens of meters (Tuck et al., 2004). Landsat imagery is among the most widely used satellite imagery in ecology and conservation studies (Pettorelli, 2013), and the data have been available for no cost since about 2010.

The United States Geological Survey (USGS), in compliance with the Global Climate Observing System[3], produces spectral indices products from Landsat imagery to support land surface change studies, which

[2] Nasa.gov

[3] Global Climate Observing System Link

includes NDVI from 1982 to present (USGS, 2016). The USGS uses remote sensing imagery from the Landsat satellites—*Landsat 4, Landsat 5, Landsat 7, Landsat 8, and Landsat 9* (*Landsat 4, 5, 7, 8, and 9*)—to generate NDVI estimates of the Earth's surface at a 30 x 30-meter pixel resolution. To apply the necessary atmospheric corrections and generate a surface reflectance product, the USGS uses a specialized software called Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) to post-process the Landsat imagery (USGS 2015; 2017a). This surface reflectance product is then used to determine NDVI, among the other spectral indices. The spectral indices products are available for the USGS Landsat Collection 2 Level-2.[4]

A.3 Collection, Review, and Analysis of NDVI for the PBHSP

Collection

NDVI from the Landsat imagery for the period 1982 to 2025 were collected from the USGS, using the Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface[5] (USGS 2017b). The interface requires a bulk request in the form of a text file list of specific Landsat scenes using the Landsat scene identifier ID.[6] To obtain complete spatial coverage of the Prado Basin area, NDVI was requested for all Landsat scenes for Path 040, Rows 036 and 037.[7] Table 1 below summarizes the Landsat satellites and periods for which NDVI was obtained to produce a near-continuous NDVI record.

[4] Prior to 2022, this program utilized NDVI from the USGS Landsat Collection 1 Level-1, but that collection has been discontinued by the USGS. In 2022, NDVI from the entire period of record from 1984 to 2022 was obtained and uploaded to the project database to have a consistent record of NDVI from the same collection so that there are no changes in the NDVI analyzed in time series that were attributable to the difference in the spectral indices products from different Landsat Collections over time .

[5] USGS Link

[6] Landsat imagery is captured in scenes that are about 106 by 114 miles. Each Landsat scene has a unique scene ID based on the specific Landsat satellite, Landsat path number, Landsat row number, and date the image was collected.

[7] The Prado Basin is in an area of the Landsat path 040 that straddles Rows 036 and 037. Landsat scenes from Path 040 Row 036 and Path 040 Row 037 overlap each other throughout most of the Prado Basin region, but both are required to obtain complete spatial coverage of the Prado Basin.

Table 1. Landsat Satellites				
Satellite	Instrument	Launched	Ended	Period of NDVI Data Obtained from USGS
Landsat 4	Thematic Mapper	July 16, 1982	December 14, 1993	1982 - 1983
Landsat 5	Thematic Mapper	March 1, 1984	June 5, 2013	1984 - 2011
Landsat 7	Enhanced Thematic Mapper Plus	April 15, 1999	January 19, 2024	1999 - 2023
Landsat 8	Operational Land Imager	February 11, 2013	Still active	2013 - 2025
Landsat 9	Operational Land Imager 2 and Thermal Infrared Sensor 2	September 27, 2021	Still active	2021-2025

NDVI from scenes produced from the *Landsat 4, 5, 7, 8, and 9* satellites were obtained from the USGS for the period 1982 through 2025. The source and frequency of availability of NDVI from the USGS varies over the period of record:

- From 1982 to 1989, NDVI is from Landsat 4 and 5 and is patchy, ranging from a frequency of eight days to one year.
- From 1990 to 1999, NDVI is from Landsat 5 at a frequency of about 16 days.
- From 1999 to 2011, NDVI is from Landsat 5 and 7 at a frequency of seven to eight days.
- In 2012, NDVI is from Landsat 7 at a frequency of 14 to 16 days.
- From 2013 to 2023, NDVI is from Landsat 7 and 8 at a frequency of seven to eight days.
- From 2021 to 2023, NDVI is from Landsat 7, 8, and 9 at a frequency of one to eight days.
- Since January 2024, NDVI is from Landsat 8 and 9 at a frequency of seven to eight days.

NDVI were cataloged, processed, and uploaded into HydroDaVE[SM], a database management software that manages gridded datasets and features tools for viewing and extracting data.[8] There is some overlap of NVDI data in areas where there is NVDI from Landsat scenes from Rows 036 and 037. HydroDaVE has the ability to compute a stacked average for Landsat scenes from Rows 036 and 037 for each NDVI pixel they overlay[9] when viewing and extracting NDVI data.

Review

Spatial NDVI were reviewed for disturbances that can be caused by cloud cover, unfavorable atmospheric conditions, or satellite equipment malfunction. In HydroDaVE[SM], maps were prepared of spatial NDVI for

[8] Hydrodave Link

[9] Not all dates will have Landsat scenes for both Rows 036 and 037 if cloud cover was greater than 20 percent in one of them; Landsat scenes with a percent cloud cover greater than 20 percent were not obtained from the USGS for this study.

the entire Prado Basin region for each date. The maps were reviewed and documented to identify specific dates for exclusion due to cloud cover or other disturbances. Erroneous NDVI estimates were discernable because NDVI patterns of permanent landscape features were distorted and/or NDVI estimates were clearly not consistent with estimates typically observed for a particular area both seasonally and over time. On average, about 34 percent of the NDVI were identified as erroneous and excluded from the analysis. Most of which were rejected because of cloud coverage, which was further verified by referencing and viewing the specific Landsat scene on the USGS *EarthExplorer* website.[10]

After excluding erroneous NDVI estimates, there was one date for 1982, and there were no dates for 1983; as such, the time-series data discussed throughout Section 3 of the report include NDVI estimates for 1984 to 2025.

NDVI estimates derived from *Landsat 7* satellite imagery from mid-2003 to 2023 were further reviewed date-by-date for the occurrence of spatial data gaps, resulting from the failure of the Scan Line Corrector (SLC) on the *Landsat 7* satellite, which accounts for the satellite's forward motion. SLC failure results in data gaps along scan line paths of variable widths and occurrences. An estimated 22 percent of any given *Landsat 7* scene is lost because of SLC failure; however, the imagery acquired between these gaps is valid and useable for analysis.[11] All NDVI estimates derived from *Landsat 7* satellite imagery from 2003 to 2023 were evaluated spatially date-by-date to determine if the valid portion of the data covers the defined areas of interest used for the temporal analysis of NDVI in the time series discussed in Section 3 of this report. Date-by-date analysis is necessary because the spatial position and size of the data gaps from the *Landsat 7* satellite vary for each date. Generally, areas of interest for NDVI analysis that are larger than about 400 square meters cannot use any NDVI determined from *Landsat 7* satellite imagery during this time period because it would include data gaps within the area; while areas of interest less than 400 square meters can use NDVI determined from the *Landsat 7* satellite imagery if the data gap area is not within the area of interest. During 2012, the *Landsat 7* satellite was the only Landsat satellite collecting data. Therefore, there are no data for the areas of interest larger than 400 square meters during 2012. After the launch of the *Landsat 9* satellite in 2022, there were several dates without spatial data gaps from the *Landsat 7* satellite, which was able to be included in the analysis of the larger areas.

[10] Earthexplorer Link

[11] Landsat Link

Analyses of Time-series Data

HydroDaVE[SM] contains features to calculate and extract a spatial average NDVI for a designated area and time period. The NDVI spatial average for each available date is plotted in time-series charts to analyze seasonal and temporal changes for a defined area. Time-series charts of NDVI for various areas in the Prado Basin are first introduced in Section 3.1 of this report.

When viewing time-series charts of NDVI for the period of record, it should be noted that a methodological factor that can affect observed NDVI trends is the difference between the technology of the *Landsat 4, 5, and 7* satellites, and the *Landsat 8 and 9* satellites. The *Landsat 4, 5, and 7* satellites use thematic mapper technology to scan the land surface, whereas *Landsat 8* and *Landsat 9* use operational land imager sensors. It has been well documented that the NDVI estimates obtained from the operational land imager sensors used on the *Landsat 8 and 9* satellites generate slightly higher index values for vegetated land cover (Xu and Guo 2014; She et al., 2015). In order to analyze the time-series of NDVI derived across all Landsat satellites for the period of record, a bias-correction factor of -0.05, derived from literature review (Li et al., 2014; Flood, 2014: and Ke et al., 2015), was used to transform all Landsat 8 and 9 NDVI estimates such that all historical NDVI estimates could be analyzed collectively (Roy et al., 2016). The *Landsat 9* satellite was launched into orbit in 2022, and from 2022 to 2023, NDVI was available from *Landsat 7, 8, and 9* satellites. During 2023, data was collected from both the *Landsat 8 and 9* satellites on some of the same dates. On these dates, only NDVI from the *Landsat 9* satellite was used. The *Landsat 7* satellite stopped collecting data in January 2024 and since then, NDVI has been available from *Landsat 8 and 9* satellites.

In previous reports, the Average Growing-Season NDVI was the average for March through October. During WY 2025, this was revised to April through October to exclude the early to mid-March period where vegetation is still dormant or just starting to grow. Including March in the averaging period added variability that did not accurately reflect overall vegetative conditions, as NDVI values during this time are often reduced by plant growth dormancy and inconsistent green-up timing, and are frequently unusable due to storm activity and cloud cover. By shifting the period of analysis to April through October, the average growing-season NDVI values capture a more representative measure of vegetation health during the growing season.

A.4 References

Achard F., and Estreguil, C. 1995. *Forest Classification of Southeast Asia Using NOAA AVHRR data*. Remote Sensing of the Environment v. 56, pg. 198-208.

Chen, J., Jonsson, P., Tamura, M, Gu, Z., Matsushita, B., and Eklundh, L. 2004. *A Simple Method For Reconstructing A High-Quality NDVI Time-Series Data Set Based On The Savitzky-Golay Filter.* Remote Sensing Of Environment V. 91, Pg. 332-344.

Campbell, 2007. *Introduction to Remote Sensing. Fourth edition*. Published 2007 Guilford Press.

Gandhi, M., Parthiban, S., Thummalu, N., and A., C. 2015. *Ndvi: Vegetation Changes Detection Using Remote Sensing And Gis – A Case Study Of Vellore District.* Procedia Computer Science v. 57, pg. 1199-1210.

Hird, J., and McDermid, G. 2009. *Noise reduction of NDVI time series: An Empirical Comparison of Selected Techniques.* Remote Sensing of Environment V. 113, Pg. 248-258.

Intera Inc. 2015. *Memorandum Remote-Sensing Based Evaluation of Temporal Changes in Riparian Vegetation Health Along Temescal Creek, Prado Reservoir, Corona, California*. Prepared for Orange County Water District. January 30, 2015.

Jones, H., and Vaughan, R. 2010. *Remote Sensing of Vegetation: Principles, Techniques and Applications*. Oxford University Press, Oxford.

Jenson, J. 2007. *Remote Sensing of the Environment: An Earth Resource Perspective, Second Edition*.

Published 2007 by Prentice-Hall, Upper Saddle River, N.J.

James, M., and Kalluri, S. 1994. *The Pathfinder AVHARR Land Data Set; An Improved Coarse Resolution Data Set for Terrestrial Monitoring*. International Journal Of Remote Sensing V. 15, Pg. 3347-3363.

Ke, Y., Im, J., Lee, J., Gong, H., and Ryu, Y. 2015. *Characteristics of Landsat 8 OLI-derived NDVI by Comparison with Multiple Sensors and In-Situ Observations.* Remote Sensing of Environment v. 164, pg. 298-313.

Lillesand,T, Kiefer, R, and Chipman, J. 2008. *Remote Sensing and Image Interpretation*, *Sixth Edition*. Published in 2008 by John Wiley & Sons, New York.

Markon, C., Fleming, M., and Binnian, E. 1995. *Characteristics of Vegetation Phenology Over Alaskan Landscape Using AVHRR Time-Series Data*. Polar Records v. 31, pg.179-190.

Markon, C., and Peterson, K. 2002. *The Utility Of Estimating Net Primary Productivity Over Alaska Using Baseline AVHRR Data.* International Journal of Remote Sensing, v.23, pg. 4571-4596

Pettorelli, N. 2013. *The Normalized Difference Vegetation Index.* First edition. Published 2013 by Oxford University Press.

Peters, A., Walter-Shea, E., Ji, L, Vina, A., Hayes, M., and Svoboda, M.D. 2002. *Drought Monitoring with NDVI-Based Standardized Vegetation Index.* Photogrammetric Engineering & Remote Sensing v. 68, no. 1, pg. 71-75.

Pinzon, J., Brown, M., and Tucker, C. 2004. *Monitoring Seasonal and International Variations in Land-surface Vegetation from 1981-2003 Using GIMMS NDVI* . Landval Link

She, X., Zhang L., Cen, Y., Wu, T., Changping, H., and Ali Baig, H. 2015. *Comparison of the Continuity of Vegetation Indices Derived from Landsat * OLI and Landsat 7 ETM+ Data Among Different Vegetation Types*. Remote Sensing v.7, pg. 13485-13506. October 16, 2015. pg. 13485-13506. October 16, 2015.

Schimdt, H. and Karnieli, A. 2000. *Remote Sensing of Seasonal Variability of Vegetation In A Semi-Arid Environment.* Journal of Arid Environments v.45, pg. 43-59.

Tucker C., Justice, C., and Prince, S. 1986. *Monitoring the Grasslands of Sahel 1984-1985. International Journal of Remote Sensing*, v. 71, pg. 1571-1581.

Tucker C., Grant, D., and Dykstra, J.D. 2004. *NASA's Global Orthorectified Landsat Data Set. Photogrammetric Engineering & Remote Sensing,* v. 70, pg. 313-322.

United State Geological Survey. 2013. *Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) Algorithm Description.* Open-File Report 2013-1057. 2013.

United State Geological Survey. 2016. *Product Guide – Landsat Surface Reflectance-Derived Spectral Indices. Version 3.3.* December 2016.

United State Geological Survey. 2017a. *Product Guide – Landsat 4-7 Climate Data Record (CDR) Surface Reflectance. Version 7.2.* January 2017.

United State Geological Survey. *2017b. User Guide – Earth Resources Observation and Science (EROS) Center Science Processing Architecture (ESPA) On Demand Interface. Version 3.7.* January 2017.

United States Department of Agriculture. 1996. *Using NDVI to Assess Departure From Average Greenness and its Relation to Fire Business. Burgan, R.E., Hartford, R.A, and Eidenshink, J.C. General Technical Report INT-GTR-333.* April 1996.

Verbesselt, J., Hyndman, R., Newnham, G., and Culvenor, D. 2010. *Detecting Trend and Seasonal Changes In Satellite Image Time-Series.* Remote Sensing of Environmental, v. 17, pg. 231-235.

Wang, J., Rich, P., Price, K., and Kettle, W. 2004. *Relations between NDVI and Tree Productivity in The Central Great Plains.* International Journal or Remote Sensing, v. 25, pg. 3127-3138.

Weiss, J., Gutzler, D., Allred Coonrod, J., and Dahm, C. 2004. *Long-Term Vegetation Monitoring with NDVI In A Diverse Semi-Arid Setting Central New Mexico, USA*. Journal of Arid Environments v. 58, pg. 249-272.

Xie, Y., Sha, Z., and Yu, M. 2008. *Remote Sensing Imagery In Vegetation Mapping: A Review.* Journal of Plant Ecology. V. 1, no.1, pg 9-23.

Xue, J. and Su, B. 2017. *Significant Remote Sensing Vegetation Indices a Review of Development and Applications*. Journal of Sensors V. 2017, Article ID 1353691 17 pages.

Appendix B

Mann-Kendall Analysis of NDVI

DRAFT

B.1 Introduction

The Mann-Kendall statistical trend test (Mann-Kendall test) was performed on the average growing-season NDVI metrics (NDVI) for the period of 1984 to 2025 for all 17 areas where NDVI are analyzed for the *Annual Report of the Prado Basin Habitat Sustainability Committee Water Year 2025*. The Mann-Kendall test was utilized to evaluate whether the average growing-season NDVI increased, decreased, or remained stable over time.

B.2 Methods

The Mann-Kendall test is a non-parametric statistical trend test. It is analogous to parametric trend testing such as regression (linear regression) except the data do not need to have a particular probability distribution (normal) and be accurately described by a particular measure of centrally tendency (mean, standard deviation, etc.) (Helsel and Hirsch, 2002).

To perform the test, the NDVI values are ordered chronologically and the signs (+/–) are recorded for all of the possible differences between a given NDVI value and every NDVI value that preceded it in the time series. The Mann-Kendall test statistic **S** is defined as the number of positive differences (+) minus the number of negative differences (–). From **S** and the number of NDVI values, **n**, the **τ** coefficient (analogous to the **r** correlation coefficient in linear associations) is then calculated. The **τ** coefficient represents the strength of the monotonic relationship between time and NVDI values with a possible range of -1 to 1. A perfect positive trend would yield a **τ** coefficient equal to 1, and a perfect negative trend would yield a **τ** coefficient equal to -1.

The Mann-Kendall test utilizes the null hypothesis that there is no trend. If the **S** test statistic and **τ** coefficient are significantly different than zero, the null hypothesis is rejected, and a trend exists. The level of statistical significance is expressed as a p-value between 0 and 1. The smaller the p-value the stronger the evidence that the null hypothesis should be rejected. In this study, a p-value of less than or equal to 0.05 was used to determine if a trend existed. In summary, the three possible outcomes of the test are

- Increasing trend (p-value ≤ 0.05, $\tau > 0$)
- No trend (p-value > 0.05)
- Decreasing trend (p-value ≤ 0.05, $\tau < 0$)

B.4 Data Analysis and Results

The Mann-Kendall **S** test statistic, **τ** coefficient and p-value were computed for average-growing season NDVI from 1984 to 2025 for the 17 areas in Prado Basin, using the python package *pyMann-Kendall* (Hussain, 2019). Tables B-1 through B-3 list the results of the Mann-Kendall test for the three time periods of interest: 1984 through 2025 (entire period of record); 1984 through 2006 (period prior to the Peace II Agreement); and 2007 through 2025 (period after the Peace II Agreement implementation).

Table B-1. 1984 to 2025

Area	n (number of NDVI values)	S Test Statistic	τ coefficient	p-value	Trend
Riparian Vegetation Extent	41	170	0.21	5.77E-02	No Trend
Chino Creek Area	41	592	0.72	3.18E-11	Increasing
Mill Creek Area	41	2	0.00	9.91E-01	No Trend
Upper Mill Creek Area	41	346	0.42	1.07E-04	Increasing
CC-1	42	643	0.75	3.46E-12	Increasing
CC-2	42	619	0.72	2.12E-11	Increasing
CC-3	42	617	0.72	2.46E-11	Increasing
CC-4	42	409	0.48	9.79E-06	Increasing
MC-1	42	549	0.64	2.87E-09	Increasing
MC-2	42	99	0.11	2.88E-01	No Trend
MC-3	42	309	0.36	8.44E-04	Increasing
MC-4	42	333	0.39	3.21E-04	Increasing
MC-5	42	119	0.14	2.01E-01	No Trend
MC-6	42	289	0.34	1.80E-03	Increasing
SAR-2	42	291	0.34	1.67E-03	Increasing
SAR-3	42	491	0.57	1.09E-07	Increasing
SAR-4	42	594	0.64	2.87E-09	Increasing

Table B-2. 1984 to 2006

Area	n (number of NDVI values)	S Test Statistic	τ coefficient	p-value	Trend
Riparian Vegetation Extent	23	59	0.23	1.26E-01	No Trend
Chino Creek Area	23	127	0.50	8.76E-04	Increasing
Mill Creek Area	23	-121	-0.48	1.53E-03	Decreasing
Upper Mill Creek Area	23	-27	-0.11	4.92E-01	No Trend
CC-1	23	137	0.54	3.28E-04	Increasing
CC-2	23	145	0.57	1.43E-04	Increasing
CC-3	23	137	0.54	3.28E-04	Increasing
CC-4	23	29	0.11	4.60E-01	No Trend
MC-1	23	87	0.34	2.31E-02	Increasing
MC-2	23	-63	-0.25	1.02E-01	No Trend
MC-3	23	-55	-0.22	1.54E-01	No Trend
MC-4	23	-1	0.00	1.00E+00	No Trend
MC-5	23	41	0.16	2.91E-01	No Trend
MC-6	23	-77	-0.30	4.47E-02	Decreasing
SAR-2	23	-137	-0.54	3.28E-04	Decreasing
SAR-3	23	-1	0.00	1.00E+00	No Trend
SAR-4	23	73	0.29	5.72E-02	No Trend

Table B-3. 2007 to 2025

Area	n (number of NDVI values)	S Test Statistic	τ coefficient	p-value	Trend
Riparian Vegetation Extent	18	33	0.22	2.25E-01	No Trend
Chino Creek Area	18	99	0.65	2.06E-04	Increasing
Mill Creek Area	18	71	0.46	8.01E-03	Increasing
Upper Mill Creek Area	18	89	0.58	8.58E-04	Increasing
CC-1	19	111	0.65	1.19E-04	Increasing
CC-2	19	139	0.81	1.38E-06	Increasing
CC-3	19	103	0.60	3.59E-04	Increasing
CC-4	19	79	0.46	6.36E-03	Increasing
MC-1	19	125	0.73	1.44E-05	Increasing
MC-2	19	97	0.57	7.83E-04	Increasing
MC-3	19	75	0.44	9.63E-03	Increasing
MC-4	19	53	0.31	6.89E-02	No Trend
MC-5	19	59	0.35	4.24E-02	Increasing
MC-6	19	133	0.78	3.87E-06	Increasing
SAR-2	19	133	0.78	3.87E-06	Increasing
SAR-3	19	119	0.70	3.65E-05	Increasing
SAR-4	19	133	0.78	3.87E-06	Increasing

B.5 References

Helsel, D.R., and Hirsch R.M. 2002. *Statistical Methods in Water Resources*. Techniques of Water Resource Investigations of the United States Geological Survey, Book, 4 Hydrological Analysis and Interpretation. September 2002.

Hussain et al. 2019. *Journal of Open Source Software*. pyMannKendall: a python package for non parametric Mann Kendall family of trend tests. 4(39), 1556, https://doi.org/10.21105/joss.01556

Appendix C

Draft 2025 Prado Basin Vegetation Survey Report

DRAFT

April 28, 2026

Veva Weamer
Principal Scientist
West Yost & Associates, Inc.
25 Edelman
Irvine, CA 92618
Via Email: vweamer@westyost.com

RE: Draft Prado Basin 2025 Vegetation Survey Project, Western Riverside County, California

Dear Ms. Weamer:

ECORP Consulting Inc., (ECORP) conducted vegetation monitoring for the Inland Empire Utilities Agency (IEUA) and the Chino Basin Watermaster (CBWM) – Prado Basin Habitat Sustainability Program (PBHSP) in the City of Chino, San Bernardino County, California. This draft letter report is being submitted to document the results of the 2025 vegetation survey project (Project) conducted for the PBHSP.

PROJECT DESCRIPTION AND LOCATION

The Project is located within the Prado Flood Control Basin (Prado Basin), north of State Route (SR-) 99, east of SR-71, south of Kimball Avenue, and west of Interstate 15 (Figure 1). The Project Area encompasses a total of 20 vegetation monitoring sites (monitoring site plots) along three monitoring sections in the Prado Basin including the Santa Ana River (SAR), Mill Creek, and Chino Creek (Figure 2). Land use surrounding the 20 monitoring site plots includes residential neighborhoods, agriculture, Prado Regional Park, and the El Prado Golf Course.

Prado Basin includes approximately 600 acres of riparian habitat which is ecologically important because its high species richness contributes to regional ecological diversity. The dominant riparian plant species in the Prado Basin are typically Goodding's black willow (*Salix gooddingii*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), sandbar willow (*Salix exigua*), Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), ash (*Fraxinus* sp.), blue elderberry (*Sambucus mexicana*), Southern California black walnut (*Juglans californica*), and black cottonwood (*Populus trichocarpa*). These riparian tree species must maintain root contact with groundwater for long-term survival.

In addition, the riparian habitat within the southern Prado Basin provides breeding habitat for three state endangered species: least Bell's vireo (Vireo bellii pusillus), southwestern willow flycatcher (Empidonax traillii extimus), and western yellow-billed cuckoo (Coccyzus americanus occidentalis).

The PBHSP was implemented in 2016 to address the potential impact to the Prado Basin riparian habitat as a result of drawdown of groundwater levels from increased groundwater production by the Chino Desalter Authority (CDA) at wells located north of the Prado Basin. Because riparian vegetation relies on shallow groundwater, a decrease in groundwater levels could negatively affect the health of existing riparian trees and negatively impact breeding habitat.

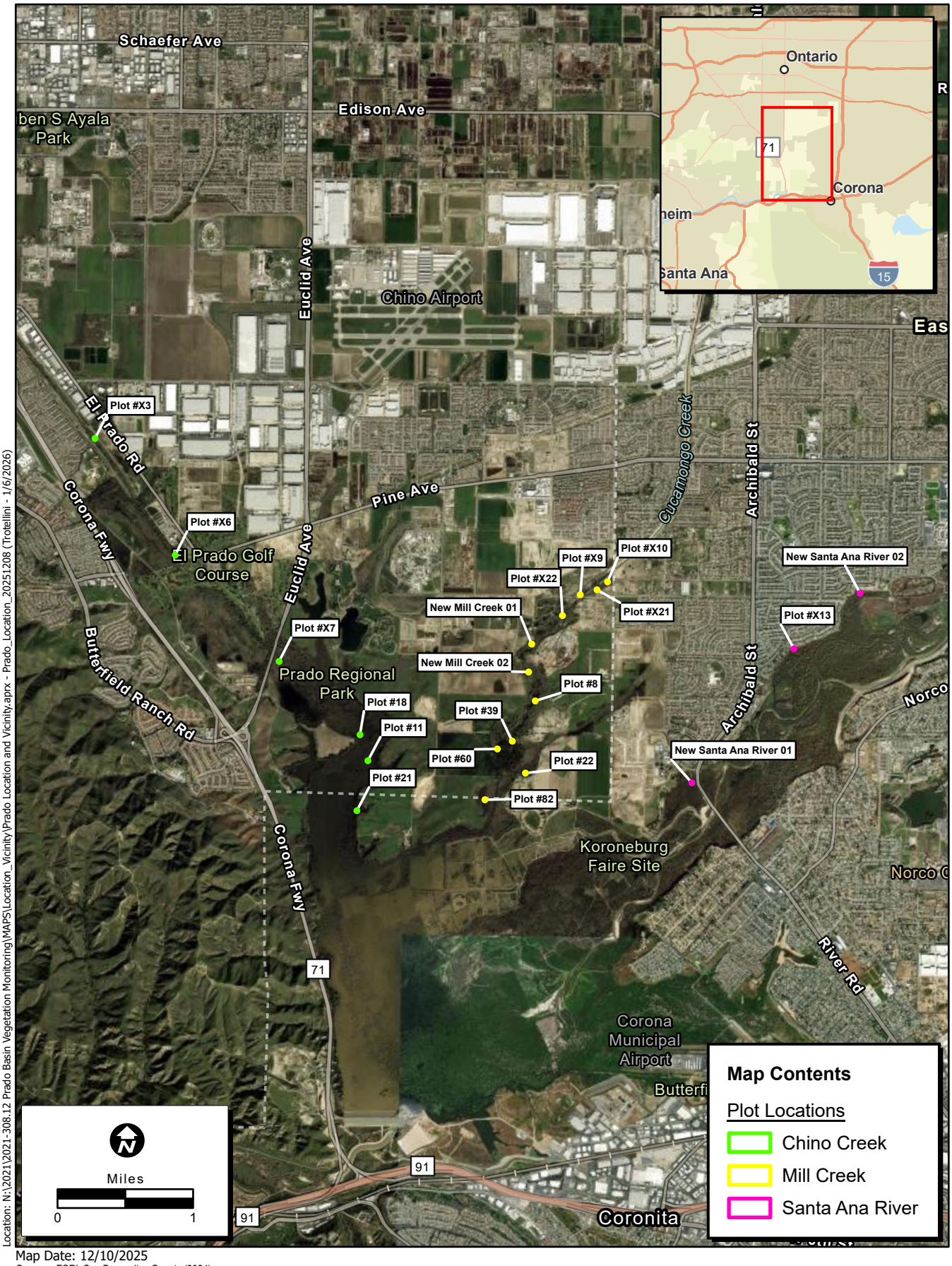


Location: N:\2021\2021-308.12 Prado Basin Vegetation Monitoring\MAPS\Location_Vicinity\Prado Location and Vicinity.aprx - Prado_Vicinity_20251208 (Trotellini - 12/8/2025)

Map Date: 12/8/2025

Sources: ESRI

Figure 1. Project Vicinity



Location: N:\2021\2021-308.12 Prado Basin Vegetation Monitoring\MAPS\Location_Vicinity\Prado Location and Vicinity.aprx - Prado_Location_20251208 (Trotellini - 1/6/2026)

Map Date: 12/10/2025

Sources: ESRI, San Bernardino County (2024)

Figure 2. Project Location

PROJECT BACKGROUND

Vegetation monitoring has been conducted for the PBHSP at a frequency of approximately every 3 years since 2003. The purpose of the site-specific vegetation monitoring is to help ground-truth data collected as part of a regional assessment (remote sensing Normalized Difference Vegetation Index [NDVI], and air photo analysis) and to get a more comprehensive understanding of what is occurring on the ground, including any observed changes in vegetation structure and composition.

Vegetation monitoring for the PBHSP was conducted by the United States Bureau of Reclamation (USBR) in 2003, 2007, 2013, 2016, 2019, and 2022 and by ECORP in 2025. In 2003, Mill Creek was selected as the study area and Chino Creek was selected as the control area for the vegetation monitoring. Since 2003, the monitoring methodology has changed over time to achieve overall study goals with the available resources.

Between 2003 and 2007, USBR used a fixed area sampling method that measured species composition, density, and basal area. In addition, nested variable quadrats based on vegetation layer were used at each monitoring site plot. During this timeframe, data were collected for overstory species and understory species, including herbaceous vegetation. In each monitoring site plot, live and dead trees, saplings, shrubs, and seedlings were all counted by species. Data collected for tree and shrub species included height, diameter at breast height (DBH) measured 4.5 feet above the ground for trees, and stem diameter measured 30 centimeters (cm) above the ground for shrubs. Canopy cover data was collected using four spherical densiometer measurements taken approximately five meters from the center of the monitoring site plot in each of the four cardinal directions. In addition, photo points were established at the center of each plot and representative photos were taken in each of the four cardinal directions. In 2007, the monitoring site plot locations were marked using t-posts and trees within the plots were affixed with numerical identification tags to make the monitoring more consistent during future events.

Starting in 2013, USBR updated the monitoring methodology to exclude herbaceous vegetation from the understory monitoring due to it being less relatable to groundwater levels. Since 2013, the only vegetation monitored within the understory included shrubs or saplings with a DBH of less than 8 cm. In addition, monitoring was conducted for overstory trees with a DBH greater than 8 cm. Additionally, trees within each monitoring site plot were assessed for health condition (alive, dead or stressed), and assessed for the presence of polyphagous shot-hole borer (PSHB; *Euwallacea* sp.).

In 2016, there were no changes in the monitoring methodology, however, a total of 14 additional monitoring site plots were established along Chino Creek, Mill Creek, and the SAR.

In 2019, both the methodology and the monitoring site plots remained the same as 2016.

In 2022, a total of two additional monitoring site plots were established along Mill Creek and the monitoring protocol was modified to eliminate the collection of DBH and tree height since these variables were not used in the assessment of riparian health.

The methods used during the 2025 monitoring were mostly consistent with the methods implemented during the 2022 monitoring. Further details regarding the 2025 monitoring methods can be found in the section below.

METHODS

Vegetation monitoring in 2025 was conducted at a total of 20 variable radius monitoring site plots including 16 previously established monitoring site plots (six along Chino Creek, nine along Mill Creek, and one along the SAR), two newly established monitoring site plots along Mill Creek, and two newly established monitoring site plots along the SAR. Table 1 includes each monitoring site plot, plot location, latitude, longitude, and plot radius. Some of the plots monitored during the 2022 monitoring event were excluded from the 2025 monitoring event due to inaccessibility, safety concerns, and/or these plots no longer being necessary to collect sufficient data for the Project. The four newly established monitoring site plots were selected in target areas near Mill Creek and the SAR that were representative of the riparian system and contained approximately 10 riparian trees within a 10-meter radius. Data were taken for the understory and overstory layers and photo points were taken at each of the 20 monitoring site plots.

Table 1. Monitoring Site Plots

Monitoring Site Plot	Plot Location	Latitude	Longitude	Plot Radius (m)
New Santa Ana River 02	Santa Ana River	33.946763	-117.579331	10
X13	Santa Ana River	33.940723	-117.587734	5
New Santa Ana River 01	Santa Ana River	33.926269	-117.600619	10
X10	Mill Creek	33.947640	-117.611773	5
X21	Mill Creek	33.946774	-117.613108	10
X9	Mill Creek	33.946234	-117.615259	5
X22	Mill Creek	33.943969	-117.617503	10
New Mill Creek 01	Mill Creek	33.940879	-117.621398	10
New Mill Creek 02	Mill Creek	33.937888	-117.621760	10
8	Mill Creek	33.934851	-117.620868	5
39	Mill Creek	33.930463	-117.623704	10
60	Mill Creek	33.929597	-117.625472	10
22	Mill Creek	33.927071	-117.621991	5
82	Mill Creek	33.924159	-117.627152	10
X3	Chino Creek	33.962238	-117.677826	5

Table 1. Monitoring Site Plots				
Monitoring Site Plot	**Plot Location**	**Latitude**	**Longitude**	**Plot Radius (m)**
X6	Chino Creek	33.949904	-117.667274	5
X7	Chino Creek	33.938667	-117.653791	10
18	Chino Creek	33.930885	-117.643301	5
11	Chino Creek	33.928158	-117.642209	10
21	Chino Creek	33.922884	-117.643576	5

Understory Sampling

All shrubs and riparian saplings (trees that had a DBH of less than 8 cm) were assessed within each of the monitoring site plots. Shrubs and saplings were identified to species and assessed for their health condition (alive, dead or stressed) and all stems that branch below 10 cm above the ground were counted. Nonnative species were excluded but the presence and species were noted. An estimation of sapling density was calculated by taking the total number of saplings observed in the monitoring plots along with the total acreage of the plots and then extrapolating out the estimated number of saplings per hectare (ha).

Overstory Sampling

All riparian trees that had a DBH greater than 8 cm were assessed within the monitoring site plots. Monitoring site plots had a radius of five or ten meters and were originally designed to have approximately 10 riparian trees present. Since the establishment of the plots, the radius has been held constant across sampling years regardless of changes to tree count. Table 1 includes the radius of each of the plots. Trees within the monitoring site plots were identified to species, assessed for their health condition (alive, dead or stressed), and checked for signs of PSHB such as entry/exit holes, weeping sap, and/or branch failure. An estimation of the tree canopy cover was also recorded for each of the monitoring site plots by taking four densitometer measurements approximately 1 meter from the center of the monitoring plot in each of the four cardinal directions.

Plot Photos

Photographs were taken in each of the four cardinal directions from the center of each of the monitoring site plots.

RESULTS

The 2025 vegetation monitoring was conducted by ECORP biologists Carley (Lancaster) Adams, Greg Hampton, and Alexandra Dorough on October 1 through October 3, and October 7 and 10, 2025. The

following sections present the results from the 2025 monitoring conducted for all 20 monitoring site plots. Photo documentation completed during the monitoring event is included in Appendix A.

Appendix B includes a table that summarizes monitoring results by plot, including the number of tress measured in each plot, canopy cover in 4 directions and overall average, number and percent of live/stressed/dead trees for each plot, presence of PSHB, and number of saplings per ha.

Canopy Cover

Canopy cover is an estimate of how much of the ground is covered by overstory vegetation. Canopy cover at each monitoring site plot is calculated as the overall average of the estimated canopy cover in each of the four cardinal directions. Overall, canopy cover fluctuated among the 20 monitoring site plots within the three monitoring sections of the Prado Basin. The maximum and minimum canopy cover across the monitoring site plots were 100.0 and 10.8 percent respectively (at Chino Creek sites X3 and 18 and Mill Creek site 82and Mill Creek site 60). The highest mean canopy cover was 80.4 percent for the Chino Creek plots and the lowest was 52.1 percent for the SAR plots. Mean canopy cover decreased from 2022 to 2025 at Chino Creek, Mill Creek, and the SAR. Table 2 lists the mean, maximum, and minimum overall canopy cover estimates for the plots along Chino Creek, Mill Creek, and SAR.

Table 2. Mean, Maximum, and Minimum Canopy Cover

	Chino Creek (%)	Mill Creek (%)	SAR (%)
Mean Cover	80.4	69.2	52.1
Maximum Cover	100.0	100.0	78.7
Minimum Cover	55.0	10.8	36.2

Appendix B includes the overall canopy cover and canopy cover in each of the four cardinal directions for each of the monitoring plots.

Shrubs

Two shrub species were observed within the Mill Creek and the SAR monitoring site plots, mulefat (*Baccharis salicifolia*) and blue elderberry (*Sambucus mexicana*). Mulefat and blue elderberry are important species to riparian habitats because they provide habitat for endangered species such as least Bell's vireo. Mulefat and blue elderberry provide multi-layered vegetation which is preferred by least Bell's vireo. There weren't any shrub species observed within the monitoring site plots at Chino Creek. The most abundant shrub species was mulefat which had a total of 43 individuals observed. A total of 58 individual shrubs were observed and documented during the 2025 monitoring event, which is a significant increase from the five shrubs that were documented during the 2022 monitoring event. Tables 3 and 4 list the species, total number of stems, and health of the shrubs observed within the plots. The total number of stems were counted because a higher number of stems on a shrub may correlate to growth output and overall health.

Table 3. SAR Shrub Coverage				
Monitoring Site Plot	**Scientific Name**	**Common Name**	**Total Stems**	**Health**
New SAR 01	*Baccharis salicifolia*	Mulefat	8	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	1	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	1	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	9	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	15	Dead
New SAR 01	*Baccharis salicifolia*	Mulefat	1	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	1	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	15	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	22	Stressed
New SAR 01	*Baccharis salicifolia*	Mulefat	9	Stressed
New SAR 01	*Baccharis salicifolia*	Mulefat	10	Stressed
New SAR 01	*Baccharis salicifolia*	Mulefat	4	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	3	Alive
New SAR 01	*Baccharis salicifolia*	Mulefat	2	Alive

Table 4. Mill Creek Shrub Coverage				
Monitoring Site Plot	**Scientific Name**	**Common Name**	**Total Stems**	**Health**
New Mill Creek 01	*Sambucus mexicana*	Blue elderberry	3	Alive
08	*Baccharis salicifolia*	Mulefat	18	Alive
X09	*Baccharis salicifolia*	Mulefat	10	Alive
X09	*Baccharis salicifolia*	Mulefat	11	Alive
X09	*Baccharis salicifolia*	Mulefat	9	Stressed
X10	*Baccharis salicifolia*	Mulefat	5	Dead
X10	*Baccharis salicifolia*	Mulefat	5	Dead
X10	*Baccharis salicifolia*	Mulefat	4	Alive
X10	*Baccharis salicifolia*	Mulefat	5	Alive
X21	*Baccharis salicifolia*	Mulefat	1	Alive
X21	*Baccharis salicifolia*	Mulefat	2	Alive

Table 4. Mill Creek Shrub Coverage				
Monitoring Site Plot	**Scientific Name**	**Common Name**	**Total Stems**	**Health**
X21	*Baccharis salicifolia*	Mulefat	2	Dead
X21	*Baccharis salicifolia*	Mulefat	4	Dead
X21	*Baccharis salicifolia*	Mulefat	16	Alive
X21	*Baccharis salicifolia*	Mulefat	29	Alive
X21	*Baccharis salicifolia*	Mulefat	5	Alive
X21	*Baccharis salicifolia*	Mulefat	2	Alive
X21	*Baccharis salicifolia*	Mulefat	4	Dead
X21	*Baccharis salicifolia*	Mulefat	15	Alive
X21	*Baccharis salicifolia*	Mulefat	11	Alive
X21	*Baccharis salicifolia*	Mulefat	10	Alive
X21	*Baccharis salicifolia*	Mulefat	12	Alive
X21	*Baccharis salicifolia*	Mulefat	17	Alive
X21	*Sambucus mexicana*	Blue elderberry	9	Alive
X22	*Baccharis salicifolia*	Mulefat	5	Alive
X22	*Baccharis salicifolia*	Mulefat	5	Alive
X22	*Baccharis salicifolia*	Mulefat	4	Alive
X22	*Baccharis salicifolia*	Mulefat	10	Alive
X22	*Baccharis salicifolia*	Mulefat	8	Alive
X22	*Baccharis salicifolia*	Mulefat	6	Alive
X22	*Baccharis salicifolia*	Mulefat	3	Alive
X22	*Sambucus mexicana*	Blue elderberry	3	Alive
X22	*Sambucus mexicana*	Blue elderberry	1	Alive
X22	*Sambucus mexicana*	Blue elderberry	1	Stressed
X22	*Sambucus mexicana*	Blue elderberry	2	Stressed
X22	*Sambucus mexicana*	Blue elderberry	1	Alive
X22	*Sambucus mexicana*	Blue elderberry	2	Dead
X22	*Sambucus mexicana*	Blue elderberry	7	Stressed
X22	*Sambucus mexicana*	Blue elderberry	4	Alive
X22	*Sambucus mexicana*	Blue elderberry	4	Stressed
X22	*Sambucus mexicana*	Blue elderberry	7	Alive
X22	*Sambucus mexicana*	Blue elderberry	2	Stressed

Table 4. Mill Creek Shrub Coverage				
Monitoring Site Plot	**Scientific Name**	**Common Name**	**Total Stems**	**Health**
X22	*Sambucus mexicana*	Blue elderberry	4	Stressed
X22	*Sambucus mexicana*	Blue elderberry	10	Stressed

Saplings

Three riparian sapling species were observed within the monitoring site plots including Goodding's black willow, ash (*Fraxinus* sp.), and western sycamore (*Platanus racemosa*). The most abundant sapling species was ash which had a total of seven individuals documented. Saplings were only observed at the three monitoring sites listed below. Table 5 lists overall sapling species, Table 6 lists the sapling density per ha, Table 7 lists the sapling health, and Table 8 lists the sapling species composition.

Table 5. Overall Sapling Species			
Monitoring Site Plot	**Scientific Name**	**Common Name**	**Total Stems**
X7	*Fraxinus* sp.	Ash	1
X7	*Fraxinus* sp.	Ash	1
X7	*Fraxinus* sp.	Ash	1
X7	*Fraxinus* sp.	Ash	1
X7	*Fraxinus* sp.	Ash	1
X7	*Platanus racemosa*	Western sycamore	1
X7	*Platanus racemosa*	Western sycamore	1
X22	*Fraxinus* sp.	Ash	1
New SAR 01	*Salix gooddingii*	Goodding's black willow	3

Table 6. Sapling Density (saplings/ha)		
Chino Creek	**Mill Creek**	**SAR**
84.9	4.0	14.1

Table 7. Sapling Health			
Health Status	**Chino Creek (%)**	**Mill Creek (%)**	**SAR (%)**
Live	100.0	100.0	100.0

Table 7. Sapling Health			
Health Status	**Chino Creek (%)**	**Mill Creek (%)**	**SAR (%)**
Dead	0.0	0.0	0.0
Stressed	0.0	0.0	0.0

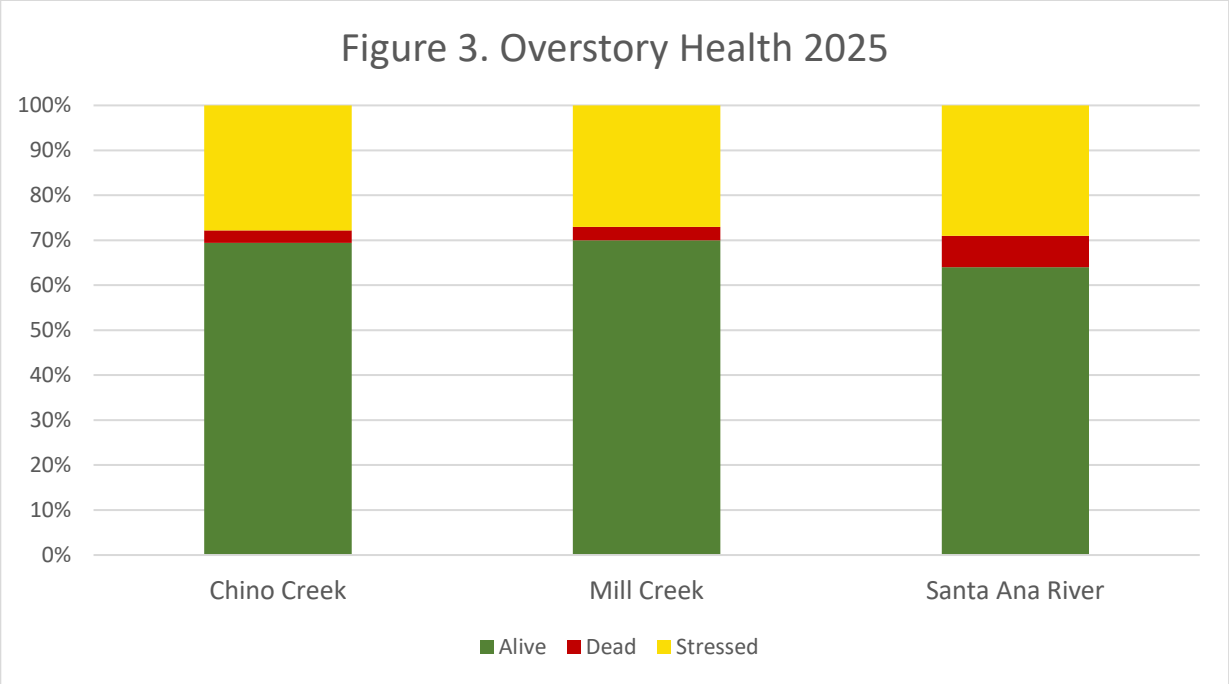
Table 8. Sapling Species Composition			
Species	**Chino Creek (%)**	**Mill Creek (%)**	**SAR (%)**
Salix gooddingii	0.0	0.0	100.0
Fraxinus sp.	75.0	100.0	0.0
Platanus racemosa	25.0	0.0	0.0

Overstory Trees

Health

The majority of trees documented within the monitoring site plots were alive and healthy. On average, 27.7 percent of the trees across all monitoring site plots were showing signs of stress. The SAR monitoring site plots had the highest percentage of stressed and dead trees (28.6 percent and 7.1 percent, respectively). The Mill Creek monitoring site plots were healthiest, with 70.0 percent of the trees being alive and only 26.7 percent showing signs of stress. Similarly, in Chino Creek, 69.4 percent of the trees were alive. The results of the overstory tree health are presented in Table 9 and Figure 3.

Table 9. Tree Health			
Health Status	**Chino Creek (%)**	**Mill Creek (%)**	**SAR (%)**
Live	69.4	70.0	64.3
Dead	2.8	3.3	7.1
Stressed	27.8	26.7	28.6



Tree Species Composition

Goodding's black willow was the most abundant tree species documented within the monitoring site plots. Other tree species documented within the monitoring site plots included Fremont cottonwood, ash, blue elderberry, and walnut. Species composition varied from 2022 to 2025 due to the 2025 surveys not documenting nonnative species at the monitoring site plots. Nonnative species were excluded from data collection in 2025 because they don't reflect the health of riparian communities as a whole.

Table 10. Tree Species Percent Composition

Scientific Name	Common Name	Chino Creek (%)	Mill Creek (%)	SAR (%)
Salix gooddingii	Goodding's black willow	72.2	95.0	85.7
Populus fremontii ssp. *fremontii*	Fremont cottonwood	-	1.7	-
Fraxinus sp.	Ash	27.8	1.7	-
Sambucus mexicana	Blue elderberry	-	1.7	7.1
Juglans sp.	Walnut	-	-	7.1

Nonnative, Invasive, and Nuisance Plant Species

Nonnative and invasive plant species were documented in each of the monitoring sections at various levels of cover. Nonnative and invasive tree species observed within and adjacent the monitoring site

plots included tree of heaven (*Ailanthus altissima*), eucalyptus (*Eucalyptus* spp.), Chinese flame (*Koelreuteria bipinnata*), Chinese elm (*Ulmus parvifolia*), and Mexican fan palm (*Washingtonia robusta*). Chino Creek Site X3 was the only monitoring site plot observed to have significant growth of nonnative and invasive tree species during the 2025 monitoring event. Many nonnative and invasive saplings were observed within this plot and cover of these species was estimated to be approximately 10 to 15 percent.

Nonnative and invasive shrub and herbaceous species commonly observed within and adjacent to the monitoring site plots included Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), perennial pepperweed (*Lepidium latifolium*), hairy beggarticks (*Bidens pilosa*), and golden crownbeard (*Verbesina encelioides*). Perennial pepperweed is of particular concern as it has a California Invasive Plant Council (Cal-IPC) rating of high and can produce both asexually and through seed production. Mill Creek monitoring site plots X9, X10, X21, and 81 and SAR monitoring site plots New SAR 01 and New SAR 02 were observed to have high levels of perennial pepperweed in the understory during the 2025 monitoring visit with the level of cover of this species ranging from approximately 25 to 50 percent across the various monitoring site plots.

In addition to nonnative and invasive plant species, two nuisance species were also observed. Rough cocklebur (*Xanthium strumarium*) was proliferating at Chino Creek Site 21 and wild grape (*Vitis* sp.) was proliferating at SAR monitoring site plots X13 and New SAR 01. While both of these species are native, they can proliferate quickly in riparian habitats and compete with other species for resources. Additionally, wild grape can add significant weight to tree limbs which can lead to limb failure.

Polyphagous Shot-Hole Borer (PSHB)

The presence of the PSHB was first documented during vegetation surveys in 2016. This species of beetle is highly problematic for a wide range of native riparian tree species because it has a symbiotic relationship with the fungus *Fusarium euwallaceae*. This fungus is the food source for PSHB but disrupts the vascular system of trees. Moderate and severe infestations of trees with PSHB can lead to significant decline and/or death. During this monitoring event, the presence of PSHB was documented in each of the three monitoring sections. Evidence of PSHB was observed on seven alive trees, seven stressed trees, and two dead trees. The SAR monitoring site plots had the highest percentage of trees infected with PSHB. Table 11 lists the percentage of trees with evidence of PSHB during the 2016, 2019, 2022, and 2025 monitoring events. Although the percentage of trees infected by PSHB has increased from 2022 to 2025, the overall health of the monitoring site plots is good and several of the trees that had evidence of the PSHB did not appear to have a current infestation.

Table 11. Percentage of Trees with Shot-Hole Borer Evidence*

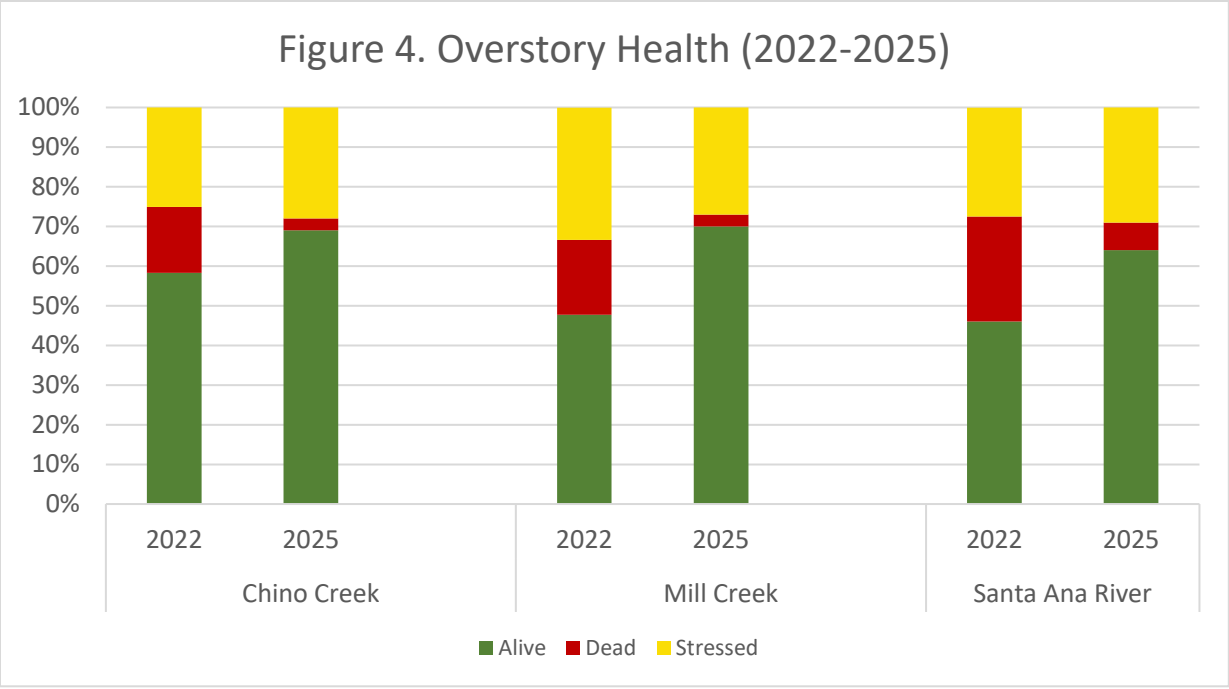
Year	Chino Creek (%)	Mill Creek (%)	SAR (%)
2016	28.1	56.5	44.2
2019	2.5	9.2	0.0
2022	3.3	9.0	1.8

Table 11. Percentage of Trees with Shot-Hole Borer Evidence*			
Year	**Chino Creek (%)**	**Mill Creek (%)**	**SAR (%)**
2025	19.4	6.7	35.7

*Potential presence of PSHB in 2022 was only documented for trees with obvious damage, while potential presence of this species in 2025 was documented for all trees that had any signs of infestation (e.g., entry/exit holes, weeping sap, branch failure, etc.)

Temporal Comparison

Chino Creek, Mill Creek, and SAR were evaluated for changes in overstory health between 2022 and 2025. At Chino Creek the number of trees alive increased by 11 percent, the number of trees dead decreased by 14 percent, and the number of trees stressed increased by 3 percent. At Mill Creek the number of alive trees increased by 22 percent, the number of dead trees decreased by 16 percent, and the number of stressed trees decreased by 6 percent. Lastly, at the SAR, the number of alive trees increased by 20 percent, the number of dead trees decreased by 20 percent, and the number of stressed trees increased by 2 percent. These changes in overstory health are presented in Figure 4 below. It should be noted that the evaluation of overstory tree health conducted in 2022 included both nonnative and native tree species while the evaluation of tree health conducted in 2025 only included native tree species.



DISCUSSION

Riparian vegetation within the Prado Basin are easily affected by floods, winds, fire events, and variations in precipitation and growing seasons. As a result, differences in vegetation between sampling years are expected. Climatic and natural events have resulted in previously marked trees to fall and resprout,

convoluting the data over the years. Additionally, many multi-trunked trees encountered during the 2025 monitoring event had been previously marked as multiple trees, likely due to inundation and/or sediment buildup in previous years obscuring the base and root crown of these trees.

Although these variables, combined with changes to monitoring methods, complicate the ability to discern specific long-term trends, the health of the riparian vegetation in the monitoring site plots are trending in a positive direction from 2022 to 2025. The primary driver of observed variability is climate, ranging from extreme wet years to dry years. Overall, the monitoring site plots showed:

- A decrease in mean canopy cover. Mean canopy cover at the Chino Creek and Mill Creek monitoring site plots showed a minor decrease from 81.5 percent cover in 2022 to 80.4 percent cover in 2025 and 76.2 percent cover in 2022 to 69.2 percent cover in 2025, respectively. Mean canopy cover at the SAR monitoring site plots showed a more significant decrease from 72.7 percent cover in 2022 to 52.1 percent cover in 2025 which could be the result of higher levels of scouring and invasion from nonnative and invasive plant species. Changes in mean canopy cover between survey years could be attributed to natural and climatic changes. The drop in mean canopy cover could be a result of 1) lower-than-average precipitation levels during the 2025 rainy season (NOAA 2025), 2) scouring from heavy rainfall during the 2023 and 2024 rainy seasons, and/or 3) competition with nonnative and invasive species such as perennial pepperweed, poison hemlock, golden crownbeard, and eucalyptus. Lower precipitation may have resulted in less canopy output during the growing season and/or earlier seasonal dieback in deciduous species (e.g., willows) This is a short-term change which is ithin the normal fluctuation of canopy cover and may be reversed when precipitation levels return to average. Scouring of the riparian system during periods of heavy rainfall during the 2023 and 2024 rainy seasons could have cleared out or knocked down larger riparian while at the same time opening up areas for perennial pepperweed and other invasive species to proliferate. Additionally, densitometer readings provide estimations of canopy cover and not exact quantifiable data.

- A decrease in sapling recruitment. Saplings per hectare significantly decreased at Chino Creek, Mill Creek, and the SAR. Saplings per hectare decreased at Chino Creek by 175.0, Mill Creek by 68.2, and the SAR by 28.3. The significant decrease in sapling recruitment could be the result of lower-than-average precipitation levels and/or competition with nonnative and invasive weeds. Since 2022 was also a dry year, competition with nonnatives, especially perennial pepperweed, might have played a larger role in the reduction of sapling recruitment from 2022 to 2025. Additionally, data taken in 2025 only recorded saplings for native riparian species due to their dependence on groundwater availability compared to non-riparian species while sapling counts conducted in 2022 also included nonnative species.

- An increase in the number of shrubs. In 2025, an increase in shrub recruitment was observed. Shrubs are an important component of riparian vegetation, providing stacked habitat for species. For example, Mulefat, which is the most abundant shrub in Prado Basin provides quality habitat for the Least Bell's Vireo, one of the listed endangered species in the Prado Basin. A shift in the proportion of sapling versus shrub recruitment indicates that riparian vegetation health is still good overall. Additionally, since shrubs rely on shallower groundwater than trees (<10 feet-below

ground surface), an increase in shrub recruitment suggests that groundwater levels remain adequate.

- An increase in the percentage of healthy trees in the overstory. The percentage of healthy, alive overstory trees increased, and the percentage of dead trees decreased from 2022 to 2025 for Chino Creek, Mill Creek, and the SAR; however, the percentage of stressed trees showed a slight increase for the SAR and Chino Creek. The increase in healthy, alive trees could be attributed to trees previously documented as stressed now recovering. The increase in the percentage of stressed trees at the Chino Creek and SAR monitoring site plots could be attributed to these monitoring site plots becoming overgrown with grape (*Vitis* sp.) and/or proliferation of nonnative and invasive weeds. The fact that the percentage of stressed trees remains between 25 and 30 percent, however, is indicative of overall sustained good health.

Nonnative and invasive plant species can be problematic for riparian systems and often follow periods of disturbance. These species can outcompete native shrub and tree species for water, sunlight, and nutrients causing significant stress and dieback. Perennial pepperweed is of particular concern as this species can spread asexually through extensive root systems and through seed production. Because this species is perennial and difficult to control, it can proliferate and cause significant damage in riparian systems. Perennial pepperweed was found to be especially problematic in the upper reaches of Mill Creek downstream from previous diversions and disturbance. Nonnative and invasive species tend to follow both natural and anthropogenic disturbances.

While the percentage of trees with evidence of PSHB infestation showed an increase during the 2025 monitoring event, much of the evidence is old (e.g., old entry and exit holes with not weeping sap) and many of the trees that had evidence of PSHB were recovering and appeared healthy. Additionally, the potential presence of PSHB in 2022 was only documented for trees with obvious damage, while potential presence of this species in 2025 was documented for all trees that had any signs of infestation (e.g., entry/exit holes, weeping sap, branch failure, etc.). Currently, the potential presence of PSHB does not appear to be having a significant impact on the health of the riparian system. Continued monitoring for PSHB should be conducted on a regular basis and lab tests should be conducted to confirm the presence of PSHB.

Overall, the riparian vegetation at the monitoring site plots appears to be healthy, and the riparian system is functioning properly. Additionally, the condition of the riparian vegetation observed in all three monitoring sections during the 2025 monitoring is consistent with the condition of riparian vegetation observed in other riparian systems throughout Southern California during 2025. Therefore, it is unlikely that any observable decline in the riparian system for the monitoring site plots could be linked to groundwater pumping and is likely the result of the issues discussed above.

Limitations and Recommendations

Survey limitations during the 2025 monitoring event included sampling bias due to access limitations and inconsistencies with 2022 data collected by USBR such as multi-trunked trees being counted as separate trees in 2022 and exclusion of data collected for nonnative/invasive trees in 2025. Ground truthing at the at the monitoring site plots helps to support the results of the NDVI and air photo analysis by providing

additional information to substantiate what is being observed in these analyses. Ground truthing allows for on the ground determinations of site conditions that can be compared to what is being observed in aerial imagery.

Monitoring of the site plots should continue to be conducted at a minimum of every 3 years. If feasible, additional qualitative monitoring should be conducted each year to provide early detection of any decline in the health of the riparian system.

If you have any questions about the information presented in this letter, please contact me at cadams@ecorpconsulting.com or (916) 782-9100.

Sincerely,



Carley Adams
Senior Biologist

REFERENCES

NOAA. 2025. Climate Date Online: Daily Precipitation Summaries for Chino, California. Available online: https://www.ncdc.noaa.gov/cdo-web/search. Accessed on: January 7, 2025.

LIST OF APPENDICES

Appendix A – 2025 Monitoring Plot Site Photos

Appendix B – Data Summary Table

APPENDIX A

2025 Monitoring Plot Site Photos



Photo 1. Chino Creek – Monitoring Site Plot X3 (facing north).



Photo 2. Chino Creek – Monitoring Site Plot X3 (facing east).



Photo 3. Chino Creek – Monitoring Site Plot X3 (facing south).



Photo 4. Chino Creek – Monitoring Site Plot X3 (facing west).



Photo 5. Chino Creek – Monitoring Site Plot X6 (facing north).



Photo 6. Chino Creek – Monitoring Site Plot X6 (facing east).



Photo 7. Chino Creek – Monitoring Site Plot X6 (facing south).



Photo 8. Chino Creek – Monitoring Site Plot X6 (facing east).



Photo 9. Chino Creek – Monitoring Site Plot X7 (facing north).



Photo 10. Chino Creek – Monitoring Site Plot X7 (facing east).



Photo 11. Chino Creek – Monitoring Site Plot X7 (facing south).



Photo 12. Chino Creek – Monitoring Site Plot X7 (facing west).



Photo 13. Chino Creek – Monitoring Site Plot 18 (facing north).



Photo 14. Chino Creek – Monitoring Site Plot 18 (facing east).



Photo 15. Chino Creek – Monitoring Site Plot 18 (facing south).



Photo 16. Chino Creek – Monitoring Site Plot 18 (facing west).



Photo 17. Chino Creek – Monitoring Site Plot 11 (facing north).



Photo 18. Chino Creek – Monitoring Site Plot 11 (facing east).



Photo 19. Chino Creek – Monitoring Site Plot 11 (facing south).



Photo 20. Chino Creek – Monitoring Site Plot 11 (facing west).



Photo 21. Chino Creek – Monitoring Site Plot 21 (facing north).



Photo 22. Chino Creek – Monitoring Site Plot 21 (facing east).



Photo 23. Chino Creek – Monitoring Site Plot 21 (facing south).



Photo 24. Chino Creek – Monitoring Site Plot 21 (facing west).



Photo 25. Mill Creek – Monitoring Site Plot X10 (facing north).



Photo 26. Mill Creek – Monitoring Site Plot X10 (facing east).



Photo 27. Mill Creek – Monitoring Site Plot X10 (facing south).



Photo 28. Mill Creek – Monitoring Site Plot X10 (facing west).



Photo 29. Mill Creek – Monitoring Site Plot X21 (facing north).



Photo 30. Mill Creek – Monitoring Site Plot X21 (facing east).



Photo 31. Mill Creek – Monitoring Site Plot X21 (facing south).



Photo 32. Mill Creek – Monitoring Site Plot X21 (facing west).



Photo 33. Mill Creek – Monitoring Site Plot X09 (facing north).



Photo 34. Mill Creek – Monitoring Site Plot X09 (facing east).



Photo 35. Mill Creek – Monitoring Site Plot X09 (facing south).



Photo 36. Mill Creek – Monitoring Site Plot X09 (facing west).



Photo 37. Mill Creek – Monitoring Site Plot X22 (facing north).



Photo 38. Mill Creek – Monitoring Site Plot X22 (facing east).



Photo 39. Mill Creek – Monitoring Site Plot X22 (facing south).



Photo 40. Mill Creek – Monitoring Site Plot X22 (facing west).



Photo 41. Mill Creek – Monitoring Site Plot New Mill Creek 01 (facing north).



Photo 42. Mill Creek – Monitoring Site Plot New Mill Creek 01 (facing east).



Photo 43. Mill Creek – Monitoring Site Plot New Mill Creek 01 (facing south).



Photo 44. Mill Creek – Monitoring Site Plot New Mill Creek 01 (facing west).



Photo 45. Mill Creek – Monitoring Site Plot New Mill Creek 02 (facing north).



Photo 46. Mill Creek – Monitoring Site Plot New Mill Creek 02 (facing east).



Photo 47. Mill Creek – Monitoring Site Plot New Mill Creek 02 (facing south).



Photo 48. Mill Creek – Monitoring Site Plot New Mill Creek 02 (facing west).



Photo 49. Mill Creek – Monitoring Site Plot 08 (facing north).



Photo 50. Mill Creek – Monitoring Site Plot 08 (facing east).



Photo 51. Mill Creek – Monitoring Site Plot 08 (facing south).



Photo 52. Mill Creek – Monitoring Site Plot 08 (facing west).



Photo 53. Mill Creek – Monitoring Site Plot 39 (facing north).



Photo 54. Mill Creek – Monitoring Site Plot 39 (facing east).



Photo 55. Mill Creek – Monitoring Site Plot 39 (facing south).



Photo 56. Mill Creek – Monitoring Site Plot 39 (facing west).



Photo 57. Mill Creek – Monitoring Site Plot 60 (facing north).



Photo 58. Mill Creek – Monitoring Site Plot 60 (facing east).



Photo 59. Mill Creek – Monitoring Site Plot 60 (facing south).



Photo 60. Mill Creek – Monitoring Site Plot 60 (facing west).



Photo 61. Mill Creek – Monitoring Site Plot 22 (facing north).



Photo 62. Mill Creek – Monitoring Site Plot 22 (facing east).



Photo 63. Mill Creek – Monitoring Site Plot 22 (facing south).



Photo 64. Mill Creek – Monitoring Site Plot 22 (facing west).



Photo 65. Mill Creek – Monitoring Site Plot 82 (facing north).



Photo 66. Mill Creek – Monitoring Site Plot 82 (facing east).



Photo 67. Mill Creek – Monitoring Site Plot 82 (facing south).



Photo 68. Mill Creek – Monitoring Site Plot 82 (facing west).



Photo 69. Santa Ana River – Monitoring Site New Santa Ana River 01 (facing north).



Photo 70. Santa Ana River – Monitoring Site New Santa Ana River 01 (facing east).



Photo 71. Santa Ana River – Monitoring Site New Santa Ana River 01 (facing south).



Photo 72. Santa Ana River – Monitoring Site New Santa Ana River 01 (facing west).



Photo 73. Santa Ana River – Monitoring Site Plot X13 (facing north).



Photo 74. Santa Ana River – Monitoring Site Plot X13 (facing east).



Photo 75. Santa Ana River – Monitoring Site Plot X13 (facing south).



Photo 76. Santa Ana River – Monitoring Site Plot X13 (facing west).



Photo 77. Santa Ana River – Monitoring Site Plot New Santa Ana River 02 (facing north).



Photo 78. Santa Ana River – Monitoring Site Plot New Santa Ana River 02 (facing east).



Photo 79. Santa Ana River – Monitoring Site Plot New Santa Ana River 02 (facing south).



Photo 80. Santa Ana River – Monitoring Site Plot New Santa Ana River 02 (facing west).

APPENDIX B

Data Summary Table

Monitoring Site Plot	Plot	Number of Trees	Cover in Cardinal Directions (%)				Overall Cover (%)	Alive (%)	Stressed (%)	Dead (%)	PSHB Present	PSHB (%)	Saplings Per Hectare
			N	E	S	W							
Chino Creek	X3	3	100	100	100	100	100.0	0	67	33	Yes	67	0
Chino Creek	X6	10	95	95	90	70	87.5	60	40	0	No	0	0
Chino Creek	X7	6	80	75	100	70	81.3	100	0	0	Yes	75	84.9
Chino Creek	11	5	50	25	60	100	58.8	63	38	0	No	0	0
Chino Creek	18	2	100	100	100	100	100.0	100	0	0	No	0	0
Chino Creek	21	7	90	40	40	50	55.0	100	0	0	No	0	0
Mill Creek	X9	4	25	40	100	65	57.5	0	100	0	No	0	0
Mill Creek	X10	1	99	100	100	98	99.3	0	100	0	Yes	100	0
Mill Creek	X21	1	25	70	98	98	72.8	100	0	0	No	0	0
Mill Creek	X22	5	4	50	15	60	32.3	60	20	20	No	0	4.0
Mill Creek	New Mill Creek 01	9	90	20	35	50	49	67	33	0	No	0	0
Mill Creek	New Mill Creek 02	11	85	75	85	75	80.0	100	0	0	No	0	0
Mill Creek	8	2	95	98	85	65	86	100	0	0	No	0	0
Mill Creek	22	7	95	95	95	100	96.3	86	14	0	No	0	0
Mill Creek	39	4	65	90	95	60	77.5	100	0	0	No	0	0
Mill Creek	60	5	10	18	0	15	10.8	20	80	0	No	0	0
Mill Creek	82	11	100	100	100	100	100.0	73	18	9	Yes	27	0
Santa Ana River	X13	3	5	50	65	25	36.3	0	100	0	No	0	0
Santa Ana River	New Santa Ana River 01	5	80	90	65	80	78.8	80	20	0	Yes	40	14.1
Santa Ana River	New Santa Ana River 02	6	50	15	25	75	41.3	83	0	17	Yes	50	0

CHINO BASIN WATERMASTER

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

STAFF REPORT

DATE: June 18, 2026

TO: Advisory Committee Members

SUBJECT: Application: Water Transaction – 802.36 AF from San Antonio Water Company to Monte Vista Water District (Consent Calendar Item I.D.)

Issue: To consider the Consolidated Water Transfer Forms for the sale and transfer of 802.36 acre-feet of water from San Antonio Water Company to Monte Vista Water District. This purchase is requested to be transferred from San Antonio Water Company's Annual Production Right. Monte Vista Water District is utilizing this transaction to produce its San Antonio Water Company shares. [Within WM Duties and Powers]

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

Financial Impact: None.

ACTIONS:
Appropriative Pool – May 14, 2026 [Final]: Provided advice and assistance.
Non-Agricultural Pool – May 14, 2026 [Final]: Provided advice and assistance.
Agricultural Pool – May 14, 2026 [Final]: Provided advice and assistance.
Advisory Committee – June 18, 2026 [Recommended]: Advice and assistance.
Watermaster Board – June 25, 2026 [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 this 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 of the Judgment or the Basin (Storage and Recovery Programs do not have this presumption).

The date of this application is April 7, 2026. Notice of the transaction along with the materials submitted by the requestors was transmitted to stakeholders electronically on May 8, 2026.

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 of the Judgment, or to the Basin.

The 85/15 Rule is a replenishment assessment policy that is intended to lessen the burden on Appropriative Pool overproducers that were original Parties to the Judgment. The policy may apply to water transactions when: 1) the buyer is an 85/15 Party, 2) the purpose of the transfer is to meet current demand above and beyond a party's production right, and 3) the water is placed into the buyer's Annual Account. The Rule does not apply when the buyer is utilizing the transaction to produce its West End Consolidated Water Company or San Antonio Water Company shares. Buyers that own shares in these two agencies are entitled to a certain amount of water each year and therefore those transactions would not qualify under the 85/15 Rule. Monte Vista Water District, in this application, is utilizing this transaction to produce its San Antonio Water Company shares. Therefore, the 85/15 Rule does not apply in this case.

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 at their June 2026 meetings respectively.

At the Pool Committee meetings held on May 14, 2026, 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 Form 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 20 25 - 20 26

DATE REQUESTED: April 7, 2026 **AMOUNT REQUESTED:** 802.36 Acre-Feet

TRANSFER FROM (SELLER / TRANSFEROR):	**TRANSFER TO (BUYER / TRANSFEREE):**
San Antonio Water Company Name of Party	Monte Vista Water District Name of Party
139 N. Euclid Avenue Street Address	10575 Central Avenue Street Address
Upland (City) CA (State) 91786 (Zip Code)	Montclair (City) CA (State) 91763 (Zip Code)
909.982.4107 Telephone	909.267.2125 Telephone
NA Facsimile	NA 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 Meet SAWCO entitlement for Calendar Year 2026

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:

700-1,000 gpm
Projected Rate of Recapture

Projected Duration of Recapture

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

Pumping

PLACE OF USE OF WATER TO BE RECAPTURED:

Regular Production Wells

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

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 ☒

Brian C. Lee Digitally signed by Brian C. Lee Date: 2026.04.07 14:17:16 -07'00'

Seller / Transferor Representative Signature

Brian C. Lee

Seller / Transferor Representative Name (Printed)

Justin Scott-Coe Digitally signed by Justin Scott-Coe DN: O=Monte Vista Water District, CN=Justin Scott-Coe, E=jscottcoe@mvwd.org Reason: I am the author of this document Location: Date: 2026.04.08 15:09:17-07'00' Foxit PDF Editor Version: 13.1.5

Buyer / Transferee Representative Signature

Justin M. Scott-Coe

Buyer / Transferee Representative Name (Printed)

TO BE COMPLETED BY WATERMASTER STAFF:

DATE OF WATERMASTER NOTICE: May 8, 2026

DATE OF APPROVAL FROM APPROPRIATIVE POOL: May 14, 2026

DATE OF APPROVAL FROM NON-AGRICULTURAL POOL: May 14, 2026

DATE OF APPROVAL FROM AGRICULTURAL POOL: May 14, 2026

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:

May 8, 2026

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: **April 07, 2026** Date of this notice: **May 08, 2026**

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

- Notice of Sale or Transfer – The purchase of 802.36 acre-feet of water from San Antonio Water Company by Monte Vista Water District. This purchase is made from San Antonio Water Company's Annual Production Right. Monte Vista Water District is utilizing this transaction to produce its San Antonio Water Company shares.

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

Appropriative Pool:	May 14, 2026
Non-Agricultural Pool:	May 14, 2026
Agricultural Pool:	May 14, 2026

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: June 18, 2026

TO: Advisory Committee Members

SUBJECT: Application: Recharge – San Antonio Water Company (Consent Calendar Item I.E.)

Issue: To consider the Application for Recharge submitted on April 16, 2026 by San Antonio Water Company for up to a total of 17,500 acre-feet to be recharged into basins along the San Antonio Channel.

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

Financial Impact: None

ACTIONS:
Appropriative Pool – May 14, 2026 [Final]: Provided advice and assistance.
Non-Agricultural Pool – May 14, 2026 [Final]: Provided advice and assistance.
Agricultural Pool – May 14, 2026 [Final]: Provided advice and assistance.
Advisory Committee – June 18, 2026 [Recommended]: Advice and assistance.
Watermaster Board – June 25, 2026 [Recommended]: Approval.

BACKGROUND

The Court approved the Peace Agreement, the OBMP Implementation Plan and the goals and objectives identified in the OBMP Phase I Report on July 13, 2000, and ordered the Chino Basin Watermaster (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 (MPI), Watermaster must approve the application. Where the request for Watermaster approval is submitted by a Party to the Judgment, there is a rebuttable presumption that most of the proposed activities do not result in MPI to a Party to the Judgment or the Basin (Storage and Recovery Programs do not have this presumption).

DISCUSSION

On April 16, 2026, San Antonio Water Company (SAWCo) submitted an Application for Recharge (Attachment 1) for up to 17,500 acre-feet total from July 2026 through June 2031. The Application states that the method of recharge is surface spreading into the Upland and Montclair Basins located in Management Zone 1 (MZ-1) of the Chino Basin and identifies the source of water to be local supplemental groundwater form the San Antonio Creek.

Pursuant to Article X of the Judgment, Section 10.10, "Watermaster Summary and Notification of a Pending Application," Watermaster issued a notice of this application electronically via email to parties on May 8, 2026 and the notice is also provided below in Attachment 2. The amount recharged will be subject to evaporative losses as consistent with all surface water recharge in Chino Basin. This water may be used to offset over-production during the same fiscal year it was imported, and if not used in the fiscal year for over-production, the water will then be placed into storage. Pursuant to the Peace II Agreement and achievement of Hydraulic Control, losses will be applied to all water placed into a Local Supplemental Storage Account in a manner consistent to all other water held in storage.

West Yost completed an MPI analysis on April 27, 2026, declaring no negative impacts to the Basin from this proposed recharge event (Attachment 3). The deliveries of the water will be monitored and accounted for in coordination with IEUA and SAWCo through Watermaster's Form 2b and Form 2c (Report of Supplemental Water Recharge by a Person).

Once approved, SAWCo must complete Form 2b *Request to Recharge Supplemental Water by a Person to Watermaster* for each recharge event during the Application's proposed period. Form 2b will be used by Watermaster staff to coordinate with SAWCo and the Inland Empire Utilities Agency (IEUA) to develop a Recharge Operations Plan. During the Recharge event, Watermaster and IEUA will collect data to properly ensure the water is accounted for. Upon completion of the recharge event, SAWCo will be required to submit Form 2c *Report of Supplemental Water Recharge by a Person* to Watermaster for final review and accounting.

This item was presented at the May 14, 2026 Pool Committee meetings where the Appropriative and Overlying (Agricultural) Pools unanimously recommended Advisory Committee to recommend to the Watermaster to approve the proposed application; the Overlying (Non-Agricultural) Pool unanimously recommended its representatives to support at Advisory Committee and Watermaster Board meetings subject to changes they deem appropriate.

ATTACHMENTS
1. SAWCo Recharge Application Dated April 16, 2026
2. Notice Forms
3. April 27, 2026 letter from West Yost to Watermaster: Analysis of Material Physical Injury for the San Antonio Water Company Recharge Application, Submitted to Chino Basin Watermaster on April 16, 2026

Form 2a - Application for Supplemental Water Recharge

Applicant Information and Recharge Request			
Person	San Antonio Water Company	Date Requested	04/16/2026
Contact (individual)	Brian C. Lee	Date Approved	
Street Address	139 North Euclid Avenue	Proposed Period of Time Covered by Recharge Application (mm/yyyy to mm/yyyy)	7/1/2026 to 6/31/2031
City	Upland		
State	CA		
Zip Code	91786	Requested Total Amount of Recharge Over the Application Period (AF)	3,500 AF/YR 17,500 AF total
Telephone	909.982.4107		
Fax	na	Approved Total Amount of Recharge Over the Application Period (AF)	
Email	blee@sawaterco.com		

Source(s) of Supply (check box and provide supporting information)		
( )	State Water Project	
( )	Colorado River Aqueduct	
(✓)	Local Supplemental (identify source and attach source water quality characterization including TDS and TN; use as many sheets as necessary)	
( )	Recycled Water (identify source and attach source water quality characterization including TDS and TN; use as many sheets as necessary)	
( )	Other (identify source and attach source water quality characterization including TDS and TN; use as many sheets as necessary)	

Method of Recharge (check box and provide supporting information)		
(✓)	Surface Spreading	
	Recharge Basin Name(s)	Upland and Monclair Basins
	Expected Period of Recharge (mm/dd to mm/dd)	7/1/2026 - 6/31/2030
	Depth to Water in Recharge Area (ft-bgs)	
	Water Quality in Recharge Area (attach characterization)	
( )	Injection	
	Well Names and Locations (attach well completion report if not on file with the Watermaster)	
	Expected Period of Recharge (mm/dd to mm/dd)	
	Depth to Water in Recharge Area (ft-bgs)	
	Water Quality in Recharge Area (attach characterization)	
( )	In-Lieu Exchange	
	Treatment Plant and Turnout	
	Share of Safe Yield (percent and AFY)	
	Carryover Right, if Applicable (AF)	
	Water in Storage (AF)	
	Pumping Capacity (mgd or AFM)	
	Expected Period of Recharge (mm/dd to mm/dd)	
	Depth to Water in Area Impacted by In-Lieu Recharge (ft-bgs)	
	Water Quality in Area Impacted by In-Lieu Recharge (attach characterization)	

Form 2a - Application for Supplemental Water Recharge

Material Physical Injury

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 or the Basin (provide list of mitigation measures and rational either below or attach one to this application)

BY: Brian C. Lee Digitally signed by Brian C. Lee Date: 2026.04.16 14:10:37 -07'00'

Applicant

April 16, 2026

Date

To Be Completed by Watermaster

Is the Person a Party to the Judgment that has:

Previously contributed to the implementation of the OBMP? ☐ YES ☐ NO

Is in compliance with their continuing covenants under the Peace Agreement? ☐ YES ☐ NO

(If answer to previous question is NO)

Paid or delivered to Watermaster "financial equivalent" consideration to offset the past performance prior to the OBMP implementation? ☐ YES ☐ NO

Promised continued future compliance with Watermaster Rules and Regulations? ☐ YES ☐ NO

Date of Approval from Appropriative Pool (mm/dd/yyyy) 05/14/2026

Date of Approval from Overlying Non-Ag Pool (mm/dd/yyyy) 05/14/2026

Date of Approval from Overlying Ag Pool (mm/dd/yyyy) 05/14/2026

Hearing Date (if any) (mm/dd/yyyy)

Date of Approval by Advisory Committee (mm/dd/yyyy)

Date of Approval from Board (mm/dd/yyyy)

Recharge Agreement Number

CHINO BASIN WATERMASTER

NOTICE

OF

APPLICATION(S)

RECEIVED FOR

RECHARGE

Date of Notice:

May 8, 2026

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 RECHARGE

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: **April 16, 2026** Date of this notice: **May 08, 2026**

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

- Notice of Application for Recharge – On April 16, 2026, San Antonio Water Company submitted an Application for Recharge for up to 17,500 acre-feet to be recharged into basins along the San Antonio Channel.

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

Appropriative Pool:	May 14, 2026
Non-Agricultural Pool:	May 14, 2026
Agricultural Pool:	May 14, 2026

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
recharge_storage@cbwm.org

WEST YOST
Water. Engineered.

25 Edelman
Irvine CA 92618

949.420.3030 phone
530.756.5991 fax
westyost.com

April 27, 2026

Project No.: 941-80-25-03
SENT VIA: EMAIL

Chino Basin Watermaster
Attention: Mr. Todd Corbin, General Manager
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

SUBJECT: Analysis of Material Physical Injury for the San Antonio Water Company Recharge Application, Submitted to Chino Basin Watermaster on April 16, 2026

Dear Mr. Corbin:

Pursuant to your direction, West Yost Associates, Inc. (West Yost) conducted a material physical injury (MPI) analysis on a Recharge Application submitted by the San Antonio Water Company (SAWC) to the Chino Basin Watermaster on April 16, 2026 (hereafter, April 16, 2026 recharge application). The MPI analysis was completed pursuant to the Watermaster Rules and Regulations and Peace Agreement.

In 2016, Watermaster approved a procedure for the recharge of supplemental water. This procedure includes three main steps:

1. Apply for and obtain Watermaster approval to recharge Supplemental Water
2. Plan, schedule, coordinate, and execute a Supplemental Water recharge event
3. Provide the monitoring and accounting necessary to enable the applicant and Watermaster to measure and record the volume of water that was physically recharged during a recharge event

Under Step 1, Any Person seeking to recharge Supplemental Water is required to complete Watermaster Form No. 2a *Application for Recharge*.[1] Watermaster staff reviews the completed application and conducts an analysis to determine if the proposed recharge as described in the recharge application will cause potential MPI.

Pursuant to the Peace Agreement (page 8), MPI is defined as:

> "[…] material injury that is attributable to Recharge, Transfer, storage and recovery, management, movement or Production of water or implementation of the OBMP, including, but not limited to, degradation of water quality, liquefaction, land subsidence, increases in pump lift and adverse impacts associated with rising groundwater."

[1] https://www.cbwm.org/pages/forms/

Article 10 of the Watermaster Rules and Regulations (paragraph 10.10) requires that:

> "[…] Watermaster prepare a written summary and analysis (which will include an analysis of the potential for material physical injury) of the Application and provide the Parties with a copy of the written summary and advanced notice of the date of Watermaster's scheduled consideration and possible action on any pending Applications."

The MPI analysis presented herein is based on our professional experience and judgment in the Chino Basin, including the past analyses of monitoring data, past evaluations of storage programs, past groundwater modeling of various groundwater management alternatives, and prior MPI analyses.

SAWC APRIL 16, 2026 RECHARGE APPLICATION

SAWC proposes to recharge up to 17,000 acre-feet (af) of local supplemental water from the San Antonio Creek into the Chino Basin during the 5-year period of July 1, 2026 to June 31, 2031 (3,500 af per year). SAWC proposes to divert San Antonio Creek water through its existing non-potable system and subsequently discharge it to the concrete-lined reach of San Antonio Creek located downstream of the Pomona Valley Protective Association (PVPA) diversion facilities and upstream of the College Heights Basin. SAWC proposes to recharge this water in the Upland Basin and Montclair Basins 1-4. Diversions into the Upland Basin would occur through the existing San Antonio Creek diversion into Upland Basin. Diversions into the Montclair Basins would occur through the existing San Antonio Creek diversion into Montclair Basin 1 and subsequently be routed to other basins in the Montclair Basins system. SAWC will need to coordinate their proposed diversions for recharge with the Inland Empire Utilities Agency (IEUA), the Chino Basin Water Conservation District, the City of Upland, and Watermaster to ensure that their water is diverted as proposed, measured and accounted for, and its recharge activities do not interfere with other recharge operations and stormwater management.

Watermaster classifies the water proposed to be recharged by the SAWC as supplemental water; therefore, the proposed recharge will help satisfy Watermaster's Peace II obligation to recharge 6,500 afy of supplemental water in MZ1.

West Yost evaluated for the following to determine the potential for MPI from the proposed recharge:

- Impacts to groundwater levels that could result in liquefaction and/or rising groundwater, land subsidence, and/or increases in pump lifts at wells.
- Impacts to the balance of recharge and discharge in every area and subarea of the Chino Basin.
- Impacts to groundwater quality.

Potential Impacts to Groundwater Levels

The proposed recharge will produce a localized and temporary increase in groundwater levels in the vicinity of the Upland and Montclair Basins following the recharge event. The temporary increase in groundwater levels will be followed by a return to the groundwater levels that would occur had the water not been recharged, as the recharge mound dissipates. The impacts of these localized changes in groundwater levels are described below:

- *Liquefaction and/or rising groundwater*. The current depth to water is described below:

- Near the Montclair Basin, depth to groundwater as of December 2025 was about 550 ft-bgs as measured at well MVWD 26.
- Near the Upland Basin, depth to groundwater as of December 2025 was about 90 ft-bgs, as measured at well MWU-1. Depth to groundwater near the Upland Basin is shallower than at Montclair Basin due to a clay layer that underlies the Upland Basin that results in perched groundwater.[2]

Depth to water in near both basins is below 50 feet bgs, the depth at which there may be a threat of liquefaction.[3] The below 50 feet bgs liquefaction threshold is assumed to be protective of rising groundwater.

- *Land subsidence*. Land subsidence due to changes in groundwater levels typically occurs with declining groundwater levels. Thus, there will be no threat of aquifer-system compaction and land subsidence due to the localized increases in groundwater levels caused by the recharge.
- *Pumping lifts*. Because of the temporary increases in groundwater levels, pumping lifts and pumping costs may be temporarily reduced for wells in the vicinity of the recharge.

Potential Impacts to the Balance of Recharge and Discharge in Every Area and Subarea

SAWC did not provide information on how it plans to recover the recharged water, so the location of future recovery remains unknown; thus, the balance of recharge and discharge cannot be analyzed.

Potential Impacts to Water Quality

The source of the supplemental water in SAWC's April 16, 2026 recharge application is San Antonio Creek water diverted upstream of San Antonio Dam. West Yost obtained water quality data of the San Antonio Creek water from SAWC and the Watemaster's database for the period 2021-2025. These data indicate no exceedances of primary California Title 22 maximum contaminant levels (MCLs).

Potential Impacts to Receiving Waters

The proposed recharge water is of equal or better quality than current groundwater in the area of recharge; hence, recharge of this water will likely improve the general groundwater quality in the vicinity of the Upland and Montclair Basins.

We compared observed concentrations of chemicals regulated under Title 22 drinking water regulations at wells located near the Upland and Montclair Basins to the MCLs. The contaminants with observations exceeding MCLs in the vicinity of the Upland and Montclair Basins included 1,2,3-Trichloropropane (TCP), 1,2-Dibromo-3-chloropropane (DBCP), nitrate, and perchlorate—with all being commonly observed contaminants in areas previously used in citrus cultivation in the Chino Valley area. The "Groundwater Quality" section of the 2024 State of the Basin Report (West Yost, 2025)[4] shows the maximum observed

[2] According to a study conducted by URS on behalf of IEUA in 2005, it was concluded that the "clayey sequence does not create a complete barrier to groundwater recharge."

[3] Fife, Donald et al. *Geologic Hazards in Southwestern San Bernardino County, California.* California Division of Mines and Geology, 1976.

[4] https://arcg.is/1mfKvj

concentrations of these and other constituents at municipal wells in the Chino Basin during the five-year period of July 2019 to June 2024.

The potential source(s) of TCP contamination in groundwater in this area were investigated in 2019 and it was concluded that the likely source of the TCP appears to be from land applications of soil fumigants.[5] The investigation also concluded it is unlikely that managed aquifer recharge (MAR) operations in the area will have a significant impact on the TCP concentrations at MVWD wells.

In 2021, Watermaster conducted a groundwater modeling study to evaluate a 100,000 af storage and recovery program in the Chino Basin, which included recharge at the recharge basins and four Monte Vista injection wells in MZ1. The study concluded that the "displacements [of contaminant plumes due to the storage and recovery program] are negligible and are not potential MPI."[6]

Based on the water quality of the recharge source water, the water quality at nearby wells, the results of the groundwater modeling studies, and the location and magnitude of the proposed recharge, our professional opinion is that the proposed recharge will not change the direction and/or speed of movement of known contaminant plumes in the Chino Basin.

Basin Plan Compliance

The proposed recharge will occur in the Chino North Groundwater Management Zone (GMZ). The 2004 Regional Water Quality Control Plan for the Santa Ana Basin (Basin Plan) has maximum benefit-based TDS and nitrate (expressed as nitrogen) concentration objectives in the Chino-North GMZ of 420 milligrams per liter (mg/L) and 5 mg/L, respectively. Pursuant to the Basin Plan, Watermaster and the IEUA are required to manage artificial recharge in Chino North GMZ such that the five-year, volume-weighted average TDS and nitrate concentrations of the recycled water, imported water, and new stormwater recharged across all recharge facilities does not exceed the maximum benefit-based Basin Plan objectives.

Water quality data from the San Antonio Creek indicate that TDS concentration averaged is expected to be less than 260 mg/L (TDS concentrations ranged from 150 to 240 mg/L between 2021 and 2025) and nitrate concentration is expected to be less than the detection limit (nitrate concentrations ranged from below the detection limit to 0.5 mg/L between 2021 and 2025).

The current ambient TDS and nitrate concentrations in the Chino-North GMZ (covering the 20-year period from 2001 to 2021) are 360 mg/L and 10.8 mg/L,[7] respectively. Thus, the proposed recharge will not encroach on the current assimilative capacity or interfere with Watermaster and the IEUA's regulatory obligations.

[5] WEI, 2019. *Investigation of the Likely Source of 1,2,3-Trichloropropane (1,2,3-TCP) in Groundwater near Recharge Basins in Management Zone 1 (MZ1) and the Impact of Managed Aquifer Recharge (MAR) on It*. Technical Memorandum dated December 16, 2019.

[6] West Yost (2021). *Evaluation of the Local Storage Limitation Solution*. February 2021.

[7] West Yost (2023). *2021 Ambient Water Quality Pilot Study*. Prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force. October 2023.

Conclusion

Based on the information available at this time, our professional opinion is that there will be no MPI due to the SAWC's proposed recharge as described in its April 16, 2026 recharge application.

Please contact me if you have any questions or concerns regarding this MPI analysis.

Sincerely,
WEST YOST



Carolina Sanchez, PE
Senior Engineer
RCE #85598

cc: Alonso Jurado

CHINO BASIN WATERMASTER

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

STAFF REPORT

DATE: June 18, 2026

TO: Advisory Committee Members

SUBJECT: Review Final 2025 Safe Yield Reevaluation Report (Business Item II.A.)

Issue: To review Final 2025 Safe Yield Reevaluation Report. [Within WM Duties and Powers]

Recommendation: Provide advice and assistance to Watermaster on the Final 2025 Safe Yield Reevaluation Report.

Financial Impact: None

ACTIONS:
Appropriative Pool – June 11, 2026 [Recommendation]: Provide advice and assistance.
Non-Agricultural Pool – June 11, 202 [Recommendation]: Provide advice and assistance.
Agricultural Pool – June 11, 2026 [Recommendation]: Provide advice and assistance.
Advisory Committee – June 18, 2026 [Recommendation]: Provide advice and assistance.
Watermaster Board – June 25, 2026 [Recommendation]: Find the report was completed in accordance with prior court orders.

BACKGROUND

The Court-ordered update to the Chino Basin groundwater model is complete. Also, the technical analysis in support of the Draft 2025 Safe Yield Reevaluation Report along with independent Peer Review recommendations are also complete.

The Board, on September 25, 2025, received an informational presentation by the independent Peer Review firm, S.S. Papadopulos (SSP&A) of the findings and recommendations. Subsequent to this presentation, the Draft 2025 Safe Yield Reevaluation Report including the Peer Review report was distributed to parties for feedback. Watermaster received written feedback from individual parties, and from the Appropriative Pool. The feedback was discussed at the December 2025 Pool Committee meetings which resulted in the advice and assistance described below.

In October 2025, SSP&A provided its official recommendation in Appendix A, *the Supplemental Hydrogeologic Information*, and the Executive Summary is provided as Attachment 1. Included in Appendix A, on October 23, 2025, West Yost provided its response on Appendix E-1, *Response to Recommendations from SSP&A Peer Review Report* (Attachment 2). On December 5, 2025, Mr. Jim Van de Water and Mr. Thomas Harder of Thomas Harder & Company (Appropriative Pool technical consultant) provided a letter in response to the Peer Review recommendation (Attachment 3).

At their December 11, 2025, meetings, the three Pool Committees provided their advice and assistance on the draft Safe Yield Reevaluation Report and Peer Review Recommendations as follows:

- The Appropriative Pool made a motion out of Confidential Session, directing their technical consultant, Mr. Thomas Harder of Thomas Harder & Company, to work with West Yost to develop a recommended scope of work to implement the agreed-upon recommendations to improve identified elements of the Chino Valley Model. The Pool further indicated that they do not believe the technical analysis work for the reevaluation of the safe yield to be complete.
- The Overlying (Non-Agricultural) Pool expressed support for the Appropriative Pool's position, though the Pool expressly stated that they do not intend to fund any related additional technical work.
- The Overlying (Agricultural) Pool was given an update from staff as to the other Pool Committees' positions. They further discussed the item in Confidential Session and did not provide any reportable action.

In 2026, a scope of work was developed and budget amendment approved by the Advisory Committee and Watermaster Board to implement refinements to the Chino Valley groundwater Model. The refinements were completed, peer reviewed, and documented in the final report. Section 7.3.2 of the report details the results of the technical analysis and a Tentative Safe Yield of 121,200 for the ten-year period 2021-2030.

DISCUSSION

To continue advancing the Safe Yield Reevaluation effort, the Final 2025 Safe Yield Reevaluation Report is presented to the Pool Committees for review and final comments. The Advisory Committee, and Watermaster Board will consider the advice and assistance provided by the Pool Committees and individual parties (June 12, 2026 submittal deadline).

The Watermaster Board will consider whether the 2025 Safe Yield Reevaluation Report's evaluation of the Safe Yield of the Basin for the period July 1, 2020 through June 30, 2030 was conducted in accordance with prior court orders and the 2022 Safe Yield reset methodology. Subsequent to this Watermaster Board action, the Pools, the Advisory Committee and Watermaster Board will discuss over the next 30-60 days what actions should be taken based on the results of the technical analysis and recommendations in the report.

At the June 11, 2026 Pool meetings, staff provided a presentation which included a reminder that final comments on the report were due on Friday, June 12, 2026. No formal advice and assistance was provided by the Pools.

ATTACHMENT
1. Final 2025 Safe Yield Reevaluation Report

DRAFT REPORT | MAY 2026

2025 Safe Yield Reevaluation

PREPARED FOR

Chino Basin Watermaster

PREPARED BY

2025 Safe Yield Reevaluation

Prepared for

Chino Basin Watermaster

Project No. 941-80-24-32

DRAFT

Prepared by: Garrett Rapp	Date
QA/QC Review: Andy Malone	Date

Table of Contents

SECTION 1 Introduction 1-1

1.1 Background 1-1
1.1.1 Prior Safe Yield Recalculations 1-1
1.1.2 2022 Safe Yield Reset Methodology 1-3
1.1.3 2025 Safe Yield Reevaluation 1-4

1.2 Scope of Work 1-5

1.3 Peer Review and Stakeholder Engagement 1-6
1.3.1 Third-Party Peer Review of 2025 CVM and 2025 SYR 1-6

1.4 Report Organization 1-7

SECTION 2 Update of Hydrogeologic Conceptual Model 2-1

2.1 Introduction and Scope 2-1

2.2 Geologic and Lithologic Information 2-1

2.3 Remote Sensing 2-2
2.3.1 InSAR 2-2
2.3.2 NDVI and Aerial Photos 2-6
2.3.3 DEM 2-6

2.4 Faults and Basin Boundaries 2-8

SECTION 3 2025 Updates to the Chino Valley Model 3-1

3.1 Extension of Historical Simulation Period for the 2025 CVM 3-3
3.1.1 Time Series Data 3-3
3.1.2 Land Use 3-3

3.2 Updates to the MODFLOW Model 3-3
3.2.1 Model Domain and Grid 3-3
3.2.2 Model Layer Elevation and Thickness 3-3
3.2.3 Travel Time of DIPAW Through the Vadose Zone 3-10
3.2.4 Evapotranspiration of Groundwater 3-10
3.2.5 Santa Ana River and Tributaries 3-10
3.2.6 Groundwater Pumping 3-10
3.2.7 Fault Barriers 3-14
3.2.8 Subsurface Inflow 3-14

SECTION 4 Model Calibration and Uncertainty Analysis 4-1

4.1 Validation of R4 Model 4-1
4.1.1 Evaluation Criteria 4-1
4.1.2 Validation Results 4-1
4.1.2.1 Simulated Streamflow 4-1
4.1.2.2 Simulated Urban Outdoor Water Use 4-3
4.1.2.3 Stormwater Recharge in Basins 4-7

4.2 Recalibration and Uncertainty Analysis 4-12
4.2.1 Methods 4-12

DRAFT

Table of Contents

4.2.2 Update of Calibration Period 4-13
4.2.3 Select Adjustable Model Parameters and Prepare Input Files for PESTPP-IES 4-14
4.2.3.1 DIPAW 4-14
4.2.3.2 Evapotranspiration 4-15
4.2.3.3 Subsurface Inflow 4-15
4.2.3.4 Specified Head Boundary 4-15
4.2.3.5 Santa Ana River and Its Tributaries 4-16
4.2.3.6 Faults 4-16
4.2.3.7 Aquifer Properties and Pilot Points 4-16
4.2.4 Prepare Observation Data as Calibration Targets 4-17
4.2.4.1 Groundwater Elevation Time Series 4-18
4.2.4.2 Stream Discharge Time Series 4-19
4.2.5 Use PESTPP-IES to Generate Calibrated Realizations 4-19
4.2.5.1 Manual Calibration 4-22
4.2.5.2 Automated Calibration 4-23
4.2.5.2.1 Pilot Point Scenario 5 4-24
4.2.6 Rank and Select Calibrated Realizations for Projection Scenarios 4-33

4.3 Water Budget and Comparison to the 2020 CVM 4-39
4.3.1 Water Budget for Selected Realization 4-39
4.3.2 Comparison of 2025 CVM Realizations to 2020 CVM 4-43
4.3.2.1 Subsurface Inflows (Figure 4-25) 4-44
4.3.2.2 Other Variable Water Budget Components (Figure 4-26) 4-44
4.3.2.3 Summary of Water Budget (Figure 4-27) 4-44

4.4 References 4-48

SECTION 5 Projection Ensemble 5-1

5.1 Objectives of the Projection Ensemble 5-1

5.2 Stakeholder Engagement and Timeline 5-2
5.2.1 Timeline for Development of the Projection Ensemble 5-3

5.3 Characterizing Uncertainty in Future Climate 5-4
5.3.1 Use of Historical Precipitation and ET_o Data 5-5
5.3.2 Incorporating DWR Climate Change Factors 5-5
5.3.3 Summary of Climate Scenarios 5-7

5.4 Characterizing Uncertainty in Future Cultural Conditions 5-11
5.4.1 Reference Water Plans 5-11
5.4.1.1 Overlying (Agricultural) Pool 5-12
5.4.1.2 Overlying (Non-Agricultural) Pool 5-12
5.4.1.3 Appropriative Pool 5-12
5.4.1.4 Summary of Reference Water Plans 5-15
5.4.2 Primary Elements of Uncertainty in Cultural Conditions 5-15
5.4.2.1 Historical Variation in Water Demands and Use of Water Supplies 5-15
5.4.2.2 Uncertainty in Demands 5-16
5.4.2.2.1 Growth 5-16

DRAFT

5.4.2.2.2 Conservation Regulation....5-16
5.4.2.2.3 Climate Change....5-18
5.4.2.2.4 Impacts of Demand Deviations on Groundwater Levels and Net Recharge....5-18
5.4.2.3 Groundwater Utilization....5-19
5.4.2.4 Imported Water Utilization....5-20
5.4.3 Water Plan Scenarios....5-21
5.4.3.1 Response to the Conservation Regulation....5-24
5.4.3.2 Groundwater and Imported Water Utilization....5-25
5.4.3.3 Pumping Adjustments for Other Parties....5-25
5.4.3.4 Buildout....5-25
5.4.3.5 Replenishment Obligation....5-26
5.4.3.6 Variability of Demands due to Climate Scenarios....5-26
5.4.3.6.1 Variability of Demands due to Precipitation....5-27
5.4.3.6.2 Variability of Demands due to Temperature....5-28
5.4.3.7 Comparison of Water Plan Scenarios....5-30
5.4.3.7.1 Demand....5-30
5.4.3.7.2 Groundwater Utilization....5-30
5.4.3.7.3 Imported Water Utilization....5-30
5.5 Summary of Projection Ensemble....5-38
5.6 Likelihoods....5-39
SECTION 6 2025 Determination of Tentative Safe Yield....6-1
6.1 Background and Methods....6-1
6.1.1 Methods....6-1
6.1.2 Development of the TSY Ensemble....6-3
6.1.2.1 Managed Storage....6-3
6.1.2.2 Imported Water Recharge....6-4
6.2 Results of TSY Ensemble....6-4
6.2.1 Water Budgets....6-9
6.2.1.1 Net Recharge and TSY....6-12
6.2.1.2 Drivers of the Difference in DIPAW Between the 2020 SYR and 2025 SYR....6-23
6.2.1.3 Average Net Recharge Across the TSY Ensemble....6-23
6.2.2 Groundwater Conditions....6-28
6.2.2.1 Groundwater Levels....6-28
6.2.2.1.1 Groundwater Level Changes, FY 2022 to 2030....6-28
6.2.2.1.2 Groundwater Level Changes, FY 2022 to 2050....6-32
6.2.2.2 Groundwater Flow Patterns....6-36
SECTION 7 2025 Safe Yield Reevaluation....7-1
7.1 Background and Objectives....7-1
7.1.1 Categories of Material Physical Injury....7-1
7.1.2 MPI Analysis Methods....7-2
7.2 MPI Analysis For the TSY Ensemble....7-3
7.2.1 Land Subsidence....7-3

DRAFT

7.2.1.1 Site-Specific MPI Thresholds for Land Subsidence 7-4
7.2.1.2 Subarea MPI Thresholds for Land Subsidence 7-4
7.2.1.3 Results of MPI Analysis for Land Subsidence 7-6
7.2.1.4 Discussion 7-6
7.2.1.4.1 Drivers of MPI for Land Subsidence 7-13
7.2.1.4.2 Potential Methods to Avoid or Mitigate MPI due to Land Subsidence 7-14
7.2.2 Pumping Sustainability 7-15
7.2.2.1 Evaluation Criteria and Methods 7-15
7.2.2.1.1 Party Input to Develop Site-Specific and Subarea MPI Thresholds 7-15
7.2.2.1.2 Subarea Threshold for MPI Due to Pumping Sustainability 7-18
7.2.2.2 Results 7-21
7.2.2.3 Discussion 7-33
7.2.2.3.1 Drivers of MPI for Pumping Sustainability 7-33
7.2.2.3.2 Potential Methods to Avoid or Mitigate MPI due to Pumping Sustainability 7-38
7.2.3 Hydraulic Control 7-38
7.2.3.1 Methods to Evaluate the State of Hydraulic Control 7-38
7.2.3.2 Results 7-39
7.2.3.3 Discussion 7-39
7.3 Determination of Viability of TSY 7-43
7.3.1 Summary of Findings 7-43
7.3.2 Evaluation of the Safe Yield 7-46
7.3.2.1 Comparison to 2020 Safe Yield Recalculation Results 7-47
7.3.2.2 Contribution from Conservation Regulations 7-47
7.4 Recommendations 7-48
7.4.1 Addressing Data Gaps and Improving CVM 7-48
7.4.2 Mitigation Measures 7-49
7.4.3 Operational Optimization 7-49

LIST OF TABLES

Table 4-1. R4 Model Calibration Statistics for Streamflow in the 2020 CVM and 2025 CVM 4-3
Table 4-2. R4 Model Calibration Statistics for Urban Outdoor Water Use in the 2020 CVM and 2025 CVM 4-7
Table 4-3. Calibration and Validation of R4 Model - Recharge Basins 4-12
Table 4-4. Number of Monitoring Wells by Screened Model Layer 4-19
Table 4-5. Summary of Adjustable Parameters for Scenario 5 4-33
Table 4-6. Summary of Net Recharge Statistics and Chosen Realizations, Pilot Point Scenario 5 4-34
Table 4-7. Water Budget for the Chino Basin for the Calibration Period - Realization C 4-40
Table 4-8. Comparison of Water Budget Components - 2020 and 2025 CVM 4-43
Table 5-1: Datasets Used for Climate Scenarios 5-7

DRAFT

Table 5-2. Aggregate Reference Water Plan for the Watermaster Parties 5-15
Table 5-3. Water Plan Scenario Descriptions 5-22
Table 5-4. Reductions in Demand Required to Meet the Water Use Objectives 5-23
Table 5-5. Summary of Conservation Regulation Responses in Water Plan Scenarios 5-24
Table 5-6a. Aggregate Water Plans for the Expected Demand Scenario 5-30
Table 5-6b. Aggregate Water Plans for the High Demand Scenario 5-30
Table 5-6c. Aggregate Water Plans for the Low Demand Scenario 5-30
Table 5-7. Historical and Projected Pumping for the Chino Basin Parties 5-31
Table 5-8. Projection Ensemble 5-35
Table 5-9. Projection Ensemble with Likelihood Weights 5-37
Table 6-1. Projection Ensemble 6-9
Table 6-3. Water Budget Components for 2020 SYR and 2025 SYR TSY Ensemble, FY 2021-2030 (afy)[(a)] 6-12
Table 6-4. Decadal Average Water Budget Components for 2025 SYR TSY Ensemble (afy)[(a)] 6-28
Table 6-5. Summary of Groundwater Elevations Selected Projection Realizations, July 2030 (ft-amsl) 6-32
Table 6-6. Summary of Groundwater Elevations Selected Projection Realizations, July 2050 (ft-amsl) 6-32
Table 7-1. Percentage of Wells Below Land Subsidence Thresholds, FY 2030 and FY 2050 7-7
Table 7-2. Summary of Party Responses to Pumping Sustainability Threshold Information Request 7-20
Table 7-3. Percentage of Wells Below Pumping Sustainability Thresholds, FY 2030 and FY 2050 7-34
Table 7-4. Potential Basin-Management Activities to Avoid MPI and Maintain or Enhance Safe Yield 7-50

LIST OF FIGURES

Figure 1-1. Hydrologic and Adjudicated Boundaries of the Chino Basin 1-2
Figure 2-1. Geologic Map and Boundaries of the Chino Basin 2-3
Figure 2-2. Borehole Locations 2-4
Figure 2-3. Map View of the Hydrostratigraphic Cross-Sections 2-5
Figure 2-4. Vertical Ground Motion as Estimated by InSAR 2-7
Figure 3-1. Chino Valley Model Surface Water Models 3-2
Figure 3-2. Hydrologic Sub-Areas 3-4
Figure 3-3. Land Use 2017 3-5
Figure 3-4. Land Use 2022 3-6

DRAFT

Figure 3-5. Layer Thickness – L1 3-7
Figure 3-6. Layer Thickness – L3 3-8
Figure 3-7. Layer Thickness – L5 3-9
Figure 3-8. Travel Time of DIPAW Through Vadose Zone 2020 CVM 3-11
Figure 3-9. Travel Time of DIPAW Through Vadose Zone 2025 CVM 3-12
Figure 3-10. Modeled Streams 3-13
Figure 3-11. Simulated Faults of 2020 and 2025 CVM 3-15
Figure 3-12. Segmentation of Simulated Faults – 2025 CVM 3-16
Figure 3-13. Subsurface Inflow Boundary 3-17
Figure 3-14. Specified Head Boundary 3-18
Figure 4-1. Location Map 4-2
Figure 4-2. R4-USGS Discharge Chino Creek 4-5
Figure 4-3. R4-USGS Discharge Cucamonga Creek 4-6
Figure 4-4. IEUA Estimated Total Monthly Water Supply to the RP1/RP4 Sewershed 4-8
Figure 4-5. IEUA Estimated Total Monthly Water Supply to the RP2/CC/RP5 Sewershed 4-9
Figure 4-6. IEUA – R4 Supply for RP1 – RP4 4-10
Figure 4-7. IEUA – R4 Supply for CC – RP5 4-11
Figure 4-8. Precipitation Time Series in the Chino Basin, FY 1896-2022 4-14
Figure 4-9. Calibration Wells 4-20
Figure 4-10. Calibration Targets 4-21
Figure 4-11. Comparison of Simulated and Measured Groundwater Levels in Wells 4-25
Figure 4-12. 2025 CVM: Manual Calibration Residuals of Groundwater Elevation 4-26
Figure 4-13. 2025 CVM: Manual Calibration RMSE of Groundwater Elevation 4-27
Figure 4-14. 2025 CVM: Manual Calibration Trend of Groundwater Elevation Residuals 4-28
Figure 4-15. MODFLOW Estimated Streamflow 4-29
Figure 4-16. Comparison of Simulated Stream Discharge at Prado Dam 4-30
Figure 4-17. Simulated Net Recharge for the Chino Basin Pilot Point Scenario 5 4-31
Figure 4-18. Mean Net Recharge in the Chino Basin 4-32
Figure 4-19. Comparison of Simulated and Measure Groundwater Levels in Wells 4-35
Figure 4-20. Residuals of Groundwater Elevation 4-36
Figure 4-21. RMSE of Groundwater Elevation 4-37
Figure 4-22. Trend of Groundwater Elevation Residuals 4-38
Figure 4-23. Mean Net Recharge in the Chino Basin 4-41

DRAFT

Figure 4-24. Simulated Net Recharge for Chosen Realizations 4-42
Figure 4-25. Comparison of Subsurface Inflows – 2020 and 2025 CVM 4-45
Figure 4-26. Comparison of Other Variable Water Budget Components – 2020 and 2025 CVM 4-46
Figure 4-27. Comparison of Net Recharge and Discharge – 2020 and 2025 CVM 4-47
Figure 5-1. Historical and Projected Annual Precipitation by Climate Scenario 5-8
Figure 5-2. Cumulative Departure from Mean Precipitation by Climate Scenario 5-9
Figure 5-3. Historical and Projected Annual ET_o by Climate Scenario 5-10
Figure 5-4. Projected Active Agricultural Wells at Buildout 5-14
Figure 5-5. Historical Water Supplies of the Chino Basin Parties 5-17
Figure 5-6. Process to Develop the Water Plan Scenarios 5-24
Figure 5-7. Projected Chino Basin Demands with Precipitation-Demand Multipliers 5-29
Figure 5-8. Total Demands for Water Plan Scenarios 5-35
Figure 5-9. Total Chino Basin Groundwater Pumping Demands for Water Plan Scenarios 5-36
Figure 5-10. Total Imported Water Demands for Water Plan Scenarios 5-37
Figure 6-1. Flowchart Characterizing Steps 6 through 9 of 2022 Safe Yield Reset Methodology 6-2
Figure 6-2. Managed Storage 6-5
Figure 6-3. Projected Imported Water Recharge, TSY Ensemble Scenario 1 6-6
Figure 6-4. Projected Imported Water Recharge, TSY Ensemble Scenario 5 6-7
Figure 6-5. Projected Imported Water Recharge, TSY Ensemble Scenario 9 6-8
Figure 6-6. Water Budget for the Chino Basin Scenario D1 6-13
Figure 6-7. Comparison of Subsurface Inflows 2020 SYR and 2025 SYR 6-14
Figure 6-8. Comparison of DIPAW 2020 SYR and 2025 SYR 6-15
Figure 6-9. Comparison of Managed Aquifer Recharge 2020 SYR and 2025 SYR 6-16
Figure 6-10. Comparison of SAR Infiltration 2020 SYR and 2025 SYR 6-17
Figure 6-11. Comparison of ET 2020 SYR and 2025 SYR 6-18
Figure 6-12. Comparison of Rising Groundwater 2020 SYR and 2025 SYR 6-19
Figure 6-13. Comparison of Net Recharge 2020 SYR and 2025 SYR 6-20
Figure 6-14. Comparison of Change in Storage 2020 SYR and 2025 SYR 6-21
Figure 6-15. Cumulative Change in Storage – TSY Ensemble 6-22
Figure 6-16. Average Net Recharge for the TSY Ensemble, FY 2021-2030 6-25
Figure 6-17. Likelihood-Weighted Exceedance Curve Average Net Recharge for TSY Ensemble, FY 2021-2030 6-27
Figure 6-18. Hydraulic Head Contours – Layer 1 6-29
Figure 6-19. Hydraulic Head Contours – Layer 3 6-30

DRAFT

Figure 6-20. Hydraulic Head Contours – Layer 5 6-31
Figure 6-21. Projected Hydraulic Head Change – Layer 1 Scenario D1 6-33
Figure 6-22. Projected Hydraulic Head Change – Layer 1 Scenario E9 6-34
Figure 6-23. Projected Hydraulic Head Change – Layer 1 Scenario A5 6-35
Figure 6-24. Projected Hydraulic Head Change – Layer 1 Scenario D1 6-37
Figure 6-25. Projected Hydraulic Head Change – Layer 1 Scenario E9 6-38
Figure 6-26. Projected Hydraulic Head Change – Layer 1 Scenario A5 6-39
Figure 6-27. Projected Groundwater Level Elevations and Flow Vectors for July 2030 Scenario D1, Layer 1 6-40
Figure 6-28. Projected Groundwater Level Elevations and Flow Vectors for July 2030 Scenario E9, Layer 1 6-41
Figure 6-29. Projected Groundwater Level Elevations and Flow Vectors for July 2030 Scenario A5, Layer 1 6-42
Figure 6-30. Projected Groundwater Level Elevations and Flow Vectors for July 2050 Scenario D1, Layer 1 6-43
Figure 6-31. Projected Groundwater Level Elevations and Flow Vectors for July 2050 Scenario E9, Layer 1 6-44
Figure 6-32. Projected Groundwater Level Elevations and Flow Vectors for July 2050 Scenario A5, Layer 1 6-45
Figure 7-1. Site-Specific MPI Thresholds for Land Subsidence 7-5
Figure 7-2. Assessment of MPI due to Land Subsidence 2030 and 2050, Central MZ-1 7-8
Figure 7-3. Assessment of MPI due to Land Subsidence 2030 and 2050, Northeast Area 7-9
Figure 7-4. Assessment of MPI due to Land Subsidence 2030 and 2050, Northwest MZ-1 7-10
Figure 7-5. Assessment of MPI due to Land Subsidence 2030 and 2050, Southeast Area 7-11
Figure 7-6. Simulated Groundwater Levels Well 7-12
Figure 7-7. Count of Subareas Indicating MPI for Land Subsidence for the TSY Ensemble (FY 2030 and 2050) 7-13
Figure 7-8. Change in Storage and Prevalence of MPI for Land Subsidence 7-17
Figure 7-9. Wells with Pumping Sustainability Thresholds 7-19
Figure 7-10. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Chino Basin Desalter Authority 7-22
Figure 7-11. Assessment of MPI due to Pumping Sustainability 2030 and 2050, City of Chino 7-23
Figure 7-12. Assessment of MPI due to Pumping Sustainability 2030 and 2050, City of Chino Hills 7-24
Figure 7-13. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Cucamonga Valley Water District 7-25

DRAFT

Figure 7-14. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Fontana Water Company 7-26
Figure 7-15. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Golden State Water Company 7-27
Figure 7-16. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Jurupa Community Services District 7-28
Figure 7-17. Assessment of MPI due to Pumping Sustainability 2030 and 2050, Monte Vista Water District 7-29
Figure 7-18. Assessment of MPI due to Pumping Sustainability 2030 and 2050, City of Ontario 7-30
Figure 7-19. Assessment of MPI due to Pumping Sustainability 2030 and 2050, City of Pomona 7-31
Figure 7-20. Assessment of MPI due to Pumping Sustainability 2030 and 2050, City of Upland 7-32
Figure 7-21. Count of Subareas Indicating MPI for Pumping Sustainability for the TSY Ensemble (FY 2030 and 2050). 7-33
Figure 7-22. Change in Storage and Prevalence of MPI for Pumping Sustainability 7-37
Figure 7-23. Groundwater Flow Vectors and Groundwater Pumping Near Line of Hydraulic Control, Scenario D1 - 2030 7-40
Figure 7-24. Groundwater Flow Vectors and Groundwater Pumping near Line of Hydraulic Control, Scenario D1 - 2050 7-41
Figure 7-25. Flow through Chino Creek Well Field – TSY Ensemble 7-42
Figure 7-26. Count of Subareas Indicating MPI for All Categories for the TSY Ensemble (FY 2030 and 2050). 7-43
Figure 7-27. Change in Storage and Prevalence of MPI, TSY Ensemble 7-45

LIST OF APPENDICES

Appendix A. Supplemental Hydrogeologic Information
Appendix B. Results from the Calibration and Uncertainty Analysis
Appendix C. Scenario Design Information
Appendix D. TSY Ensemble Results
Appendix E. Peer Review and Stakeholder Comments and Responses

DRAFT

LIST OF ACRONYMS AND ABBREVIATIONS

2015 SYRM	2015 Safe Yield Reset Methodology
2017 Court Order	April 28, 2017 Court Order on the Safe Yield of the Chino Basin
2020 SYR	2020 Safe Yield Recalculation
2022 R&R	Rules and Regulations
2025 CVM	2025 Chino Valley Model
2025 SYR	2025 Safe Yield Reevaluation
afy	Acre-Feet/Year
AP	Appropriative Pool
Basin	Chino Basin
CDA	Chino Basin Desalter Authority
CDFM	Cumulative Departure from Mean Precipitation
CF	Change Factor
CII	Commercial, Industrial, And Institutional
CMIP6	Coupled Model Intercomparison Project
CVM	Chino Valley Model
DEM	Digital Elevation Model
DIM	Dedicated Irrigation Meter
DIPAW	Deep Infiltration of Precipitation and Applied Water
DWR	Department of Water Resources
ET	Evapotranspiration
ET_o	Reference Evapotranspiration
ETS1	Evapotranspiration Segments Package
FHB	Flow and Head Boundary Package
FY	Fiscal Year
GLMC	Ground-Level Monitoring Committee
GSP	Groundwater Sustainability Plan
GWU	Groundwater Utilization
HCM	Hydrogeologic Conceptual Model
HFB	Horizontal-Flow Barrier
HK	Horizontal Hydraulic Conductivity
HSPF	Hydrologic Simulation Program – Fortran
iES	Iterative Ensemble Smoother
IEUA	Inland Empire Utilities Area
InSAR	Interferometric Synthetic Aperture Radar
IWU	Imported Water Utilization
Judgment	Stipulated Judgment
LST	Land Subsidence Threshold
MNW2	Multi-node Well Package
MPI	Material Physical Injury
MWD	Metropolitan Water District of Southern California

DRAFT

MZ-1	Management Zone 1
NDVI	Normalized Difference Vegetation Index
NSE	Nash-Sutcliffe Efficiency
OBMP	Optimum Basin Management Program
ONAP	Overlying Non-Agricultural Pool
OWDS	Onsite Wastewater Disposal System
PBHSP	Prado Basin Habitat Sustainability Program
PEST	Parameter Estimation
PRISM	Parameter-Elevation Relationships on Independent Slopes Model
PST	Pumping Sustainability Threshold
RCH	Recharge Package
RDM	Robust Decision Making
RMSE	Root Mean Squared Error
SAR	Santa Ana River
SFR	Streamflow-Routing Package
SS	Specific Storage
SSP&A	S.S. Papadopulos and Associates
State Board	State Water Resources Control Board
SY	Specific Yield
TM	Technical Memorandum
TSY	Tentative Safe Yield
UOWU	Urban Outdoor Water Use
USGS	United Stated Geological Survey
UWMP	Urban Water Management Plan
VK	Vertical Hydraulic Conductivity
WEL	Well Package
WQMP	Water Quality Management Program
WY	Water Year

DRAFT

SECTION 1
Introduction

This *2025 Safe Yield Reevaluation* (2025 SYR) report describes and documents the evaluation of the Safe Yield of the Chino Basin for the period of Fiscal Year (FY) 2021 through 2030.[1] The 2025 SYR was completed pursuant to the April 28, 2017 Court Order on the Safe Yield of the Chino Basin (2017 Court Order),[2,3] which was incorporated into Watermaster's Rules and Regulations (2022 R&R).[4] This 2025 SYR follows the 2022 Safe Yield Reset Methodology that was approved by the Court in December 2022. This section describes background information on the Court requirements to conduct the 2025 SYR, the scope of work of this effort, the peer review and stakeholder engagement, and the organization of this report.

1.1 BACKGROUND

The original Safe Yield of the Chino Basin (Basin) was defined in the Stipulated Judgment (Judgment) entered in 1978 (Chino Basin Municipal Water District vs. the City of Chino et al. [SBSC Case No. RCV 51010]). Figure 1-1 shows the adjudicated and hydrologic boundaries of the Basin. The Judgment defined the Safe Yield as "[t]he long-term average annual quantity of ground water... which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result," set an initial Safe Yield of 140,000 acre-feet/year (afy), and defined the allocation of pumping rights among the Parties. A physical solution was also established, requiring the Court-appointed Watermaster (the Chino Basin Watermaster, or Watermaster) to offset pumping in excess of these rights by acquiring and recharging supplemental water funded by assessments on over-producers.

In 2000, Watermaster developed the Optimum Basin Management Program (OBMP) and the Parties to the Judgment entered into the Peace Agreement and prepared the OBMP Implementation Plan. The OBMP Implementation Plan required that Watermaster recalculate the Safe Yield in 2011 and every ten years thereafter, acknowledging that the Safe Yield is influenced by changes in cultural conditions such as land use, water use, and groundwater pumping patterns.

1.1.1 Prior Safe Yield Recalculations

The initial Safe Yield recalculation was completed in 2015 for the period from FY 2011 through 2020. The methodology for this recalculation, known as the 2015 Safe Yield Reset Methodology (2015 SYRM), relied on long-term hydrology and incorporated data spanning 1921 to 2011. The 2015 SYRM involved recalibrating Watermaster's groundwater-flow model using the most recent data available, especially data collected since the implementation of the OBMP. To estimate the future net recharge in the Basin, the 2015 SYRM also considered a long-term historical record of precipitation along with anticipated future charges in cultural conditions, such as plans for pumping, stormwater recharge, and supplemental water recharge. Based on this process, a Safe Yield of 135,000 afy was calculated for the period from FY 2011 through 2020.

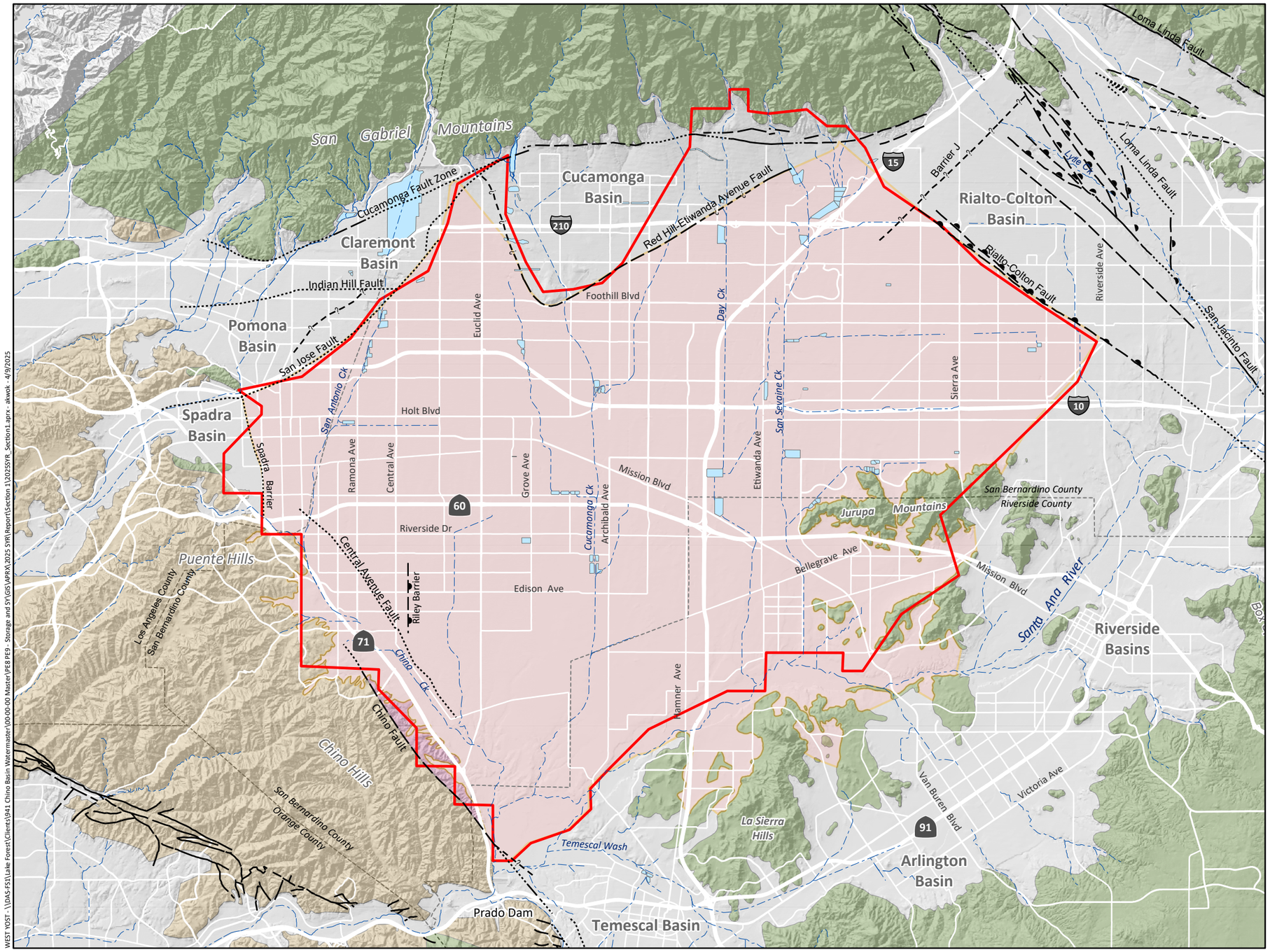
---

[1] 20200716 Notice of Lodging of [Proposed] Order re CBWM Motion re 2020 Safe Yield Reset.pdf

[2] *Orders for Watermaster's Motion Regarding* the *2015 Safe Yield Reset Agreement, Amendment of Restated Judgment, Paragraph 6,* Superior Court for the County of San Bernardino (2017).

[3] *Order Regarding the Appeal Parties Motion,* Superior Court for the County of San Bernardino (2019).

[4] 2022 Watermaster Rules and Regulations



Chino Basin Adjudicated Boundary

Chino Basin Hydrologic Boundary

Rivers and Streams

Flood Control and/or Conservation Basins

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Plio-Pleistocene Sedimentary Rocks

Cretaceous to Miocene Sedimentary Rocks

Pre-Tertiary Igneous and Metamorphic Rocks

Faults

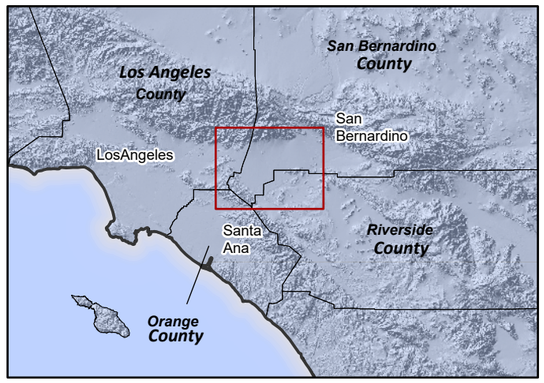
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 2 4 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Recalculation

Hydrologic and Adjudicated Boundaries of the Chino Basin

DRAFT

Figure 1-1

WEST YOST - \\DAS-FS1\Lake Forest\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX\2025 SYR\GIS\APRX\2025 SYR\Report\Section 1\2025SYR_Section1.aprx - akwok - 4/9/2025

Pursuant to the 2017 Court Order, Watermaster completed the 2020 Safe Yield Recalculation (2020 SYR) for the period of FY 2021 through 2030 using on the 2015 SYRM. Watermaster's groundwater-flow model was recalibrated using long-term historical data and was used to project a prospective net recharge to the Basin of 131,000 afy under then-current and projected cultural conditions for the period of FY 2021 through 2030. The 2020 SYR resulted in the Court adopting a Safe Yield of 131,000 afy for the period of FY 2021 through 2030.

1.1.2 2022 Safe Yield Reset Methodology

During the peer review process for the 2020 SYR, the parties and peer reviewers provided several comments and recommendations to address the uncertainty in future water plans in calculating the Safe Yield. These included recommendations to simulate multiple pumping scenarios to address predictive uncertainty more comprehensively. In addition to the comments on the 2020 SYR Report, the City of Chino opposed the 2020 Safe Yield Reset on the grounds that the process did not adequately address uncertainty.[5]

The 2017 Court Order[6] permits Watermaster, with recommendation and advice from the Pools and Advisory Committee, to supplement the 2015 SYRM by incorporating advancements in best management practices and hydrologic science. In response to recommendations arising from the 2020 SYR, objections to the 2020 SYR, and pursuant to the authority granted by the 2017 Court Order, Watermaster initiated a process in 2021 to update the 2015 SYRM.

The SYRM update process began in October 2021. Three workshops occurred during the period from October 2021 through July 2022, in which three draft technical memoranda were circulated for review and comment by the parties and technical peer reviewers. The final technical memorandum (TM) documenting the revised SYRM (called the 2022 Safe Yield Reset Methodology, or 2022 SYRM) was published on October 6, 2022[7] and approved by the Court in December 2022.[8] The 2022 SYRM includes the following steps:

(i) Use data collected since the implementation of the OBMP to re-calibrate the Watermaster's groundwater-flow model. The re-calibration period should be long enough to include wet and dry periods relative to the long-term historical precipitation record.

(ii) Conduct an uncertainty analysis of the re-calibrated groundwater-flow model to identify a plausible range of calibrated models.

(iii) Describe current and projected future cultural conditions, including but not limited to land use and water-management practices, such as: pumping, managed recharge, managed groundwater storage, impervious land cover, water recycling, and water conservation practices. Identify a possible range of projected future cultural conditions.

(iv) Using the most current research on future climate and hydrology, identify a possible range of projected future climatic conditions in the Santa Ana River watershed.

[5] 20200615 City of Chino's Opposition to CVWM Motion re 2020 Safe Yield Reset.pdf

[6] See pages 16-17 of the 2017 Court Order and Section 6.5(d) of the 2022 R&R.

[7] Final 2022 SYRM TM

[8] 20221219 Notice of Ruling and Entry of Orders.pdf

(v) *Using the results of [3.] and [4.] above, prepare an ensemble of multiple projection scenarios of combinations of future climate/hydrology and cultural conditions (herein called the "Projection Ensemble"). Assign likelihoods to each scenario in the Projection Ensemble.*

(vi) *Simulate the range for the potential future water budget and groundwater conditions in the Chino Basin over no less than a 50-year future period. This is accomplished by using:*

- i. *The range of calibrated models developed in [2.], and*
- ii. *The Projection Ensemble developed in [5.] as model input data.*

(vii) *Using the results of [6.] above, characterize the range in the model results for:*

- i. *Groundwater conditions, including: groundwater elevations, groundwater in storage, and groundwater flow directions, and*
- ii. *The water budget, including: basin inflows, outflows, change in storage, and net recharge.*

(viii) *Using the set of net recharge results from [7.ii], determine a tentative Safe Yield as the likelihood-weighted average net recharge over the 10-year prospective period for which the Safe Yield is being redetermined (Tentative Safe Yield).*

(ix) *Evaluate whether the groundwater production at the Tentative Safe Yield estimated in [8] above will cause or threaten to cause "undesirable results" or "Material Physical Injury." If groundwater production at Tentative Safe Yield will cause or threaten to cause "undesirable results" or "Material Physical Injury," then Watermaster will identify and implement prudent measures necessary to mitigate "undesirable results" or "Material Physical Injury," set the value of Safe Yield to ensure there is no "undesirable results" or "Material Physical Injury," or implement a combination of mitigation measures and a changed Safe Yield.*

1.1.3 2025 Safe Yield Reevaluation

The 2017 Court Order (restated in Section 6.5(f) of the 2022 R&R) requires that Watermaster update its groundwater model and evaluate the 2020 Safe Yield (131,000 afy) by June 30, 2025. Watermaster maintains and updates the Chino Valley Model (CVM) to facilitate this evaluation. The CVM, used for the 2020 SYR, has been updated for the 2025 SYR to implement the 2022 SYRM.

The 2025 SYR will apply the 2022 SYRM to evaluate the current Safe Yield for FY 2021 through 2030. If the Section 6.5(c) of the 2022 R&R outlines the potential next steps if the 2025 SYR results indicate that the reevaluated Safe Yield deviates by more than 2.5% from the current Safe Yield. This section states that the Safe Yield may be reset if:

(i) *with the recommendation and advice of the Pools and Advisory Committee and in the exercise of prudent management discretion described in Section 6.5(e)(iii), below, Watermaster recommends to the court that the Safe Yield must be changed by an amount greater (more or less) than 2.5% of the then-effective Safe Yield.*

(ii) The California State Water Resources Control Board develops water conservation measures prior to June 30, 2030, that result in a reduction in urban irrigation in the Chino Basin (i.e., reduced Evapotranspiration Adjustment Factors), as required by Water Code § 10609, et seq., that is reasonably likely to materially reduce recharge in the Chino Basin and such measures are determined to change the Safe Yield by more than 2.5% of the then-effective Safe Yield, and Watermaster moves the Court to reset the Safe Yield accordingly. (Orders Regarding Chino Basin Watermaster Motion Regarding 2020 Safe Yield Reset, Amendment of Restated Judgment, Paragraph 6, dated July 31, 2020 at 15.)

1.2 SCOPE OF WORK

The scope of work for the 2025 SYR includes the following key tasks:

- **Task 1 – Update Hydrogeologic Conceptual Model.** This task involves using the most current information to update the description of the Chino Basin hydrogeology and then translate the hydrogeologic description to the CVM.
- **Task 2 – Update Model and Input Data for Historical Period.** This task involves extending and updating the input data for the surface water and groundwater models through the historical calibration period to prepare for model recalibration.
- **Task 3 – Recalibrate Groundwater Model to Generate Calibrated Realizations.** This task involves recalibrating the CVM using historical data for the updated calibration period (FY 1992 through 2022) and employing uncertainty analysis methods like PESTPP-IES to generate a range of plausible calibrated model realizations.
- **Task 4 – Develop Planning Scenarios.** This task involves creating an ensemble of future projection scenarios that incorporate uncertainties in water demands, supply plans, and climate conditions through stakeholder engagement and analysis of available planning documents.
- **Task 5 – Conduct Planning Simulations to Update Projections of Net Recharge, Identify Undesirable Results and Associated Mitigation Measures, and Reevaluate Safe Yield.** This task utilizes the calibrated CVM realizations and projection scenarios to simulate future conditions, project net recharge, evaluate potential undesirable results or material physical injury (MPI), and develop recommendations for the Safe Yield and any potential mitigation measures.
- **Task 6 – Prepare Safe Yield Reevaluation Report.** This task involves documenting the entire 2025 SYR process, including methodologies, results, analyses, and recommendations in a comprehensive report.

DRAFT

1.3 PEER REVIEW AND STAKEHOLDER ENGAGEMENT

Section 6.5(g) of the 2022 R&R requires the Pools to have the opportunity for peer review of the 2025 SYR. The 2025 SYR was developed with input from the parties and stakeholders through a series of workshops and TMs. Watermaster hosted 10 workshops to review gather feedback on interim results and various stages of the process. The workshops and TMs that supported this work are listed below.

- Workshops:
  - August 30, 2023 – Hydrogeologic Conceptual Model
  - October 24, 2023 – Scenario Design (#1)
  - March 7, 2024 – Scenario Design (#2)
  - May 29, 2024 – Calibration and Uncertainty Analysis (#1)
  - June 25, 2024 – Scenario Design (#3)
  - August 6, 2024 – Calibration and Uncertainty Analysis (#2)
  - August 27, 2024 – Scenario Design (#4)
  - November 20, 2024 – SYR Process and Evaluation of Material Physical Injury
  - March 25, 2025 – Preliminary Results
  - November 6, 2025 – Draft 2025 SYR Report
  - May 20, 2026 – Revised Draft 2025 SYR Report
- TMs/Reports:
  - Scenario Design TM #1
  - Scenario Design TM #2
  - Scenario Design TM #3
  - Analysis of Material Physical Injury and Undesirable Results for the 2025 SYR
  - 2025 Safe Yield Reevaluation Report (this report)

Each of the presentations and TMs (including draft documents) listed above are hosted on Watermaster's website[9] and were maintained for access throughout the 2025 SYR process. The written comments provided by the parties and stakeholders on the presentations and TMs were included as appendices in the TMs. Written comments from the March 25, 2025, November 6, 2025 workshop, and on the draft 2025 SYR report are documented with responses in Appendix E of this report.

1.3.1 Third-Party Peer Review of 2025 CVM and 2025 SYR

Following the March 25, 2025 workshop, the Watermaster Board directed staff to engage a third-party consultant to conduct an independent peer review of the 2025 CVM and the SYR assumptions and findings. Watermaster selected S.S. Papadopulos & Associates (SSP&A) to perform this review. The peer review was conducted from July through September 2025 and culminated with SSP&A presenting findings and recommendations to the Watermaster Advisory Committee and Board in September 2025 and

[9] https://cbwm.org/pages/syrm/

submitting a report of the findings and recommendations in October 2025. The full peer review report, along with West Yost's responses, is provided in Appendix E.

At the Appropriative Pool (AP) Committee meeting on December 11, 2025, the AP requested that West Yost work with the AP's consultant, Thomas Harder and Company (THC) to develop a scope to address the peer review recommendations. West Yost met with THC staff in December 2025 to discuss a draft of the scope of work to respond to the peer review recommendations.

1.3.1.1 Implementation of Peer Review Recommendations

In January 2026, the Watermaster Board approved a scope of work to implement selected peer review recommendations and revise the 2025 SYR study and report.[10] The scope of work was developed to incorporate the major recommendations that would impact the evaluation of the Safe Yield and support the documentation of the surface-water model component of the 2025 CVM (i.e., the HSPF and R4 models – See Section 3). The scope of work included the following tasks:

- Task 1. Develop Integrated Water Budgets
- Task 2. Refine Calibration Data
- Task 3. Refine Model Mechanics and Numerical Stability
- Task 4. Prepare, Run, and Process Additional PESTPP-IES Configuration and Projection Ensemble
- Task 5. Update Report and Appendices
- Task 6. Conduct Stakeholder Workshop
- Task 7. Project Management and Meetings Workshops

This scope of work was initiated in February 2026. During the execution of Tasks 1 through 4, West Yost held four meetings with staff from Watermaster, THC, and SSP&A to review intermediate results, answer questions, and gather feedback. Revisions made to the 2025 SYR to implement the peer review recommendations are noted throughout the report.

1.4 REPORT ORGANIZATION

The remaining sections of this report are described below:

- **Section 2** – **Update of Hydrogeologic Conceptual Model**: This section describes the new information gathered and interpreted since the 2020 SYR on the hydrogeology of the Chino Basin, including the geologic setting, stratigraphy, base of aquifer, occurrence and movement of groundwater, aquifer system, aquifer properties, and land subsidence.
- **Section 3** – **Model Updates**: This section describes the updates made to the 2025 CVM including the surface water models, vadose zone models, and the groundwater-flow model.
- **Section 4** – **Model Calibration and Uncertainty Analysis**: This section documents the calibration of the CVM using a pilot point method and PESTPP-IES to generate multiple

[10] Business Item III.B. of the January 22, 2026 Watermaster Board meeting (Meeting Package)

calibrated model realizations and presents the results of the calibration process including the historical water budget, a discussion of uncertainty, and the selected calibrated realizations.

- **Section 5** – **Projection Ensemble:** This section describes the development of the projection ensemble including: stakeholder engagement and timeline, the characterization of uncertainty in future climate and cultural conditions, and the final Projection Ensemble.
- **Section 6 – 2025 Safe Yield Reevaluation:** This section describes the evaluation criteria, the calculation of net recharge, the analysis of results of the Projection Ensemble for MPI, and the reevaluated Safe Yield for FY 2021 through 2030.
- **Section 7 – Conclusions and Recommendations:** This section provides a summary of the findings from the 2025 SYR, including recommendations for future evaluations and/or management considerations based on these findings.
- **Appendix A – Supplemental Hydrogeologic Information**
- **Appendix B – Results from the Calibration and Uncertainty Analysis**
- **Appendix C – Scenario Design Information**
- **Appendix D – TSY Ensemble Results**
- **Appendix E – Peer Review and Stakeholder Comments and Responses**

DRAFT

SECTION 2
Update of Hydrogeologic Conceptual Model

2.1 INTRODUCTION AND SCOPE

This section describes the new information and updates that were made to the geologic and hydrogeologic understanding and conceptual model for the groundwater basins that are simulated in the 2025 Chino Valley Model (2025 CVM), which include the Chino Basin, Cucamonga Basin, Six Basins, Spadra Basin, and Temescal Basin. Figure 2-1 shows these groundwater basins, the regional geology, and the model domain of the 2025 CVM.

The 2020 SYR Report described the hydrogeologic and hydrologic setting of the groundwater basins within the 2020 CVM domain, as well as the hydrogeologic conceptual model (HCM) that serves as the foundation for both the 2020 CVM and the 2025 CVM. An HCM is a description of the geologic and hydrologic framework governing the occurrence of groundwater and its flow through and across the boundaries of a basin and the general groundwater conditions in a basin or subbasin.[1]

The scope of Task 1 for the 2025 SYR includes: (i) review new data and information; (ii) update the HCM; and (iii) use the updated HCM to update the 2025 CVM. The following types of new data and information were used to update the HCM and the 2025 CVM:

- Geologic and lithologic information, such as new well lithologic logs and pump tests
- Remote sensing data
- Information on faults and basin boundaries that may affect groundwater flow

2.2 GEOLOGIC AND LITHOLOGIC INFORMATION

During the development of the 2025 CVM, Watermaster completed an inventory of new well information compiled since 2018, the cutoff for date for the update of the 2020 CVM. Watermaster maintains a comprehensive well inventory, which was augmented through contacting several agencies that have recently installed wells in the 2025 CVM domain. This effort yielded approximately 80 new well logs. Figure 2-2 is a map that shows the locations and depths of the new well logs (symbolized by CVM layer penetrated by the wells). Some of the new wells are located near each other or are nested wells, resulting in overlapping locations on the map.

The HCM relies heavily on lithological data from well driller's logs, which provide depth-specific descriptions of the thicknesses, type, and texture of the aquifer sediments that are used to characterize the basin hydrostratigraphy. For the 2025 CVM, the process of collecting and reviewing new well information was continued to update the HCM, building upon the approximately 1,150 logs reviewed for the development of the 2020 CVM and prior models.

Several of the new borehole lithologic logs were used to revise the hydrogeologic cross-sections of the HCM. Figure 2-3 shows the locations of the hydrogeologic cross-sections, with highlights indicating revisions since the 2020 CVM. Seven new wells, two in the Spadra Basin and five in the Chino Basin, were incorporated onto the cross-sections. Two wells that were used in the 2020 CVM were added to the cross-sections: Pomona well P-21 was added to more clearly delineate the Spadra Barrier (see Section 2.4), and the Monte Vista Water District Well 28 was added to more clearly delineate the layers

[1] Cal. Code Regs. Tit. 23, § 341(q)

in this region, as this lithology was used to develop a one-dimensional compaction model of the aquifer[2] to support Ground-Level Monitoring Program investigations of land subsidence. The revised cross-sections are in Appendix A.

The new hydrogeologic information, including the new well lithologic logs, were used for several updates to the 2025 CVM, including:

- Revising CVM layer elevations and thickness to improve the representation of the subsurface hydrostratigraphy.
- Integrating new information onto hydrostratigraphic sections to provide a visual representation of the subsurface hydrostratigraphy.
- Refining the understanding and characterization of the spatial distribution and values of aquifer properties.

2.3 REMOTE SENSING

Watermaster uses remote sensing datasets to support various monitoring efforts, such as the Prado Basin Habitat Sustainability Program and the Ground-Level Monitoring Program. To update the 2025 CVM, Watermaster reviewed the latest data from three remote sensing datasets: Interferometric Synthetic Aperture Radar (InSAR), Normalized Difference Vegetation Index (NDVI) and aerial photos of the Prado Basin, and a Digital Elevation Model (DEM). Watermaster reviewed the recent data for each of these datasets to inform updates to the 2025 CVM, each described in more detail below.

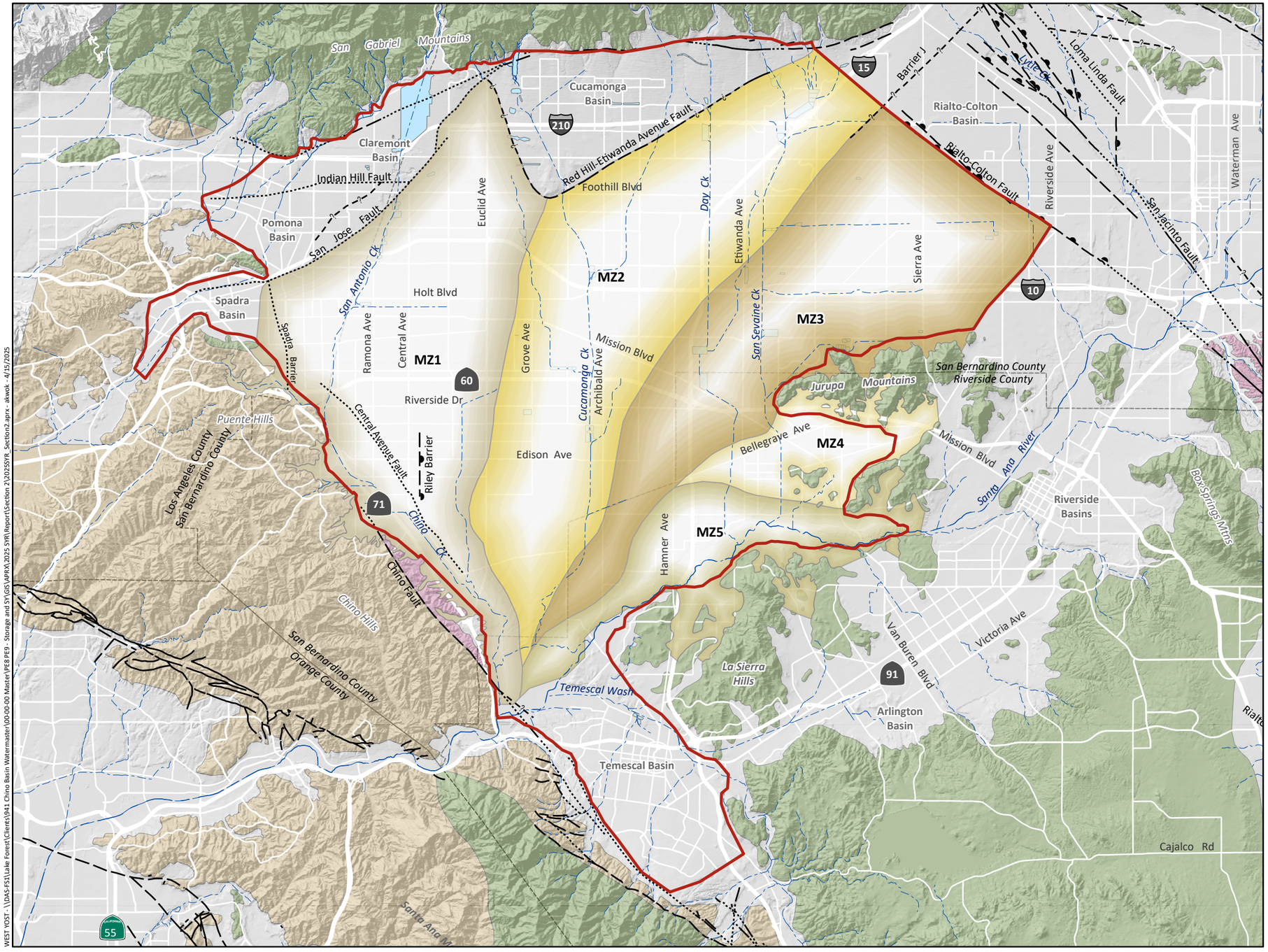
2.3.1 InSAR

Historically, the Watermaster has used InSAR as a monitoring technique to track vertical ground motion (e.g., land subsidence) as an element of its Ground-Level Monitoring Program. For instance, as groundwater levels rise, the aquifer-system sediments can expand under the increased heads, and the land surface can rise. Conversely, as groundwater levels decline, the aquifer-system sediments can compress or compact permanently, and the land surface can fall (i.e., land subsidence). Because of these aquifer-system mechanics that respond to rising and falling groundwater levels, InSAR has proven valuable in identifying the locations of subsurface faults and barriers to groundwater flow within the CVM domain.[3] This is because groundwater levels oftentimes deform differently on either side of fault barriers, which causes differential vertical ground motion across the fault barriers.

Recent InSAR data collected since the development of the 2020 CVM were reviewed to refine the location of certain fault barriers within the CVM domain. During the winter of FY 2023, InSAR measurements captured differential vertical ground motion in the northwestern corner of the CVM domain during a period of higher-than-average precipitation and recharge in the Six Basins and Cucamonga Basin. These data proved useful in refining the location of the West Cucamonga Barrier and the San Jose Fault in these areas.

[2] TM - 941 - 1D Model - Final.pdf

[3] Wildermuth Environmental, Inc. 2017. Strategic Plan for the Six Basins. Prepared for the Six Basins Watermaster. November 2017. Link



Chino Basin OBMP Management Zones

MODFLOW Model Boundary

Rivers and Streams

Flood Control and/or Conservation Basins

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Plio-Pleistocene Sedimentary Rocks

Cretaceous to Miocene Sedimentary Rocks

Pre-Tertiary Igneous and Metamorphic Rocks

Santa_Ana_River

Faults

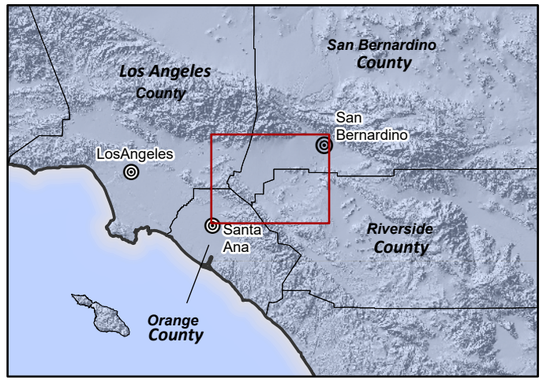
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

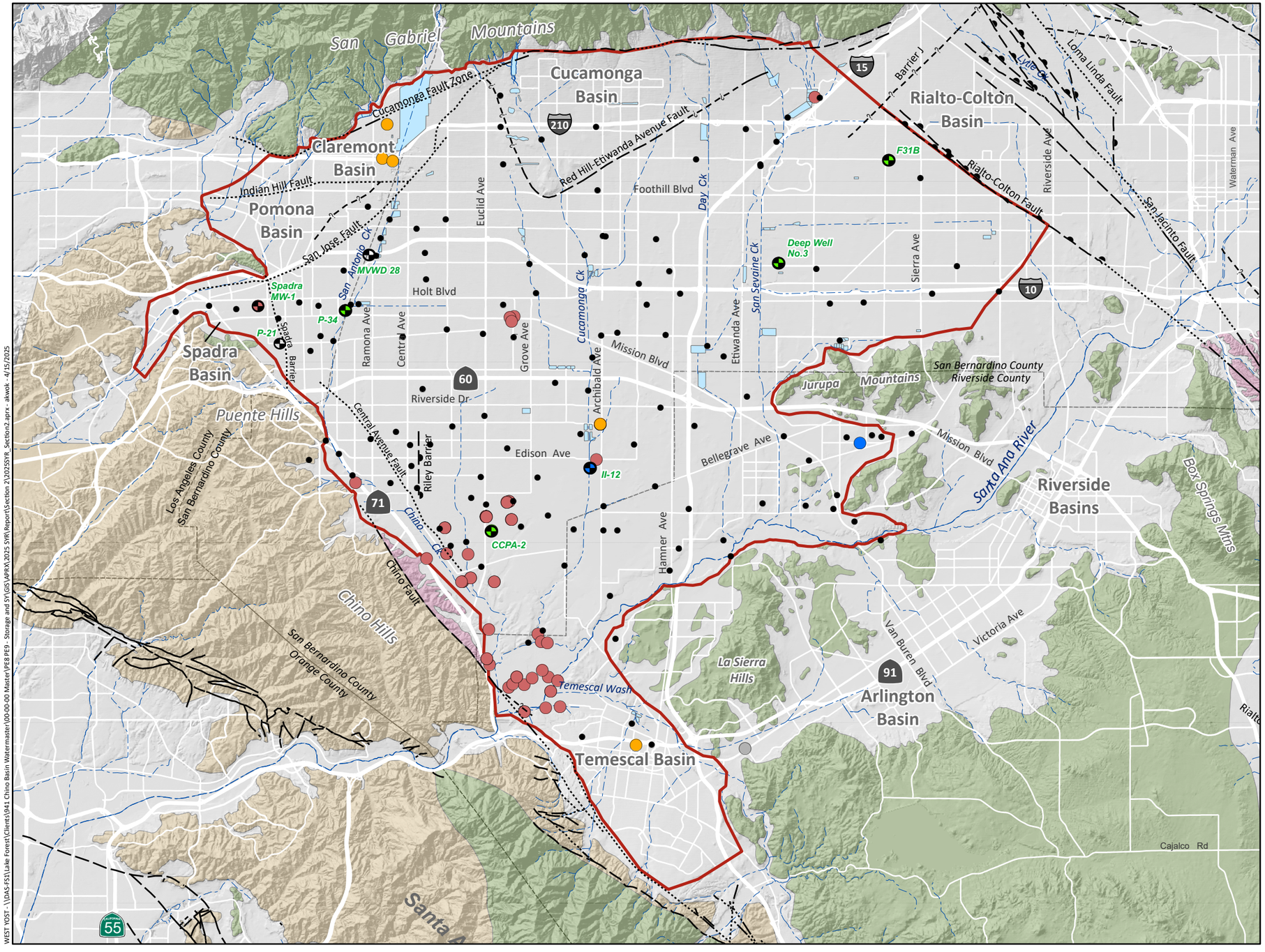
Chino Basin Watermaster
2025 Safe Yield Recalculation

Geologic Map and Boundaries of the Chino Basin

DRAFT

Figure 2-1

WEST YOST - \\OAS-FS1\Lake Forest\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX 2025 SYR\Report\Section 2\2025SYR_Section2.aprx - akwok - 4/15/2025



Borehole added to the HCM in the 2025 CVM

Borehole Lithology Used for the 2020 HCM Cross-Section

New Borehole Data Acquired for 2025 CVM

Symbolized by Aquifer Layer

- Layer 1
- Layers 1-2
- Layers 1-3
- Layers 1-4
- Layers 1-5
- Well Outside CVM Domain

MODFLOW Model Boundary

Rivers and Streams

Flood Control and/or Conservation Basins

Geology

Water-Bearing Sediments

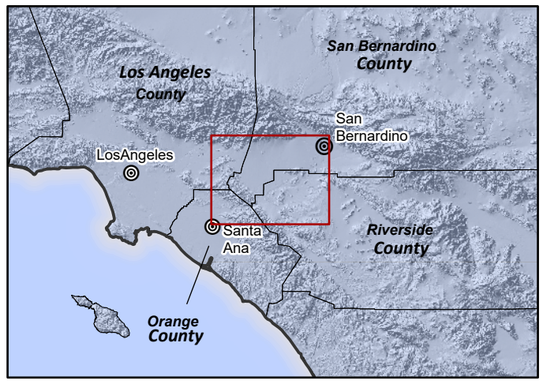
- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Recalculation

Borehole Locations Used to Describe the Hydrogeologic Conceptual Model

DRAFT

Figure 2-2

WEST YOST - \\DAS-FS1\Lake Forest\Clients\1941 Chino Basin Watermaster\100-00.00 Master\PE8 PE9 - Storage and SY\GIS\APRIX 2025 SYR\Report\Section 2\2025SYR_Section2.aprx - akwok - 4/15/2025

Hydrostratigraphic Cross-Section Profile Line Revised for the 2025 CVM

Hydrostratigraphic Cross-Section Profile Line Used for the 2020 and 2025 CVM

Borehole Used in Hydrostratigraphic Cross-Section

Borehole Added to Hydrostratigraphic Cross-Section for the 2025 CVM

MODFLOW Model Boundary

Rivers and Streams

Flood Control and/or Conservation Basins

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Plio-Pleistocene Sedimentary Rocks

Cretaceous to Miocene Sedimentary Rocks

Pre-Tertiary Igneous and Metamorphic Rocks

Faults

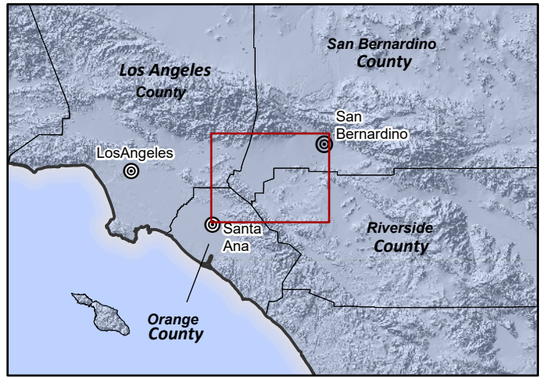
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Recalculation

Map View of the Hydrostratigraphic Cross-Sections

DRAFT

Figure 2-3

WEST YOST - \\DAS-FS1\Lake Forest\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX\2025 SYR\2025 SYR_Section2.aprx - akwok - 4/15/2025

Figure 2-4 illustrates the vertical ground motion observed in the northwestern corner of the CVM domain between Spring 2022 and Spring 2023. The areas in the Six Basins and Cucamonga Basin exhibited uplift because of the large volumes of recharge and increases in groundwater levels north of the of the West Cucamonga Barrier and the San Jose Fault, while little to no ground motion occurred south of these fault barriers. These findings not only illustrate improved understanding about the location of the fault barriers but also suggest that groundwater flow is restricted across the fault barriers. These observations and insights were used to revise the hydrologic boundary of the Chino Basin and the delineation of the San Jose Fault and the West Cucamonga Barrier in the 2025 CVM. Figure 2-4 illustrates these changes by showing the hydrologic basin boundary in the 2020 CVM as a gray line and the revised boundary in the 2025 CVM as a red line.

2.3.2 NDVI and Aerial Photos

The Prado Basin Habitat Sustainability Program (PBHSP) is designed to monitor the extent and health of the riparian vegetation in the Prado Basin in the southern Chino Basin, which is the largest groundwater-dependent ecosystem in southern California. The PBHSP publishes annual reports to document the monitoring data, analyses, and interpretations. As part of the PBHSP, Watermaster routinely collects and evaluates NDVI data and aerial photographs of the Prado Basin to determine the extent, density, and health of riparian vegetation in Prado Basin over time. For the 2025 CVM update, Watermaster reviewed these datasets in the context of the estimation of groundwater evapotranspiration (ET) in this area, which is one of the key processes that governs the water budget of the Chino Basin. Appendix B of the 2020 SYR Report documented the assumptions and process to calculate ET from the Prado Basin in the 2020 CVM.

Based on the review of the new NDVI data and aerial photos, it was determined that no changes were necessary to the existing ET estimation process, or the delineation of the riparian vegetation as implemented in the 2020 CVM. The spatial extent and density of the riparian vegetation used in the 2020 CVM has remained consistent since 2020 CVM was completed.

2.3.3 DEM

The groundwater and surface water interactions between the Chino Basin and the Santa Ana River (SAR) are important dynamics that are simulated by the CVM. Accurately characterizing the geometry (e.g., stream-bottom elevations and slope) and location of the SAR are key data for the simulations. In the 2020 CVM, the geometry and location of the SAR were computed using a 10-meter DEM from the United Stated Geological Survey (USGS). For the development of the 2025 CVM, Watermaster gathered the most recent 1-meter DEM data (2018) and aerial photos of the SAR. With these data, Watermaster updated the streambed elevations, slopes, and stream cross-sections to characterize the SAR in the groundwater-flow model.

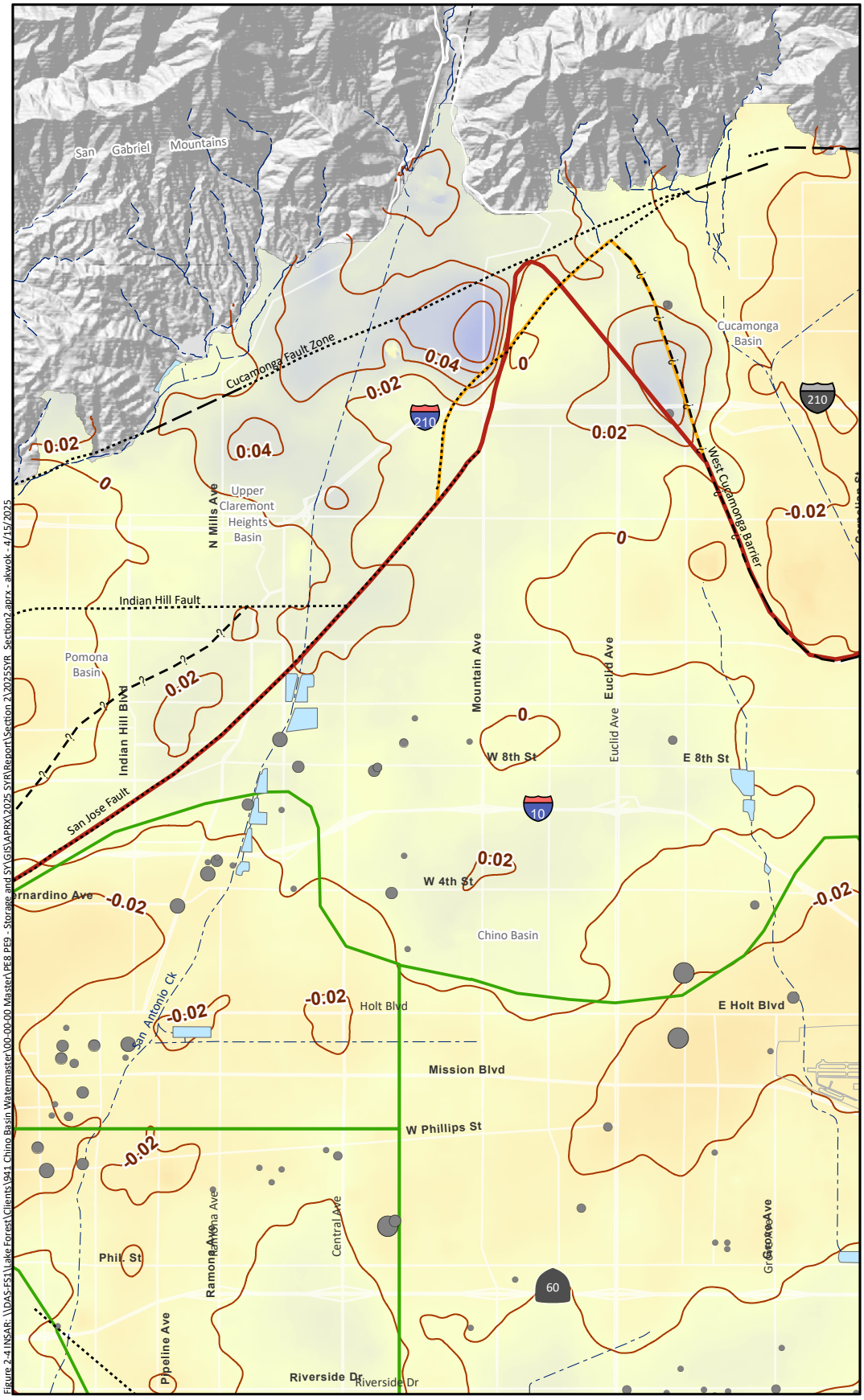


Figure 2-4 INSAR: \\DAS-FS1\Lake Forest\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 2\2025SYR_Section2.aprx - akwok - 4/15/2025

Hydrologic Boundary for the 2020 CVM

Hydrologic Boundary for the 2025 CVM

Relative Change in Land Surface Elevation as Estimated by InSAR

March 2022 to May 2023

+ 0.2 ft

- 0.2 ft

InSAR contours (ft)

Groundwater Pumping (acre-feet)

April 1, 2022 to March 31, 2023

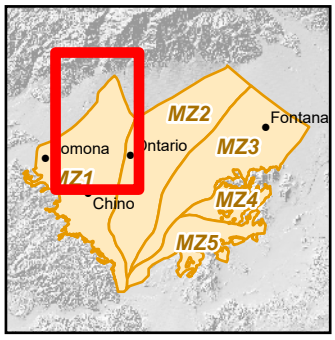
- 0.0 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 2,000
- >2,000

Recharge Basins

Areas of Subsidence Concern

Rivers and Streams

Fault (solid where accurately located; dashed where approximately located or inferred; dotted where concealed)



Prepared by:

WEST YOST

2 Miles

3 Km

Prepared for:

Chino Basin Watermaster

2025 Safe Yield Recalculation

Vertical Ground Motion as Estimated by InSAR

Spring 2022 to 2023

DRAFT

Figure 2-4

2.4 FAULTS AND BASIN BOUNDARIES

Watermaster reviewed other new information related to the location and characterization of faults and basin boundaries to further refine the HCM. The new information included:

- **Spadra Barrier:** The Spadra Barrier marks the boundary between the Chino Basin and the Spadra Basin. Groundwater levels in the Spadra Basin are approximately 50 to 200 feet higher than those in the Chino Basin. A review of groundwater-level data from wells near this boundary has refined the location of the Spadra Barrier, as shown in Figure 2-1. The revised extent and location of the Spadra Barrier aligns with a concealed fault mapped by a USGS study.[4] Additionally, the northern extent of the Central Avenue Fault, which runs parallel to the western edge of the Chino Basin south of the Spadra Barrier, has been revised to intersect with the Spadra Barrier.
- **Rialto-Colton Fault:** The Rialto-Colton Fault separates the Rialto-Colton Basin from the Chino and Riverside Basins. It is a known barrier to groundwater flow along much of its length, particularly in its northern reaches. Watermaster reviewed recent information on the characterization of this fault, including a 2014 USGS study[5] and the groundwater model report from the Integrated SAR Model.[6] The conclusion of this review was that no new significant findings emerged that would necessitate changes to the current location of this fault in the CVM or its influence on groundwater flow.
- **Boundary between the Chino and Temescal Basins:** The Temescal Basin is included within the domain of the 2020 CVM. Groundwater within the Chino Basin flows southwest towards the Prado Basin and converges with groundwater flowing northwest out of the Temescal Basin. These groundwaters mix and flow southwest toward Prado Dam. Watermaster reviewed the groundwater-flow model that was recently developed to support the 2022 Groundwater Sustainability Plan (GSP) for the Temescal Basin.[7] Based on the review of the GSP and model documentation, it was determined that no changes should be made for the 2025 CVM.

[4] Morton, D., and Miller F. Geologic Map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California. 2006. http://pubs.usgs.gov/of/2006/1217/

[5] Teague, Nick, Brown, A.A., and Woolfenden, L.R., 2014, Geohydrologic and water-quality data in the vicinity of the Rialto-Colton Fault, San Bernardino, California: U.S. Geological Survey Data Series 813, 76 p., *http://dx.doi.org/10.3133/ds813*.

[6] Geoscience, 2020. Integrated Santa Ana River Model Report. Prepared for San Bernardino Valley Municipal Water District, 2020.

[7] 2022 Temescal Basin Groundwater Sustainability Plan

SECTION 3
2025 Updates to the Chino Valley Model

This section describes the updates that were made to the four models that compose the 2025 CVM: the Hydrologic Simulation Program – Fortran (HSPF) model, the R4 model, the HYDRUS-2D model, and the MODFLOW model. The purpose of each of these models is described below.

1. **Hydrologic Simulation Program – Fortran (HSPF)**. This model was implemented based on the HSPF code (Bicknell, et al., 2005), which is a numerical model developed to simulate hydrologic and water quality processes in natural and man-made water systems. The HSPF model uses meteorological data, land use data, and physical characteristics of the model domain to estimate surface runoff and subsurface inflow from the San Gabriel Mountains to the Chino Valley. The HSPF model was calibrated during the 2020 SYR and was not recalibrated during the 2025 SYR. However, the simulation period of the HSPF model was extended through FY 2023 to cover the calibration period of the 2025 CVM and one year of the projection period.
2. **R4**. This model was implemented based on the R4 code (WEI, 2007).[1] Like the HSPF model, the R4 model uses meteorological data, land use data, and physical characteristics of the model domain to simulate the surface-water processes, including rainfall, evapotranspiration, runoff, runoff routing, and deep infiltration of precipitation and applied water (DIPAW) within the Chino Valley. The simulated streamflow from the HSPF model is used as input data to the R4 model. The R4 model was calibrated during the 2020 SYR and was not recalibrated during the 2025 SYR. However, the simulation period of the R4 model was extended through FY 2023 to cover the calibration period of the 2025 CVM and one year of the projection period.
3. **HYDRUS-2D**. Seven HYDRUS-2D models were implemented based on the HYDRUS-2D code (Simunek, et al., 1999), which is a modeling environment for the analysis of water flow and solute and heat transport in variably saturated porous media. These models were used during the 2020 SYR to simulate the movement of DIPAW through the vadose zone and to estimate the lag time for DIPAW to reach the groundwater table at selected locations in the Chino Basin. The HYDRUS-2D models were not updated during the 2025 SYR, as the lag time was assumed to be spatially static; therefore, an update to the model was not deemed necessary.
4. **MODFLOW**. This model was implemented based on the MODFLOW-NWT code (Niswonger, et al., 2011). The MODFLOW model was used to simulate saturated groundwater flow in the Chino Basin, Spadra Basin, Cucamonga Basin, and Six Basins area. The results of the HSPF, R4, and Hydrus-2D models are used to inform the input values to the domain of the MODFLOW model, including boundary subsurface inflows; subsurface inflows from the San Gabriel Mountains; runoff to streams; percolation in recharge basins; and the magnitude and timing of DIPAW.

Figure 3-1 shows the boundaries of the 2025 CVM domains for the HSPF, R4, and MODFLOW models. The remainder of this section describes the revisions that were made to the 2025 CVM during the 2025 SYR.

[1] The model is in the public domain and can be downloaded from https://github.com/weiwater/R4

2025 CVM Domains

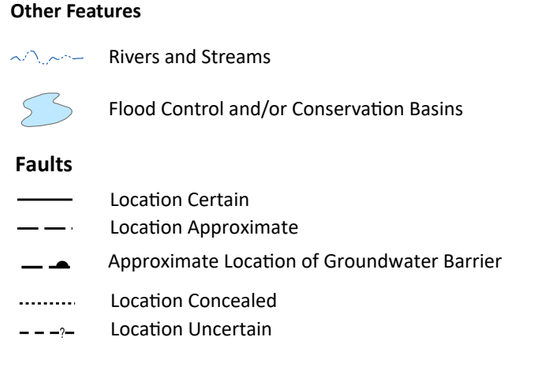
- HPSF Model Domain
- R4 Model Domain
- MODFLOW Domain

Other Features

- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM Domains for Surface-Water and Groundwater Models

DRAFT

Figure 3-1

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PEB - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwek - 6/10/2025

3.1 EXTENSION OF HISTORICAL SIMULATION PERIOD FOR THE 2025 CVM

The historical simulation period of the 2020 CVM was July 1, 1977 through June 30, 2018. For the development of the 2025 CVM, historical data was extended through June 30, 2023.

3.1.1 Time Series Data

Updated meteorological stresses, applied water, and recharged water data were used as input data for the extended simulation period of the R4 and HSPF models. The results of the HSPF and R4 models provide input data to the MODFLOW model, including surface-water runoff and mountain-front flow (from the HSPF model) and DIPAW, stormwater runoff and recharge, and subsurface boundary inflow (from the R4 model).

In addition to the output data from the R4 and HSPF models, time series data for groundwater pumping, managed aquifer recharge, and groundwater levels (to calculate time-variant specified-head boundary flows) were used to extend the historical simulation period of the MODFLOW model.

3.1.2 Land Use

The domains of the HSPF and R4 models, and the hydrologic sub-areas of these models, are shown on Figure 3-2. Land use data is an input into the HSPF and R4 models that the models use to estimate runoff, applied water, and deep percolation of precipitation and applied water. Since the development of the 2020 CVM, land use was collected in 2022 from Land IQ, a land use consulting firm that has documented recent land use changes in the southern Chino Basin. The southern portion of the Chino Basin is the only region where land use has changed significantly since the development of the 2020 CVM (the land use data for which ended in 2017) and was the only area where land use designations were updated from the 2020 CVM. Figures 3-3 and 3-4 show the land use in the Chino Basin in 2017 and 2022, respectively. Land use in the HSPF model domain was not updated for the 2025 CVM.

3.2 UPDATES TO THE MODFLOW MODEL

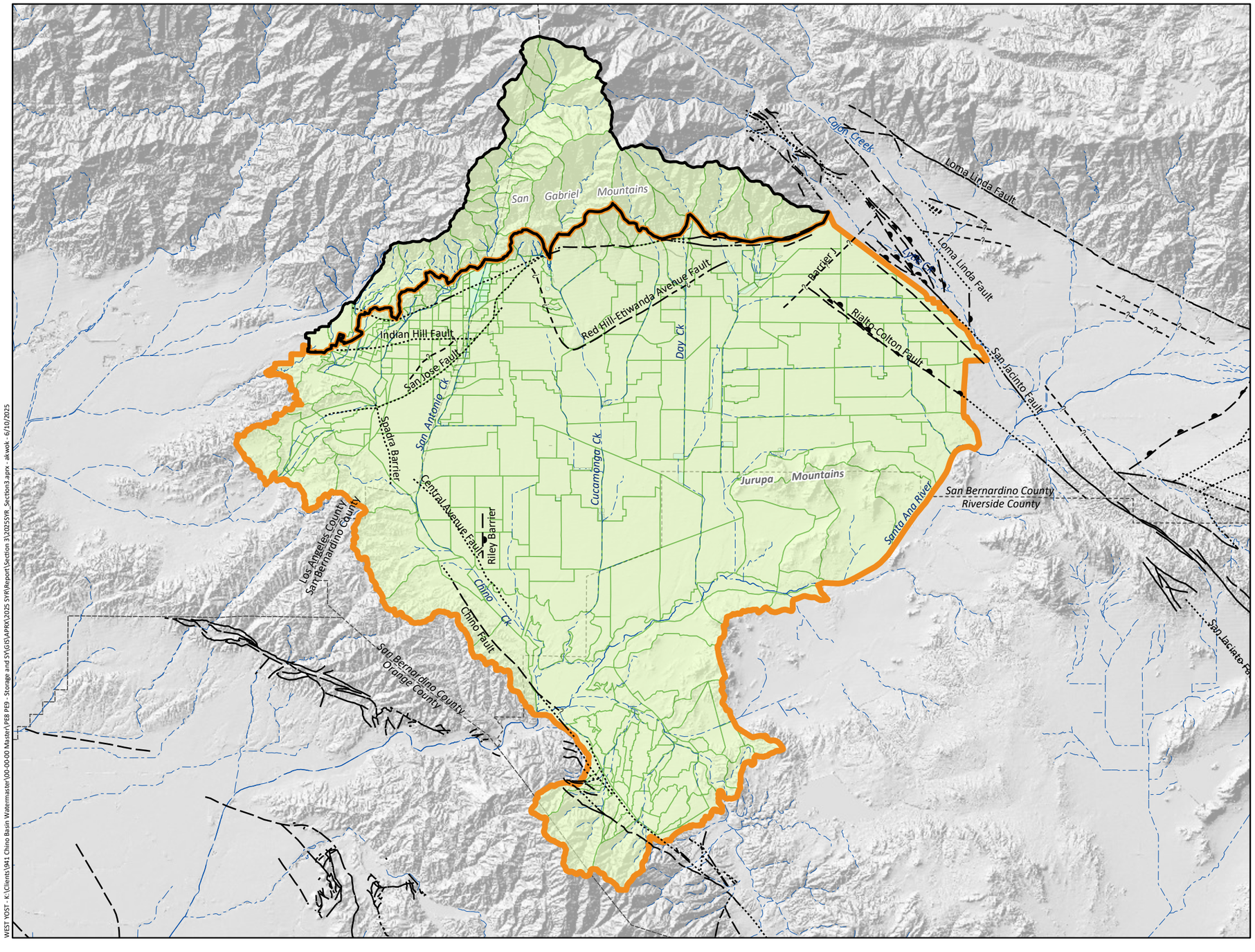
3.2.1 Model Domain and Grid

Like the 2020 CVM, the MODFLOW model of the 2025 CVM has a rectilinear grid consisting of five layers, 577 rows, and 648 columns, with a uniform row/column width of 196.86 ft (60 meters). The model has a total of 1,869,480 cells, among which 838,113 are active cells where groundwater elevations are simulated.

3.2.2 Model Layer Elevation and Thickness

The Chino Basin is simulated with five model layers. The Spadra Basin, Cucamonga Basin, Temescal Basin, and Six Basins are simulated with a single model layer. The model layer elevations were updated based on the geological cross-sections of the updated HCM that included lithological/geophysical logs from new wells constructed since the last CVM update (see Section 2 and Appendix A).

Layers 1, 3, and 5 represent regional aquifers from which most groundwater is pumped by wells. Layers 2 and 4 represent regional clay-rich aquitards. Figures 3-5 through 3-7 are maps that display the model layer thicknesses for the 2025 CVM for Layers 1, 3, and 5, respectively. The thicknesses of Layers 2 and 4 are not shown; they are typically less than 100 feet thick.



Main Features

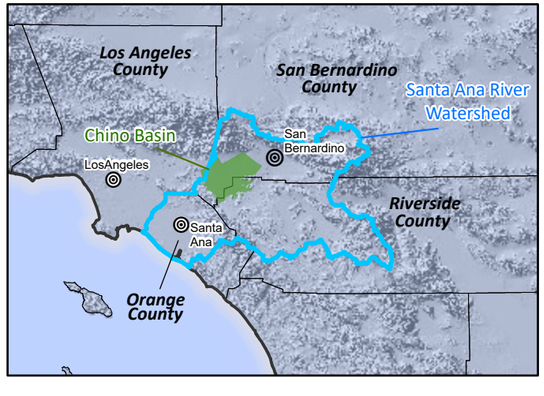
- HPSF Model Domain
- R4 Model Domain
- Hydrologic Sub Area

Other Features

- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

0 3 6 Miles

0 4 8 Km

Prepared for:

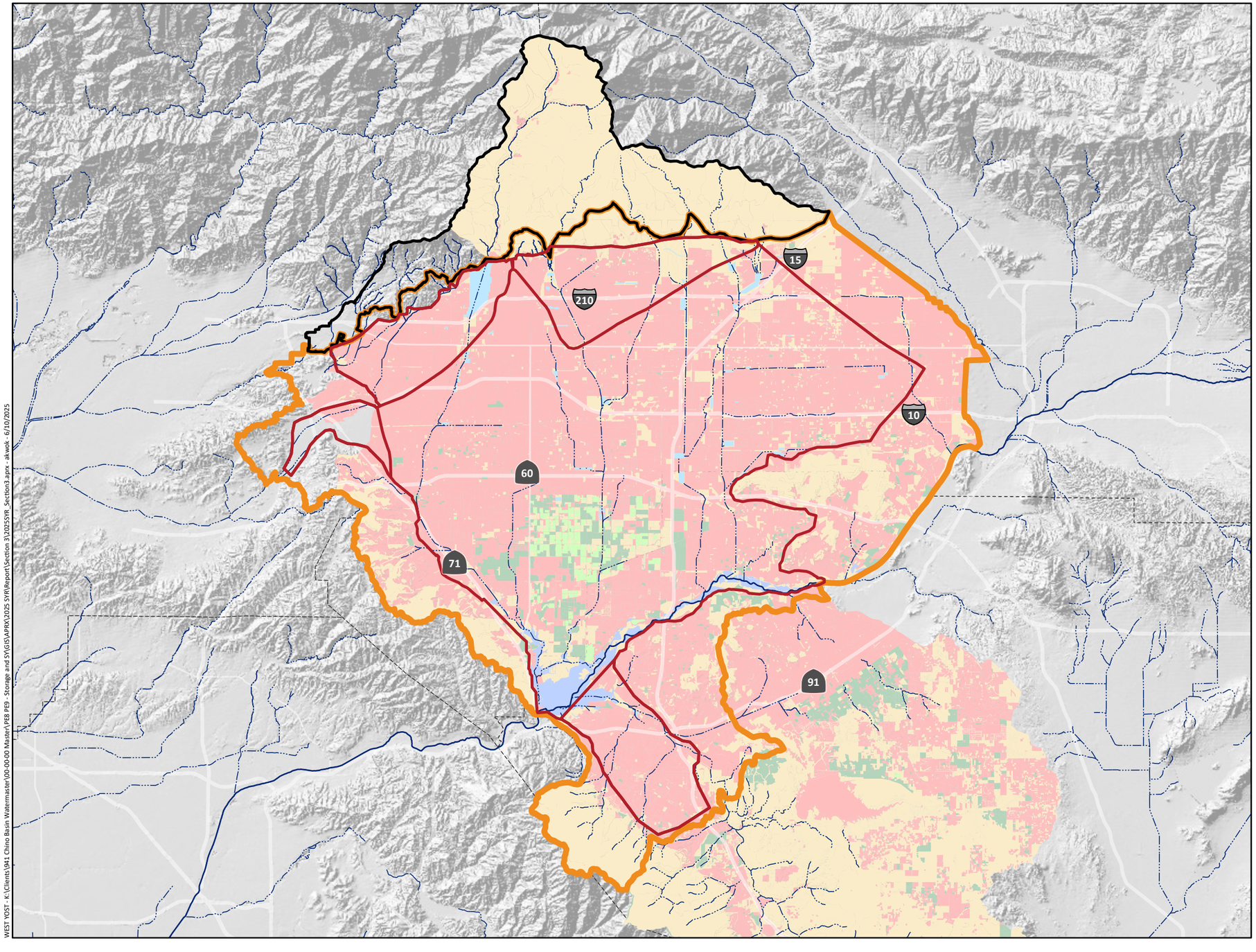
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Hydrologic Sub Areas in the HSPF and R4 Models

DRAFT

Figure 3-2

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwek - 6/10/2025

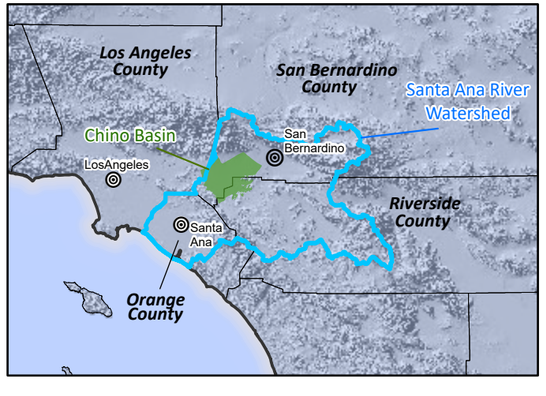


Land Uses

- Agriculture
- Dairy
- Urban
- Vacant
- Riparian Vegetation

Other Features

- MODFLOW Domain
- HPSF Model Domain
- R4 Model Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SYG\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025

Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

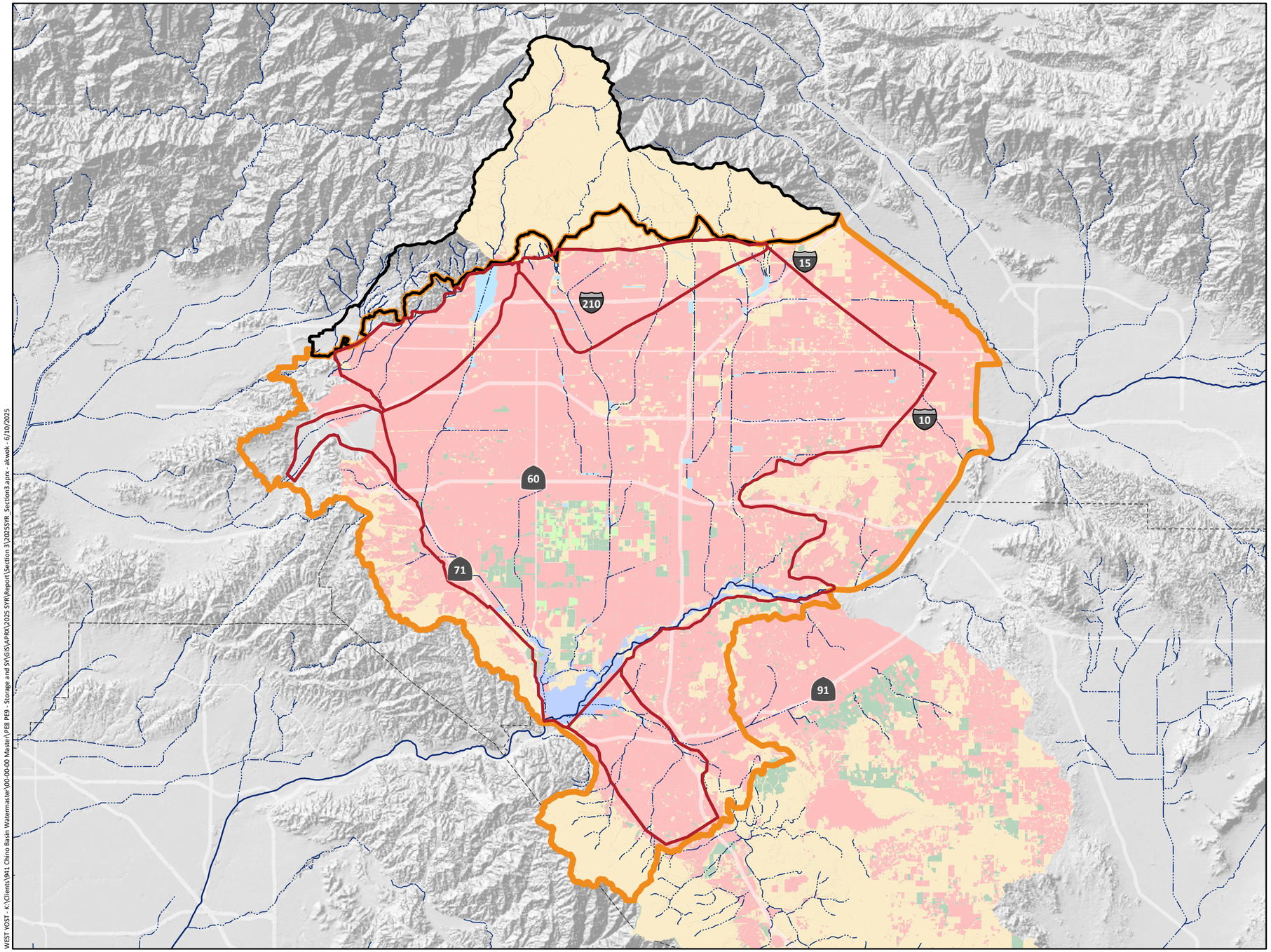
Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2017 Land Use within the Chino Basin

DRAFT

Figure 3-3

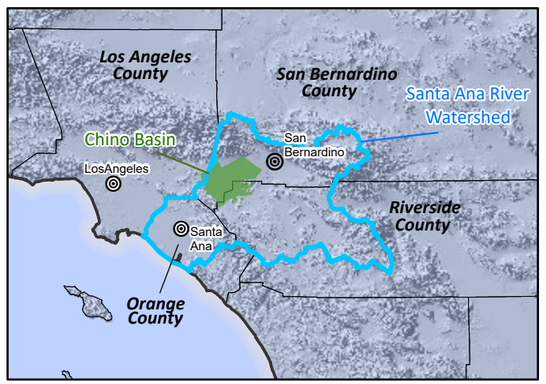


Land Uses

- Agriculture
- Dairy
- Urban
- Vacant
- Riparian Vegetation

Other Features

- HPSF Model Domain
- R4 Model Domain
- MODFLOW Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

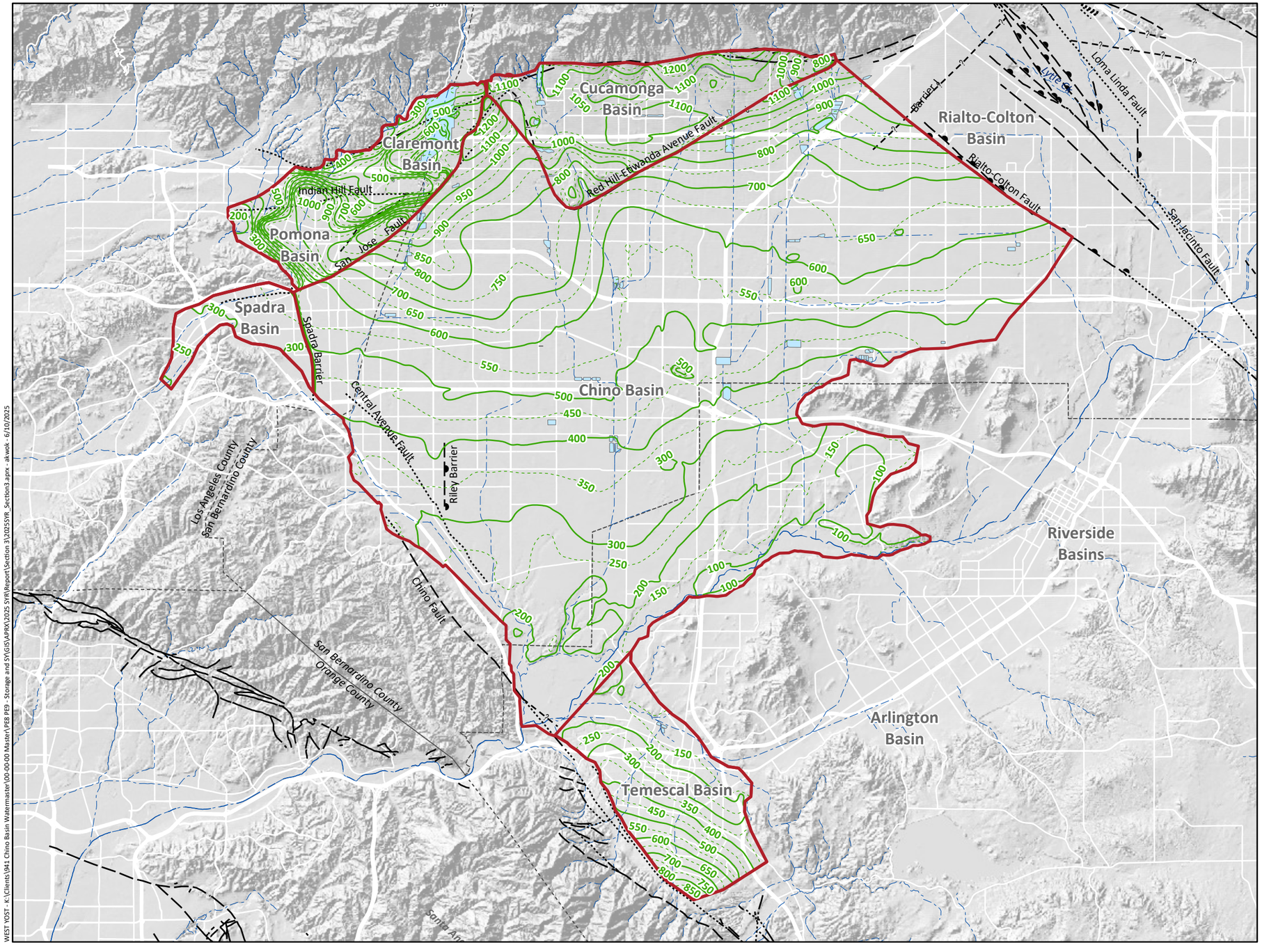
Chino Basin Watermaster
2025 Safe Yield Reevaluation

2022 Land Use within the Chino Basin

DRAFT

Figure 3-4

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\MAPPRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025



Layer 1 Thickness (ft)

–100- 100-ft contour interval

--50 - 50-ft contour interval

Other Features

2025 CVM Domain

Rivers and Streams

Flood Control and/or Conservation Basins

Faults

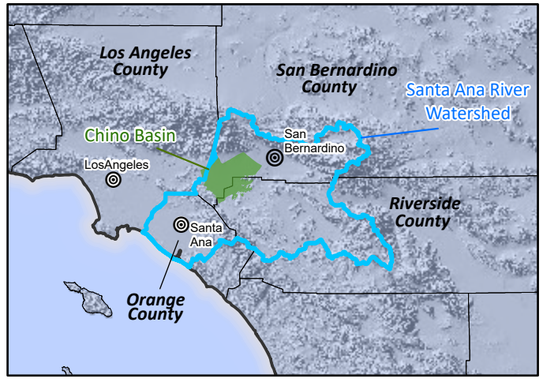
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

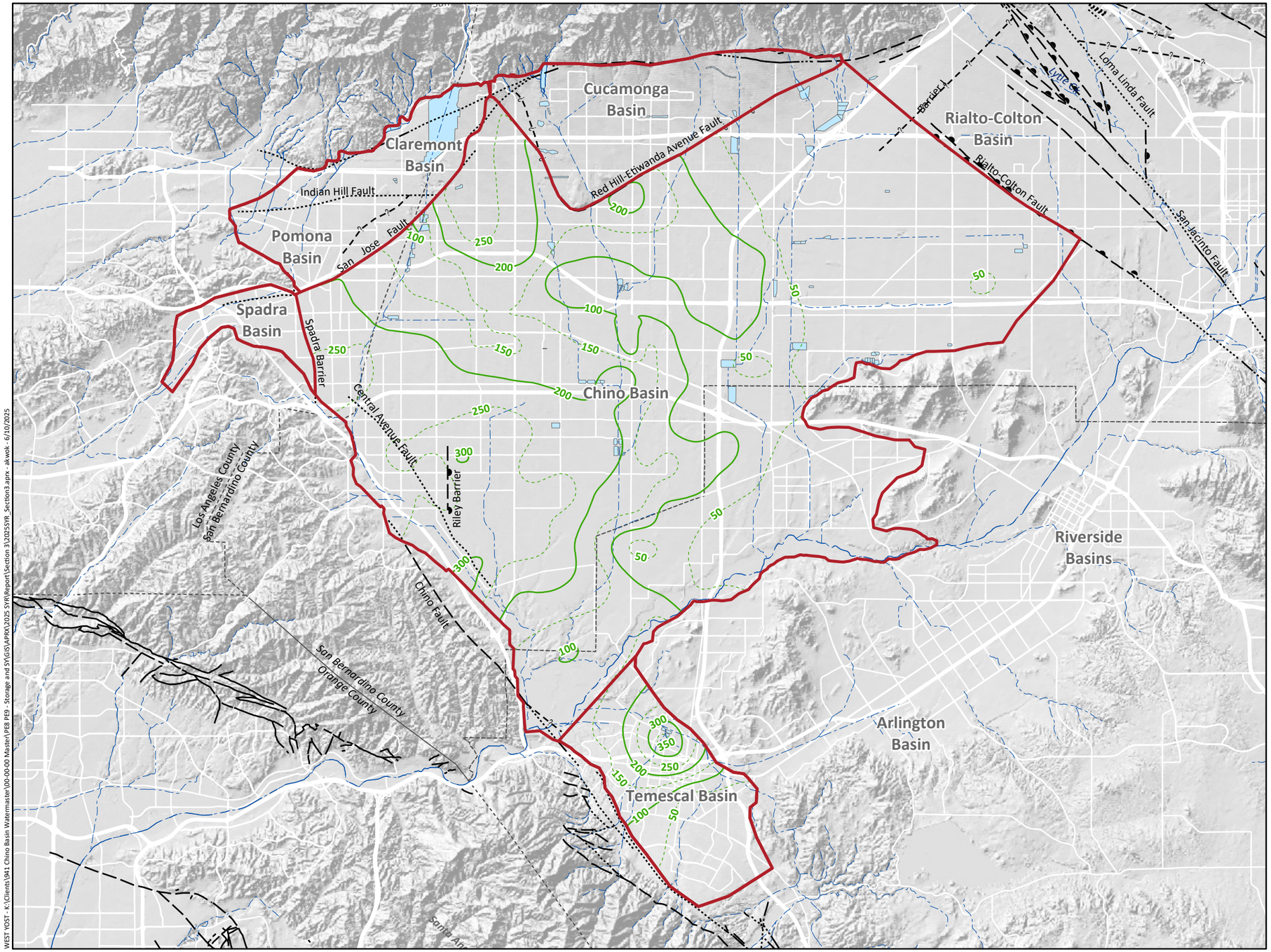
Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM Layer Thickness
Layer 1

DRAFT

Figure 3-5

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025



Layer 3 Thickness (ft)

–100– 100-ft contour interval

--50 - 50-ft contour interval

Other Features

2025 CVM Domain

Rivers and Streams

Flood Control and/or Conservation Basins

Faults

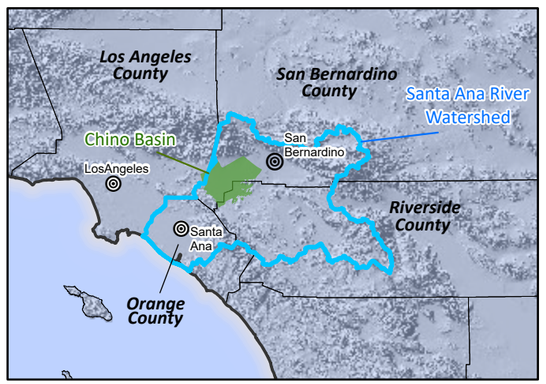
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

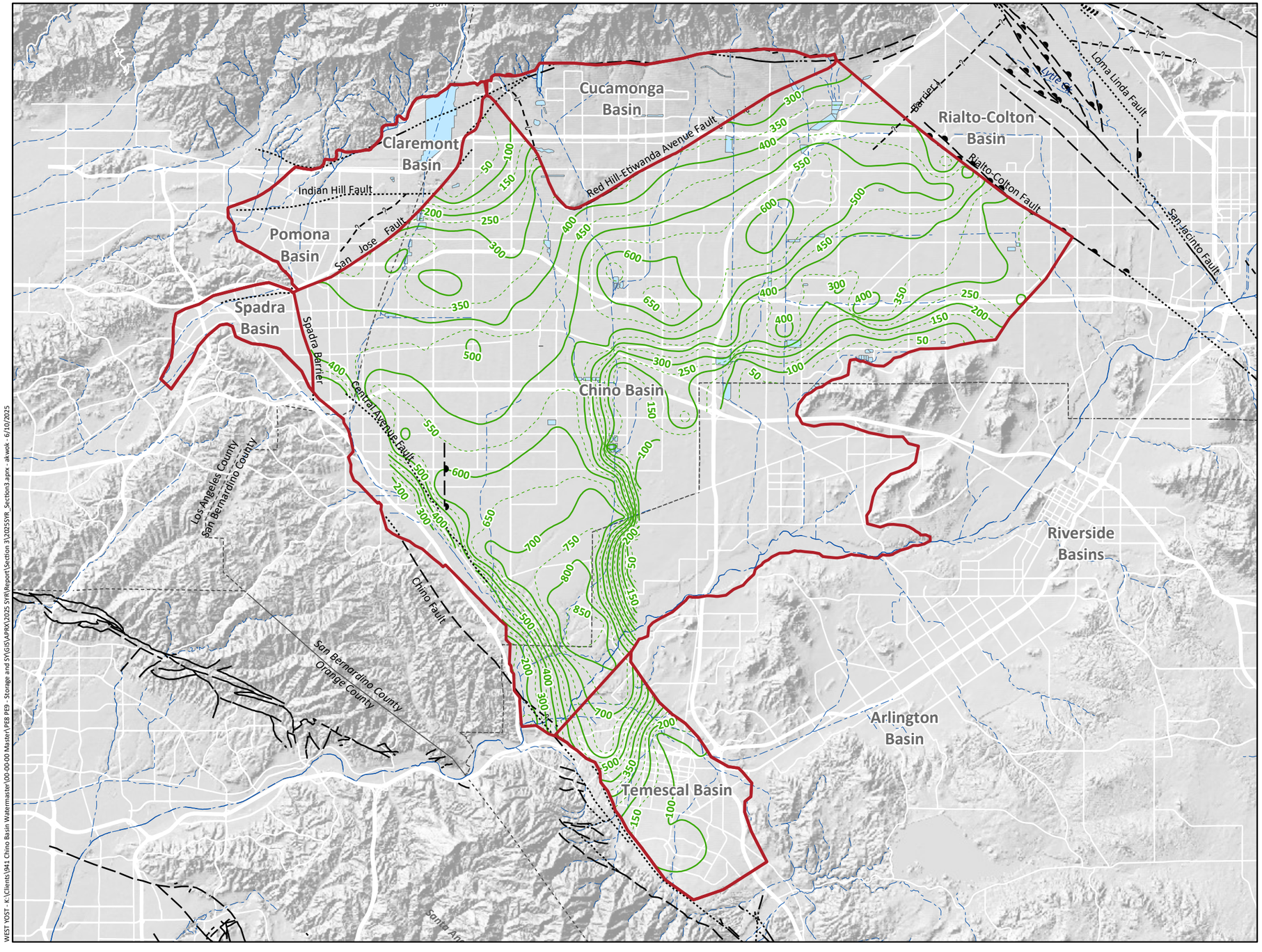
Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM Layer Thickness
Layer 3

DRAFT

Figure 3-6

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE8 PE9 - Storage and SY\GIS\MXD\PRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025



Layer 5 Thickness (ft)

–100- 100-ft contour interval

--50 - 50-ft contour interval

Other Features

2025 CVM Domain

Rivers and Streams

Flood Control and/or Conservation Basins

Faults

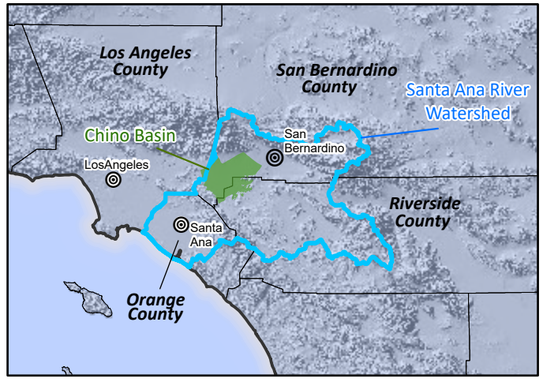
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM Layer Thickness
Layer 5

DRAFT

Figure 3-7

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PE3 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025

3.2.3 Travel Time of DIPAW Through the Vadose Zone

The magnitude and timing of DIPAW arriving at the groundwater table are based on R4 model estimates of surface-water infiltration past the root zone with the arrival time lagged based on the HYDRUS-2D model estimates of travel time through the vadose zone. The estimated annual average DIPAW is used as input to the Recharge Package (RCH) of the MODFLOW model.

Figure 3-8 shows the location of the HYDRUS-2D models and the estimated lag time for the 2020 CVM. In the 2020 CVM, a constant lag time was applied within each color-banded zone, resulting in abrupt "jumps" in DIPAW arrival times at the zone boundaries. No updates were made to the HYDRUS-2D models in the 2025 CVM, based on the assumption that lag time remains spatially static under relatively stable land use conditions across most of the Basin. To eliminate jumps in timing of DIPAW across the Basin, the lag time for the 2025 CVM is based on linear-interpolation of the estimated HYDRUS-2D lag times from the 2020 CVM data. Figure 3-9 shows the location of the HYDRUS-2D models and the estimated lag time for the 2025 CVM.

3.2.4 Evapotranspiration of Groundwater

Evapotranspiration of groundwater[2] by phreatophytes in the Prado Basin and SAR areas was simulated with the Evapotranspiration Segments Package (ETS1) of the MODFLOW model. Appendix A.3 provides a detailed description of the data, literature, and assumptions that were used to construct the input file to the EST1 Package.

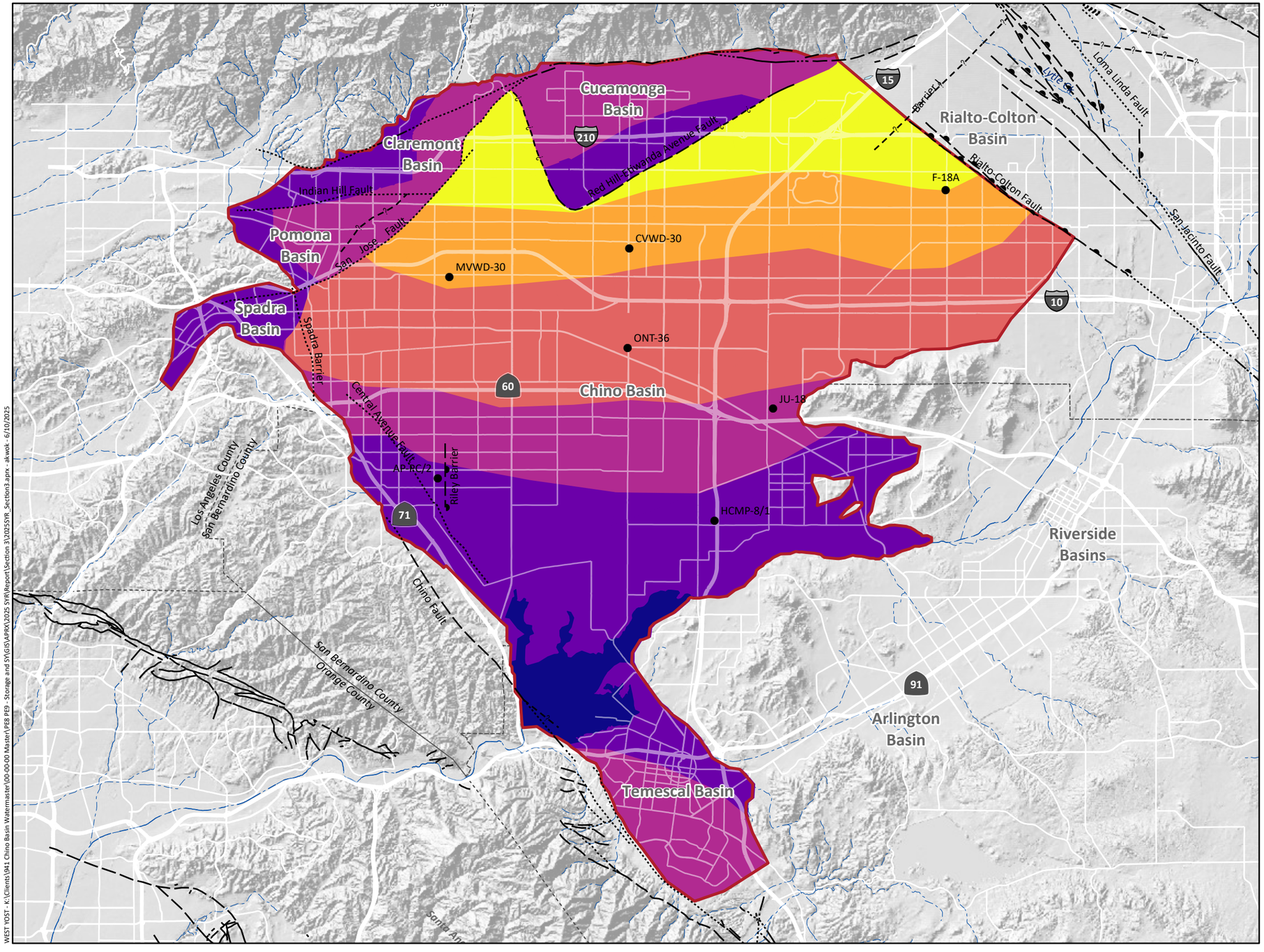
3.2.5 Santa Ana River and Tributaries

Streamflow and groundwater/surface-water interactions within the SAR and its tributaries were simulated using the Streamflow-Routing Package (SFR) of the MODFLOW model. The stream courses, streambed elevations, and streambed cross-sectional geometries were updated based on the review of historical aerial photos and the 2018 one-meter digital elevation model from the USGS (see Section 2). Figure 3-10 shows the locations of the streams simulated with the SFR package in the MODFLOW model of the 2025 CVM.

3.2.6 Groundwater Pumping

Groundwater pumping data compiled by the Watermaster were reviewed and extended to match the calibration period. The Well Package (WEL) of the MODFLOW model was used to simulate unmetered agricultural pumping from 1992 to the early 2000s that was estimated with water-duty methods. The Multi-node Well Package (MNW2) of the MODFLOW model was used to simulate metered pumping. Most metered data is available at monthly or quarterly intervals, with Watermaster's production database containing quarterly records.

[2] Evapotranspiration of surface water was simulated with the HSPF and R4 models.



Travel Time of DIPAW through Vadose Zone (years)

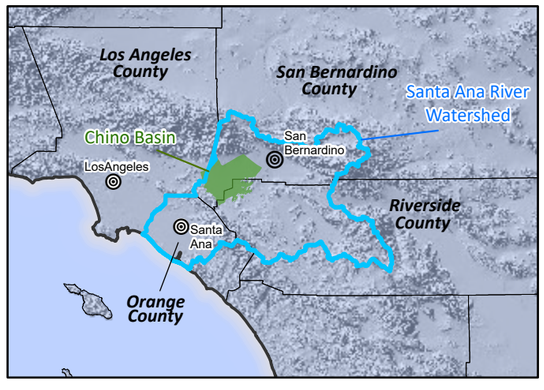
- 0 - 4
- 5 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 31 - 36

Other Features

- Boreholes Used in HYDRUS-2D
- 2025 CVM Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB #29 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\20255YR_Section3.aprx - akwok - 6/10/2025

Prepared by:

WEST YOST
Water. Engineered.

0 3 6 Miles

0 4 8 Km

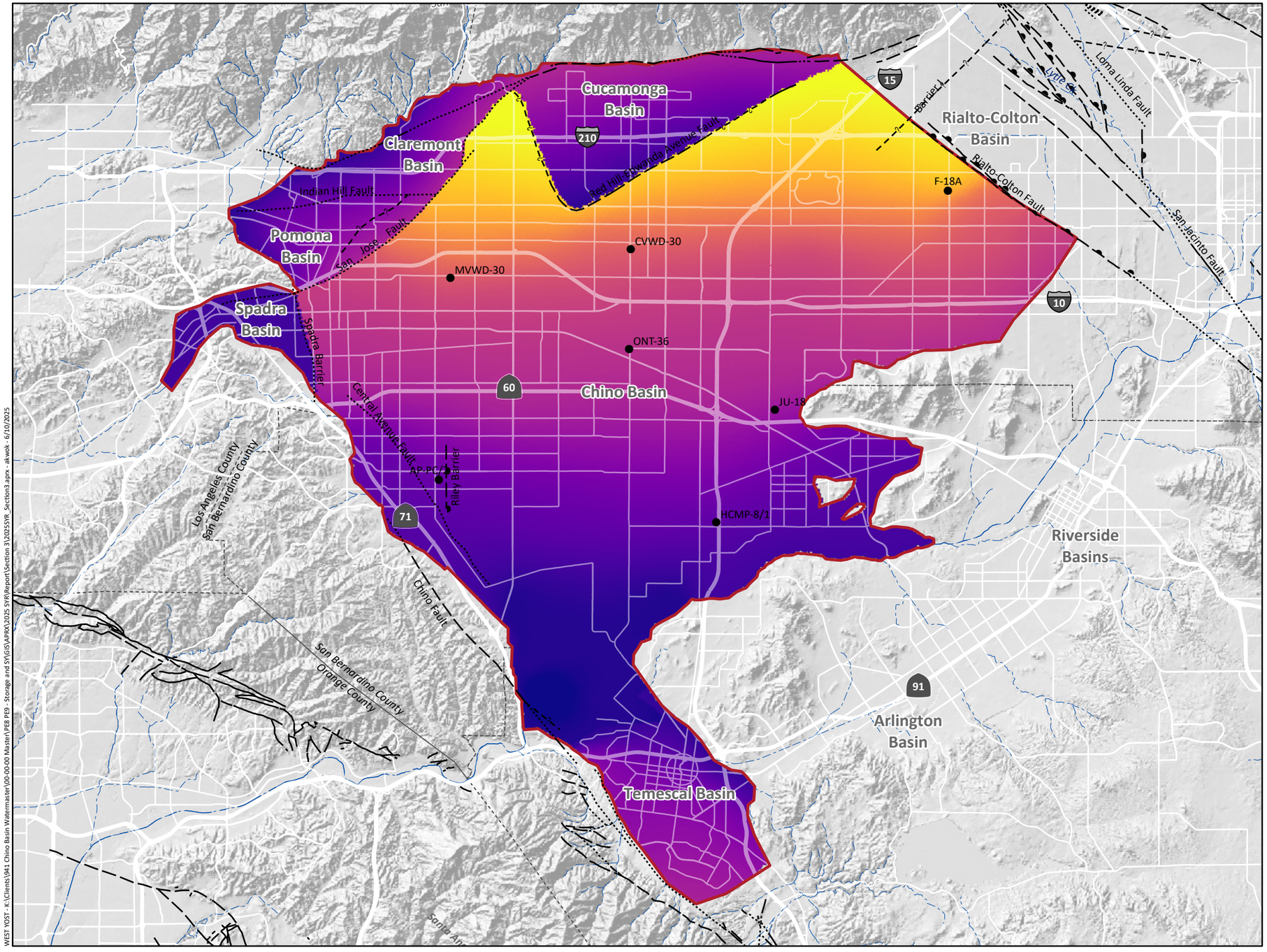
Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Travel Time of DIPAW through Vadose Zone - 2020 CVM

DRAFT

Figure 3-8



Travel Time of DIPAW through Vadose Zone (years)

36 years

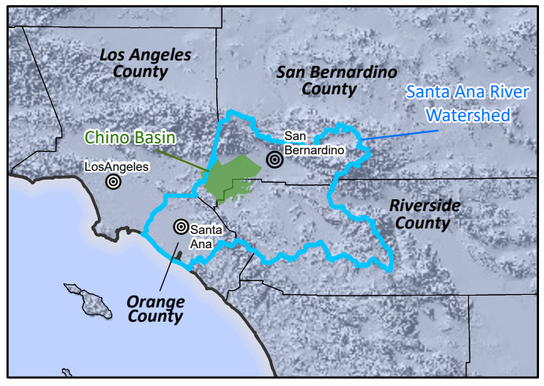
0 years

Other Features

- Boreholes Used in HYDRUS-2D
- 2025 CVM Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

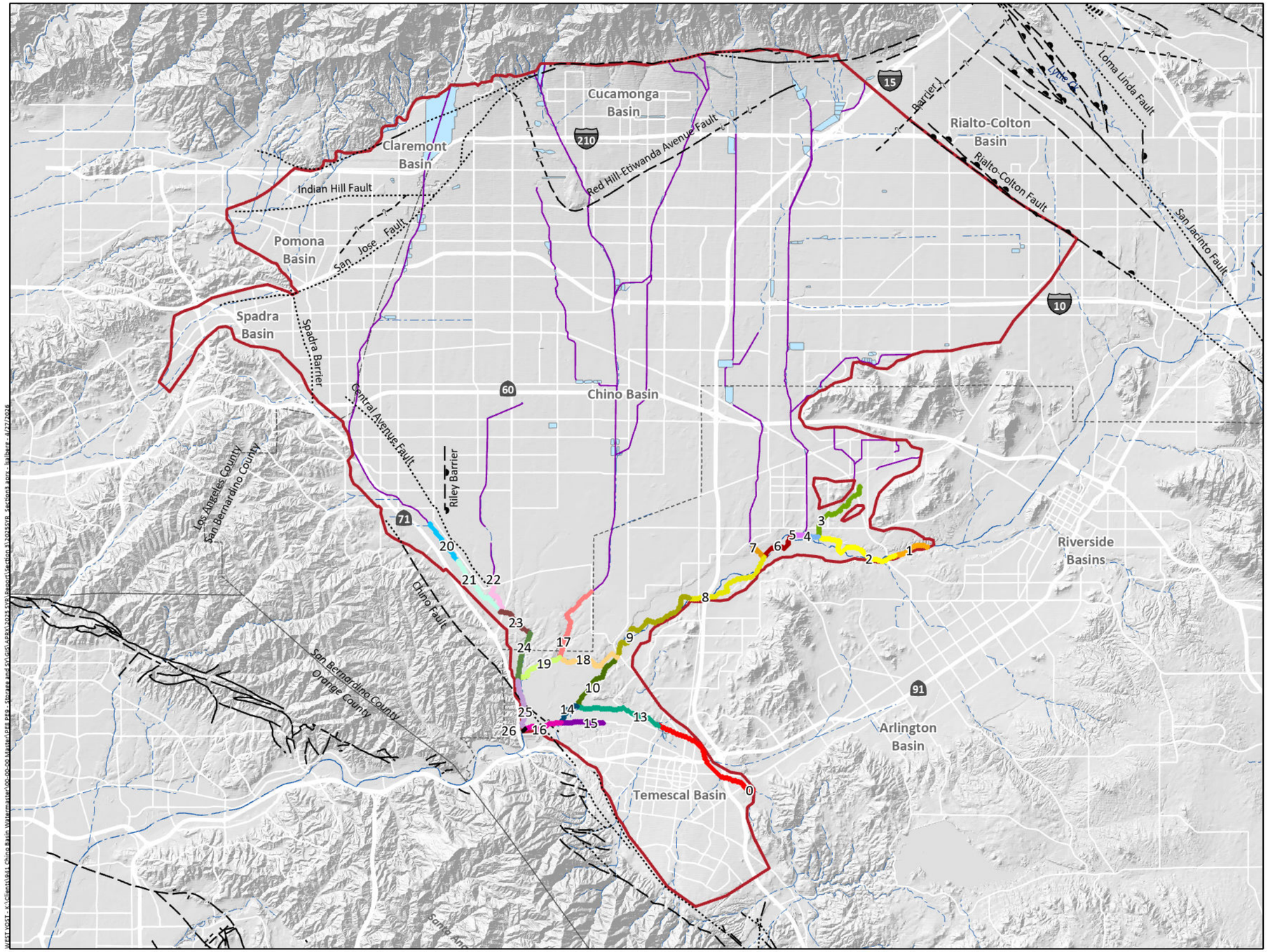
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Travel Time of DIPAW through Vadose Zone - 2025 CVM

DRAFT

Figure 3-9

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB #69 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\20255YR_Section3.aprx - akwok - 6/10/2025



Stream Segments

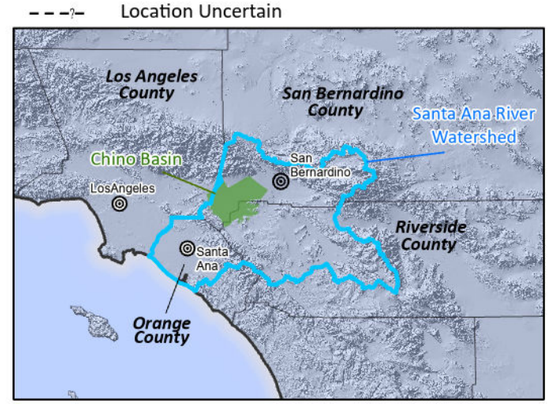
0	10	22
1	13	23
2	14	24
3	15	25
4	16	26
5	17	
6	18	
7	19	
8	20	
9	21	

Other Features

- 2025 CVM Domain
- Lined Channels
- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Modeled Streams

DRAFT

Figure 3-10

3.2.7 Fault Barriers

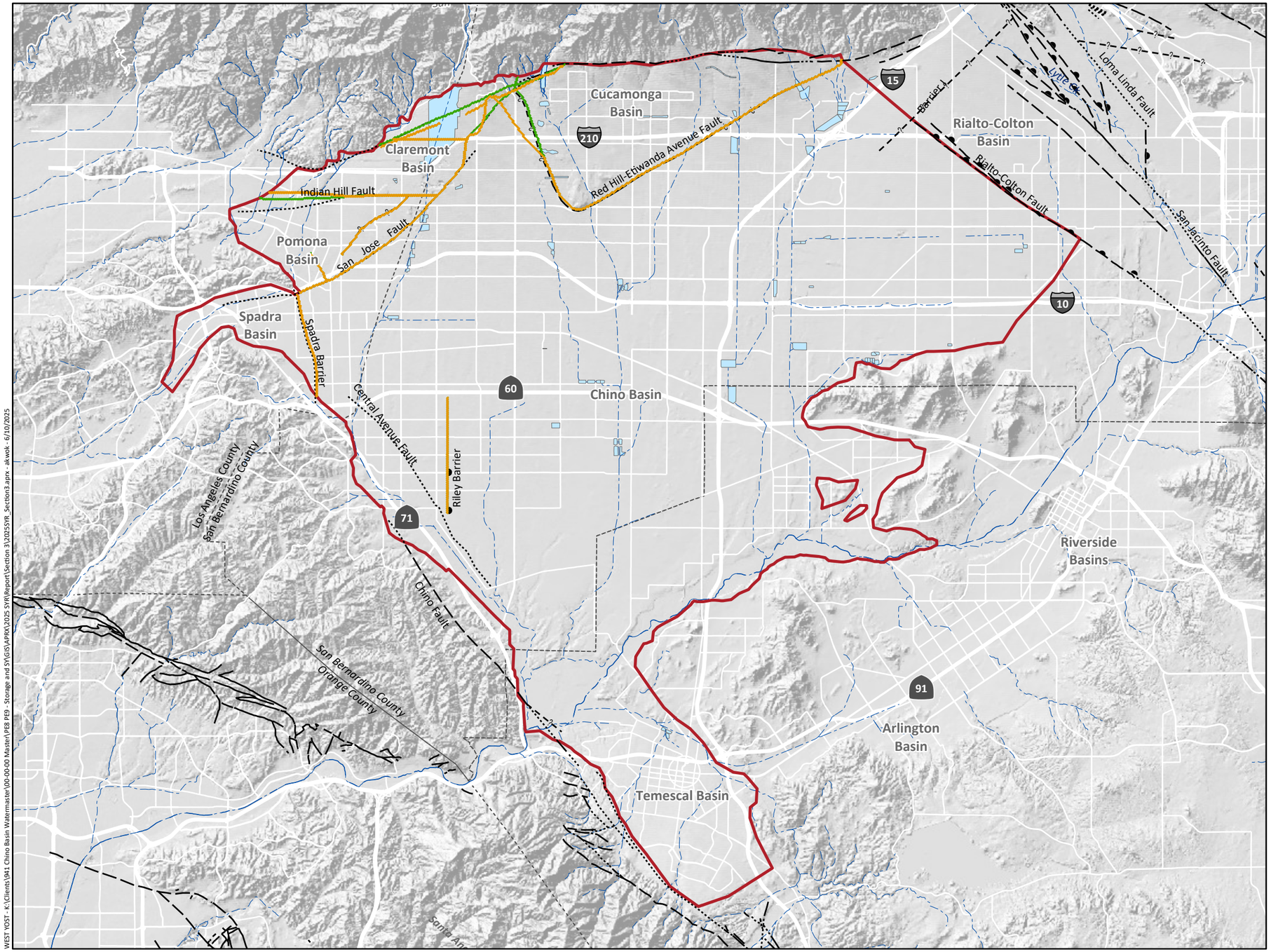
The Horizontal-Flow Barrier (HFB) Package of the MODFLOW model was used to simulate geologic faults that impede groundwater flow. Figure 3-11 shows the simulated faults of the 2020 CVM and the two modifications that were made to the simulated faults in the 2025 CVM. The first modification was adding a barrier between the Spadra Basin and Chino Basin based on the observation of abrupt change in depth of bedrock, difference in groundwater levels, and a USGS-mapped fault in that area. The second modification was shifting the fault lines north of CA-210 (i.e., the faults that separate the north portions of the Cucamonga and Six Basins from the Chino Basin) based on probable fault lines suggested by InSAR estimates of ground motion between Spring 2022 and Spring 2023 (see Section 2). Figure 3-12 shows how the faults were segmented in the 2025 CVM to apply parameters to each segment. The parameters applied to each segment were updated for the 2025 CVM and allowed to vary to consider the uncertainty in the fault properties (see Section 4 for more detail).

3.2.8 Subsurface Inflow

Subsurface inflow includes inflow from the San Gabriel Mountains to the Cucamonga and Six Basins and inflow from other adjacent groundwater basins to the basins simulated in the 2025 CVM. Figure 3-13 shows the locations of the subsurface inflow and the segmentation of these locations in the 2025 CVM. Subsurface inflow in these segments is simulated as a variable-flux boundary. The time series of subsurface inflow from the San Gabriel Mountains to the Six Basins and Cucamonga Basin was estimated by the streambed percolation estimated by the HSPF model. The time series of subsurface inflow from hillsides (e.g., Jurupa Hills, Chino Hills) to the basins simulated in the 2025 CVM was estimated by the DIPAW estimated with the R4 model.

Subsurface inflows from other regions into the 2025 CVM domain are identical to those described in Section 5 of the 2020 SYR Report. Figure 3-14 shows the locations of the time-variant specified-head boundaries for the 2025 CVM located at the western edge of Spadra Basin and at the Bloomington Divide. The time series for these specified-head boundaries are based on groundwater levels at wells near the basin boundaries, as documented in Section 5 of the 2020 SYR. The time series of subsurface inflows was extended to match the calibration period was used as input data for the Flow and Head Boundary Package (FHB) of the MODFLOW model. No changes were made to the methods to calculate subsurface inflow between the 2020 CVM and the 2025 CVM.

DRAFT



Simulated Faults

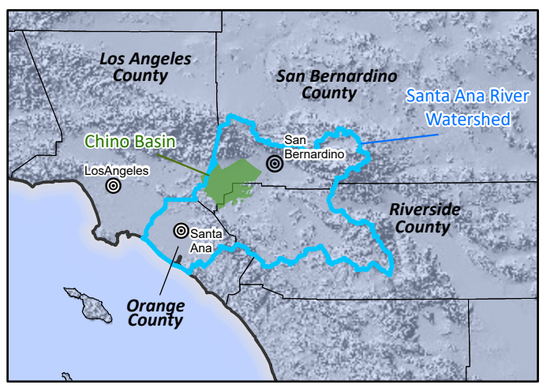
- Simulated Faults in 2020 CVM
- Simulated Faults in 2025 CVM

Other Features

- 2025 CVM Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

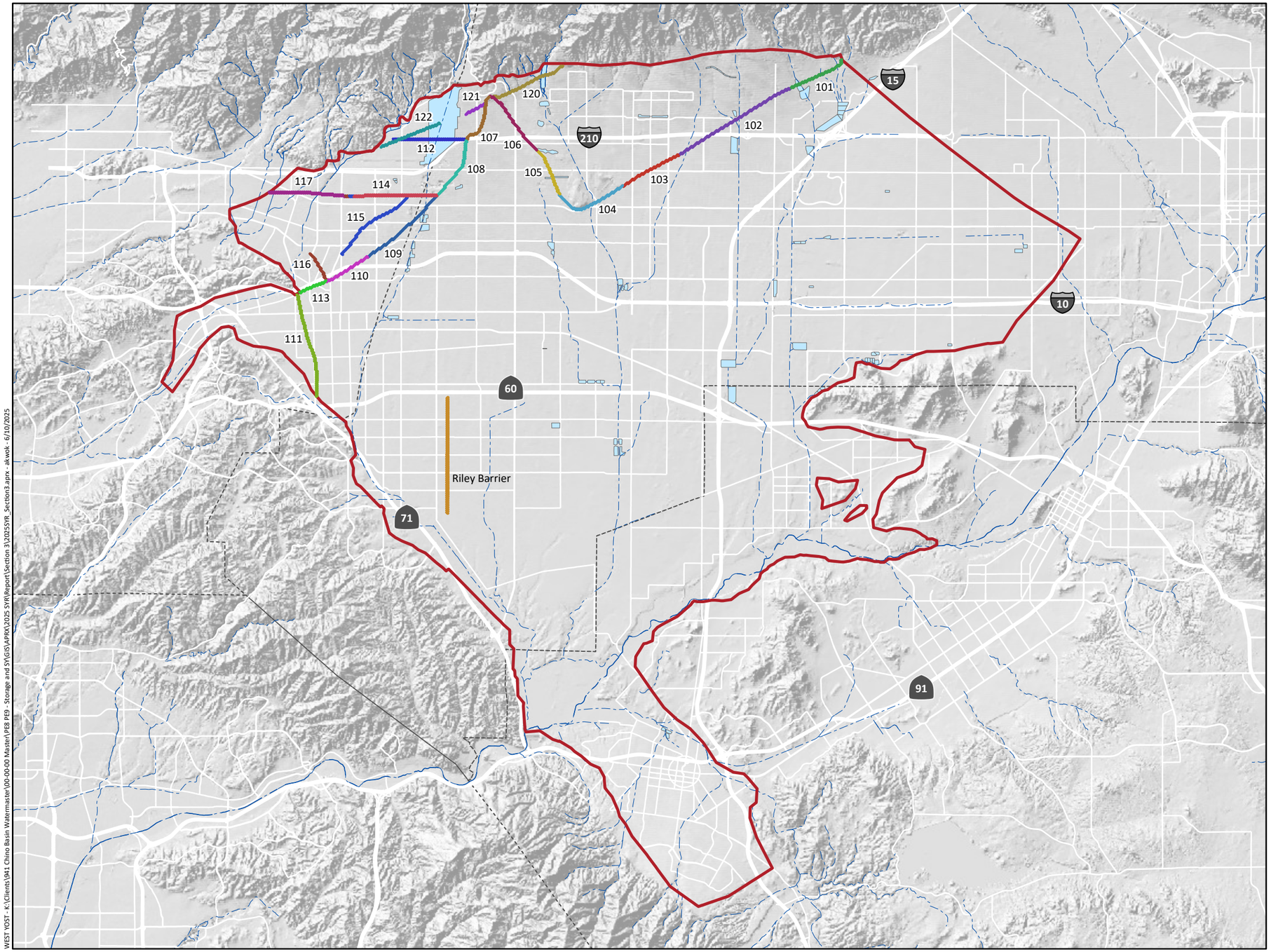
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Simulated Faults of 2020 and 2025 CVM

DRAFT

Figure 3-11

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025

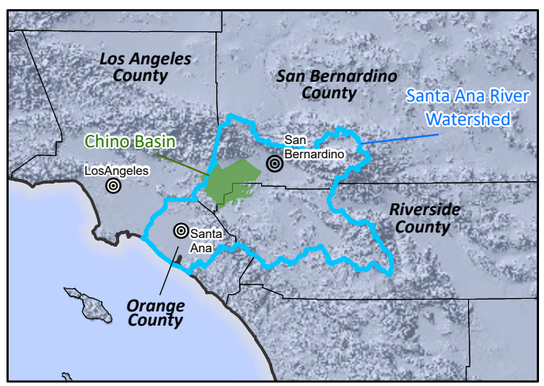


Simulated Faults Segments

- 101
- 102
- 103
- 104
- 105
- 106
- 107
- 108
- 109
- 110
- 111
- 112
- 113
- 114
- 115
- 116
- 117
- 120
- 121
- 122
- Riley Barrier

Other Features

- 2025 CVM Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 3\2025SYR_Section3.aprx - akwok - 6/10/2025

Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM
Segmentation of Simulated Faults

DRAFT

Figure 3-12

Boundary Inflow Segments

1 Boundary Inflow Segments (various colors)

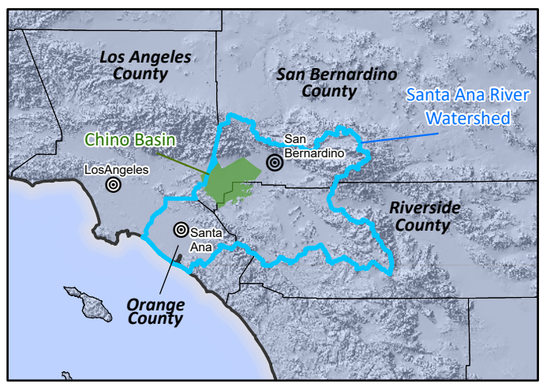
Other Features

2025 CVM Domain

Faults Simulated in 2025 CVM

Rivers and Streams

Flood Control and/or Conservation Basins



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

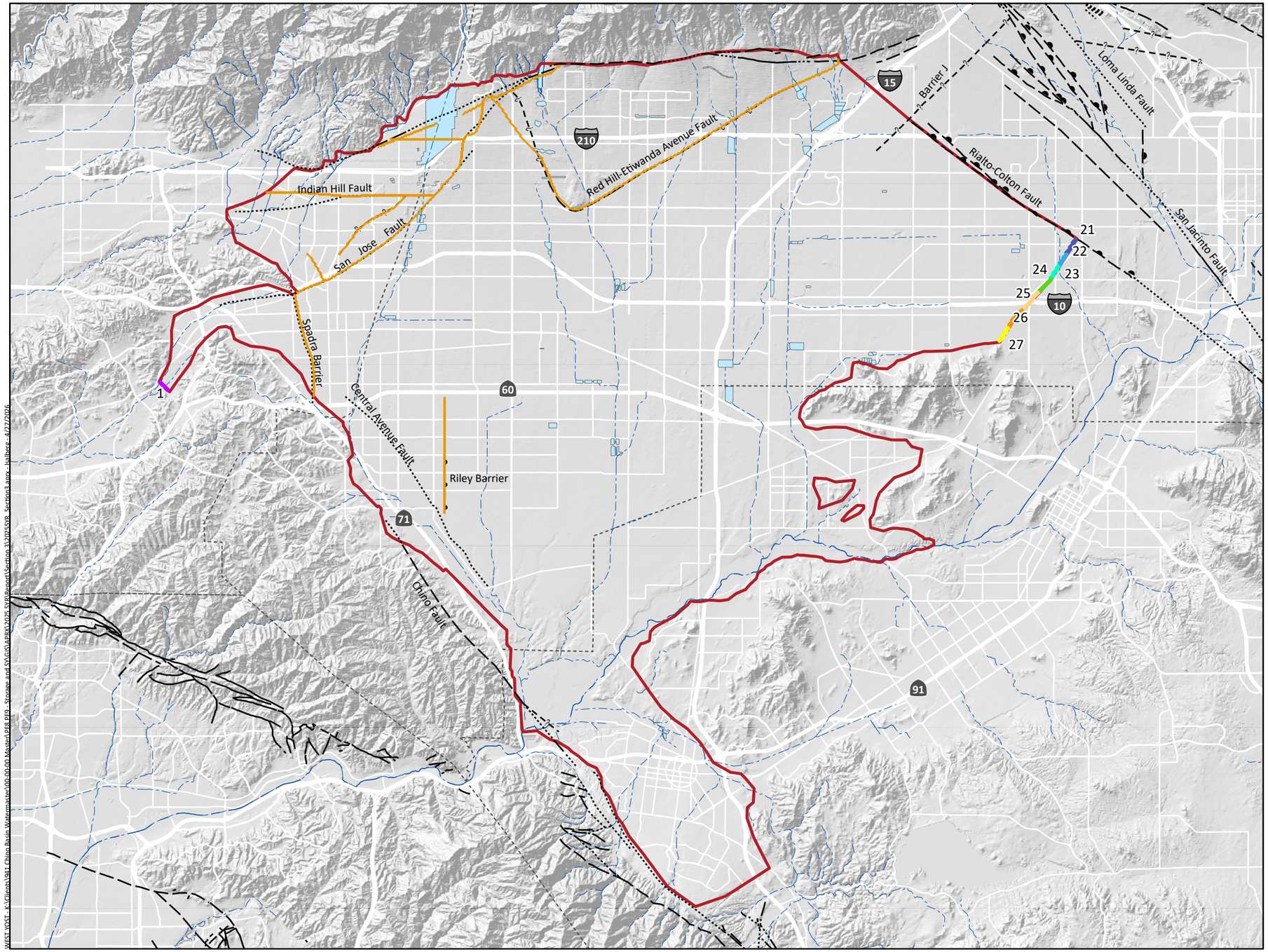
Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM
Subsurface Inflow Segments

DRAFT

Figure 3-13

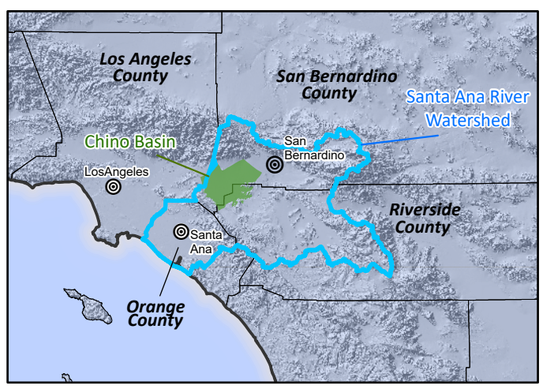


Specified-Head Boundaries

- 1
- 21
- 22
- 23
- 24
- 25
- 26
- 27

Other Features

- 2025 CVM Domain
- Simulated Faults in 2025 CVM
- Rivers and Streams
- Flood Control and/or Conservation Basins



Prepared by:

WEST YOST
Water. Engineered.

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM
Specified-Head Boundaries

DRAFT

Figure 3-14

SECTION 4
Model Calibration and Uncertainty Analysis

4.1 VALIDATION OF R4 MODEL

Section 4 documents the validation of the R4 model and the calibration and uncertainty analysis applied to the groundwater-flow (MODFLOW) model of the 2025 CVM.

The scope of revising the R4 model for the 2025 CVM specified a validation of the model using new data rather than a recalibration. The validation effort included extending and running the R4 model used in the 2020 CVM through FY 2022 and then assessing the results using the same criteria and statistics that were used to evaluate the calibration of the 2020 CVM. As the simulated outflows from the HSPF model are used as inflows for the R4 model, validation of the R4 model was assumed to be sufficient to assess the performance of both the R4 and HSPF models.

The peer review responses included the preparation of water budgets and additional documentation of the R4 model (see Appendix A).

4.1.1 Evaluation Criteria

R4 model validation used the same criteria and statistics that were used to evaluate the calibration of the R4 model in the 2020 CVM:

- Comparison of simulated streamflow with measured streamflow at two streamflow gauges in the Chino Basin (Chino Creek at Schaefer Avenue and Cucamonga Creek near Mira Loma). Figure 4-1 shows the locations of these two streamflow gauges.
- Comparison of urban outdoor water use (UOWU) simulated through the R4 root zone module with the UOWU estimated within the Inland Empire Utilities Service Area (IEUA) service area.
- Comparison of R4-simulated stormwater recharge in Chino Basin recharge basins with the stormwater recharge measured by the IEUA.

The calibration statistics for the R4 model in the 2020 CVM are documented in Section 6 of the 2020 SYR Report.

4.1.2 Validation Results

4.1.2.1 Simulated Streamflow

For the 2020 CVM, the R4 model was manually calibrated to match surface water discharges at the gaging stations shown in Figure 4-1. To evaluate the match of simulated versus measured streamflow in this validation exercise, the same statistics used in the 2020 CVM were applied: the Nash-Sutcliffe Efficiency (NSE) index[1] and the coefficient of determination (R^2).

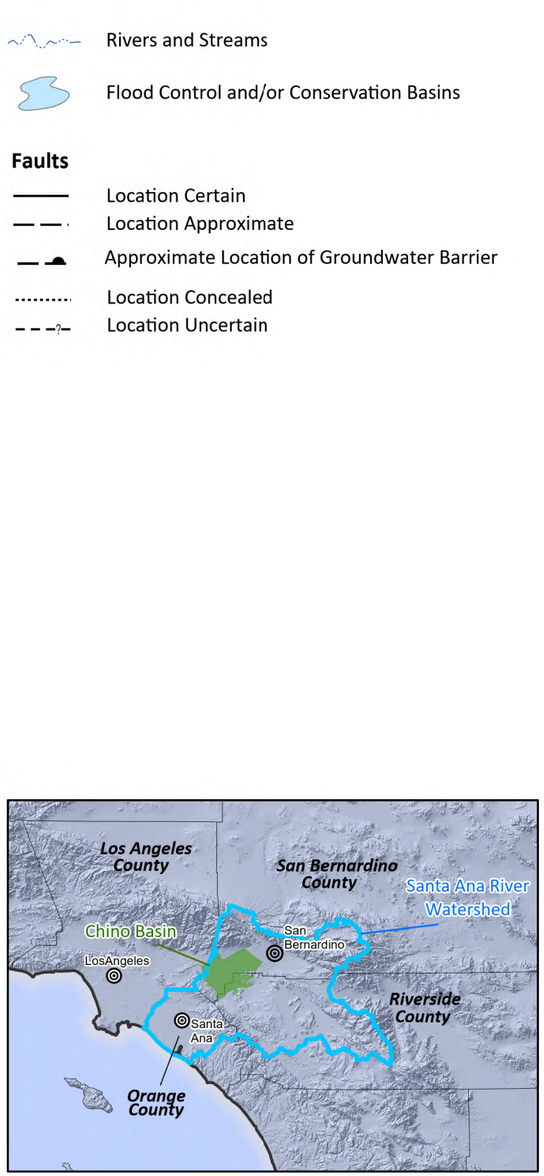
[1] Nash, J. E. and Sutcliffe, J. V. 1970. River flow forecasting through conceptual models: Part 1. A discussion of principles. J. Hydrology. 1970, Vol. 10, 3, pp. 282-290.

HPSF Model Domain
R4 Model Domain
2025 CVM Domain
Gaging Stations

Rivers and Streams
Flood Control and/or Conservation Basins

Faults

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain



Prepared by:
WEST YOST
Water. Engineered.

N

0 3 6 Miles
0 4 8 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Location Map for Gaging Stations and Flood Control and Conservation Basins Used to Calibrate the HSPF and R4 Models

DRAFT

Figure 4-1

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PEB PE9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 4\2025SYR_Section4.aprx - gnapp - 5/9/2025

Table 4-1 below documents the R^2 and NSE statistics for simulated streamflow data at each of the gaging stations for the 2020 CVM and the 2025 CVM. These statistics are calculated for monthly streamflow over the period from July 1980 through the end of the model's respective calibration period (June 2018 for the 2020 CVM and June 2022 for the 2025 CVM).

Table 4-1. R4 Model Calibration Statistics for Streamflow in the 2020 CVM and 2025 CVM

Gaging Station	R^2		NSE	
	2020 CVM[(a)]	2025 CVM[(b)]	2020 CVM	2025 CVM
Chino Creek at Schaefer Avenue (USGS 11073360)	0.91	0.91	0.95	0.89
Cucamonga Creek near Mira Loma (USGS 11073360)	0.81	0.79	0.77	0.75

(a) The 2020 CVM was calibrated to monthly streamflow over the period of FY 1981 through FY 2018
(b) The 2025 CVM was calibrated to monthly streamflow over the period of FY 1981 through FY 2022

For Chino Creek at Schaefer Avenue (USGS 11073360), the R4 model achieved an R^2 of 0.91 and an NSE index of 0.95 in the 2020 CVM, indicating a very good[2] calibration match. With the inclusion of the additional years of data in the 2025 CVM, the R^2 statistic remained at 0.91 and the NSE index slightly decreased to 0.89. The match between R4-simulated streamflow and the measured data on Chino Creek at Schaefer Avenue remained good to very good for the R4 model in the 2025 CVM.

For Cucamonga Creek near Mira Loma (USGS 11073495), the R4 model achieved an R^2 of 0.81 and an NSE index of 0.77 for the 2020 CVM, indicating a very good calibration match. With the inclusion of the additional years of data in the 2025 CVM, the R^2 statistic decreased to 0.77 and the NSE index decreased to 0.75. These statistics for the R4 model in the 2025 CVM, though slightly lower, still indicate a good match between R4-simulated streamflow and the measured data on Cucamonga Creek near Mira Loma.

Figures 4-2 and 4-3 present scatter plots that illustrate the goodness of fit between measured and R4-simulated estimates of monthly surface water discharge on Chino Creek and Cucamonga Creek, respectively. These figures highlight the four additional years of data that were added for the R4 model validation and illustrate the successful validation of the R4 model in the 2025 CVM.

4.1.2.2 Simulated Urban Outdoor Water Use

The R4 rootzone module estimates irrigation demand by simulating a soil moisture balance that accounts for vegetation type, land use, precipitation, and irrigation practices. For the 2020 CVM, UOWU estimated by the R4 model was calibrated to match irrigation demand within the IEUA sewersheds, where urban irrigation demand is assumed to be equivalent to UOWU.

[2] Moriasi et al. (2007) classify model performance based on the Nash–Sutcliffe Efficiency (NSE) such that values greater than 0.75 are considered "very good," and values between 0.65 and 0.75 are considered "good" for monthly time-step simulations, based on a review of a range of hydrologic models.

IEUA provides monthly records of total water supply and wastewater flows, which are used to independently estimate UOWU across its service area. The monthly urban irrigation demand for each sewershed is calculated as the total potable water supply minus the combined outflows of wastewater treatment plant influent, onsite wastewater disposal system (OWDS) discharge, and dry-weather flows.

Table 4-2 below documents the R^2 and NSE statistics for simulated UOWU data in each of the sewersheds for the 2020 CVM and the 2025 CVM. These statistics are calculated for monthly simulated UOWU over the period of available data from January 1991 through the end of the model's respective calibration period (June 2018 for the 2020 CVM and June 2022 for the 2025 CVM).

DRAFT

Figure 4-2. Scatter Plot of R4-Estimated Monthly Discharge and USGS-Estimated Discharge for Chino Creek at Schaefer Avenue

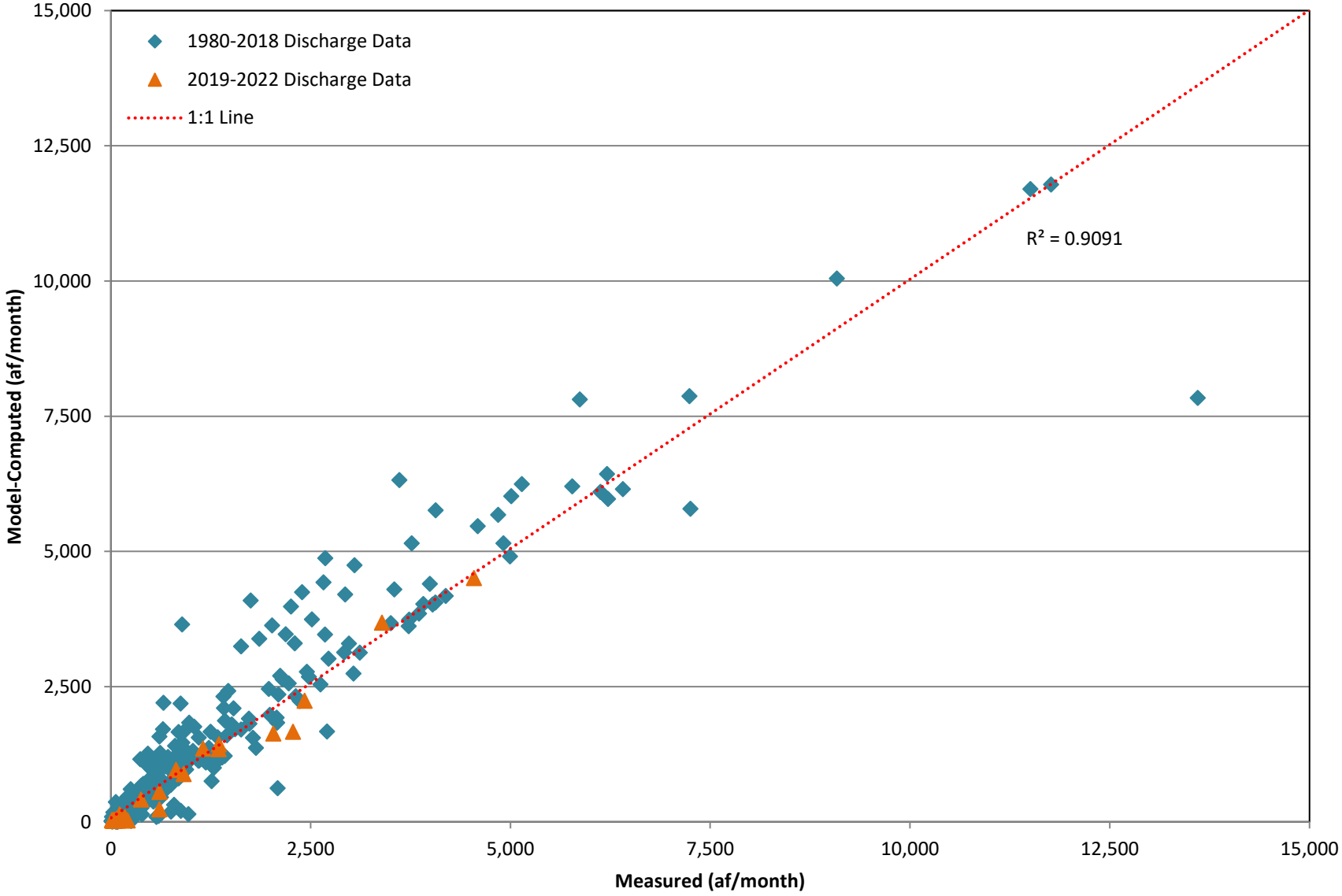


Figure 4-3. Scatter Plot of R4-Estimated Monthly Discharge and USGS-Estimated Discharge for Cucamonga Creek near Mira Loma

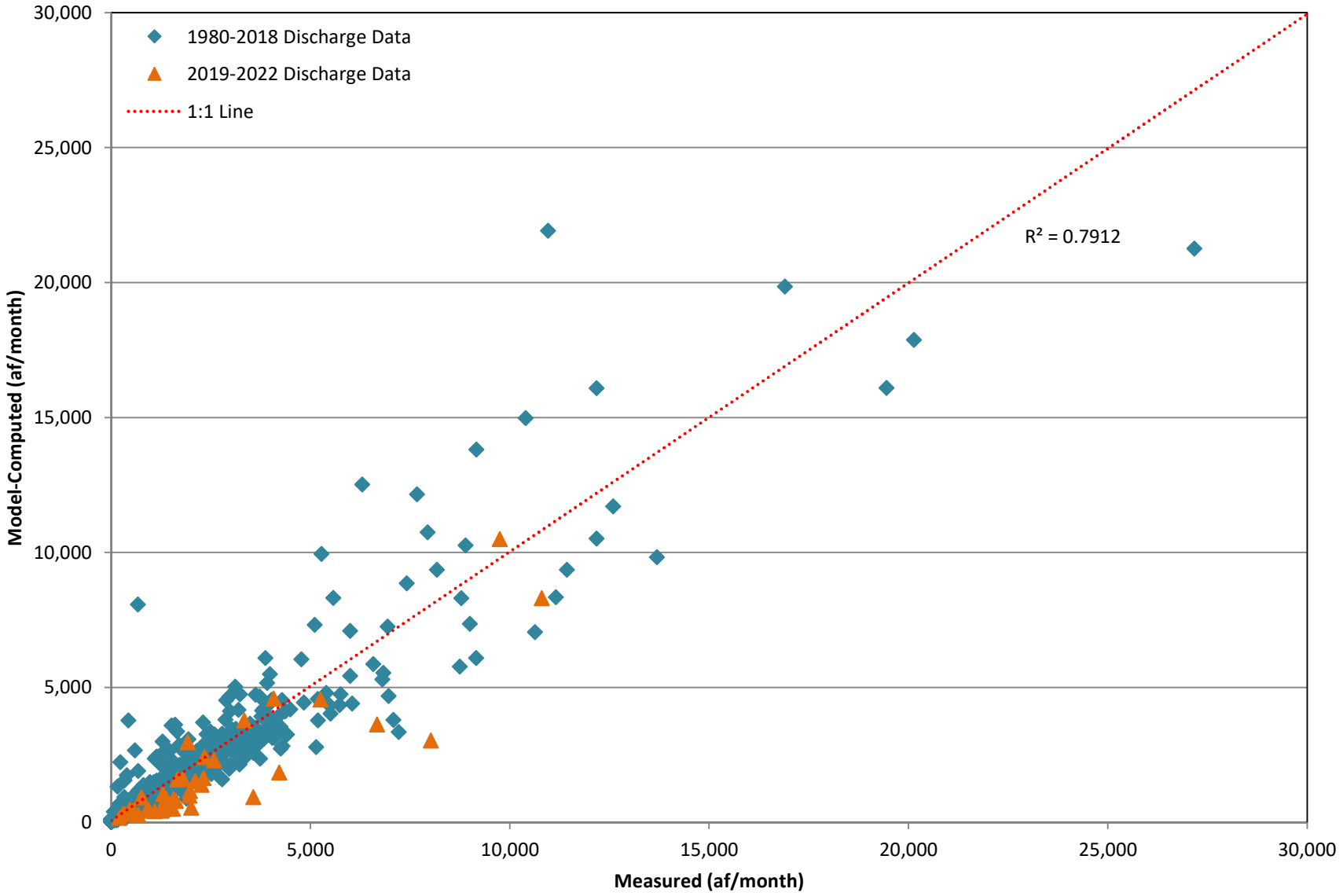


Table 4-2. R4 Model Calibration Statistics for Urban Outdoor Water Use in the 2020 CVM and 2025 CVM

Sewershed	R^2		NSE	
	2020 CVM[(a)]	2025 CVM[(b)]	2020 CVM	2025 CVM
RP1/RP4	0.76	0.76	0.74	0.74
CC/RP5	0.71	0.70	0.68	0.67

(a) The 2020 CVM was calibrated to monthly streamflow over the period of FY 1981 through FY 2018.
(b) The 2025 CVM was validated to monthly streamflow over the period of FY 1981 through FY 2022.

For the RP1/RP4 sewershed, the R4 calibration of urban irrigation demand achieved an R^2 of 0.76 and an NSE index of 0.74 in the 2020 CVM. When additional years of data were incorporated into the 2025 CVM, the R^2 and NSE remained at 0.76 and 0.74, respectively.

For the RP2/CC/RP5 sewershed, the R4 calibration of urban irrigation demand achieved an R^2 of 0.71 and an NSE index of 0.68 in the 2020 CVM. When additional years of data were incorporated into the 2025 CVM, the R^2 decreased to 0.70, while the NSE index slightly decreased to 0.67. The NSE indices indicate a good fit after adding the additional years of data.

Figures 4-4 and 4-5 are time-series charts that show the IEUA estimated total monthly water supply to the RP1/RP4 and RP2/CC/RP5 sewersheds, respectively, versus the R4-estimated urban irrigation supply. These charts illustrate the ability of R4 to replicate urban irrigation demand and its historical seasonality. Figures 4-6 and 4-7 are scatter plots that illustrate the IEUA estimated total monthly water supply versus the R4-estimated water supply for these sewersheds. Review of these figures and the R^2 and NSE statistics indicate the successful validation of the R4 model in the 2025 CVM.

4.1.2.3 Stormwater Recharge in Basins

The R4 model is calibrated to match estimates of stormwater recharge in flood control and conservation basins within the Chino Basin, using diversion estimates provided by IEUA as the comparison against observed data. Starting around FY 2006, IEUA began estimating stormwater diverted into the basins it operates using methods such as water-level sensors and assumed basin infiltration rates, with results reported as monthly totals.

For the 2020 CVM, the R4 model calibration targeted the IEUA diversion estimates and incorporated facility-specific information, including diversion rating curves, elevation-area-storage curves, outlet ratings, and depth-dependent infiltration rates. Calibration performance was assessed using R^2, which ranged from 0.14 to 0.88 across individual basins. Due to the limited number of monthly data points, NSE indices were not calculated. The quality of stormwater recharge calibration varied across facilities, with results ranging from unsatisfactory to very good. It is important to note that R4 model recharge calculations (which include evaporation, infiltration, and overflow) differ from IEUA's diversion estimates, which rely on measurements and assumptions that may not account for all these processes. As a result, the two sets of estimates are not directly comparable.

Figure 4-4. Total Water Supply to the RP1/RP4 Sewershed and the Efficacy of the Supply

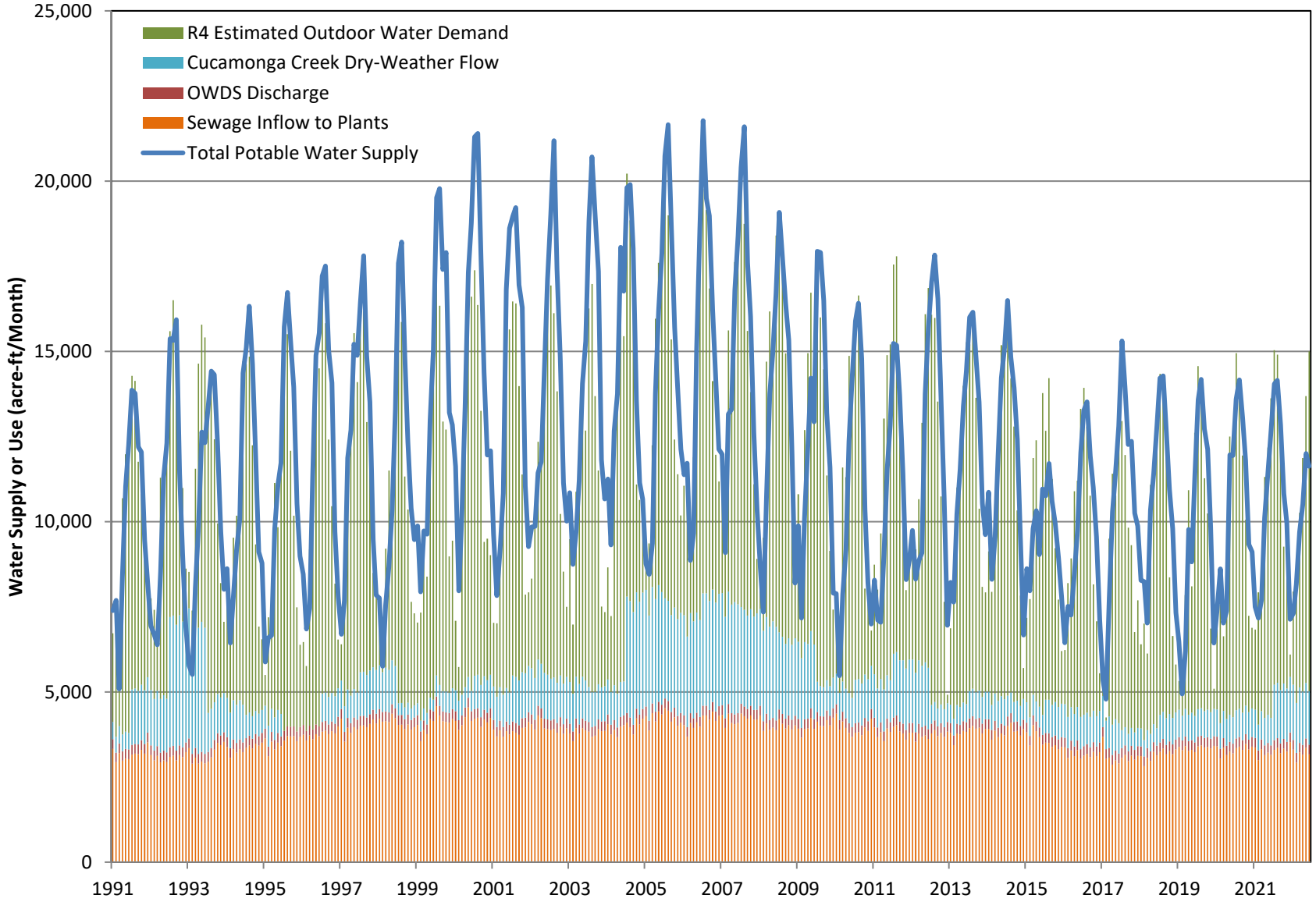


Figure 4-5. Total Water Supply to the RP2/CC/RP5 Sewershed and the Efficacy of the Supply

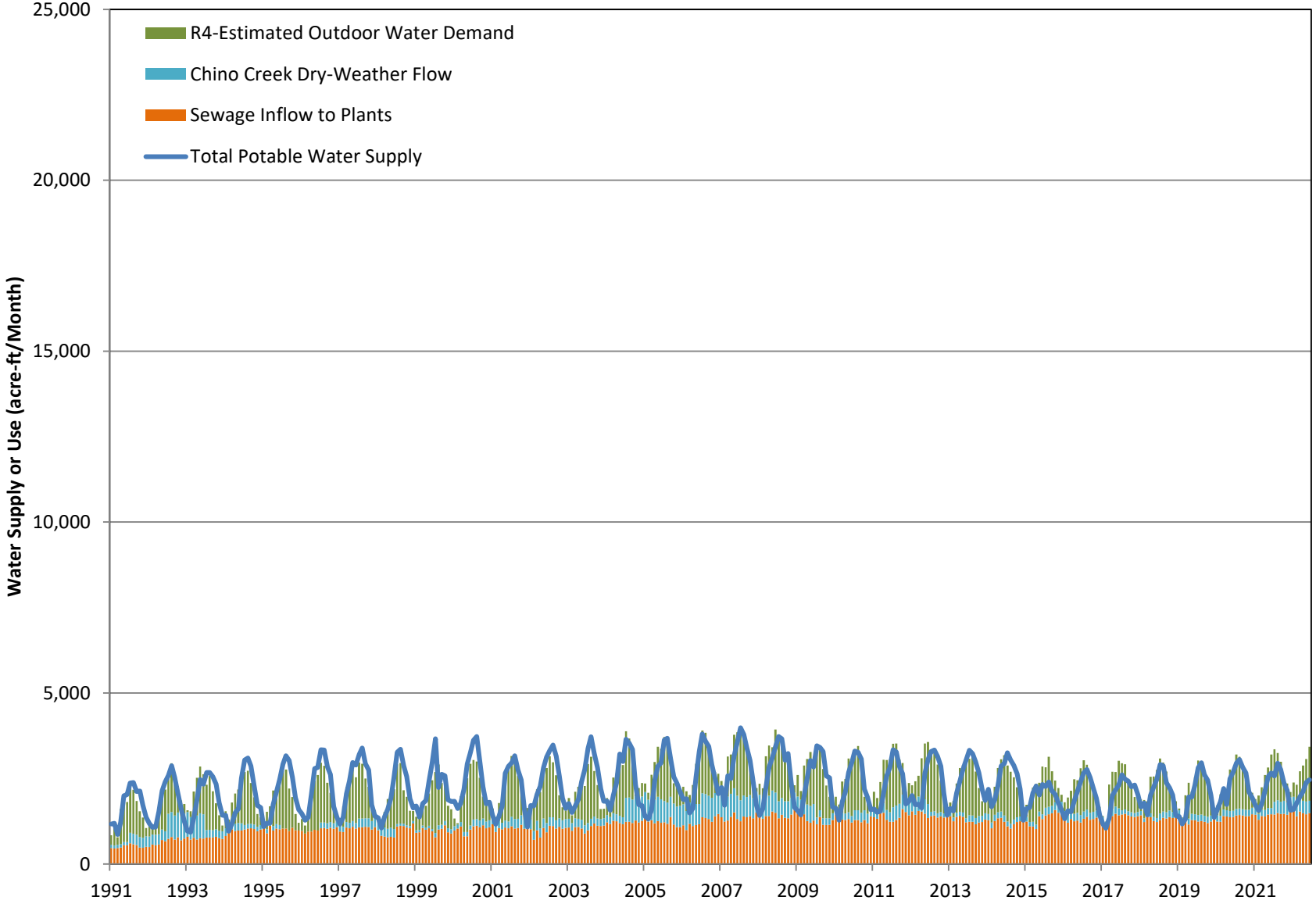


Figure 4-6. Scatter Plot of IEUA-Estimated Water Supply and the R4 Estimated Water Supply for the RP1/RP4 Sewershed

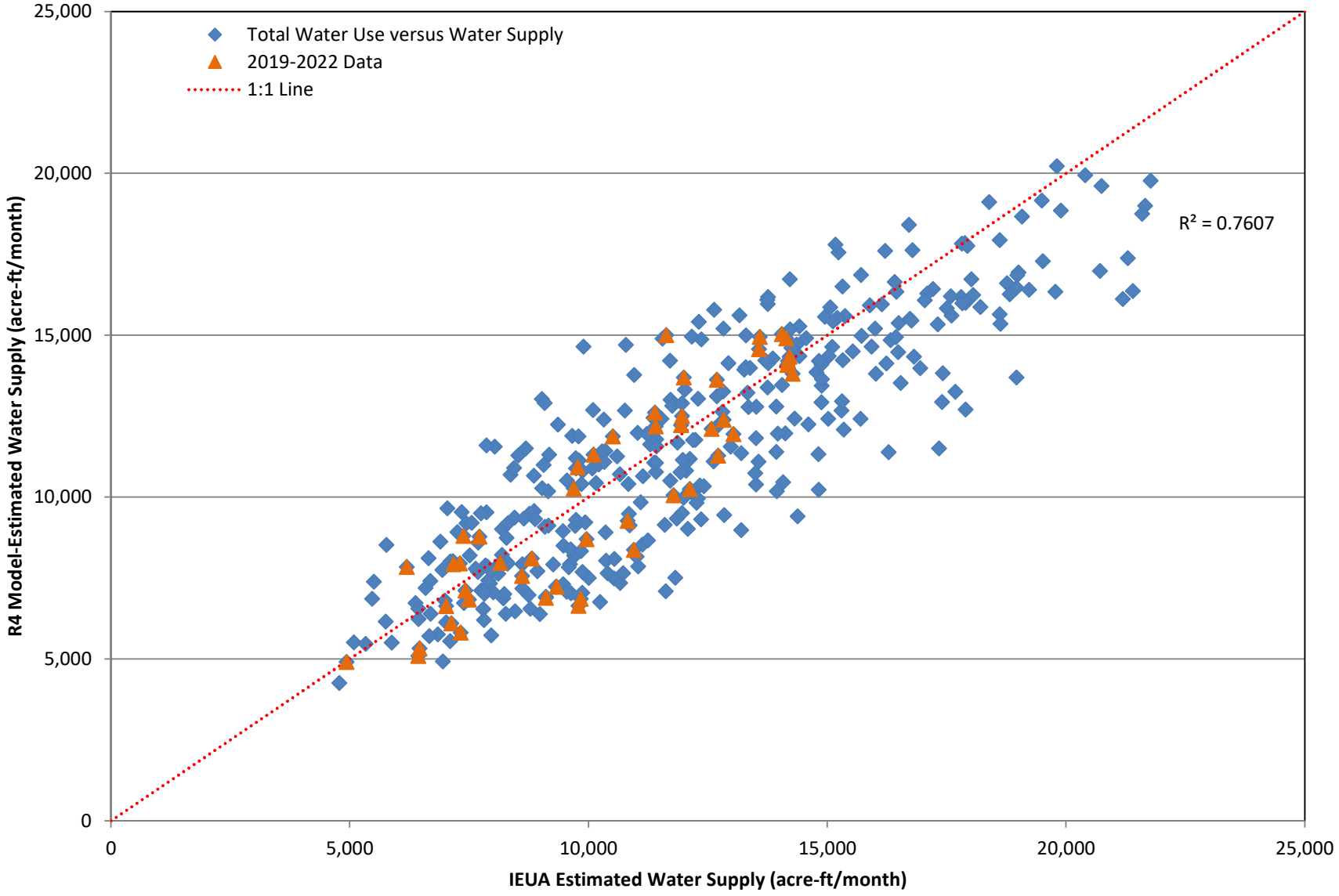


Figure 4-7. Scatter Plot of IEUA-Estimated Water Supply and the R-4 Estimated Water Supply for the RP2/CC/RP5 Sewershed

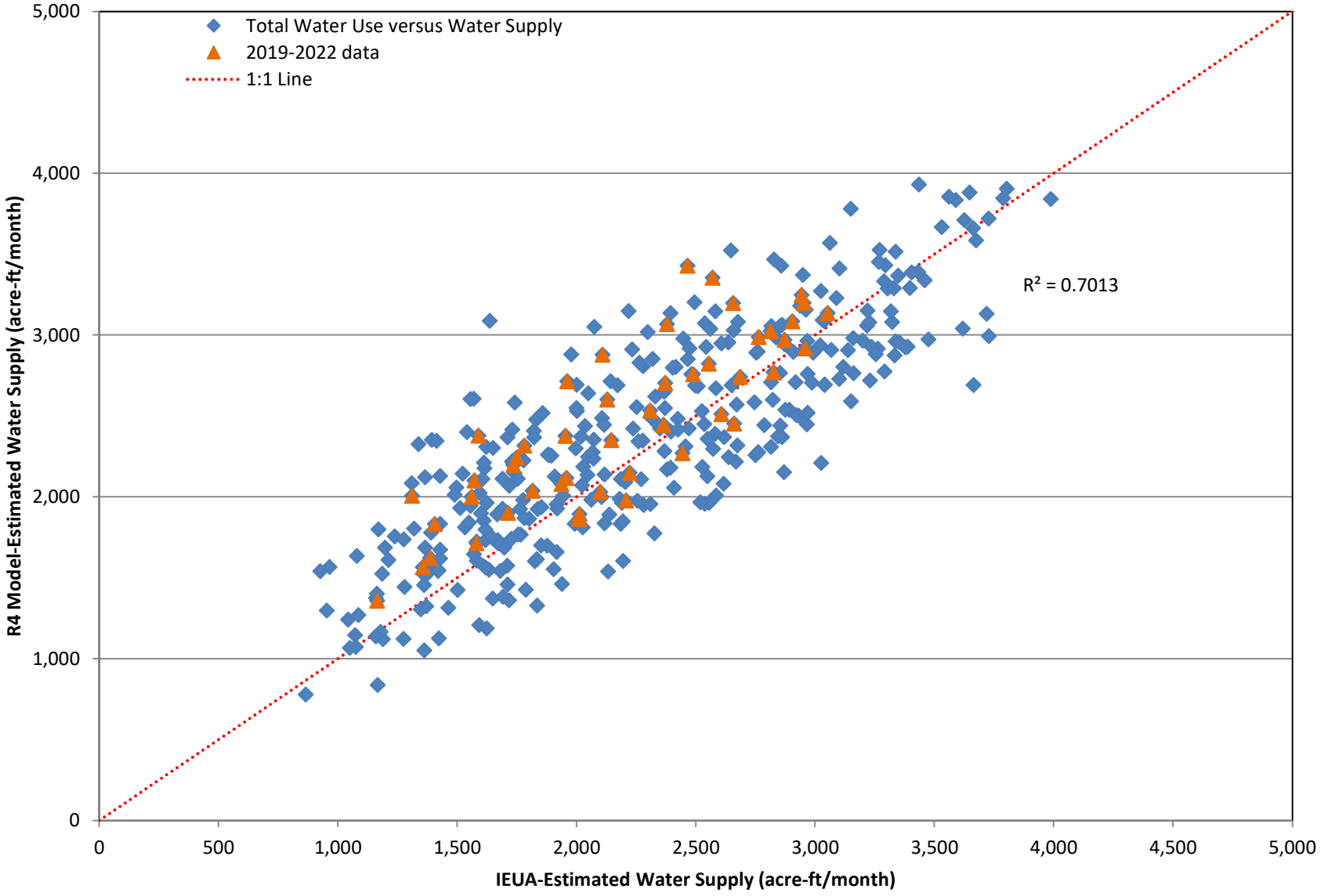


Table 4-3 compares the R^2 values based on monthly R4-simulated recharge and IEUA-estimated diversion volumes for the recharge basins, with corresponding scatter plots provided in Appendix B-1. Table 4-3 shows that the R^2 values were generally consistent after adding four additional years of data (FY 2018 through 2022). Specifically, four basins (Declez, RP3, Turner, and Upland) showed an increase in R^2 of more than 0.04, while three basins (Etiwanda Debris, Grove, and San Sevaine) showed a decrease of more than 0.04. The remaining seven basins exhibited minimal change in R^2, indicating stable model performance over the extended period.

Table 4-3. Calibration and Validation of R4 Model - Recharge Basins

Recharge Basin	R^2 (R4-Simulated Recharge versus IEUA-Estimated Diversions)	
	2020 CVM (2006-2018)	2025 CVM (2006-2022)
7th/8th Street Basins	0.68	0.68
Banana/Hickory Basins	0.27	0.29
Brooks Basin	0.84	0.80
Declez Basin	0.35	0.41
Etiwanda Debris Basin	0.67	0.49
Ely Basins	0.56	0.57
Grove Basin	0.34	0.19
Lower Day Basin	0.86	0.83
Montclair Basins	0.88	0.90
RP3 Basins	0.14	0.46
San Sevaine Basins	0.83	0.77
Turner Basins	0.64	0.78
Upland Basin	0.79	0.90
Victoria Basin	0.81	0.83

4.2 RECALIBRATION AND UNCERTAINTY ANALYSIS

This subsection describes the methods and results of conducting Steps 1 and 2 of the 2022 Safe Yield Reset Methodology (2022 SYRM):

1. Re-calibrate the Watermaster's groundwater-flow model
2. Conduct an uncertainty analysis of the re-calibrated groundwater-flow model to identify a plausible range of calibrated models

4.2.1 Methods

A calibrated realization in the context of hydrologic models refers to a specific set of model parameters that have been adjusted to provide a close match between simulated and observed conditions. Multiple calibrated realizations exist because there are often many different sets of model parameters that can

produce a good fit between the model outputs and the observed data. This phenomenon is known as "non-uniqueness" in model calibration. The 2022 SYRM TM outlined a method for updating the 2025 CVM and generating calibrated realizations. The method includes the elements listed below. The following sections describe the work conducted to execute these elements.

1. Update the HSPF and R4 surface-water models for the calibration period to generate input data to the MODFLOW model.
2. Update the MODFLOW model for the calibration period based on observation data and the results of HSPF and R4.
3. Select adjustable model parameters (e.g., horizontal hydraulic conductivity) and prepare input files to incorporate the spatial relationships and variability of those parameters into PESTPP-IES. This involves defining how the parameters are distributed and varied across the model domain using techniques such as pilot points, variograms, and covariance matrices.
4. Prepare observation data as calibration targets, such as time series of groundwater elevations at wells and stream discharge.
5. Use PESTPP-IES[3] to generate calibrated realizations.
6. Rank and select calibrated realizations for projection scenarios. Review the outcome of the model with calibration realizations and determine which calibrated realizations should be selected for projection scenarios, and whether more calibrated realizations should be added. Conduct peer review process to share calibration results. Repeat the PESTPP-IES process and review outputs until enough calibrated realizations are developed.

Elements 1 and 2 of this method were completed and documented in Section 3.

4.2.2 Update of Calibration Period

The calibration period of the 2020 CVM was July 1, 1977 through June 30, 2018. During the August 30, 2023 workshop, West Yost proposed a calibration period for the 2025 CVM of July 1, 1991 to June 30, 2022. This calibration period was selected because most groundwater-level data in the Chino Valley were collected after 1992.[4]

The calibration period contains both wet and dry periods as demonstrated through a time-series analysis of precipitation data across the Chino Valley from the Parameter-elevation Relationships on Independent Slopes Model (PRISM)5 dataset. Figure 4-8 below shows the time history of annual precipitation, long-term average annual precipitation, and a curve of cumulative departure from mean precipitation (CDFM) based on the analysis. The latter is a graphical representation used to analyze precipitation trends over time. Positive slopes of the CDFM curve indicate periods of above-average precipitation (i.e., wet years), while negative slopes indicate periods of below-average precipitation (i.e., dry years). As shown on

[3] Approaches to Highly Parameterized Inversion: PEST++ Version 5, a Software Suite for Parameter Estimation, Uncertainty Analysis, Management Optimization and Sensitivity Analysis

[4] At 152 wells in Chino Valley, there are 5,414 groundwater-elevation data points from fiscal year 1978 to 1991, and 752,473 data points from 1992 to 2022.

[5] PRISM Climate Group, Oregon State University, https://prism.oregonstate.edu

Figure 4-8, the selected calibration period for the 2025 CVM includes a wet period from 1992 to 1999 and a dry period from 1999 to 2022 with some intermittent wet years.

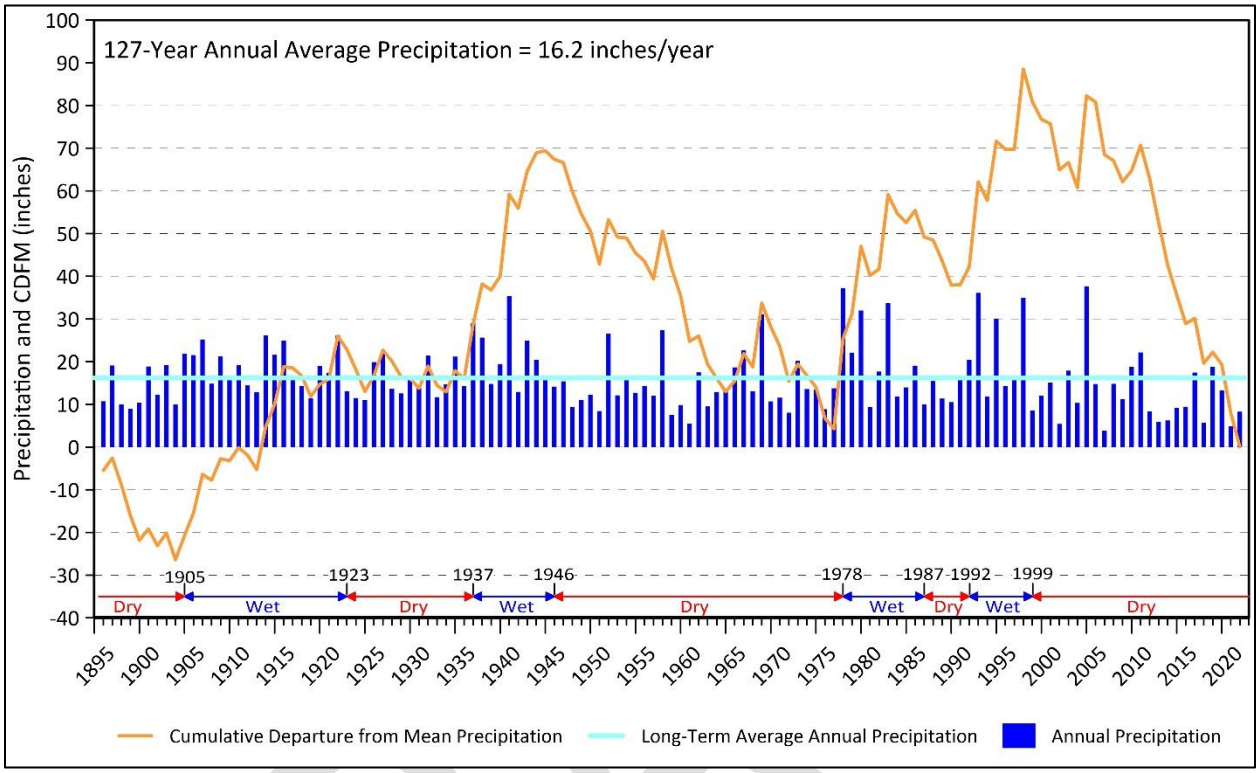


Figure 4-8. Precipitation Time Series in the Chino Basin, FY 1896-2022.

4.2.3 Select Adjustable Model Parameters and Prepare Input Files for PESTPP-IES

Many model input parameters are not well known and need to be adjusted through model calibration. For that purpose, the 2025 CVM uses the open-source computer code PESTPP-IES (Welter, et al., 2015; White, 2018; White, et al., 2020). PESTPP-IES is based on the Iterative Ensemble Smoother (iES) algorithm introduced by Chen and Oliver (2012; 2013). Using the iES algorithm, the required number of model runs for a calibration process depends on the desired number of calibrated realizations and does not depend on the number of adjustable parameters. The number of adjustable model parameters, however, still affects the required computing resources and computing time, as the information associated with each of the parameters needs to be stored and processed during the calibration process. Therefore, careful selection of a limited number of adjustable model parameters is still required. The rationale for the selected adjustable model parameters is given below.

4.2.3.1 DIPAW

Initial conditions for DIPAW are based on the outputs from the R4 rootzone module adjusted for lag time through the vadose zone (see Section 3). The DIPAW input was first applied without spatial multipliers (i.e., a uniform scaling factor across the model domain), consistent with the assumption that the R4-derived recharge estimates (after lag adjustment) were physically representative. However, in response to peer review comments, the parameterization was refined to allow for spatial variability using pilot points.

In the updated approach, arrays of annual average DIPAW values were scaled using spatially distributed multipliers defined at 240 pilot points and interpolated across the model domain. These multipliers were treated as adjustable model parameters within the calibration process. After each iteration, updated multiplier values were estimated, applied to the DIPAW fields, and used as input to the subsequent groundwater flow simulation.

The initial values of the DIPAW multipliers were defined using a normal distribution with a mean of 1.0 and a standard deviation of 0.125, such that approximately 95 percent of values fall between 0.75 and 1.25. A multiplier greater than one indicates simulated DIPAW exceeding the R4-based estimate (after lag adjustment), while a multiplier less than one indicates lower simulated DIPAW relative to that estimate. A multiplier of greater than one means that the simulated DIPAW is greater than estimated by the R4 model adjusted for lag time, and a multiplier of less than one means that the simulated DIPAW is less than estimated by the R4 model adjusted for lag time.

Although the R4 model is well-calibrated and the DIPAW estimates are considered physically defensible, inclusion of these multipliers allowed the calibration process to account for minor local or temporal variability that may not be explicitly represented in the R4 model. This approach does not alter the overall mass balance or conceptual consistency of the recharge estimates; rather, it provides limited flexibility for PESTPP-IES to reconcile small differences between the R4-estimated recharge and observed groundwater responses, ensuring numerical stability and improved spatial consistency in the calibrated realizations.

4.2.3.2 Evapotranspiration

Each array of monthly maximum ET rate was assigned a scalar multiplier as an adjustable model parameter. After each iteration of the calibration process, new values of the scalar multipliers were estimated, the associated maximum ET rates were scaled with the scalar multipliers, and then the scaled maximum ET rates were used as input to the groundwater flow simulation of the subsequent calibration iteration. Initially, the range of scalar multipliers for the maximum ET rate were allowed to vary within a range characterized by a normal distribution with a mean of 1.0 and a standard deviation of 0.1, which means that 95 percent of the multipliers would fall between 0.8 and 1.2.

4.2.3.3 Subsurface Inflow

The subsurface inflow boundary is divided into 45 segments as shown in Figure 3-14. Each segment was assigned a scalar multiplier as an adjustable model parameter to scale its inflow time series. The scalar multipliers for the inflow time series were defined using a normal distribution on a log scale with a mean of 1.0 and a standard deviation of 0.5 orders of magnitude, meaning that 95 percent of the values fell between 0.1 and 10. After each iteration of the calibration process, new values of the scalar multipliers were estimated, the associated initial inflow values were scaled with the scalar multipliers, and the scaled inflow values were then used as input to the groundwater flow simulation of the subsequent calibration iteration.

4.2.3.4 Specified Head Boundary

Two specified head boundaries were simulated with the FHB of the MODFLOW model. Figure 3-15 shows the segments of the specified head boundaries – one near Rialto and the other on the southern tip of the Spadra Basin. The specified head values at those boundaries were estimated based on nearby head measurements. Each specified head boundary was added as an adjustable model parameter. A positive addend increases the specified head, increasing the net flux into the active model domain for the stress period, and vice versa for a

negative addend. After each iteration of the calibration process, the addends were updated and then added to the initial specified head values of the respective boundary. The addends were allowed to vary between +/- 35 feet for the Bloomington Divide and between +/-10 feet at the western edge of the Spadra Basin, based on the range of historically observed variation. The Bloomington Divide was segmented into seven sections to allow for more flexibility in the heads at this boundary.

4.2.3.5 Santa Ana River and Its Tributaries

The Santa Ana River and its tributaries are divided into 24 segments as shown in Figure 3-10. The streambed hydraulic conductivity for each segment was treated as an adjustable model parameter. This property governs the rate of water exchange between the stream and the underlying aquifer, thereby influencing stream–aquifer interactions. It was initially set to 1 ft/day, and during model calibration, it was allowed to vary within a range of 0.1 to 100 ft/day. After each iteration of the calibration process, the streambed hydraulic conductivity values were updated, and used in the groundwater flow simulation of the subsequent calibration iteration.

4.2.3.6 Faults

The horizontal-flow barriers that represent faults are divided into 45 segments as shown in Figure 3-13. The hydraulic conductivity of the flow barrier in each segment is an adjustable model parameter. These conductivity values determine how easily groundwater can move across the faults, thus influencing flow connectivity between adjacent hydrogeologic units. In the model, the conductivity factors were varied across several orders of magnitude, depending on the characteristics of each barrier. After each iteration of the calibration process, the hydraulic conductivity values of the segments were updated and then used in the groundwater flow simulation of the subsequent calibration iteration.

4.2.3.7 Aquifer Properties and Pilot Points

Hydrogeological properties of the model include the horizontal hydraulic conductivity (HK), vertical hydraulic conductivity (VK), specific storage (SS), and specific yield (SY) of model layers. To represent the spatial variability of these properties, each layer was assigned several pilot points, each with an initial estimated value.

Pilot points serve as adjustable control locations within the model domain for the calibration process. Each pilot point's value for a specific hydrogeological property was treated as an independent parameter that PESTPP-IES modified during calibration. After each iteration[6], PESTPP-IES estimates updated values at these pilot point locations based on the differences between simulated and observed data.

These updated pilot point values were then spatially interpolated to assign values to all individual model cells within the corresponding layer. The Kriging method, a robust geostatistical interpolation technique, was employed for this spatial distribution. Kriging leverages the spatial correlation structure of the

[6] In the context of PESTPP-IES, an iteration represents one complete cycle of the calibration process. During each iteration, PESTPP-IES adjusts the model parameters (like the pilot point values) based on the calculated differences between simulated and observed data. The model is then run again with these adjusted parameters, producing a new set of simulated results. This process is repeated to progressively refine the parameter values and improve the model's fit to the observed data.

hydrogeological property (often defined through a variogram) to provide optimal estimates at unsampled locations (the model cell centers) based on the values at the pilot points. This method ensured that the interpolated values honor the pilot point values and reflect the assumed spatial continuity of the property.

The strategic use of pilot points, even in limited numbers, allowed for the efficient representation of complex spatial heterogeneity in hydrogeological properties across the entire model domain. By adjusting the values at these key locations, PESTPP-IES indirectly influenced the property values in all model cells through the Kriging interpolation.

The density and number of pilot points directly influence the level of spatial variability that the model can simulate. A higher density of pilot points allows for the representation of more complex and localized variations in hydrogeological properties. Ideally, with a sufficiently large number of well-placed pilot points, the precise location of individual points becomes less critical, and the interpolation method's influence diminishes as the pilot points effectively sample the spatial variability.[7]

Calibration using pilot points is specifically designed to capture the inherent heterogeneity required to adequately reproduce the observed hydrologic behavior. The pilot point parameters act as 'receptacles' for the information contained within the history-matching dataset (the observed data). Therefore, the effective placement of pilot points is crucial; they should be located in areas where they can best receive and propagate information relevant to the calibration targets. To investigate the impact of the number of realizations and the density and number of pilot points on the model's estimated net recharge values, three distinct scenarios for pilot point placement were implemented within PESTPP-IES, as described in Section 4.3.4.2.

4.2.4 Prepare Observation Data as Calibration Targets

Two types of observation data were collected and used for model calibration. The first type is the groundwater elevation time series at selected wells. The second type is the stream discharge time series observed at gaging stations. For the purposes of model calibration, a subset of the measured groundwater elevations was selected based on the principle that the selected data should be both temporally and spatially evenly distributed to avoid biasing the calibration with measurements from specific times or areas with more concentrated data collection. The selected observation data were used as calibration targets and each of the selected data is assigned a weight value. The monthly average daily stream discharge data was created based on the observed daily stream discharge data.

During the model calibration process, the differences between the (observed) calibration targets and the model calculated counterparts (i.e., the residuals) were calculated and then multiplied by the corresponding weights. These weighted residuals were squared (to avoid mutual cancelation of positive and negative residuals) and summed. The sum of the squared weighted residuals is known as the objective function, Phi (Φ).

PESTPP-IES minimizes Phi by adjusting model parameters through an iterative process. For the 2025 CVM, head values were assigned a weight value ranging from 0.5 to 10 depending on the confidence and importance of the data. For example, the piezometer at the Pomona Extensometer has highly precise and

[7] https://help.pesthomepage.org/index.html?pilot-point-emplacement.html

accurate, depth-specific, head measurements, and the measured head values were assigned a weight value of 10. All stream discharge values were assigned a weight value of 2×10^{-5}, reflecting the fact that stream discharge measurements are typically several orders of magnitude larger than head measurements. These weight values were selected so that the sum of the weighted residuals of stream discharge (in units of ft^3/day) and the sum of the weighted residuals of hydraulic head (in units of ft) lie in the same order of magnitude. This arrangement enabled PESTPP-IES to pick up adequate information for model calibration from both head and stream discharge time series.

4.2.4.1 Groundwater Elevation Time Series

A total of 102 wells in the Chino Basin, Spadra Basin, Cucamonga Basin, and the Six Basins area were selected for model calibration. The selection was based on two criteria – their screened intervals must be available, and they must have relatively long-term groundwater-elevation measurements within the calibration period. Figure 4-9 shows the locations of the selected calibration wells. Table 4-4 shows the number of wells in each of the model layers where the wells are screened (calibration wells can be screened across multiple model layers). These wells have a total of 572,938 groundwater-elevation measurements during the calibration period. Some of the wells were equipped with transducers that measure and record groundwater elevations at high frequency (e.g., sometimes as short as 15 minutes).

A total of 7,781 groundwater-elevation measurements were selected as calibration targets. This reduction was necessary to ensure computational efficiency, to avoid "over-weighting" the frequently measured wells (e.g., wells with transducers), and to preserve temporal representativeness across the model domain. Including all available measurements would have resulted in excessive clustering of calibration targets at certain locations, potentially biasing the parameter estimation process and overwhelming the influence of observations from sparsely monitored areas. To address this, a data thinning strategy was applied to retain a representative subset of observations that captures the key temporal trends and seasonal variability of groundwater elevations at each site, while reducing redundancy. This approach allowed the model to be calibrated against meaningful and distributed information without compromising performance or interpretability. Figure 4-10 shows an example of groundwater-elevation measurements and selected calibration targets.

For single-layer observation wells (i.e., those with screened intervals across a single model layer), the selected groundwater-elevation measurements and the corresponding simulated head values of the given layer are used for the calculation of the objective function.

For multi-layer observation wells (i.e., those with screened intervals across multiple model layers), the selected groundwater-elevation measurements and the corresponding layer-weighted simulated head values were used for the calculation of the objective function. The following equation was used to calculate the layer-weighted simulated head values:

$$h = \frac{\sum_{l=1}^{n} h_l \cdot w_l}{\sum_{l=1}^{n} w_l} \quad (1)$$

where n is the number of layers of the model; l is the layer number; h_l is the simulated head in layer l; and w_l is the weight of layer l. For a particular well, the initial weight of a layer is calculated based on the product of the screen length in that layer and the HK value of the model cell where the well is located. After each calibration iteration, the layer weights are adjusted based on the updated HK values.

Table 4-4. Number of Monitoring Wells by Screened Model Layer				
Model Layer	Chino Basin	Spadra Basin	Cucamonga Basin	Six Basins
1	42	2	5	18
2	17	0	0	0
3	32	0	0	0
4	10	0	0	0
5	24	0	0	0
Any layer	77	2	5	18

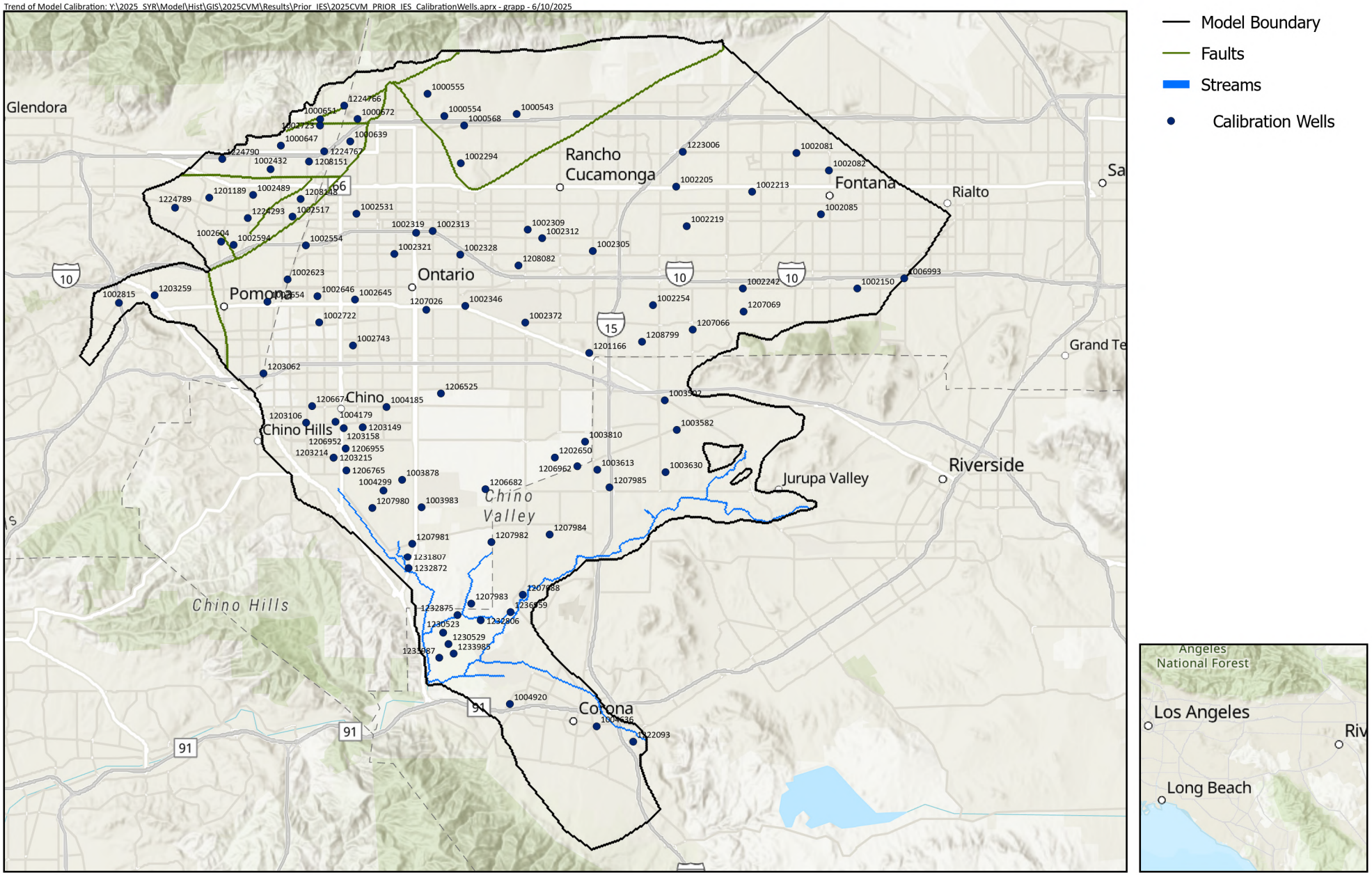
4.2.4.2 Stream Discharge Time Series

Daily streamflow data for streamflows at Prado Dam were obtained from the Santa Ana River Watermaster Annual Reports, and selected portions of the dataset were used as calibration targets. High stream discharge observations were excluded from the calibration because they are short-duration events dominated by surface runoff, not groundwater interaction. These peaks are difficult to measure accurately and are poorly represented in the groundwater-flow model focused on long-term groundwater/surface-water interactions. Including them could have distorted the parameter estimates and reduced model reliability under typical flow conditions.

4.2.5 Use PESTPP-IES to Generate Calibrated Realizations

Calibration of the 2025 CVM was conducted in two phases. In the first phase, a manual calibration was conducted with a few key model parameters. In the second phase, PESTPP-IES was used to generate calibrated realizations using all adjustable model parameters.

DRAFT



Prepared by:

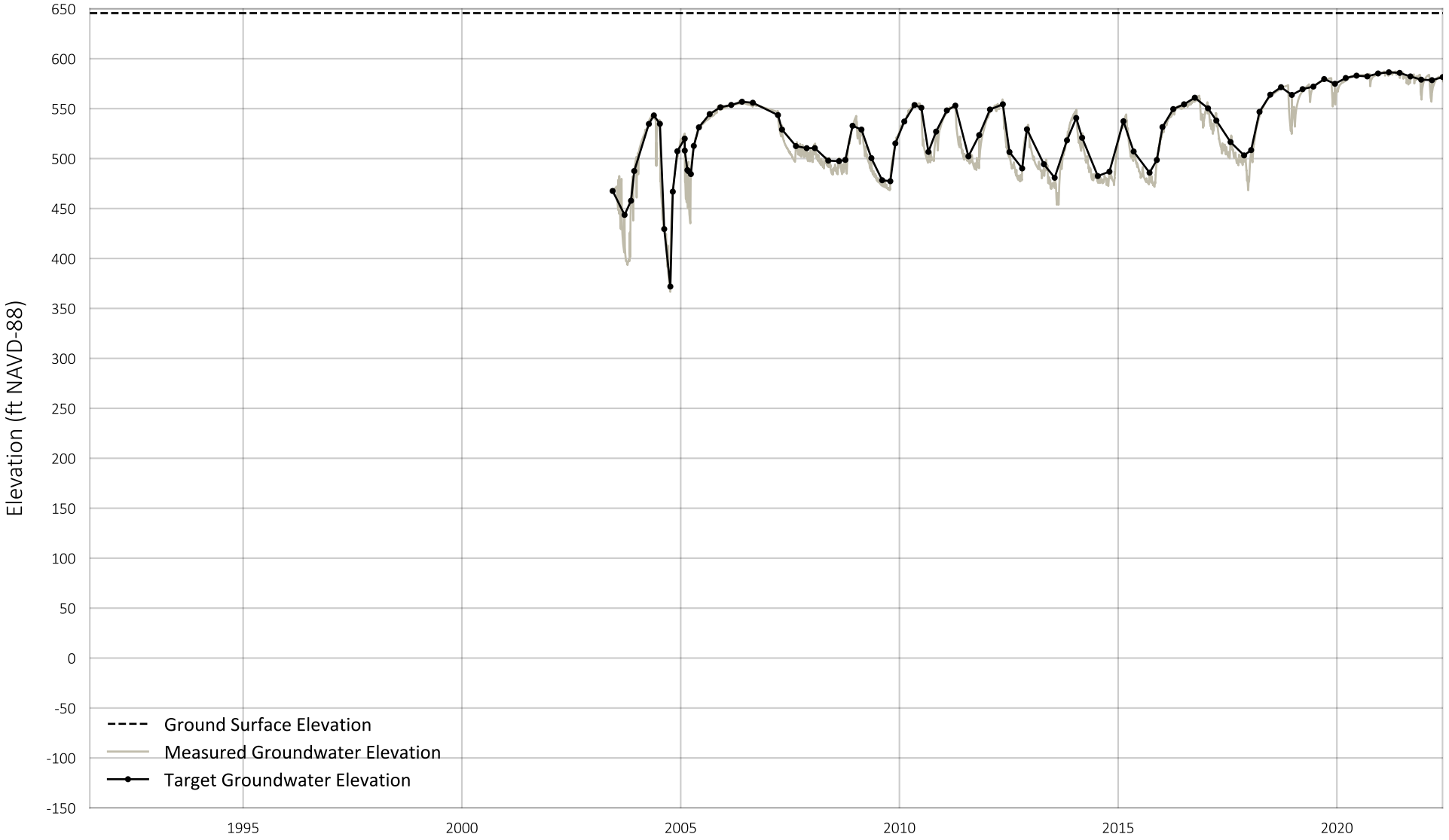
WEST YOST

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM
Calibration Wells with
HydroDaVE Well ID

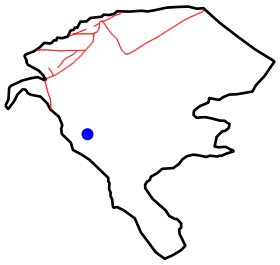
DRAFT **Figure 4-9**



Prepared by:

WEST YOST
Water. Engineered.

Well Location



Statistics

Target Groundwater Elevation (ft)
Mean = 526.27
Standard Deviation = 39.66

An Example of Groundwater Elevation Measurements and Selected Calibration Targets

DRAFT

Figure 4-10

4.2.5.1 Manual Calibration

In the first phase, a manual calibration was performed to adjust hydraulic conductivity values for faults and streambeds, as well as scalar multipliers for boundary inflow and DIPAW. The purpose of this manual calibration was twofold: to identify any potential problems or errors within the model setup and to "precondition" key model parameters, setting them to more reasonable starting values before the automated calibration phase using PESTPP-IES.

During this phase, the specific storage values of the 2020 CVM and the estimated maximum ET rates were used without any modification. The aquifer properties HK, VK, and SY of the 2020 CVM were assigned to pilot points that are placed in each model layer based on the density of groundwater elevation observation wells. The aquifer properties at pilot points were interpolated to model cells with the Kriging method. Guidance for the emplacement of pilot points outlined in the Parameter Estimation (PEST) homepage[8] was generally followed for the placement of pilot points.

Manual calibration of the model involved numerous iterative cycles. In each cycle, simulated head and stream discharge time series were compared against the calibration targets. The differences observed in this comparison then guided the adjustment of parameter values. After each parameter adjustment, the model was run again. This process was repeated until the sum of weighted squared residuals could not be meaningfully reduced by additional model runs.

The calibrated hydraulic conductivity of faults ranges between 1×10^{-9} and 0.0017 ft/day. The calibrated streambed conductivity ranges between 0.23 and 10 ft/day. The calibrated multipliers for Subsurface Inflow range from 0.6 to 1.8. The calibrated multiplier for annual DIPAW values averaged approximately 0.94.

Appendix B-2 shows the maps of aquifer properties used in the manually calibrated model. Appendix B-3 contains the time series of simulated hydraulic heads versus the calibration targets of the manually calibrated model.

Figure 4-11 shows a scatter plot of the simulated hydraulic heads versus the calibration targets in the Chino Basin, Spadra Basin, Cucamonga Basin, and Six Basins. The root mean squared error (RMSE) is 18.88 ft for calibration targets in the Chino Basin, and 25.93 ft for all calibration targets. The linear regression equation is derived based on all calibration targets. All points are distributed closely around the regression line, which matches closely with the 1:1 line, indicating good inverse modeling performance and a robust calibration. The R^2 of 0.9989 suggests that 99.89 percent of the observed variance is explained by the model. Overall, these results indicate that the calibration is improved over the 2020 CVM.

Figure 4-12 is a map of average residuals at the calibration wells. The mean and median residuals for all calibration targets are 1.47 ft and 0.63 ft, respectively. These values are close to the expected value of zero, indicating that the prediction of groundwater elevations is not biased. Figure 4-13 shows a map of RMSE. Figure 4-14 shows a map of the trend of residuals between the average simulated hydraulic heads and calibration targets. Wells with overpredicted head values (i.e., average simulated heads greater than the average calibration targets) are colored blue, while wells with underpredicted head values (i.e., average simulated heads less than the average calibration targets) are colored yellow. A spatial bias in the simulated head can be identified if the overpredicted and/or underpredicted wells cluster in areas.

[8] https://help.pesthomepage.org/index.html?pilot-point-emplacement.html

The random distribution pattern of the overpredicted and/or underpredicted wells shown in Figure 4-14 indicates that the simulated heads are not spatially biased at the basin scale.

Figure 4-15 is a time-series chart that compares model-estimated stream discharge versus total Prado inflow estimated by the Santa Ana River Watermaster. Figure 4-16 is a scatter chart of model-estimated versus observed discharge values. The red dashed line represents the 1:1 line, while the blue dashed line is the regression line, which has a slope of 1.1765. This indicates that the model tends to overpredict discharge during rare, very high-flow events. During these events, it is expected that the discharge will be overpredicted due to the operations of Prado Dam, which would temporarily reduce discharge during high-flow events. The coefficient of determination (R^2) is 0.92, demonstrating a strong correlation between simulated and observed discharge.

4.2.5.2 Automated Calibration

In the second phase, PESTPP-IES was used to adjust all adjustable model parameters to conduct the uncertainty analysis. PESTPP-IES does not seek a single set of parameters (i.e., a parameter realization) that is deemed to "calibrate" a model. Instead, it seeks a suite of parameter realizations which each result in an acceptably good match between observed and simulated conditions, and collectively express parameter uncertainty. Through a series of successive iterations, PESTPP-IES adjusts parameter realizations so that each meets the user-defined calibration criteria. Specifically, it modifies each realization within the ensemble such that, when the model is run with that parameter set, the simulated-to-measurement fit is sufficient for the model to be considered as "calibrated." The result is an ensemble of parameter realizations, which can be interpreted as samples from the posterior probability distribution of the parameters.

The effects of the number of desired calibrated realizations and the number and spatial distribution of pilot points on model-estimated net recharge were evaluated using five distinct pilot point scenarios:

- **Pilot Point Scenario 1:** Irregularly spaced pilot points were placed in each model layer based on the density of groundwater elevation monitoring wells. This scenario included a total of 2,701 adjustable parameters, of which 2,245 were pilot points. PESTPP-IES was configured to run for six iterations, with the number of desired calibrated realizations set to 100. During the calibration process, some realizations were excluded by PESTPP-IES—likely due to poorly performing parameter combinations—because their model run times exceeded twice the average runtime of successful realizations.
- **Pilot Point Scenario 2:** This scenario used the same pilot point layout and number of adjustable parameters as Scenario 1 (2,701 adjustable parameters, including 2,245 pilot points). The only change was an increase in the number of desired calibrated realizations from 100 to 400 to better explore parameter uncertainty and posterior variability.
- **Pilot Point Scenario 3:** In this scenario, regularly spaced pilot points were placed at 10-row by 10-column intervals across each model layer. This configuration significantly increased the number of adjustable parameters to 25,326, including 24,870 pilot points, enabling a more detailed exploration of spatial heterogeneity. The number of desired calibrated realizations was set to 400.
- **Pilot Point Scenario 4:** This high-resolution scenario involved 159,146 adjustable parameters, including 158,690 pilot points, and targeted 400 realizations. However, due to

the extreme computational demand, the PESTPP-IES run failed, exceeding available memory and runtime limitations.

- **Pilot Point Scenario 5:** This scenario was developed to implement several of the recommendations from the peer review, including:
  - Added spatially variable DIPAW multipliers
  - Reduced observation noise
  - Targeted 100 realizations to reduce runtime
  - Reduced head closure criteria
  - Increased weighting of streamflow observations

This scenario resulted in 32,800 adjustable parameters.

Pilot Point Scenario 5 was selected for use in projection simulations. It provided a balance between parameter complexity and computational feasibility, allowing the model to represent smaller-scale heterogeneities more effectively than the lower-resolution scenarios.

The following section provides a detailed description of Pilot Point Scenario 5.

4.2.5.2.1 Pilot Point Scenario 5

In this scenario, pilot points for aquifer properties were placed at a spacing of every ten model rows/columns in each model layer. This scenario incorporates a total of 32,800 adjustable parameters including 32,332 pilot points: 8,624 for HK, 8,067 for VK, 6,338 for SS, 2,061 for SY, and 7,440 for DIPAW multipliers.

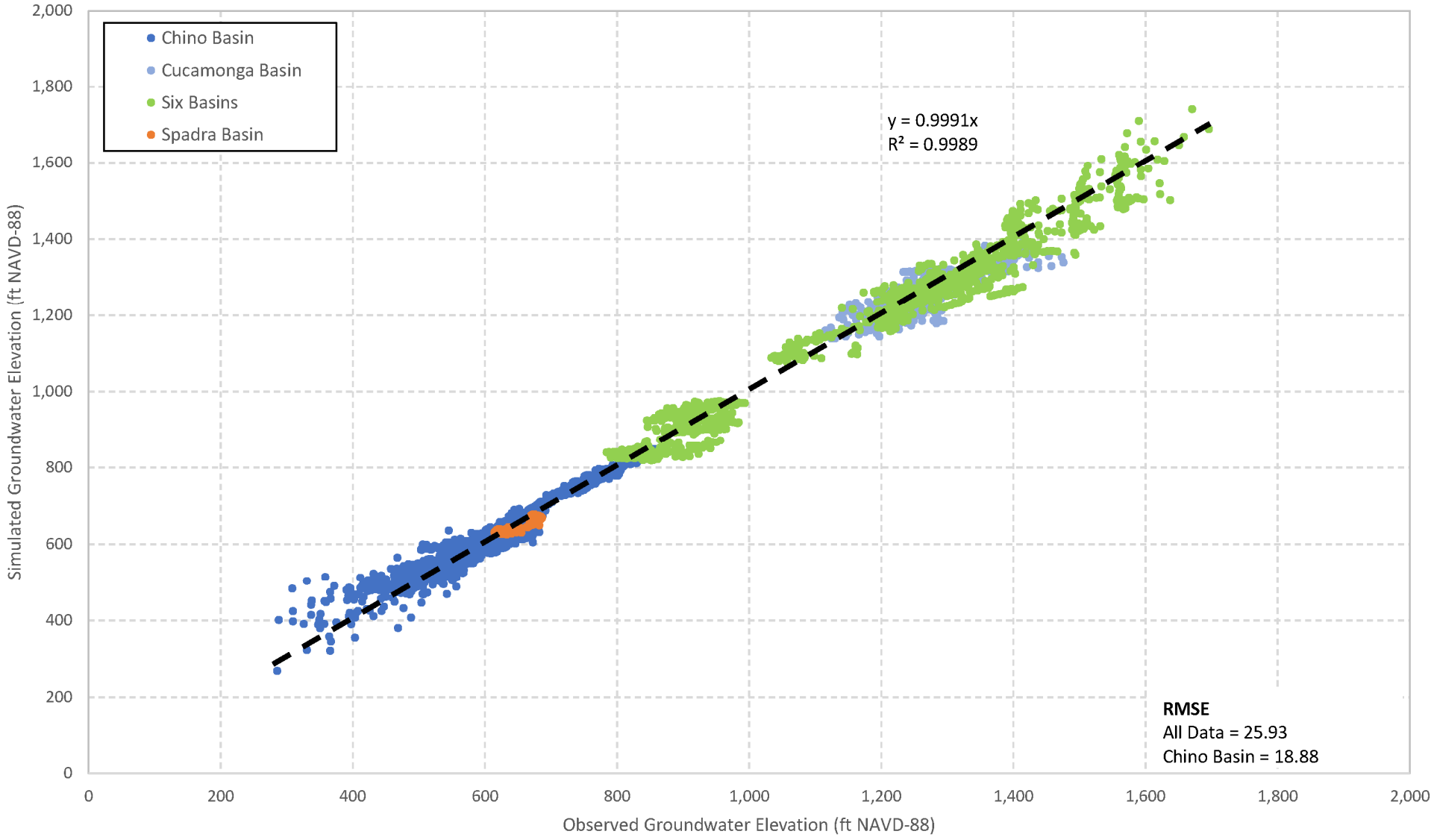
PESTPP-IES was configured to run for five iterations. The number of desired calibrated realizations was 100. Like previous scenarios, some realizations were dropped by PESTPP-IES during the calibration process. Figure 4-17 shows the range of the calculated net recharge for fiscal year 1992 to 2022 for the 97 realizations that remained active at the end of the third iteration. Runs with a larger number of adjustable parameters tended to be more complex, increasing both the calibration time and the likelihood of model instability or physically unrealistic behavior in some realizations. PESTPP-IES identified and removed such failing realizations, resulting in a smaller final ensemble.

Figure 4-18 shows a histogram of calculated mean net recharge for the 97 realizations that remained active at the end of the second iteration. The average net recharge of all active realizations for the calibration period was about 135,200 acre-feet/year (afy).

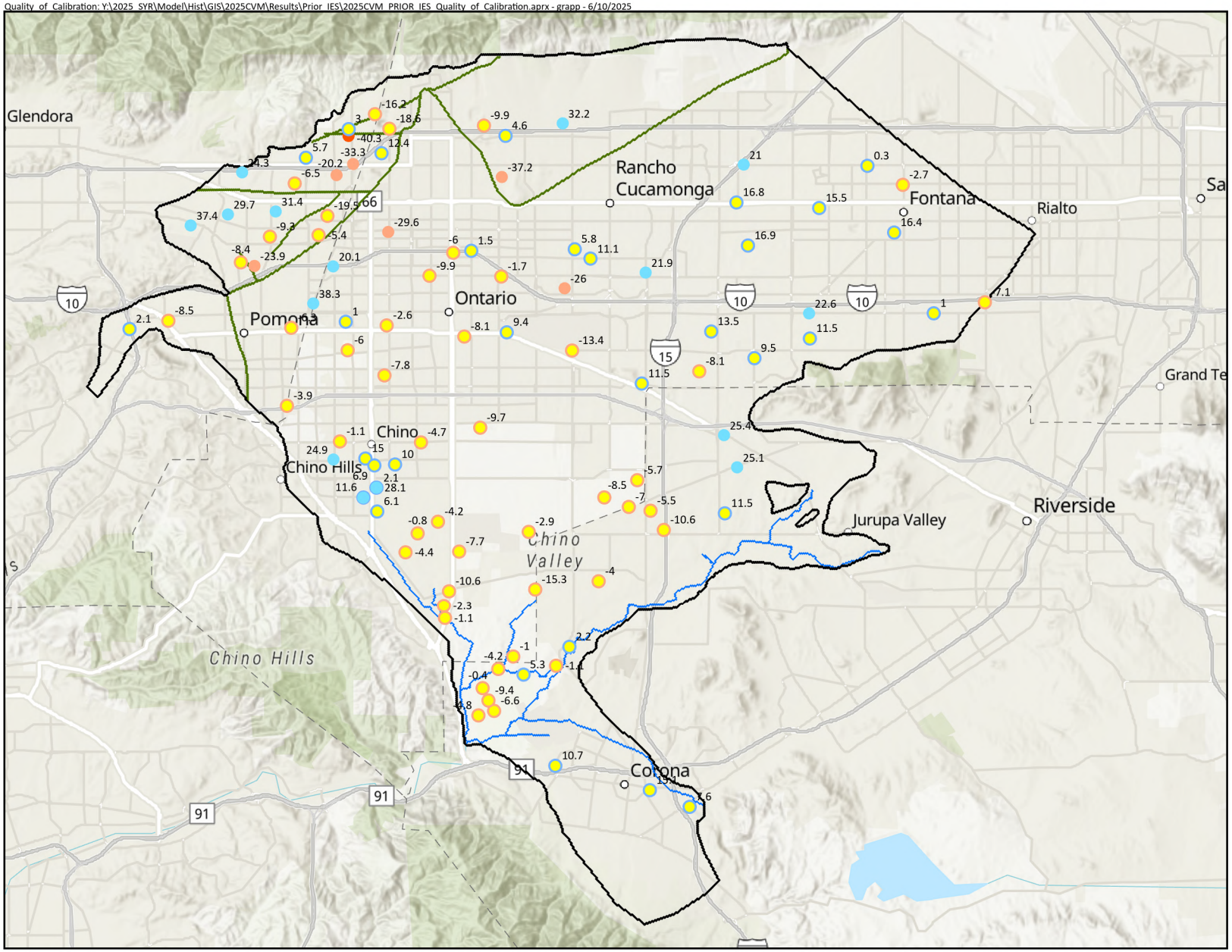
The realization with average net recharge closest to the ensemble mean at the end of the third PESTPP-IES iteration was selected to graphically illustrate the calibration results. Appendix B-4 presents maps of the calibrated aquifer properties for this realization. Appendix B-5 provides time series charts that compare simulated hydraulic heads versus the calibration targets.

DRAFT

Figure 4-11
Comparison of Simulated and Measured Groundwater Levels in Wells of the 2025 CVM Manual Calibration



Quality_of_Calibration: Y:\2025_SYR\Model\Hist\GIS\2025CVM\Results\Prior_IES\2025CVM_PRIOR_IES_Quality_of_Calibration.aprx - grapp - 6/10/2025



Model Boundary
Faults
Streams

Residuals [ft]

- Poor (< -40)
- Fair (-40 to -20)
- Good (-20 to 0)
- Good (0 to 20)
- Fair (20 to 40)
- Poor (> 40)



Prepared by:

WEST YOST

N

0 2 4 Miles

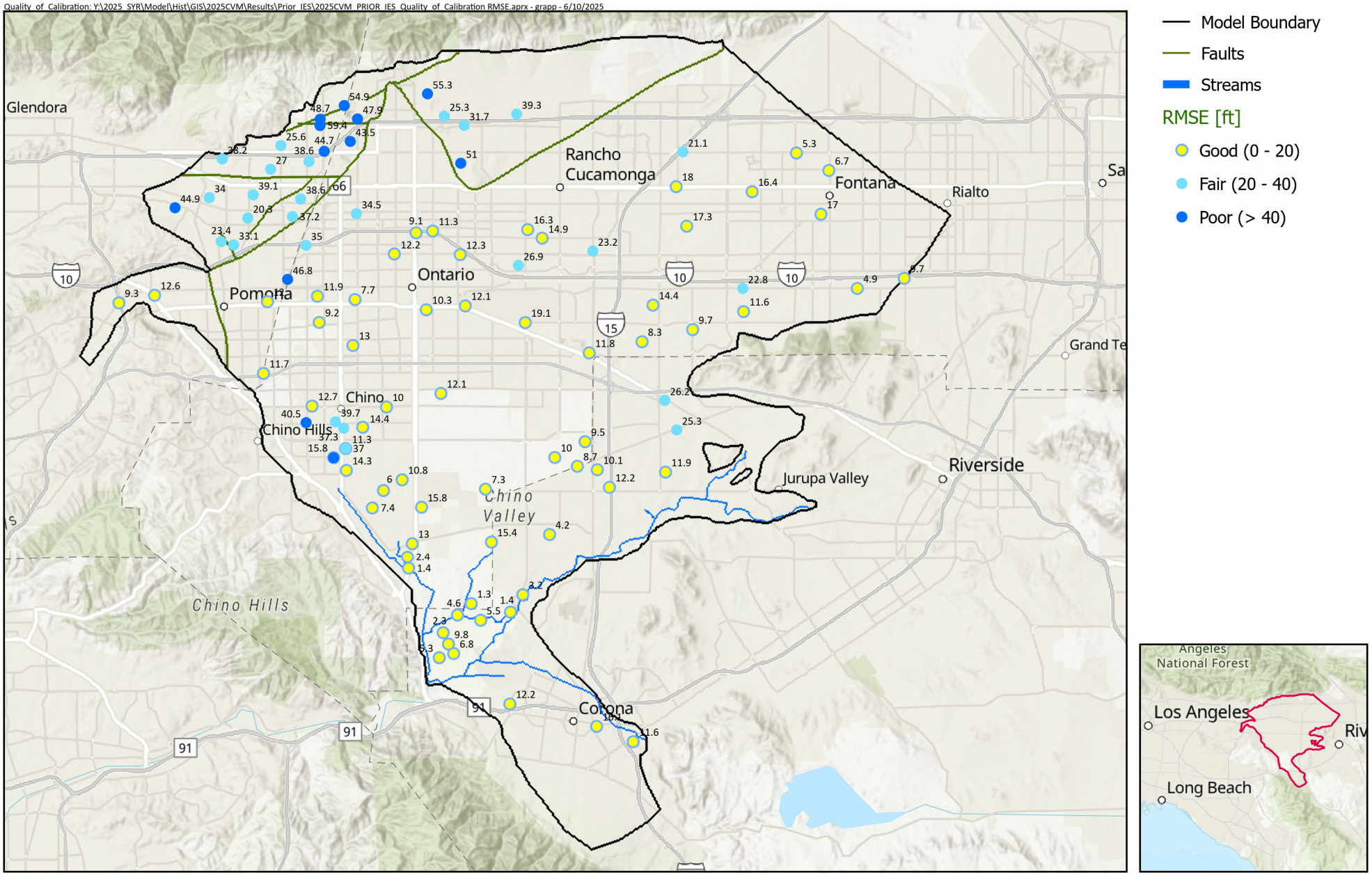
0 3 6 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM: Manual Calibration Residuals of Groundwater Elevation

DRAFT **Figure 4-12**



Prepared by:

WEST YOST

0 2 4 Miles

0 3 6 Km

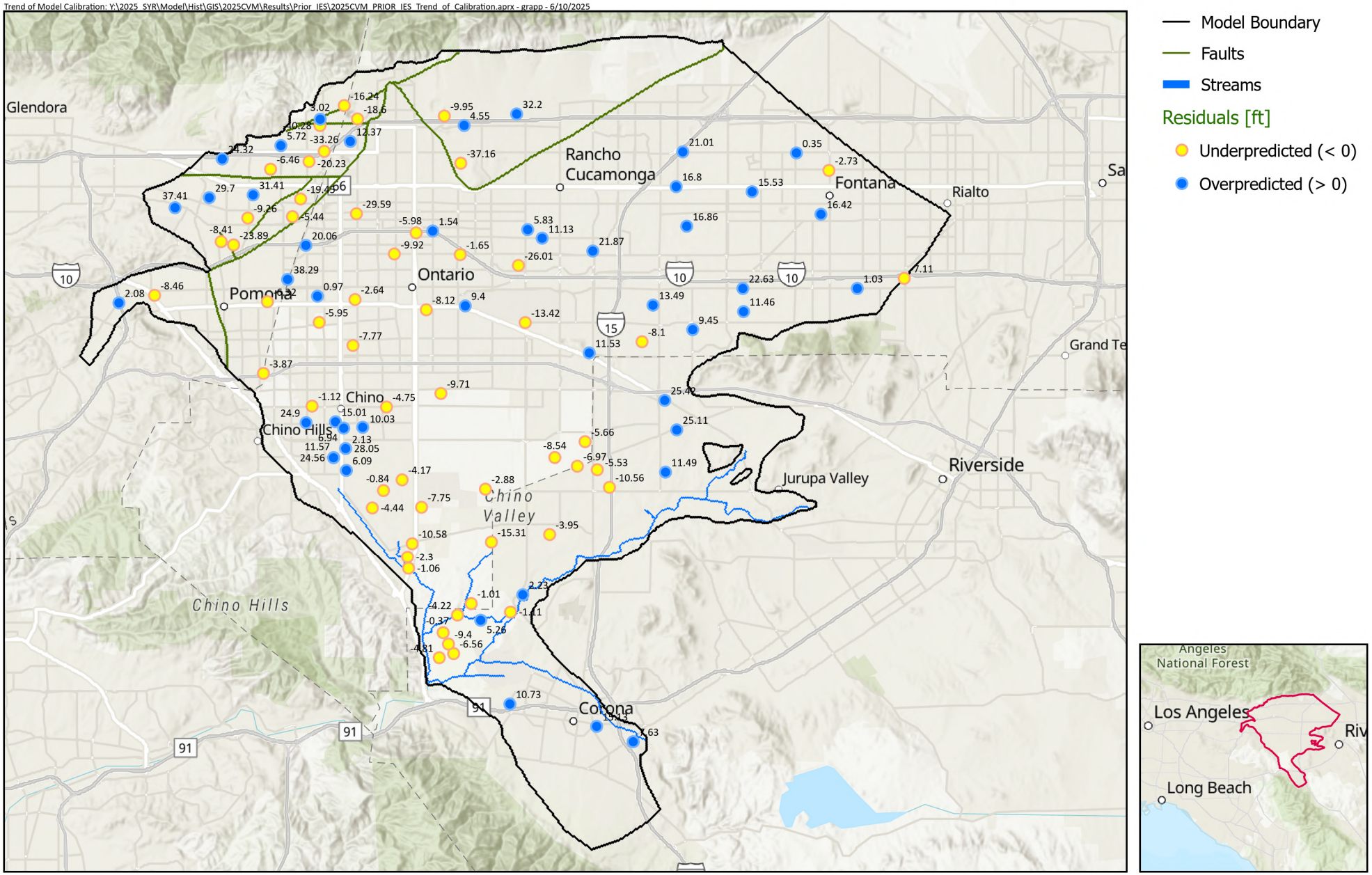
Prepared for:

Chino Basin Watermaster

2025 Safe Yield Reevaluation

2025 CVM: Manual Calibration RMSE of Groundwater Elevation

DRAFT **Figure 4-13**



Prepared by:

WEST YOST

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM: Manual Calibration
Trend of Groundwater Elevation Residuals
DRAFT **Figure 4-14**

Figure 4-15
Comparison of MODFLOW Estimated Streamflow and Santa Ana River Watermaster Estimated Streamflow to Prado Dam

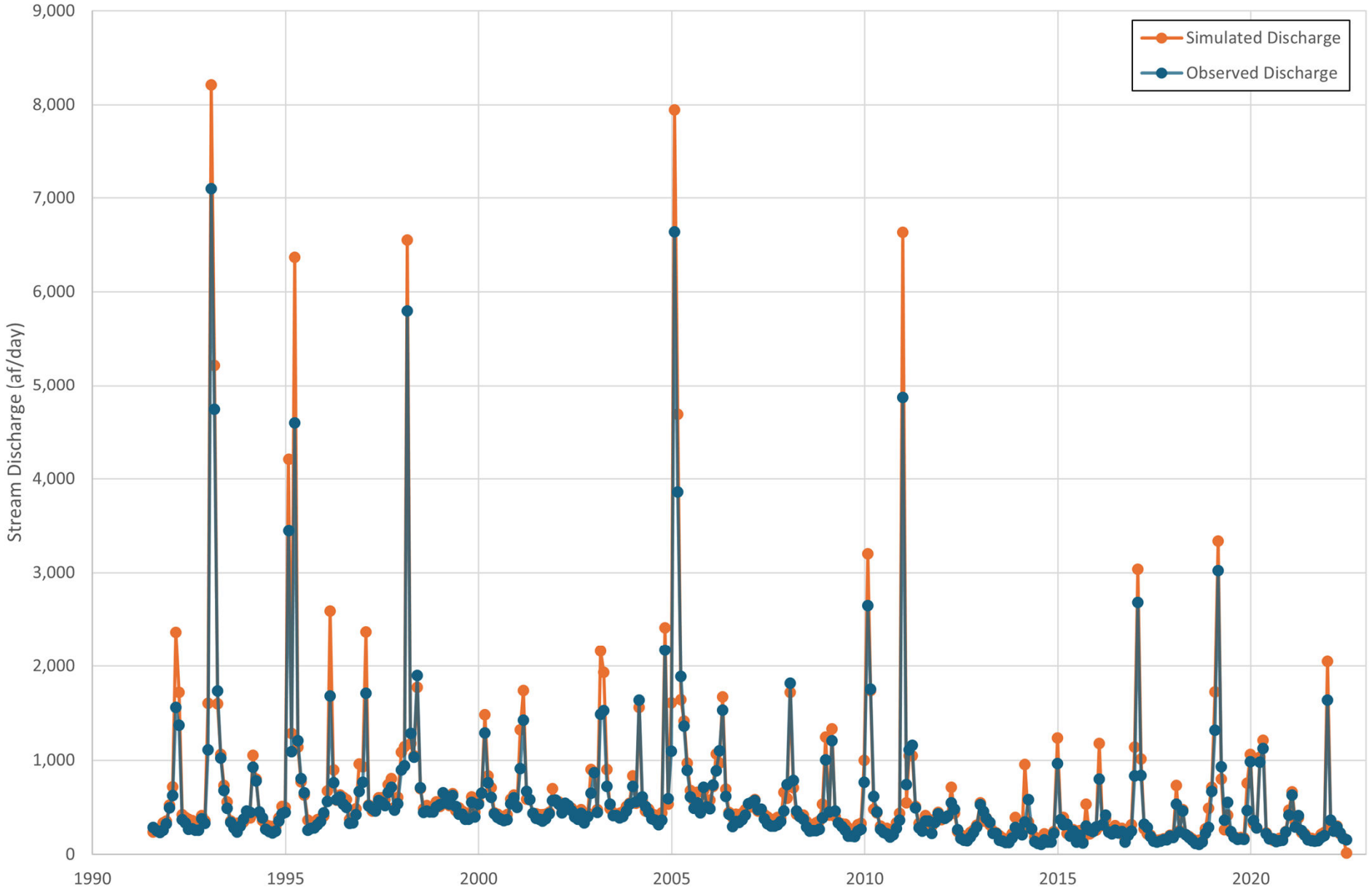


Figure 4-16
Comparison of MODFLOW Estimated Streamflow to Santa Ana River Water Master Estimated Streamflow to Prado Dam

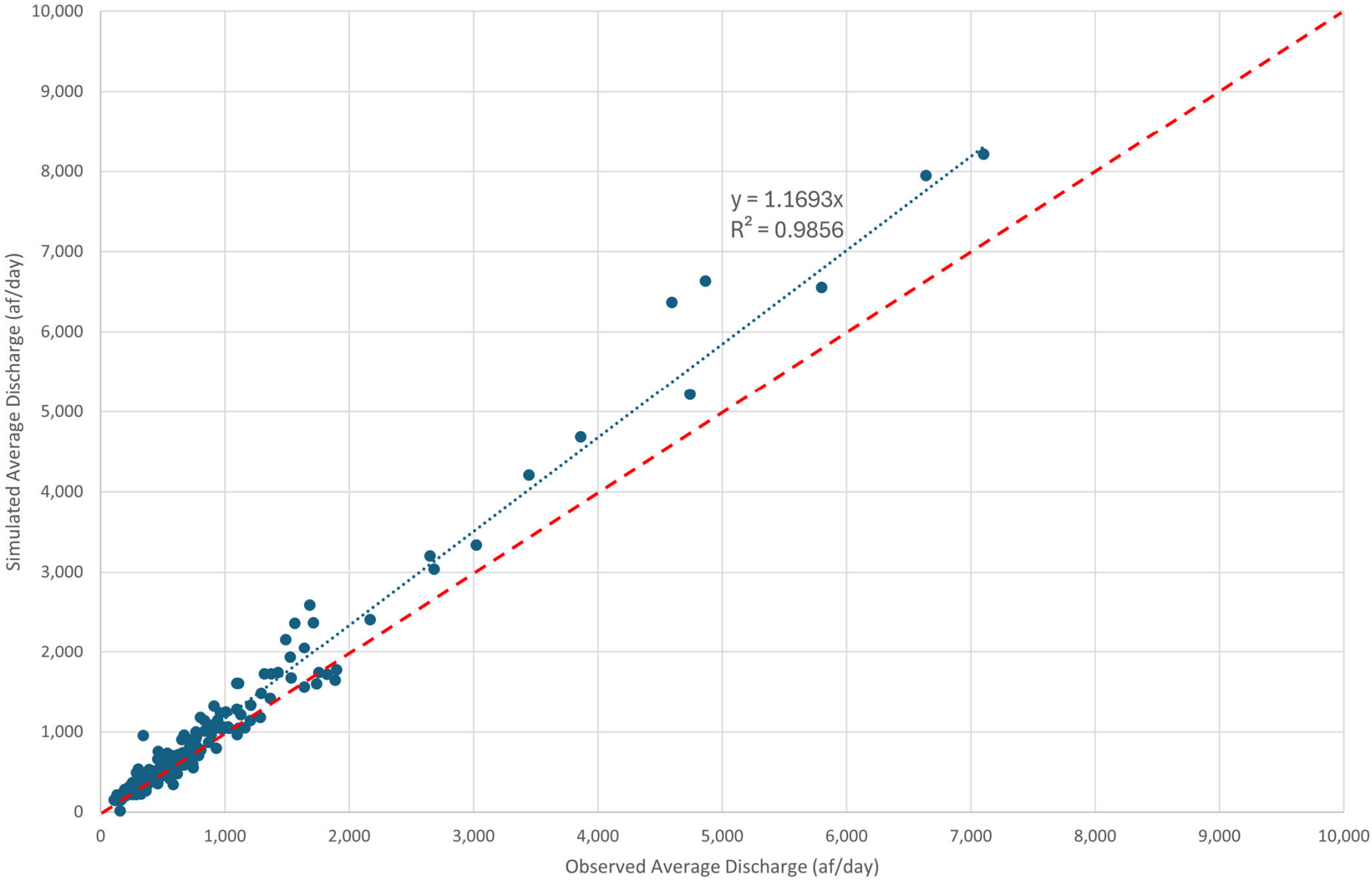


Figure 4-17
Simulated Net Recharge for the Chino Basin
Pilot Point Scenario 5 (97 Realizations)

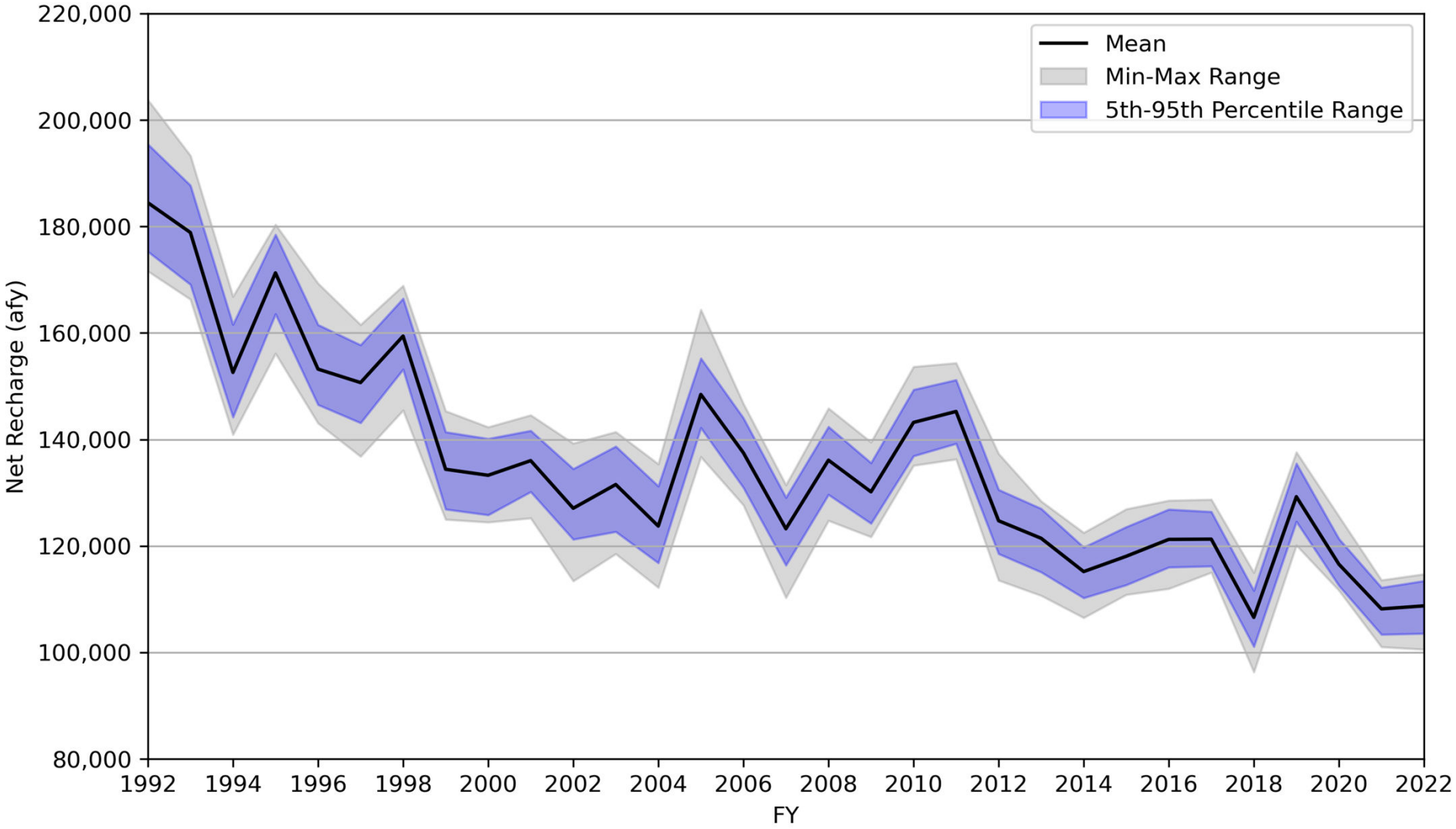


Figure 4-18
Mean Net Recharge in the Chino Basin, FY 1992-2022
Pilot Point Scenario 5 (97 Realizations)

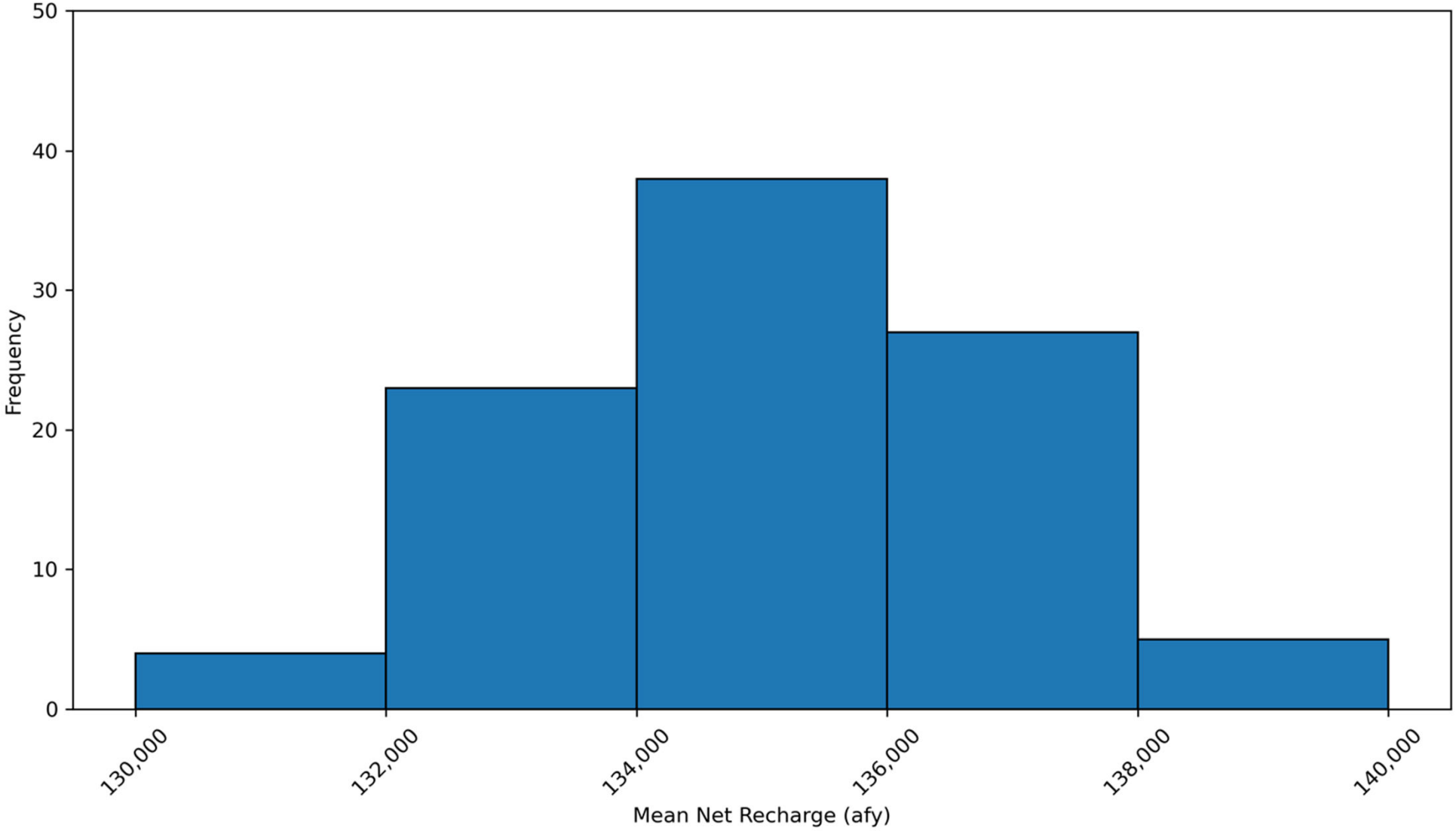


Figure 4-19 is a scatter plot of the simulated hydraulic heads versus the calibration targets at wells in the Chino Basin, Spadra Basin, Cucamonga Basin, and Six Basins. The RMSE is 21.4 ft for calibration targets in the Chino Basin, and 32.8 ft for all calibration targets. The linear regression line is derived based on all calibration targets. All points are distributed closely around the regression line, which matches closely with the 1:1 line, indicating good inverse modeling performance and a robust calibration. The coefficient of determination (R^2) of 0.998 suggests that 99.8 percent of the observed variance is explained by the model. Overall, this chart indicates that the calibration (for this calibrated realization) is improved over the manual calibration. Figure 4-20 is a map of residuals between the average simulated hydraulic heads and average calibration targets at the calibration wells. The mean and median residuals for all calibration targets are -36.2 ft and -0.6 ft, respectively. Figure 4-21 is a map of RMSE between the average simulated hydraulic heads and average calibration targets. Figure 4-22 is a map of the trend of residuals between average simulated hydraulic heads and calibration targets.

Table 4-5. Summary of Adjustable Parameters for Scenario 5

Adjustable Parameter Type	Number of Adjustable Parameters
DIPAW multiplier	7,440
Boundary Inflow multiplier	45
Addend to specified head values	8
Maximum ET Rate multiplier	372
Streambed conductivity	24
Hydraulic conductivity of faults	21
HK values at pilot points in model layers 1 to 5	8,424
VK values at pilot points in model layers 1 to 5	8,067
SY values at pilot points in model layer 1	2,061
SS values at point points in model layers 2 to 5	6,338
Total	**32,800**

4.2.6 Rank and Select Calibrated Realizations for Projection Scenarios

From the simulated scenarios, five calibrated realizations were chosen from the Pilot Point Scenario 5 for projection simulations. These five realizations include: one with the mean historical net recharge closest to the ensemble mean net recharge, and four realizations with net recharge values closest to one and two standard deviations above and below the ensemble mean, respectively.[9] For simplicity, the chosen realizations are labeled Realizations A through E based on their ranked net recharge over the historical period, as shown in Table 4-6.

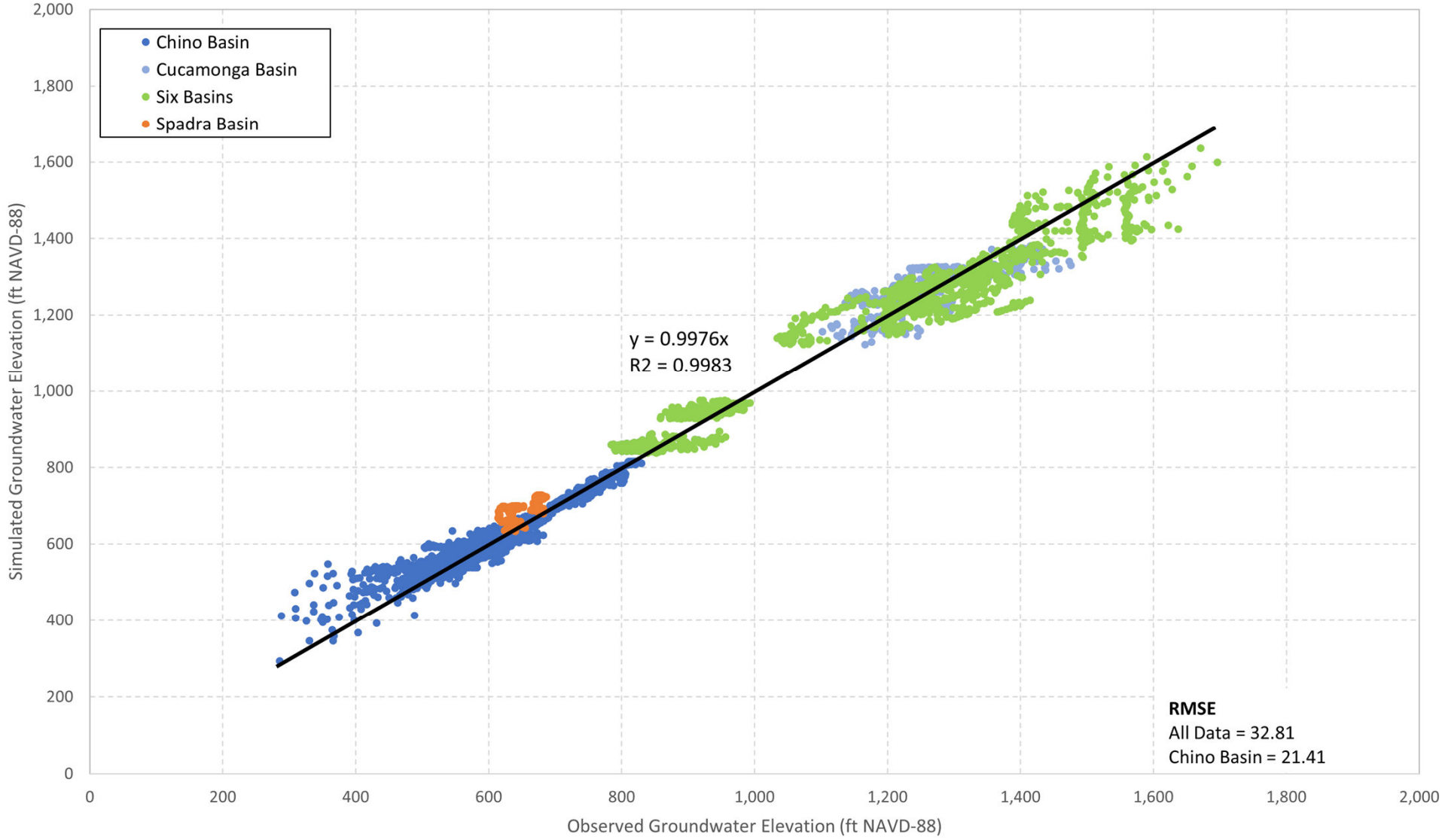
[9] The calibrated realization with the average net recharge closest to one standard deviation below the mean net recharge was excluded due to unreasonable groundwater levels in MZ-1. The next-closest calibrated realization was chosen to use as Realization B.

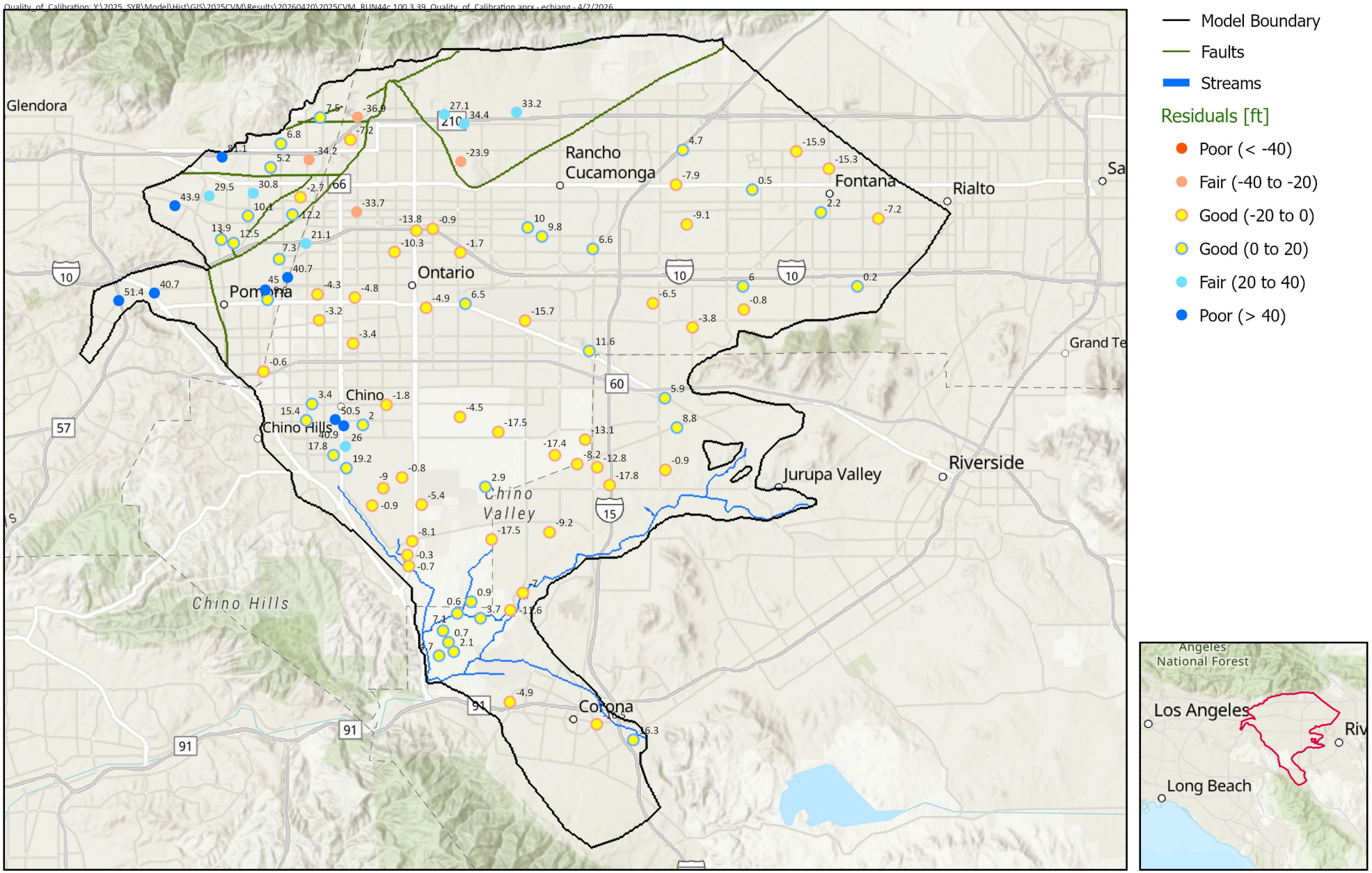
Table 4-6. Summary of Net Recharge Statistics and Chosen Realizations, Pilot Point Scenario 5

Net Recharge Statistic (FY 1992-2022)	Volume, afy
Average, All Realizations	135,210
Standard Deviation, All Realizations	1,750
Maximum, All Realizations	139,190
Minimum, All Realizations	131,180
Average, Realization A	131,840
Average, Realization B	133,210
Average, Realization C	135,190
Average, Realization D	136,940
Average, Realization E	138,890

DRAFT

Figure 4-19
Comparison of Simulated and Measured Groundwater Levels in Wells of the 2025 CVM
Pilot Point Scenario 3, Realization 3.39





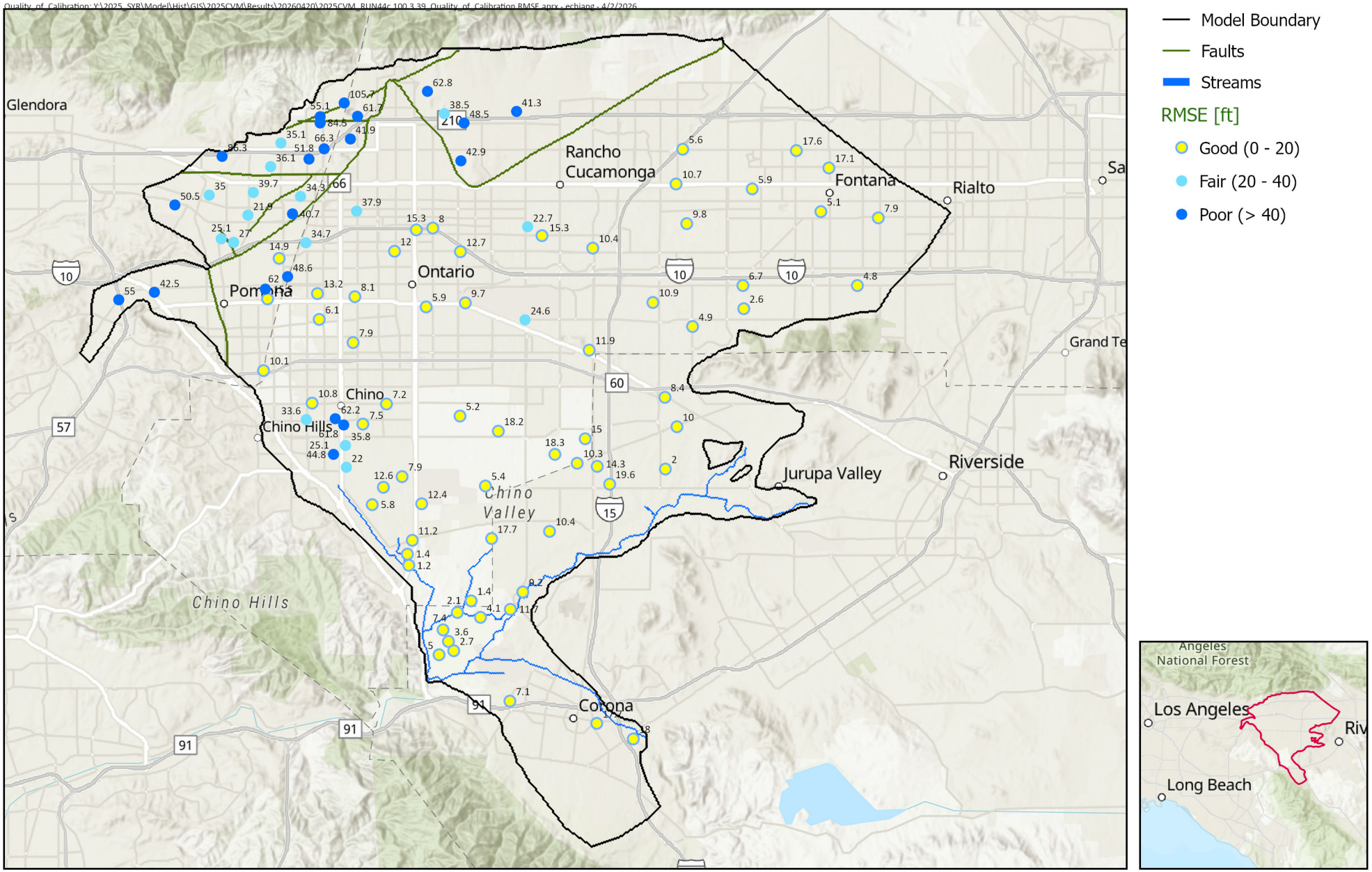
Prepared by:

WEST YOST

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM: Run_44c.3.39
Residuals of Groundwater Elevation
DRAFT **Figure 4-20**



Prepared by:

WEST YOST

0 2 4 Miles

0 3 6 Km

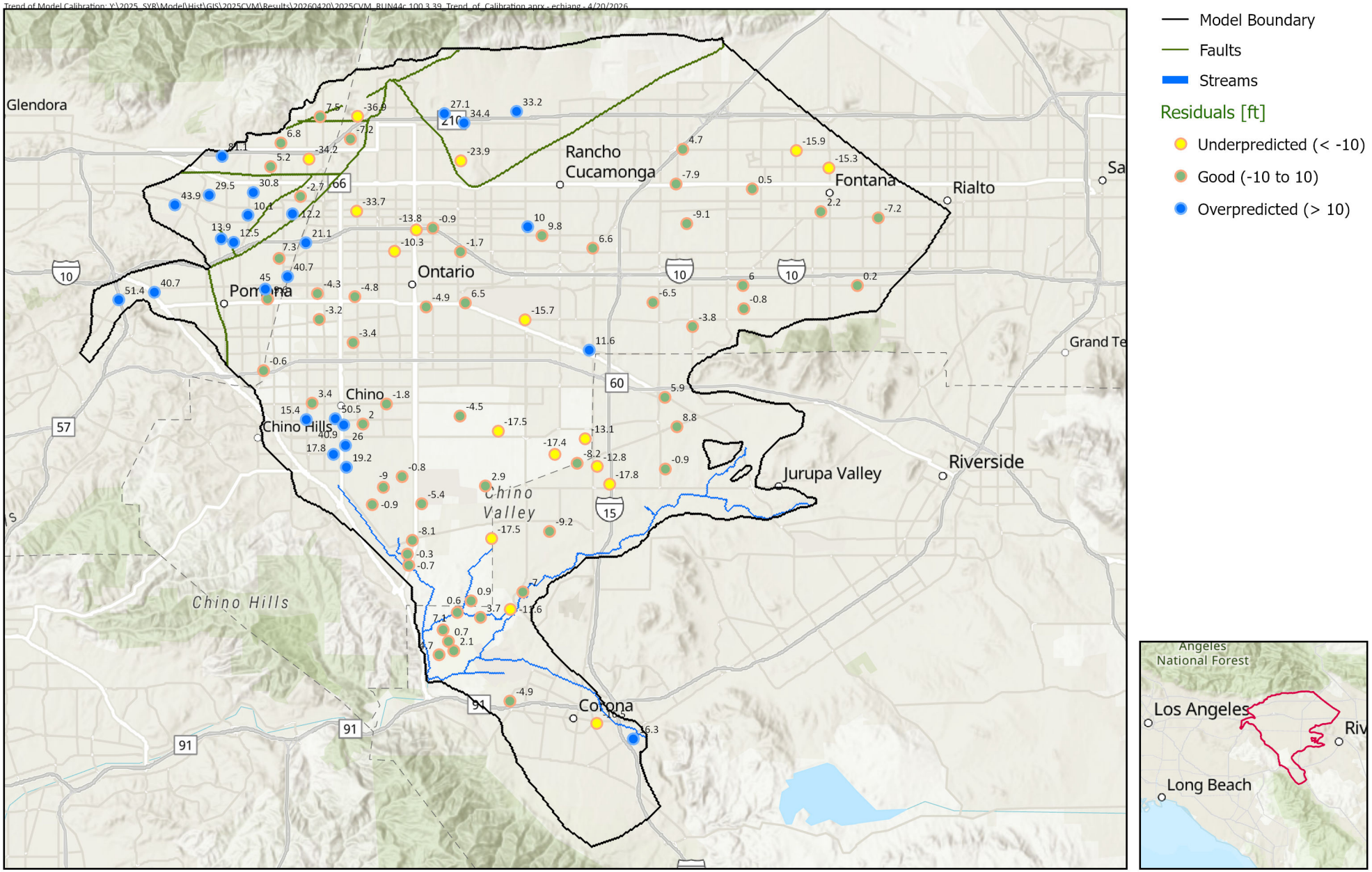
Prepared for:

Chino Basin Watermaster

2025 Safe Yield Reevaluation

2025 CVM: Run_44c.3.39
RMSE of
Groundwater Elevation

DRAFT **Figure 4-21**



Prepared by:

WEST YOST

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM: Run_44c.3.39
Trend of Groundwater Elevation Residuals
DRAFT **Figure 4-22**

Figure 4-23 illustrates the selected calibrated realizations along with the histogram based on the calculated mean net recharge for the 97 realizations. Figure 4-24 compares the net recharge time series of the selected realizations to the range of all realizations. Figure 4-24 suggests that the range of the simulated net recharge is well represented by these scenarios.

4.3 WATER BUDGET AND COMPARISON TO THE 2020 CVM

This section describes the major water budget components in the Chino Basin based on the selected realizations of the 2025 CVM and compares them to those from the 2020 CVM for the overlapping historical simulation period (FY 1992 through 2018).

4.3.1 Water Budget for Selected Realization

Table 4-7 displays the annual time series of recharge, discharge, change in storage, and net recharge from July 1, 1991 through June 30, 2022 for Realization C. Recharge and discharge components labeled with a column heading of "I" represent inputs directly provided to the 2025 CVM, with some variability introduced through PESTPP-IES as previously described. Components labeled with "R" are computational results generated by the CVM.

Water budget results for the other realizations are provided in Appendix B-6. The major water budget components for all five selected realizations, and their comparison to corresponding components in the 2020 CVM, are discussed below.

DRAFT

Table 4-7 Water Budget for the Chino Basin for the Calibration Period - Realization C (af)

Fiscal Year	Recharge												Discharge					Change in Storage		
	R*	I*	R*	R*	R*	R*	I*	R*	I	I	I		I	I	R*	R*				
	Subsurface Inflow						Deep Infiltration of Precipitation and Applied Water	Streambed Infiltration	Managed Aquifer Recharge			Total Recharge	Groundwater Pumping		Riparian Veg ET	Rising Groundwater	Total Discharge	Annual	Cumulative	Net Recharge
	Bloomington Divide	Chino/Puente Hills, Jurupa Hills, and Rialto Basin	Net Temescal Basin	Six Basins	Cucamonga Basin	Spadra Basin			Stormwater	Recycled Water	Imported Water		Overlying Non-Ag and Appropriative Pools	Overlying Agricultural Pool						
1992	14,344	5,585	4,931	3,613	34,022	2	109,846	48,766	3,598	0	5,568	230,274	102,664	77,336	15,032	21,895	216,927	13,347	13,347	187,779
1993	11,400	6,329	1,224	3,871	22,592	7	116,845	62,942	6,619	0	14,224	246,053	88,040	83,284	16,345	33,059	220,728	25,325	38,672	182,425
1994	11,108	6,269	2,568	3,588	20,226	16	113,515	38,878	1,486	0	16,448	214,104	93,564	72,115	15,567	29,577	210,823	3,280	41,952	152,511
1995	10,517	6,742	979	3,272	18,960	27	124,095	58,217	4,662	0	10,375	237,846	98,173	62,171	16,354	32,260	208,958	28,887	70,840	178,857
1996	10,677	6,844	2,185	3,334	18,401	47	113,798	42,352	2,425	0	82	200,146	109,609	71,220	17,260	31,625	229,715	-29,568	41,271	151,179
1997	10,892	6,791	2,083	3,025	18,003	77	111,261	45,906	3,305	0	16	201,360	112,998	68,968	16,664	30,950	229,580	-28,220	13,051	153,729
1998	10,635	6,716	296	3,040	17,746	103	108,263	57,609	5,780	0	8,352	218,540	104,141	45,302	17,361	34,956	201,760	16,780	29,831	157,871
1999	11,184	6,402	1,224	3,045	17,552	104	106,820	39,774	1,007	984	5,839	193,936	118,738	46,730	17,915	33,495	216,878	-22,943	6,888	135,703
2000	11,749	6,051	686	2,854	17,358	109	102,989	41,748	1,985	3,630	997	190,156	133,609	46,538	18,635	31,437	230,220	-40,064	-33,176	135,457
2001	11,835	6,161	1,130	2,696	17,201	114	108,385	41,886	3,162	6,221	6,538	205,328	129,866	41,429	18,031	33,794	223,120	-17,792	-50,967	140,744
2002	12,442	5,532	1,862	2,636	16,975	119	96,541	37,081	1,148	7,444	6,493	188,273	139,934	38,650	17,267	33,376	229,227	-40,954	-91,921	123,693
2003	12,538	5,060	445	2,633	16,860	114	104,168	47,500	6,284	7,112	6,548	209,263	133,793	36,507	17,669	35,713	223,681	-14,418	-106,340	142,220
2004	12,886	5,158	-11	2,571	16,777	112	90,494	40,399	3,357	8,942	7,607	188,293	139,028	36,809	17,054	35,532	228,423	-40,130	-146,470	119,157
2005	12,090	6,416	-2,262	2,788	16,527	126	101,357	56,121	17,648	9,377	12,259	232,446	123,538	34,503	17,711	42,322	218,075	14,371	-132,099	150,777
2006	12,412	6,104	1,945	3,065	16,314	109	93,910	46,940	12,940	1,303	34,567	229,610	133,372	30,812	17,267	38,185	219,636	9,975	-122,124	138,288
2007	12,614	5,745	1,925	2,595	16,130	101	95,850	37,511	4,745	2,993	32,960	213,168	152,223	29,919	16,671	32,461	231,274	-18,106	-140,231	128,083
2008	12,955	5,712	1,243	2,490	16,101	100	87,021	42,368	10,205	2,340	0	180,534	157,812	26,280	15,525	29,901	229,518	-48,984	-189,214	132,768
2009	12,936	5,850	548	2,464	16,080	102	87,114	42,567	7,512	2,684	0	177,857	165,801	23,386	14,591	28,175	231,952	-54,095	-243,309	132,408
2010	13,016	5,221	-224	2,469	16,024	96	84,874	49,258	14,273	7,210	5,000	197,216	137,948	22,038	14,685	28,360	203,030	-5,813	-249,123	141,962
2011	13,157	5,414	-1,044	2,494	15,904	99	90,611	54,210	17,052	8,065	9,465	215,427	123,354	18,042	15,260	31,779	188,436	26,992	-222,131	150,858
2012	13,074	5,156	520	2,545	15,671	100	82,795	38,777	9,271	8,634	22,560	199,102	136,731	22,412	14,179	27,781	201,102	-2,000	-224,131	125,948
2013	12,674	5,124	599	2,424	15,591	110	78,155	37,018	5,271	10,479	0	167,444	139,128	24,074	13,861	23,355	200,418	-32,974	-257,106	119,748
2014	12,761	4,976	358	2,512	15,501	112	70,190	38,336	4,299	13,593	795	163,433	148,475	22,131	13,040	22,083	205,729	-42,295	-299,401	113,923
2015	12,929	4,463	-17	2,253	15,282	96	67,966	39,760	8,001	10,840	0	161,574	134,339	17,552	12,693	22,189	186,773	-25,198	-324,599	115,853
2016	12,639	3,804	-182	2,307	15,106	92	71,756	42,284	9,236	13,222	0	170,264	129,492	16,908	12,541	22,196	181,136	-10,872	-335,471	122,306
2017	13,091	4,432	-104	2,222	14,968	100	59,607	48,012	11,575	13,934	13,150	180,989	127,244	16,191	12,829	24,272	180,535	453	-335,018	116,804
2018	12,830	3,833	1,330	2,122	14,553	100	62,531	34,772	4,494	13,212	33,763	183,538	123,992	16,776	12,318	21,489	174,574	8,964	-326,054	102,757
2019	12,711	5,110	-440	2,201	14,352	97	66,005	52,509	12,861	11,145	6,510	183,060	116,396	15,478	13,215	24,472	169,561	13,499	-312,555	127,719
2020	13,013	4,853	614	2,153	14,155	112	67,024	44,348	9,967	12,953	18,103	187,294	132,618	15,722	12,913	25,250	186,503	792	-311,763	118,076
2021	12,825	4,996	1,299	2,254	14,194	121	66,692	35,576	4,911	15,728	2,229	160,822	146,973	14,929	11,912	22,623	196,437	-35,616	-347,379	108,331
2022	12,735	4,626	140	2,258	14,053	119	62,103	35,340	8,108	15,042	1,742	156,265	148,608	14,077	10,965	20,873	194,523	-38,258	-385,637	107,643
Statistics for the Calibration Period 1992 through 2022																				
Total	382,671	171,477	25,849	83,793	529,179	2,842	2,802,580	1,378,762	217,187	207,086	282,191	6,083,616	3,982,201	1,108,289	473,327	905,436	6,469,254	-385,637		4,215,577
Percent	6.3%	2.8%	0.4%	1.4%	8.7%	0.0%	46.1%	22.7%	3.6%	3.4%	4.6%	100.0%	61.6%	17.1%	7.3%	14.0%	100.0%			
Average	12,344	5,532	834	2,703	17,070	92	90,406	44,476	7,006	6,680	9,103	196,246	128,458	35,751	15,269	29,208	208,686	-12,440		135,986
Median	12,674	5,532	614	2,571	16,130	101	90,611	42,352	5,780	7,210	6,510	193,936	132,618	29,919	15,525	29,901	210,823	-14,418		132,768
Maximum	14,344	6,844	4,931	3,871	34,022	126	124,095	62,942	17,648	15,728	34,567	246,053	165,801	83,284	18,635	42,322	231,952	28,887	70,840	187,779
Minimum	10,517	3,804	-2,262	2,122	14,053	2	59,607	34,772	1,007	0	0	156,265	88,040	14,077	10,965	20,873	169,561	-54,095	-385,637	102,757

Note: column heading R means model results and column heading I means model input. Asterisks indicate components that had volumes or related parameters that were allowed to vary during the uncertainty analysis.

Figure 4-23
Mean Net Recharge in the Chino Basin, FY 1992-2022
Chosen Realizations of 2025 CVM

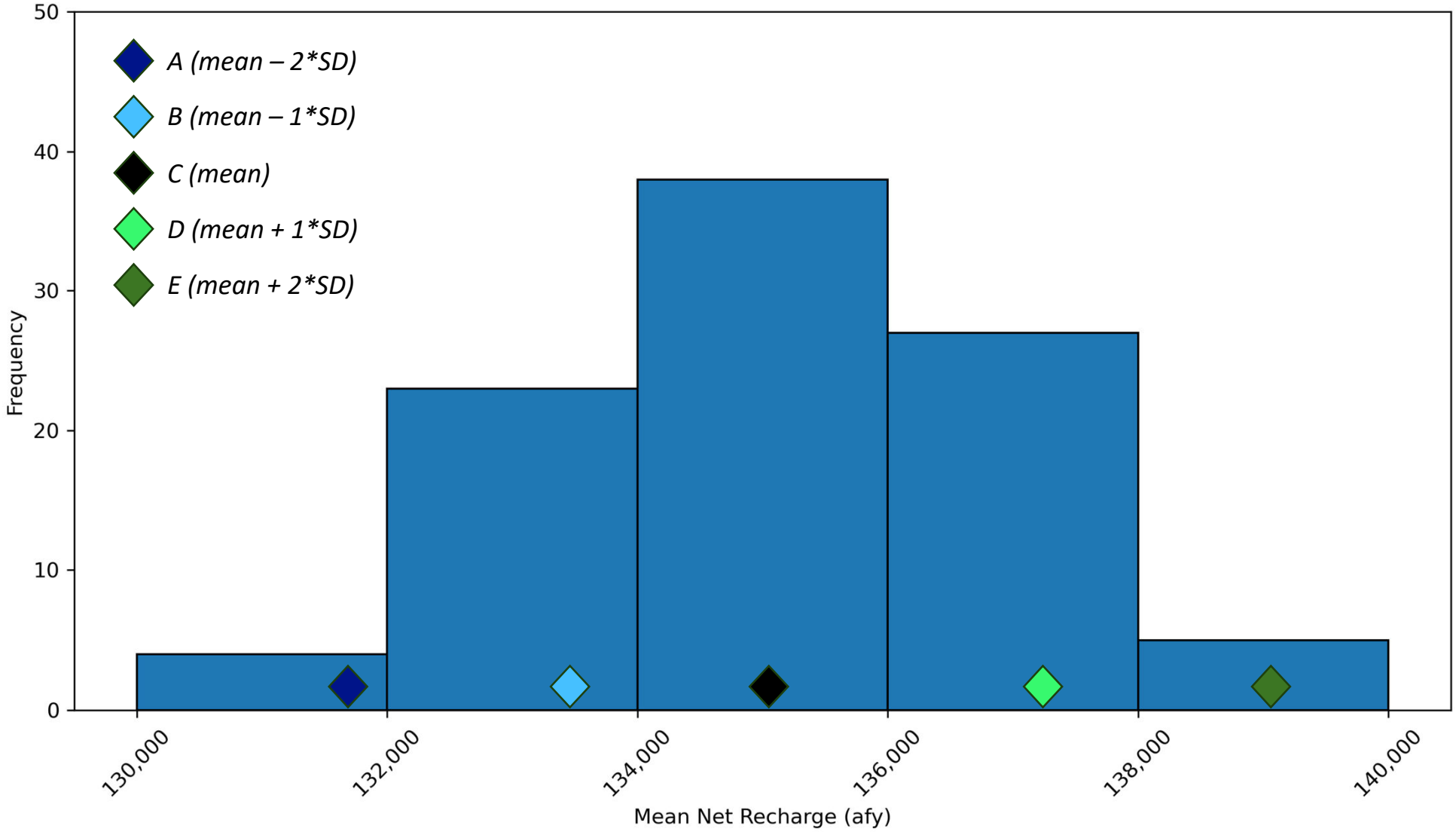
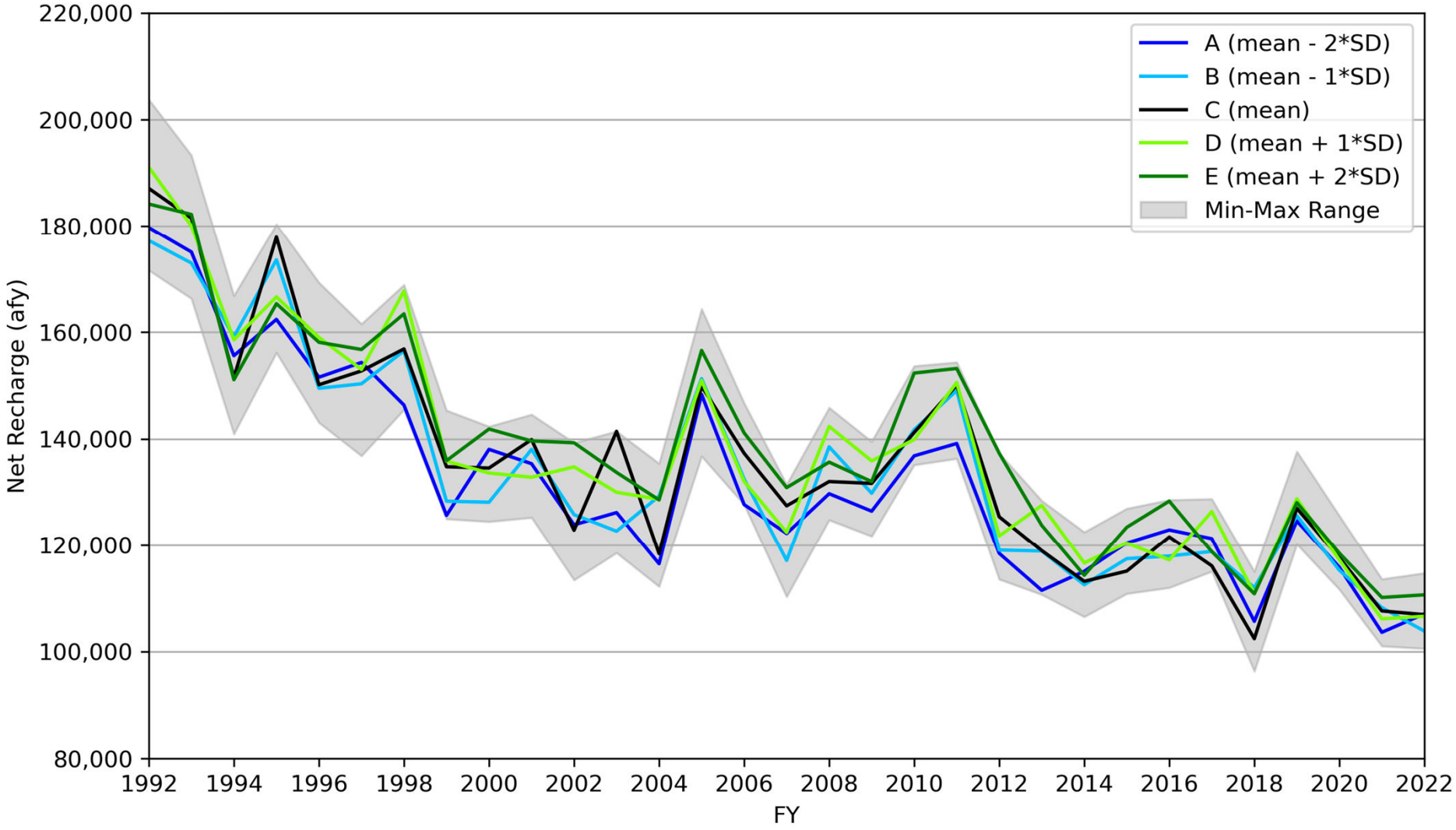


Figure 4-24
Simulated Net Recharge for Chosen Realizations of the 2025 CVM



4.3.2 Comparison of 2025 CVM Realizations to 2020 CVM

Table 4-8 compares the average annual water budget components for the FY 1992–2018 period for the 2025 CVM and the 2020 CVM. Measured components (such as managed aquifer recharge and groundwater pumping) that were not allowed to vary, are nearly identical in both models, and are therefore not included in Table 4-8. Figures 4-25 through 4-27 present time series of each of the components listed in Table 4-8, illustrating the range and mean of the volumes in the 2025 CVM compared to the corresponding time series from the 2020 CVM.

Differences between the 2020 CVM and the 2025 CVM water budgets are expected, given the recalibration and uncertainty analysis described above. Cumulative changes in the model structure, parameterization, calibration period, and the use of the PESTPP-IES tool have all contributed to the range of model outcomes. These differences are not attributable to any single factor but reflect refinements in the model processes that more accurately represent the range of possible conditions in the 2025 CVM.

Table 4-8. Comparison of Water Budget Components - 2020 and 2025 CVM

Component[a]	Figure	Mean Annual Volume, FY 1992-2018 (afy)		
		2020 CVM	2025 CVM[a]	2025 CVM minus 2020 CVM
Net Inflow from Six Basins	4-25	4,960	4,160	-800
Net Inflow from Cucamonga Basin	4-25	9,920	16,900	6,980
Net Inflow from Temescal Basin	4-25	2,120	2,580	460
Net Inflow from Spadra Basin	4-25	460	60	-400
Inflow from Bloomington Divide	4-25	14,760	10,530	-4,230
Other Subsurface Inflows	4-25	7,330	5,270	-2,060
Groundwater Pumping[b]	-	166,140	160,700	-5,440
Managed Aquifer Recharge	-	21,820	21,750	-70
DIPAW to Saturated Zone	4-26	98,030	94,140	-3,890
SAR Infiltration	4-26	31,920	45,420	13,500
ET	4-26	18,170	15,900	-2,270
Rising Groundwater	4-26	19,670	30,860	11,190
Total Recharge	4-27	190,990	214,430	23,440
Total Discharge	4-27	203,970	221,820	17,850
Net Recharge	4-27	139,600	138,300	-1,300
Change in Storage	4-27	-12,980	-7,400	5,580

(a) Volumes reflect the mean of all five calibrated realizations.
(b) Differences in groundwater pumping reflect the adjustment of the basin boundaries and refinements of the unmetered pumping in the 2025 CVM.

The following subsections describe each of the three figures comparing the 2020 CVM and the 2025 CVM.

4.3.2.1 Subsurface Inflows (Figure 4-25)

Figure 4-25 compares the subsurface inflow components of the Chino Basin, including net inflows from the Six Basins, Cucamonga Basin, Temescal Basin, Spadra Basin, the Bloomington Divide, and other subsurface inflows. The "other subsurface inflows" category includes contributions from the Chino/Puente Hills, Jurupa Hills, and Rialto Basin. Overall, the magnitude of these components is similar between the 2020 CVM and the 2025 CVM; however, relatively larger differences are observed for inflow from the Cucamonga Basin and across the Bloomington Divide. These differences reflect updated conceptualization, parameterization, or calibration of boundary conditions in the 2025 CVM, and highlight areas where subsurface flow remains more uncertain.

4.3.2.2 Other Variable Water Budget Components (Figure 4-26)

Figure 4-26 shows the variable water budget components beyond the Subsurface Inflows, including DIPAW to the saturated zone, infiltration from the SAR and its tributaries, ET, and rising groundwater outflows.

The estimated DIPAW in the 2025 CVM is approximately 3,900 afy lower than in the 2020 CVM. This difference reflects the impact of the spatial DIPAW multipliers introduced in the uncertainty analysis and the adjustment of the Chino Basin boundaries (see Section 3), which resulted in an approximately one percent reduction in area of the Chino Basin.

Both infiltration from the SAR and rising groundwater outflow are higher in the 2025 CVM by 13,500 afy and 11,200 afy, respectively, reflecting the overall increase in streambed hydraulic conductivity in the 2025 CVM. These increases suggest that groundwater/surface-water interactions are more extensive than previously represented. ET outflows from the basin are about 2,300 afy lower in the 2025 CVM compared to the 2020 CVM.

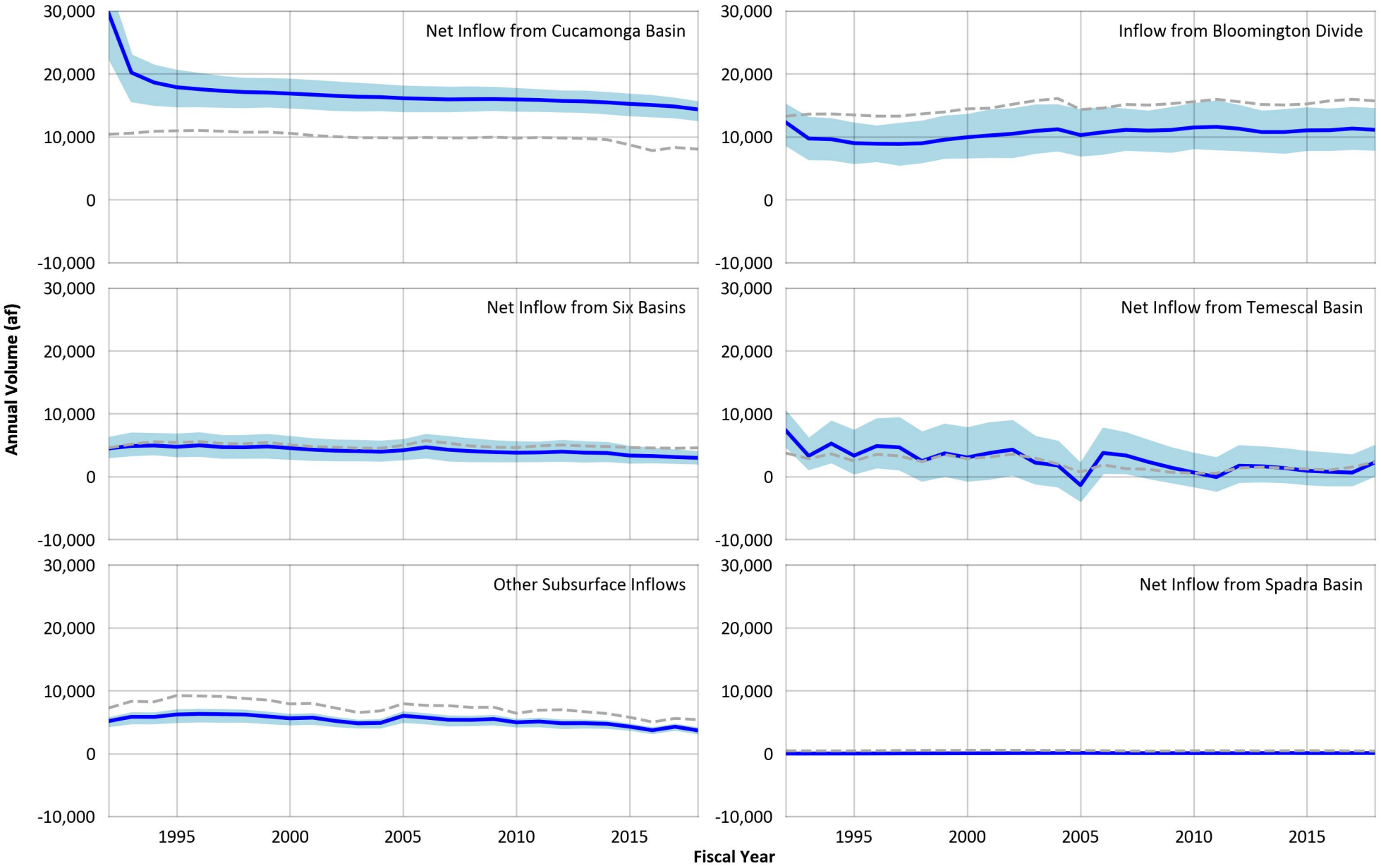
4.3.2.3 Summary of Water Budget (Figure 4-27)

Figure 4-27 compares total recharge, total discharge, net recharge, and the cumulative change in storage between the 2020 CVM and the 2025 CVM. The average volumes of all components are lower in the 2025 CVM compared to the 2020 CVM.

Net recharge represents the exploitable inflow to a groundwater basin over a given period (whether under historical conditions or future projections) and reflects the combined effects of hydrology, cultural conditions, and water management practices during that time. Net recharge is the sum of the natural recharge components (i.e., excluding supplemental water recharge) minus the sum of the natural discharge components (such as ET and rising groundwater). The methodology for computing net recharge is described in Section 1 of the 2020 SYR Report.

The average net recharge across the five selected realizations in the 2025 CVM is 138,300 afy for the 1992-2018 period, approximately 1,300 afy lower than that estimated in the 2020 CVM.

DRAFT



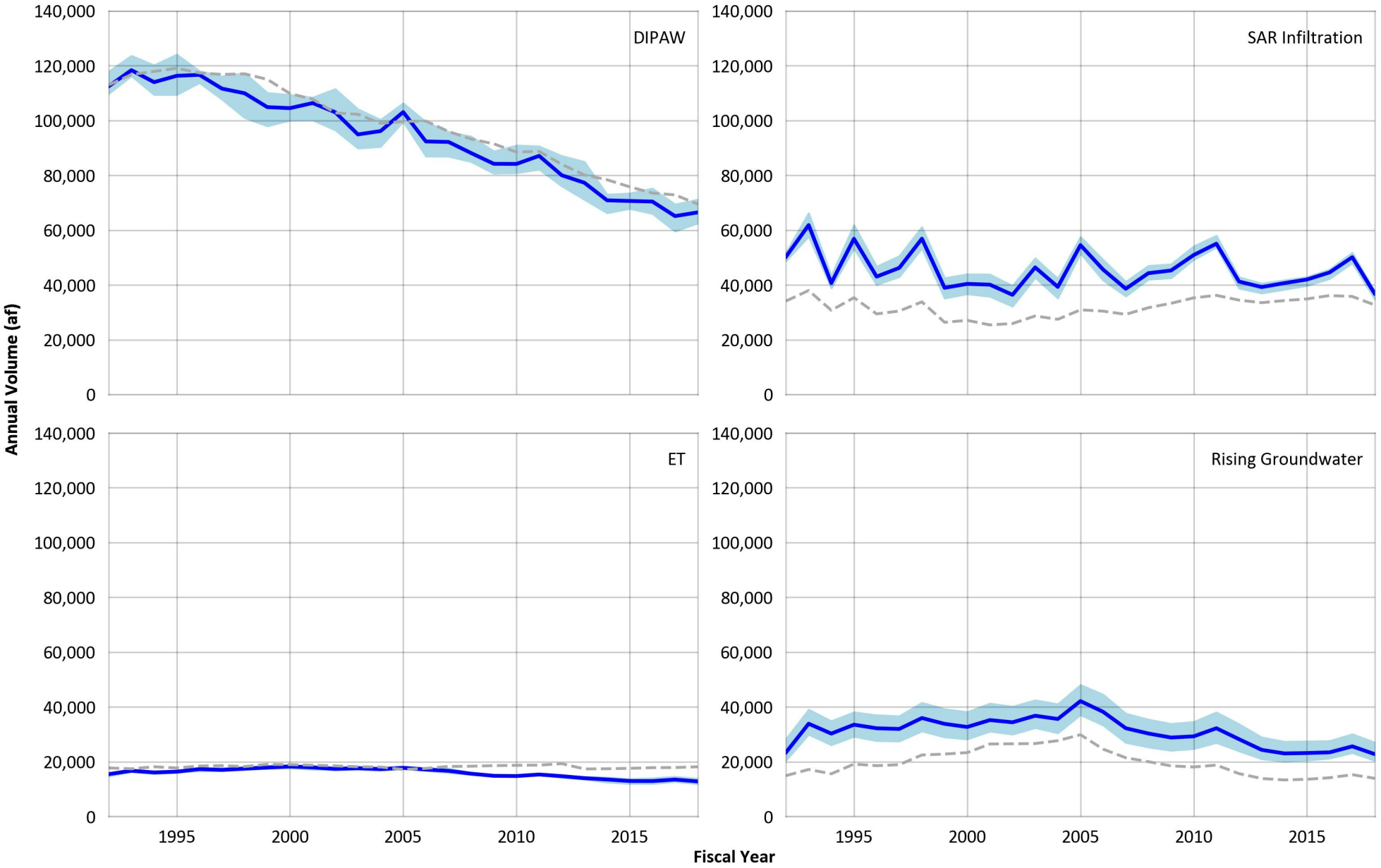
Prepared by:

WEST YOST
Water. Engineered.

Comparison of Subsurface Inflows - 2020 and 2025 CVM

DRAFT

Figure 4-25



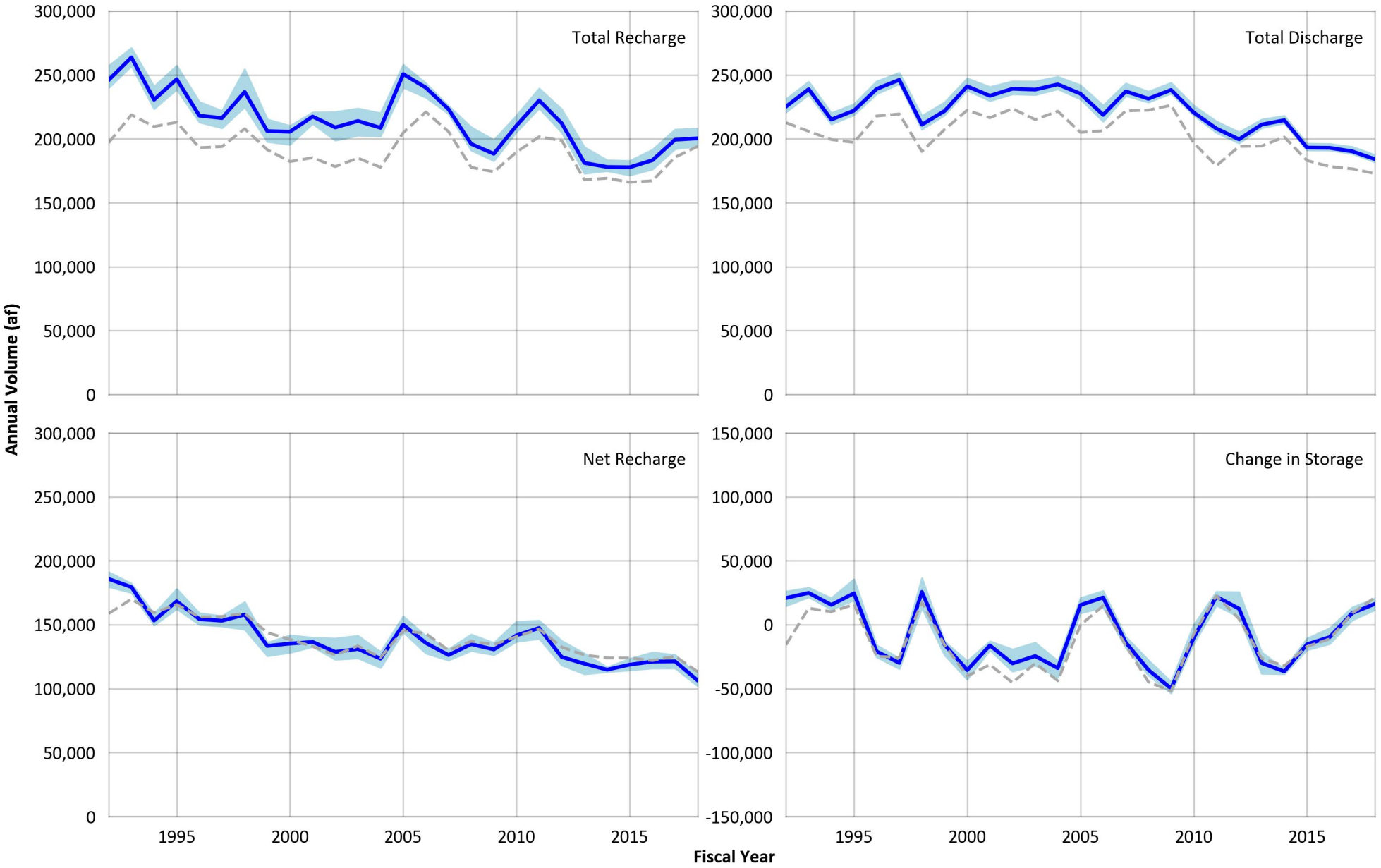
Prepared by:

WEST YOST
Water. Engineered.

Comparison of Other Variable Water Budget Components - 2020 and 2025 CVM

DRAFT

Figure 4-26



Prepared by:

WEST YOST
Water. Engineered.

Comparison of Net Recharge and Discharge - 2020 and 2025 CVM

DRAFT

Figure 4-27

4.4 REFERENCES

Bicknell, B., Imhoff, J., Kittle Jr., J., Jobes, T., & Donigian, Jr. , A. (2005). *Hydrological Simulation Program - Fortran (HSPF). User's Manual for Release 12.2.* U.S. EPA National Exposure Research Laboratory Athens, GA, in cooperation with U.S. Geological Survey, Water Resources Division, Reston,VA.

Chen, Y., & Oliver, D. (2012). *Ensemble Randomized Maximum Likelihood Method as an Iterative Ensemble Smoother*. Math. Geosci. 44 (1), 1–26.

Chen, Y., & Oliver, D. (2013). *Levenberg–Marquardt Forms of The Iterative Ensemble Smoother for Efficient History Matching And Uncertainty Quantification*. Comput. Geosci. 17 (4), 689–703.

Moriasi, D. N., et al. (2007). *Model Evaluation Guidelines for Systematic Quantification of Accuracy in Watershed Simulations*. American Society of Agricultural and Biological Engineers. 2007, Vol. 50, 3, pp. 885- 900.

Niswonger, R. G., Panday, S., & Ibaraki , M. (2011). *MODFLOW-NWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6-A37, 44 p.* Reston, Virginia: U.S. Geological Survey.

Simunek, J., Sejna, M., & van Genuchten, M. (1999). *The HYDRUS-2D software package for simulating two-dimensional movement of water, heat, and multiple solutes in variably saturated media.* (Version 2.0 IGWMC - TPS - 53 ed.). Golden, Colorado: International Groundwater Modeling Center, Colorado School of Mines.

WEI. (2007). *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description.* Wildermuth Environmental, Inc.

WEI. (2020). *2020 Safe Recalculation Final Report.* Prepared for the Chino Basin Watermaster, May 2020.

Welter, D. E., White, J. T., Hunt, R. J., & Doherty, J. E. (2015). *Approaches in Highly Parameterized Inversion: PEST++ Version 3, A Parameter ESTimation and Uncertainty Analysis Software Suite Optimized for Large Environmental Models*. Techniques and Methods 7–C12.

White, J. T. (2018). *A model-independent iterative ensemble smoother for efficient history-matching and uncertainty quantification in very high dimensions*. Enviromental Modelling and Software, 109.

White, J. T., Hunt, R. J., Fienen, M. N., & Doherty, J. E. (2020). *Approaches to Highly Parameterized Inversion: PEST++ Version 5, a Software Suite for Parameter Estimation, Uncertainty Analysis, Management Optimization and Sensitivity Analysis.* U. S. Geological Survey.

DRAFT

SECTION 5
Projection Ensemble

The Projection Ensemble is a series of planning scenarios that describe a reasonable range of future climate and cultural conditions in the Chino Basin through the planning horizon (2024-2080). The Projection Ensemble is used as input data for the 2025 CVM to simulate the potential range in future hydrologic conditions in the Chino Basin, including the water budget and changes in groundwater levels.

This section describes the objectives, methods, and results of the development of the Projection Ensemble, including the likelihoods associated with each Projection Scenario.

5.1 OBJECTIVES OF THE PROJECTION ENSEMBLE

The Projection Ensemble is designed to represent a reasonable range of uncertainty in future climate and cultural conditions, including the water demands and supply plans (Water Plans) of the water purveyors in the Chino Basin, pursuant to Steps 3 through 5 of the 2022 SYRM:[1]

- *Describe current and projected future cultural conditions, including but not limited to land use and water-management practices, such as: pumping, managed recharge, managed groundwater storage, impervious land cover, water recycling, and water conservation practices. Identify a possible range of projected future cultural conditions.*
- *Using the most current research on future climate and hydrology, identify a possible range of projected future climatic conditions in the Santa Ana River watershed.*
- *Using the results of [3.] and [4.] above, prepare an ensemble of multiple Projection Scenarios of combinations of future climate/hydrology and cultural conditions (herein called the "Projection Ensemble"). Assign likelihoods to each scenario in the Projection Ensemble.*

Recognizing that it is not feasible to include every possible permutation of future climate and cultural conditions in the Projection Ensemble, the objectives of the Projection Ensemble are to: (i) bracket a reasonable range in future climate and cultural conditions and (ii) result in the maximum potential range in the future hydrologic responses of the Chino Basin (i.e., high and low groundwater levels; high and low net recharge). This approach is based on Robust Decision Making (RDM)[2] principles, which inform strategies that perform well across a wide range of plausible futures.

This strategy informs parties about both the central tendency and potential extremes (high and low groundwater levels; high and low net recharge) of the Chino Basin's future hydrologic response. Understanding these extremes and their drivers can inform groundwater management strategies to avoid undesirable results and MPI and optimize basin management.

[1] See Attachment C of the 2022 Update of the Chino Basin Safe Yield Reset Methodology

[2] Robust Decision Making | RAND

5.2 STAKEHOLDER ENGAGEMENT AND TIMELINE

The development of the Projection Ensemble involved a collaborative process with multiple stakeholder workshops and technical documents to ensure that the scenarios were representative of the possible range in future conditions. This process involved:

- **Workshops**: Watermaster hosted four workshops with parties and other stakeholders to gather input during the development of the Projection Ensemble, to review accompanying Scenario Design TMs, and discuss stakeholder feedback:
  - **Workshop #1** (October 24, 2023). The objective of Workshop #1 was to identify key drivers for the Water Plans of the Chino Basin water purveyors. These drivers included economics, demographics, technology, policy, and climate. Stakeholders provided feedback on the methods and assumptions for quantifying the potential impacts of water conservation regulations, variation in precipitation, and temperature fluctuations.
  - **Workshop #2** (March 7, 2024). The objectives of Workshop #2 were to present a proposed *qualitative* Projection Ensemble, gather feedback on the Projection Ensemble, and gather input on proposed methods to *quantify* the Projection Scenarios.
  - **Workshop #3** (June 25, 2024). The objectives of Workshop #3 were to summarize feedback and responses from the Scenario Design TM #2 and Workshop #2 and to describe the proposed *quantitative* Projection Ensemble. Stakeholders provided feedback on the Water Plan Scenarios and the proposed methods for simulating future climate conditions.
  - **Workshop #4** (August 27, 2024). The objectives of Workshop #4 were to summarize feedback and responses from the draft Scenario Design TM #3 and Workshop #3 and to describe updates made to the proposed *quantitative* Projection Ensemble. Stakeholders provided feedback on the Water Plan Scenarios and the proposed Climate Scenarios.
- **Targeted Outreach to the Appropriative Pool Parties**: During the scenario design process, West Yost reached out to the Appropriative Pool (AP) parties to solicit input on the scenario development. Many AP parties[3] provided input and reviewed draft Water Plan Scenarios that were developed for each party.
- **Technical Memoranda**: Three TMs were prepared to document the development of the Projection Ensemble:
  - **Scenario Design TM #1** outlined the approach for developing Water Plan projections and presented questions for the first workshop.
  - **Scenario Design TM #2** documented feedback from the first workshop, described the proposed Water Plan projections, presented recommended climate datasets, and outlined the Projection Ensemble.

[3] All AP retailers were contacted to provide input on the scenario design process. The AP parties that provided input included the Cities of Chino, Chino Hills, Ontario, Pomona, Upland, Cucamonga Valley Water District, Jurupa Community Services District, the Chino Desalter Authority, Monte Vista Water District, and Fontana Water Company.

— **Scenario Design TM #3** documented feedback from previous TMs and workshops and quantitatively described the proposed Projection Ensemble.

Parties provided feedback on the TMs, the proposed Projection Ensemble, and the data used to prepare the Projection Ensemble. All written input was responded to in the Scenario Design TMs. General themes of the verbal feedback from the workshops were addressed in subsequent Scenario Design TMs and workshops.

- **Website**: Throughout the Scenario Design process, Watermaster maintained a webpage[4] on its website with links to the timeline, draft and final TMs, and workshop materials.
- **Updates at Watermaster Meetings**: Updates on the 2025 SYR process, including the development of the Projection Ensemble, were provided at monthly Pool Committee, Advisory Committee, and Board meetings. Updates included announcing distribution of TMs, future workshop dates, summaries of workshops, and other status updates.

5.2.1 Timeline for Development of the Projection Ensemble

The timeline for the development of the Projection Ensemble was:

- **October 20, 2023:** Scenario Design TM #1 was distributed to the parties.
- **October 24, 2023**: Scenario Design Workshop #1.
- **December 1, 2023**: Stakeholders provided written comments on Scenario Design TM #1.
- **March 5, 2024:** Scenario Design TM #2 was distributed to the parties.
- **March 7, 2024**: Scenario Design Workshop #2.
- **April 12, 2024**: Stakeholders provided written comments on Scenario Design TM #2.
- **Spring 2024**: West Yost requested information from five AP retailers to inform the development of Water Plan projections. This included the estimated response to the urban water-use objectives being developed to comply with Assembly Bill 1668 and Senate Bill 606 in 2018 ("Making Conservation a California Way of Life").
- **June 25, 2024**: A draft of Scenario TM #3 was distributed, and Scenario Design Workshop #3 was held.
- **July 19, 2024**: Stakeholders provided written comments on draft Scenario Design TM #3.
- **August 27, 2024**: A revised draft of Scenario TM #3 was distributed, and Scenario Design Workshop #4 was held.
- **September 27, 2024**: Stakeholders provided written comments on draft Scenario Design TM #3.
- **Fall 2024:** West Yost submitted draft Water Plan Scenarios to nine AP parties for their input. West Yost held meetings with five of the nine parties to discuss the Water Plan Scenarios and gather feedback.

[4] Chino Basin Watermaster - 2017 Safe Yield Court Order Implementation

- **February 12, 2025**: The final Scenario Design TM #3 was published, including responses to all written stakeholder comments on Scenario Design TM #2 and prior drafts of Scenario Design TM #3.

5.3 CHARACTERIZING UNCERTAINTY IN FUTURE CLIMATE

Future climate will directly and indirectly impact the hydrology of the Chino Basin by influencing water use, the availability of water supplies, and recharge. For instance, hotter and drier weather can lead to increased water demands, reduced natural recharge, and reduced water supplies (including surface waters used for artificial recharge). Future climate is also inherently uncertain due to natural variability in short-term weather conditions, incomplete knowledge of future climate trends, and the limitations of models used to forecast climate.

To incorporate the uncertainty of future climate into the 2025 SYR, as required in Step 4 of the 2022 SYRM, three "Climate Scenarios" were developed to represent the "possible range of projected future climatic conditions": *Average, Hot/Dry,* and *Cool/Wet*. Each Climate Scenario includes a time series for projected precipitation and reference evapotranspiration (ET_o) from FY 2024 through 2080. Each time series was derived from historical observations that were adjusted to incorporate the uncertainty in short-term weather patterns and long-term climatic trends.

The development of Climate Scenarios for the 2025 SYR involved two main steps. The first step was to prepare a 57-year time series of precipitation and ET_o for the period 2024-2080 based on historical data. The second step was to modify the time series to produce the three Climate Scenarios (i.e., a possible range in future climate conditions). The following subsections describe the development of the Climate Scenarios.

DRAFT

5.3.1 Use of Historical Precipitation and ET_o Data

The historical record of precipitation and ET_o data[5] from FY 1950-2022[6] was used to develop a reasonable range of potential future climate conditions in the Chino Basin (i.e., *Average, Hot/Dry,* and *Cool/Wet*) for the projection period of FY 2024-2080. Each Climate Scenario is based on a continuous 7-year historical period to represent FY 2024-2030 and a continuous 50-year historical period to represent FY 2031-2080. Details for each period are outlined below:

1. **FY 2024-2030**: This 7-year period represents the final years over which the current Safe Yield was calculated. Precipitation and ET_o during this period will have the greatest influence on net recharge and the evaluation of Safe Yield for the period 2021-2030. Hence, the historical data was analyzed and used to prepare a potential range for future precipitation and ET_o for the period FY 2024-2030:
   - The **Average Climate Scenario** used historical precipitation and ET_o data from FY 1968-1974, the 7-year period that most closely matches the annual average precipitation over the period FY 1950-2022.
   - The **Hot/Dry Climate Scenario** used historical precipitation and ET_o data from FY 2012-2018, the driest 7-year period over the period FY 1950-2022.
   - The **Cool/Wet Climate Scenario** uses historical precipitation and ET_o data from FY 1977-1983, the wettest 7-year period over the period FY 1950-2022.
2. **FY 2031-2080**: All three Climate Scenarios used the same continuous 50-year historical period from FY 1959-2008. This 50-year period was selected because its annual average precipitation (15.2 in) is similar to the long-term annual average precipitation from 1915-2011 (15.4 in), includes a mix of wet and dry periods, and falls within the period for which the Department of Water Resources (DWR) developed climate change factors (FY 1915-2011).

5.3.2 Incorporating DWR Climate Change Factors

To incorporate for future climate trends, we initially explored the use of climate data from the sixth iteration of the Coupled Model Intercomparison Project (CMIP6). As documented in Scenario Design TM #2, CMIP6 models offer improvements in representing atmospheric processes, have denser grids, and better simulate historical conditions compared to CMIP5 models. We processed the precipitation and

[5] Estimates of daily precipitation over the Chino Basin were developed from precipitation stations and gridded precipitation data products produced by the PRISM Climate Group and the National Oceanic and Atmospheric Administration. Estimates of daily ET_o over the Chino Basin were developed from the Pomona and Riverside California Irrigation Management Information System stations using a spatial-temperature interpolation algorithm, supplemented by evaporation data from Puddingstone Reservoir. Details can be found in Sections 3 of the 2020 SYR Report.

[6] 1950-2022 was chosen to derive the data for the climate scenarios because (1) it is consistent with the historical time series of climate data processed for the R4 model in the 2020 SYR; (2) includes multiple dry and wet periods; (3) overlaps the period for which the DWR developed change factors (through 2011); and (4) the average annual precipitation over the 2025 CVM domain and watershed area are approximately equal to their respective long-term precipitation averages. See Figure 3-13 from the 2020 SYR Report and Figure 4-8 from this report.

temperature datasets that Cal-Adapt[7] generated from the downscaled[8] CMIP6 scenarios. The data processing and review identified discrepancies between the CMIP6 datasets and the historical precipitation datasets for the overlapping historical period in the Chino Basin. We reviewed these discrepancies with the Cal-Adapt team and were unable to resolve the discrepancies in time to use the CMIP6 models in the 2025 SYR.

Instead, we followed the DWR recommended approach for incorporating climate change into groundwater sustainability planning (e.g., DWR, 2018).[9] The DWR-recommended approach employs Change Factors (CFs) derived from spatially downscaled climate data from CMIP5.[10] CFs are used to adjust historical climate datasets to reflect projected future conditions, which preserves historical variability while incorporating future climate change trends. The DWR provides CFs for the following four climatic conditions:

1. 2030 Central Tendency (2030 CT)
2. 2070 Central Tendency (2070 CT)
3. 2070 Wet with Moderate Warming (2070 WMW)
4. 2070 Dry with Extreme Warming (2070 DEW)

To incorporate climate change in the Climate Scenarios, we applied distinct climatic conditions to each scenario. All Climate Scenarios used the 2030 Central Tendency CF but differ in their 2070 CF as follows: the Average Climate Scenario used the 2070 Central Tendency CF, the Hot/Dry Climate Scenario used the 2070 Dry with Extreme Warming CF, and the Cool/Wet Climate Scenario uses the 2070 Wet with Moderate Warming CF.

Since the DWR CFs represent snapshots of climate conditions at specific future points (e.g., the 2030 CF represents 2030 conditions and the 2070 CFs represent 2070 conditions), a continuous time series of CFs for each year between 2024–2080 was developed for each Climate Scenario.

- 2024–2030: The CF was equal to the 2030 CF.
- 2031–2070: Unique CFs were calculated for each year using linear interpolation between the 2030 and 2070 CFs.
- 2071–2080: The CF was equal to the 2070 CF.

These CF time series were then applied to the precipitation and ET_o datasets presented in Section 5.3.1 to generate the time series of precipitation and ET_o for each Climate Scenario.

[7] https://analytics.cal-adapt.org/

[8] Memo on Evaluating Global Climate Models for Studying Regional Climate Change in California

[9] California Department of Water Resources. 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. Accessed on 15 Aug 2024 at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Climate-Change-Guidance_Final_ay_19.pdf

[10] Memo on Evaluating Global Climate Models for Studying Regional Climate Change in California

5.3.3 Summary of Climate Scenarios

Table 5-1 summarizes the three Climate Scenarios used in the 2025 SYR:

Table 5-1: Datasets Used for Climate Scenarios

Climate Scenario	Precipitation and ET	
	FY 2024 through 2030	FY 2031 through 2080
Average	Historical period with average precipitation[(a)] (FY 1968-1974) and ET_o modified with 2030 CT	Historical period (FY 1959-2008) modified using 2030 CT and 2070 CT
Hot/Dry	Historical period with lowest precipitation (FY 2012-2018)[(b)] and ET_o	Historical period (FY 1959-2008) modified using 2030 CT and 2070 DEW
Cool/Wet	Historical period with highest precipitation (FY 1977-1983) and ET_o modified with 2030 CT	Historical period (FY 1959-2008) modified using 2030 CT and 2070 WMW

(a) Calculated based on continuous seven-year periods taken from the historical (PRISM) data for FY 1950 through 2022.
(b) CFs are only available through 2011; therefore, precipitation and ET_o were not adjusted for this period.

Figure 5-1 shows the time series for annual precipitation averaged across the Chino Basin over the historical period (1950-2023) and for each Climate Scenario over the projection period (2024-2080). For the 2024-2030 period, note the wide range in annual precipitation between Climate Scenarios that is designed to simulate the potential range in shorter-term weather variability. During the early part of the 2031--2080 period, there are smaller differences in precipitation between scenarios because of the strong influence of 2030 CT which is identical for each scenario. The mean precipitation over the historical period was 14.3 inches. The mean precipitation for the *Average*, *Hot/Dry*, and *Cool/Wet* Climate Scenarios are 15.3 inches, 13.8 inches, and 18.3 inches, respectively.

Figure 5-2 shows the CDFM for the three Climate Scenarios for FY 2024 through 2080. CDFMs are calculations of the accumulated differences between the annual precipitation relative to the long-term mean. To characterize the differences in precipitation between scenarios through the projection period, the CDFM for each scenario is calculated relative to the mean of the Average Climate Scenario (15.3 inches). This results in the CDFM for the Average Climate Scenario equaling zero at the end of the projection period, whereas the Hot/Dry and Cool/Wet scenarios are less than and greater than zero, respectively, at the end of the projection period. Generally, an upward trending CDFM curve indicates wetter-than-average period, while a downward trending CDFM curve indicates a drier than average period. Figure 5-2 illustrates that, over the projection period, the Hot/Dry Climate Scenario is projected to receive approximately 86 inches less precipitation than the Average Climate Scenario, while the Cool/Wet Climate Scenario is projected to receive about 171 inches more.

Figure 5-3 shows the time series for annual ET_o in the Chino Basin over the historical period (1950-2023) and for each Climate Scenario over the projection period (2024-2080). These ET_o estimates represent the annual ET_o averaged across the Chino Basin. The mean ET_o over the historical period was 53.3 inches. The mean ET_o for the *Average*, *Hot/Dry*, and *Cool/Wet* Climate Scenarios are 56.7 inches, 58.4 inches, and 55.4 inches, respectively.

Figure 5-1. Historical and Projected Annual Precipitation by Climate Scenario

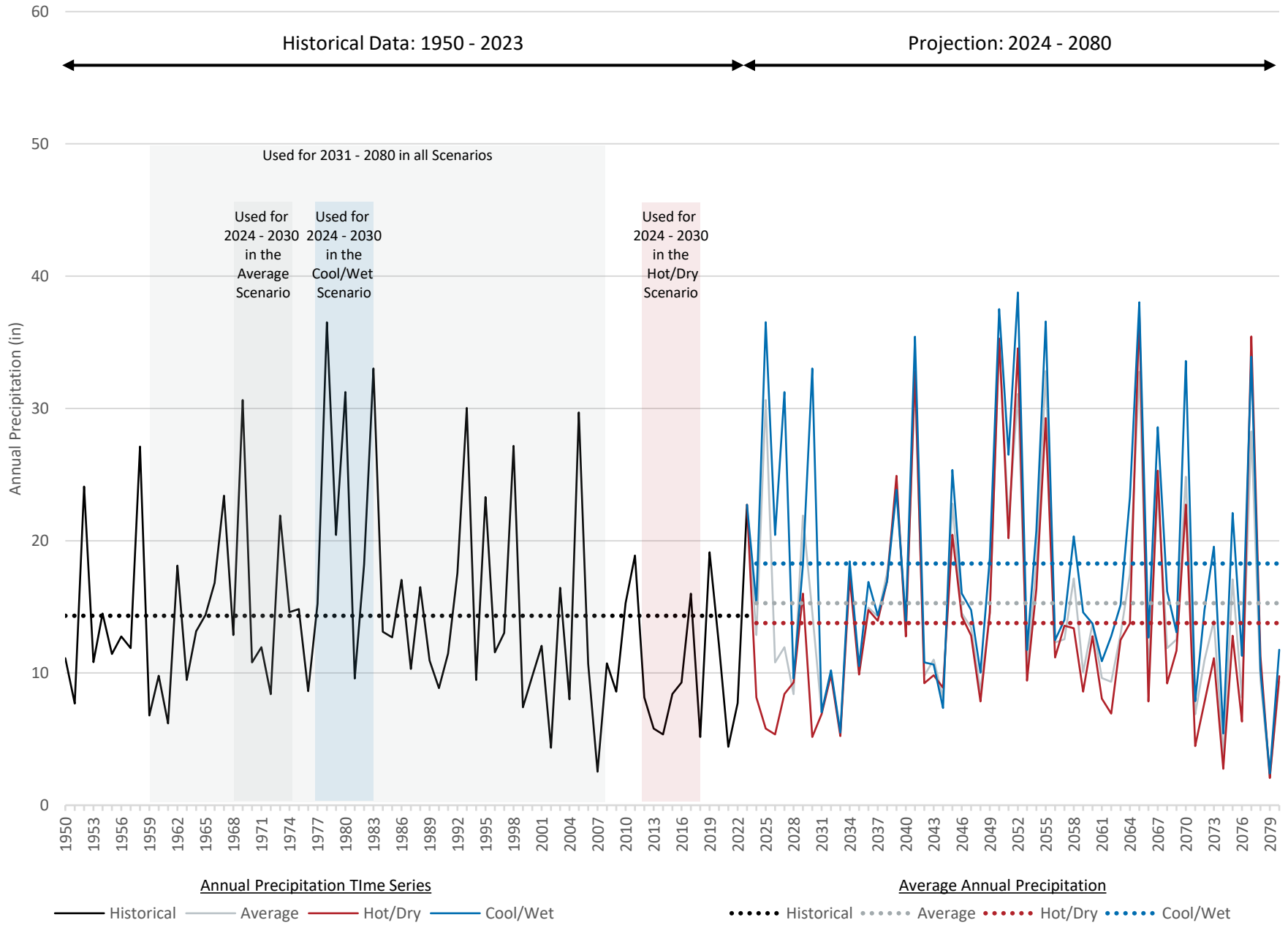


Figure 5-2. Cumulative Departure from Mean Precipitation by Climate Scenario

Calculated Relative to Mean of Average Climate Scenario (15.3 inches/year)

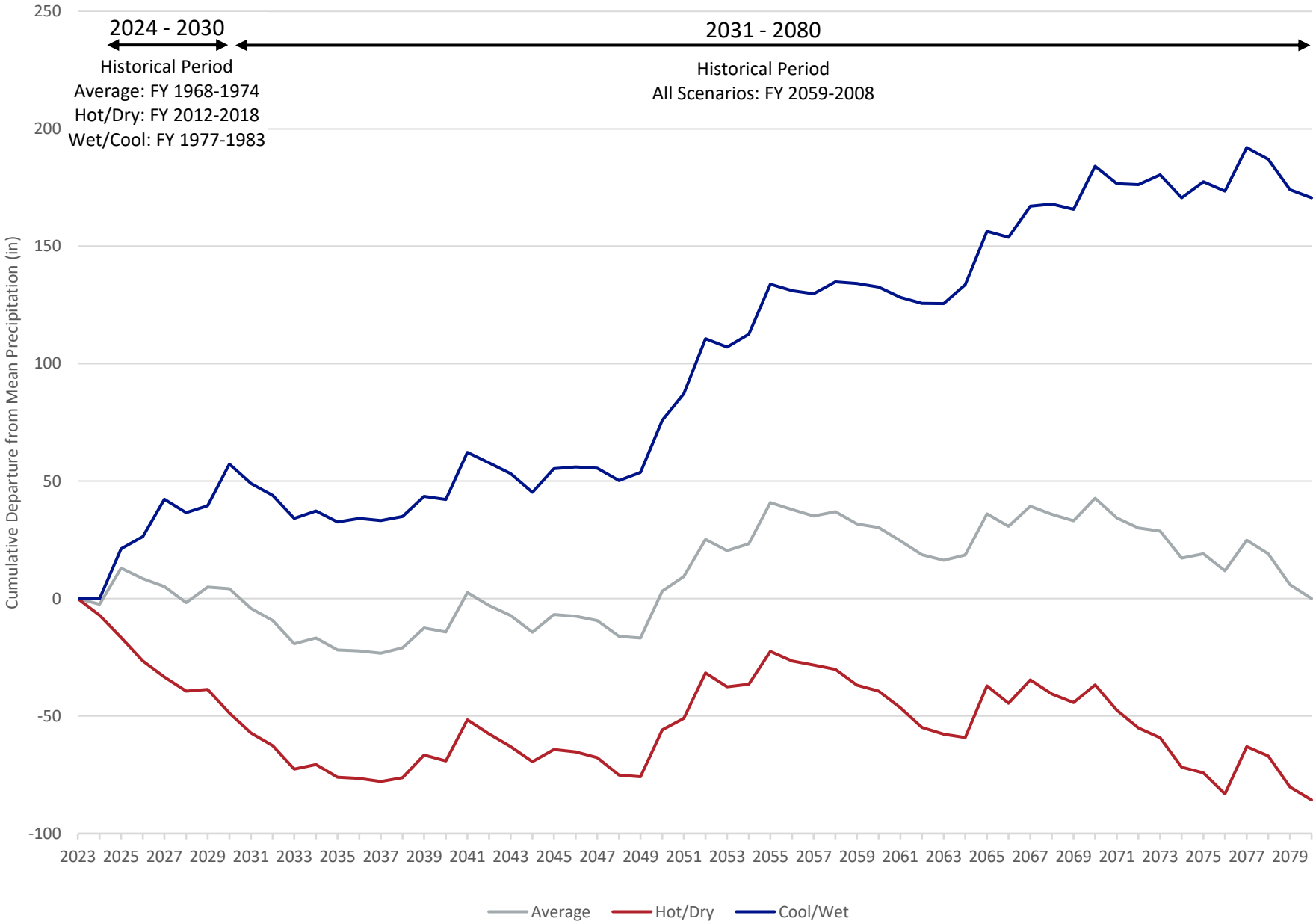
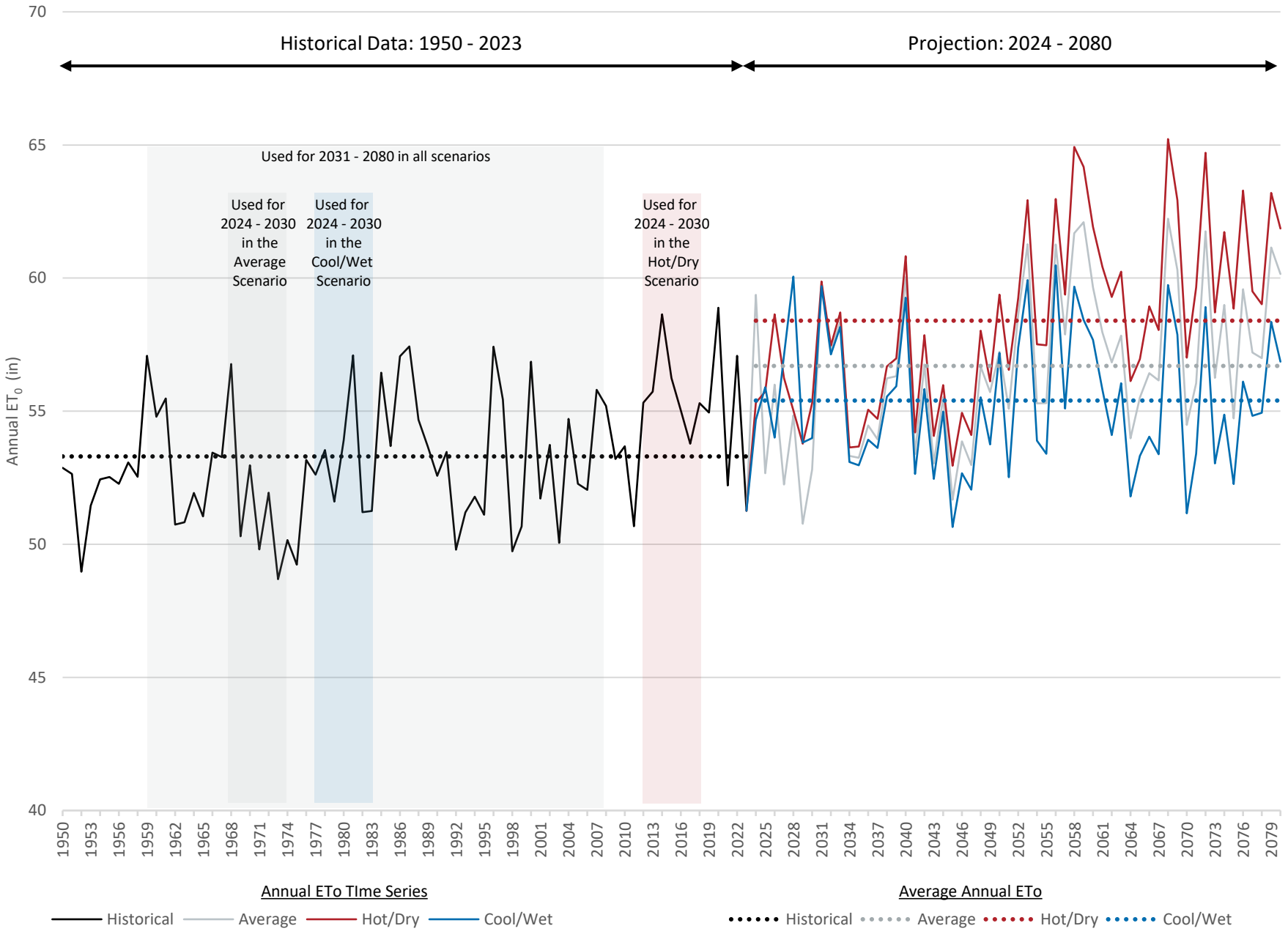


Figure 5-3. Historical and Projected Annual ET_o by Climate Scenario



5.4 CHARACTERIZING UNCERTAINTY IN FUTURE CULTURAL CONDITIONS

Cultural conditions—including but not limited to land use, groundwater pumping, managed aquifer recharge, groundwater storage, and water conservation efforts—play a critical role in shaping the behavior of the groundwater basin. However, projecting future cultural conditions is inherently uncertain due to the complex interplay of various drivers that influence water and land management practices over time. These uncertainties arise from several sources, including:

- Changes in economic conditions influence population growth, land-use changes, and water demands.
- Innovations in water management, conservation technologies, and data monitoring tools may emerge and enable new water management (e.g., conservation) strategies or alter the feasibility of existing strategies.
- Future changes in laws, policies, or regulations governing land-use and water management are difficult to predict, yet they can significantly alter water-use practices and priorities.
- The ongoing and unpredictable effects of climate change—including changes in precipitation, temperature, evapotranspiration, and extreme weather events—can substantially affect recharge rates, outdoor water demands, water availability, and water management strategies.

Simulating multiple future Water Plans (i.e., water demand and supply projections) provides a framework for evaluating how the groundwater basin might respond under a range of plausible future conditions.

In alignment with Step 3 of the 2022 SYRM, three Water Plan Scenarios—Expected Demand, High Demand, and Low Demand—were developed to characterize the potential range of future cultural conditions. The development of these scenarios began with the creation of Reference Water Plans, which represent each party's best estimate of future water use in the absence of the recently adopted Conservation Regulation. Building upon these Reference Water Plans, Watermaster worked with the parties to identify and quantify the primary sources of uncertainty - demand, groundwater utilization, and imported water utilization. These elements were then systematically varied to construct the Water Plan Scenarios, each of which reflects distinct assumptions about future conditions and behaviors. The following subsections describe the formulation of the Reference Water Plans (Section 5.4.1), the primary elements of uncertainty considered in scenario development (Section 5.4.2), and the methodology used to develop the three Water Plan Scenarios (Section 5.4.3).

5.4.1 Reference Water Plans

Before developing the Water Plan Scenarios, Reference Water Plans were prepared for each party. The Refence Water Plans represent the best estimate of future cultural conditions in the absence of the conservation regulations adopted by the State Board on July 3, 2024 (Conservation Regulation).[11] The Conservation Regulation was not included in the Reference Water Plans because it had not been finalized at the time of their development. Instead, anticipated responses to the regulation are incorporated, to

[11] Final text of Conservation Regulation

varying degrees, into the Water Plan Scenarios. These Reference Water Plans were used as the foundation for the development of the three Water Plan Scenarios.

5.4.1.1 Overlying (Agricultural) Pool

The Reference Water Plans for the parties in the Overlying (Agricultural) Pool (Agricultural Pool) were developed based on the estimated "buildout"[12] of urban land uses by 2040. Watermaster estimated Agricultural Pool production at buildout using historical data and projections for wells expected to operate in the future. In addition to these wells, several agricultural areas are irrigated with recycled water, some of which are anticipated to remain in use. Figure 5-4 shows the Agricultural Pool wells that are expected to produce in the future beyond buildout of the Basin and the projected pumping at these wells. The total projected water use by the Agricultural Pool is approximately 11,100 afy in 2025, decreasing to 4,000 afy in 2040, when most of the basin is assumed to reach buildout, and remaining stable thereafter.

5.4.1.2 Overlying (Non-Agricultural) Pool

The Reference Water Plans for the parties in the Overlying (Non-Agricultural) Pool (ONAP) (excluding those also in the AP, such as Ontario and Monte Vista Water District (MVWD)) were developed based on historical trends or the party's response to Watermaster's annual data request. Excluding pumping from General Electric Company, which injects approximately the same volume of water that it pumps, the total projected pumping by the ONAP is about 1,430 afy in 2025 and remains constant over time.

5.4.1.3 Appropriative Pool

To develop the Refence Water Plans for the retailer members in the AP, we began by reviewing the Water Plans obtained as part of the Watermaster's annual data collection and evaluation process. The AP retailers included:

- City of Chino (Chino)
- City of Chino Hills (Chino Hills)
- City of Norco (Norco)
- City of Ontario (Ontario)
- City of Pomona (Pomona)
- City of Upland (Upland)
- Cucamonga Valley Water District (CVWD)
- Fontana Water Company (FWC)
- Golden State Water Company (GSWC)
- Jurupa Community Services District (JCSD)
- Marygold Mutual Water Company (MMWC)

[12] Buildout refers to the point at which all available land within a designated area has been fully developed to its planned capacity, based on zoning regulations, infrastructure constraints, and land-use policies. At buildout, population growth within the area is typically limited to changes in household density (e.g., converting single-family homes to multi-family units) rather than new land development.

- Monte Vista Water District (MVWD)
- Santa Ana River Water Company (SARWC)
- San Antonio Water Company (SAWCo)
- West Valley Water District (WVWD)

The "major" AP retailers, indicated in italics above, collectively produce the majority of Chino Basin groundwater (historically 56-65 percent, excluding the Chino Desalter Authority), serve most of the Basin area, and are subject to the Conservation Regulation.

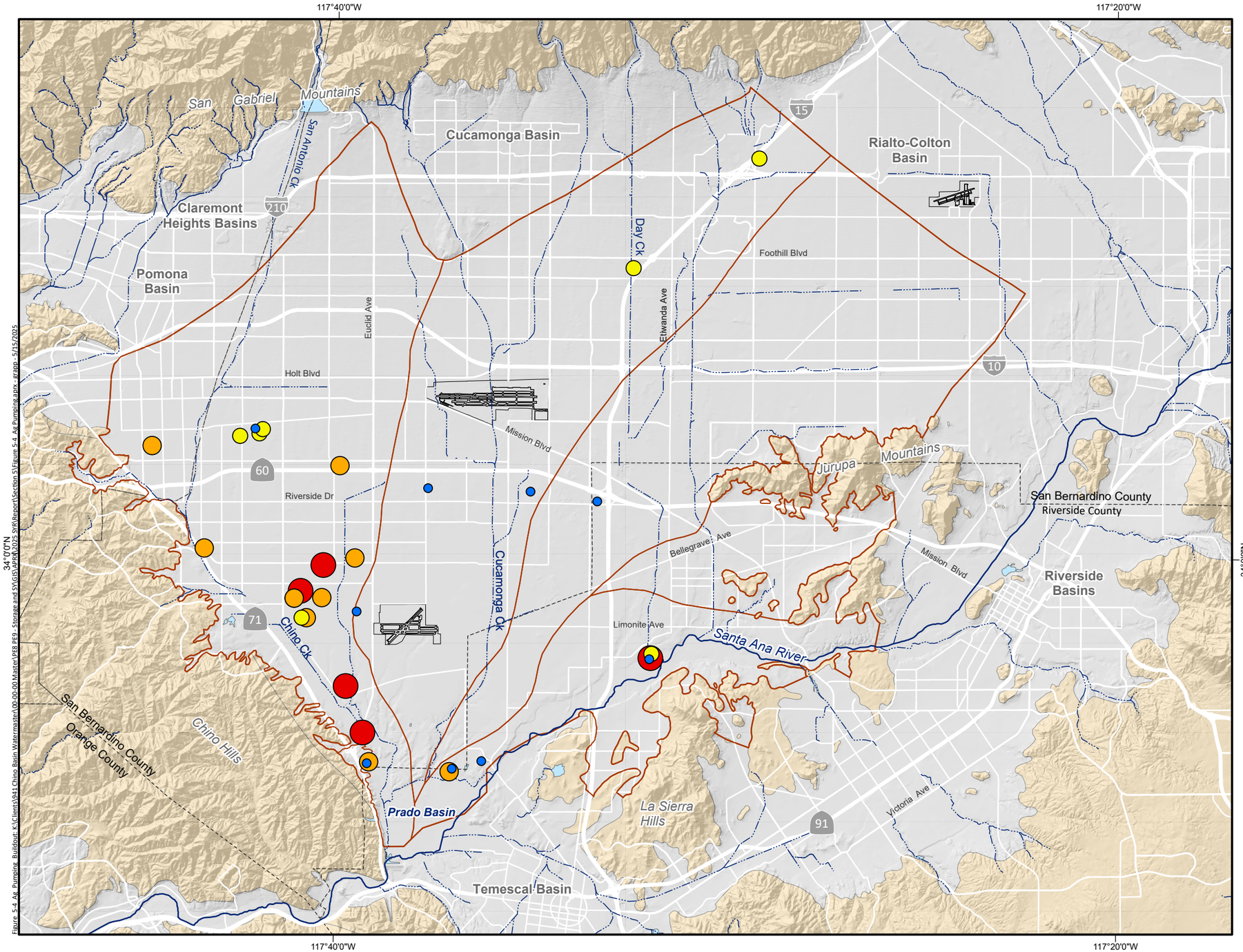
We then worked closely with major AP retailers to refine these plans to consider historical overestimates in demands[13], define water supply priorities when projected supplies exceed demands, and develop monthly projections from the annual estimates. Our consultations with the major AP retailers were crucial for understanding the assumptions behind their initial demands projections and ensuring the Refence Water Plans accurately reflected actual demands aligned with this modeling effort's goals. Based on their input, we adjusted the projected demands and corresponding supplies, primarily resulting in reduced demands. The Reference Water Plans for the major AP retailers can be found in Appendix C.

For AP parties other than the major AP retailers and non-retail parties (e.g., BlueTriton Brands, Inc.), Reference Water Plans were developed based on historical averages, similar to the method used to develop Reference Water Plans for the Overlying Non-Agricultural Pool.

The Refence Water Plans indicate that projected pumping for all AP parties is about 134,400 afy in 2025, 161,800 afy in 2040, and 166,500 af in 2045.

DRAFT

[13] Scenario Design TM #1 documented the projected demands from prior groundwater studies compared to actual demands, concluding that historical projections are consistently greater than actual demands.



Projected Active Agricultural Wells at Buildout

Projected Annual Pumping (afy)

- 0 - 5
- 6 - 10
- 11 - 50
- 51 - 250
- > 250

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Hydrology

- Streams & Flood Control Channels
- Flood Control & Conservation Basins
- OBMP Management Zones



Figure 5-4 Ag Pumping Buildout K:\Clients\5941 Chino Basin Watermaster\00-00 Master\PE8 PE9 - Storage and SY\GIS\APRX\2025 SYAR\Report\Section 5\Figure 5-4 Ag Pumping.aprx - dcapp - 5/15/2025

Prepared by:

WEST YOST
Water. Engineered.

Author: AK

Date: 5/15/2025

N

0 3 6 Miles

0 4 8 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Active Agricultural Wells at Buildout

DRAFT

Figure 5-4

5.4.1.4 Summary of Reference Water Plans

The Aggregate Reference Water Plans for the Watermaster Parties is shown in Table 5-2. As stated above, the Reference Water Plans assume no response to the Conservation Regulation.

Table 5-2. Aggregate Reference Water Plan for the Watermaster Parties

Water Supply	2020[(a)]	2025	2030	2035	2040	2045
Volume, afy						
Chino Basin Groundwater	151,365	146,897	155,317	159,266	168,447	171,961
Non-Chino Basin Groundwater	48,308	52,682	53,077	53,371	53,762	53,954
Local Surface Water	26,620	13,154	13,154	13,154	13,118	13,154
Imported Water	59,637	71,398	74,901	81,651	87,287	87,799
Recycled Water for Direct Use	20,857	25,091	27,088	28,385	29,982	30,482
Total	**306,787**	**309,222**	**323,537**	**335,826**	**352,596**	**357,350**
Percent of Total Supply						
Chino Basin Groundwater	49	48	48	47	48	48
Non-Chino Basin Groundwater	16	17	16	16	15	15
Local Surface Water	9	4	4	4	4	4
Imported Water	19	23	23	24	25	25
Recycled Water for Direct Use	7	8	8	8	9	9
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

(a) Historical data compiled for Water Year 2020 for the Chino Basin SGMA Annual Report.

5.4.2 Primary Elements of Uncertainty in Cultural Conditions

In the initial stages of the scenario design process, Watermaster presented an overview of cultural conditions and their impact on the hydrology of the Chino Basin. Following this presentation, input was gathered from the parties to achieve the following two objectives (1) ensure that the list of cultural conditions considered all major impacts to groundwater conditions and (2) identify the most significant sources of uncertainty related to cultural conditions and the parties' Water Plans. Based on the feedback from Scenario Design TM #1 and the October 24, 2023 workshop, three primary elements were identified for addressing uncertainty: (1) demands; (2) groundwater utilization; and (3) imported water utilization.

5.4.2.1 Historical Variation in Water Demands and Use of Water Supplies

To understand the year-to-year variability in historical Water Plans, we compiled the historical water demand and supply data from the Chino Basin parties. Figure 5-5 shows the historical data on water supplies used to meet demands data compiled from Water Year (WY) 2015 through 2023. Over this period, total water demand ranged between 271,000 af (WY 2023) to 307,000 af (WY 2020). There was no discernible upward or downward trend in total water demand over the period. However, the historical use of water supplies varied depending on hydrologic conditions. The nine-year period included three wetter-than-average years (WYs 2017, 2019, and 2023), while the other six years experienced below-average precipitation. Total groundwater use declined from 67 percent of total supplies in dry years

to 63 percent in wet years. Conversely, total imported and local surface water use increased from 25 percent of total supplies in dry years to 31 percent of total supplies in wet years.

5.4.2.2 Uncertainty in Demands

Demands refers to the total quantity of potable and non-potable water required to meet the needs of the parties. During the first scenario design workshop, the parties emphasized that uncertainty in the following factors will have the largest influence on demand projections:

- Growth (e.g., population, economic, buildout, infrastructure improvements)
- Water conservation efforts
- Climate

5.4.2.2.1 Growth

Growth plays a significant role in projecting demand; however, it is inherently uncertain due to factors such as changes in migration patterns, economic conditions, and policy and governance. For example, the recent urban densification legislation[14] in California, aimed at increasing housing supply, has the potential to impact the pace and type of land use changes associated with growth.

Feedback from the parties emphasized that growth primarily affects demand projections through the timing of buildout. If buildout occurs faster than expected, demand is likely to rise more quickly than projected. Conversely, if buildout occurs slower than expected, demand is likely to rise more gradually than projected.

5.4.2.2.2 Conservation Regulation

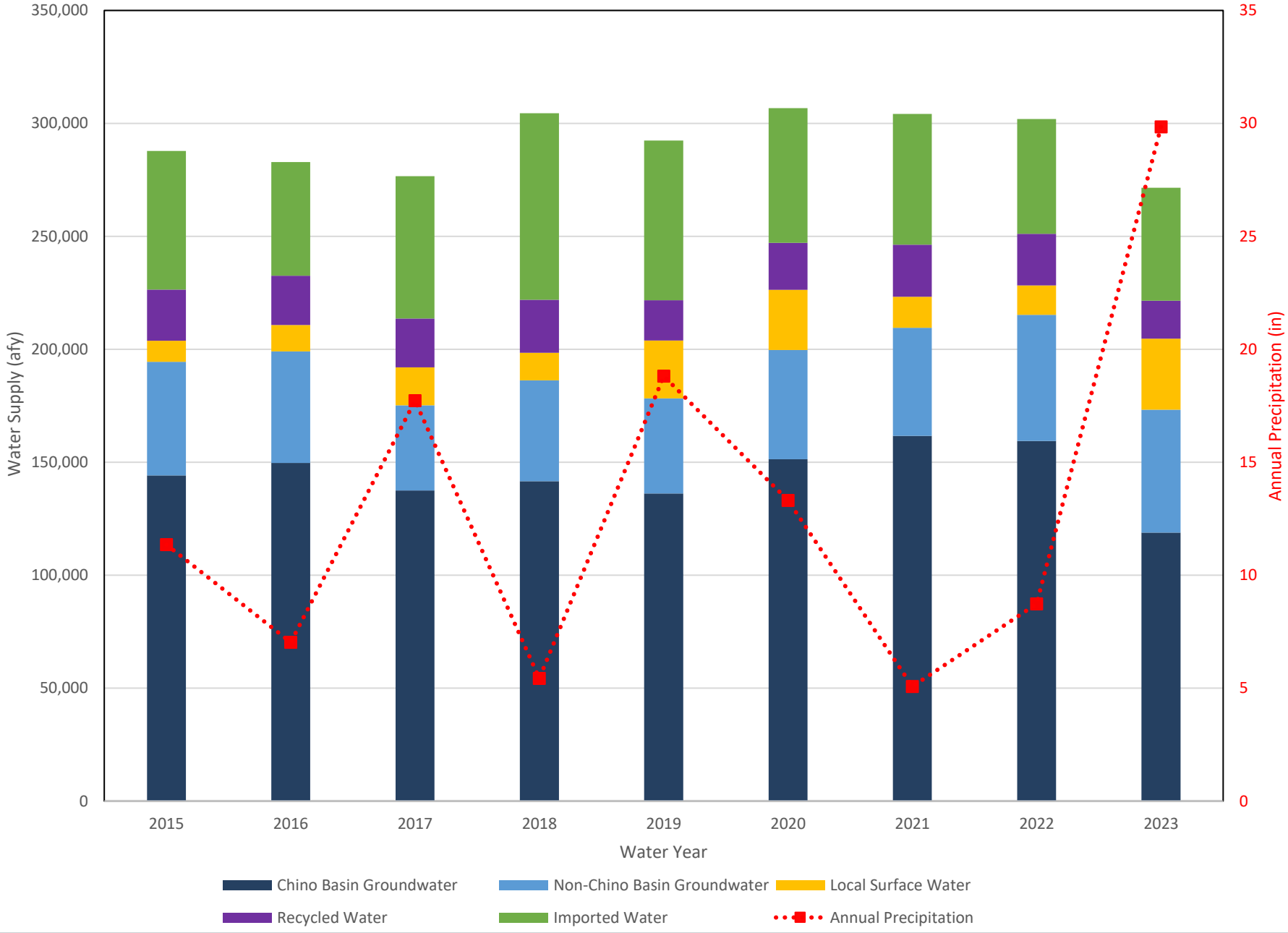
Since 2018, the State Water Resources Control Board (State Board) and the DWR have been developing new water use efficiency standards for urban retail water suppliers to implement the 2018 Urban Water Use Objectives legislation (Assembly Bill 1668 and Senate Bill 606) and the related "Making Conservation a California Way of Life" regulation.[15] The State Board adopted the Conservation Regulation on July 3, 2024. The Conservation Regulation took effect in January 2025, with compliance expected to be assessed beginning in 2027.

The Conservation Regulation requires water agencies to calculate their total urban water use annually and compare it to an agency-specific overall water use objective. This objective is the sum of four components: (1) residential water use, including indoor, outdoor, and residential agricultural use; (2) water losses; (3) outdoor irrigation for commercial, industrial, and institutional properties with dedicated irrigation meters (Commercial, Industrial, And Institutional (CII) with Dedicated Irrigation Meter (DIMs)); and (4) bonus credits for recycled water use. Each component is determined using statewide efficiency standards and local service area factors such as population, climate, and landscape area. These efficiency standards become stricter over time, meaning that even if local conditions remain unchanged, the overall water use objective is required to gradually decrease.

[14] e.g., Assembly Bill 2011 (2022) and Assembly Bill 2243 (2024)

[15] Making Conservation a California Way of Life Fact Sheet

Figure 5-5. Historical Water Supplies of the Chino Basin Parties, Water Year 2015 through 2023



Based on feedback from the parties, there is significant uncertainty regarding how customers will respond to the Conservation Regulation and how this will ultimately impact demand. Since compliance with the regulation is not required until 2027, no historical data exists to evaluate customer behavior or the State's actions in cases of non-compliance. Several Parties facing significant required reductions have indicated that, even with additional funding, achieving full compliance would remain challenging.

This introduces substantial uncertainty in forecasting the anticipated scale of response to the Conservation Regulation. Should the actual response exceed projections, water demand will likely be lower than estimated. Conversely, if the response falls short of projections, water demand will likely exceed anticipated levels.

5.4.2.2.3 Climate Change

Climate trends influence water demand projections. Typically, water use increases during hot and dry periods and decreases during cooler, wetter conditions (e.g., WY 2023 in Figure 5-5). However, the projected demands in the Reference Water Plans assume an "average hydrologic year"[16] and do not account for interannual variability. Extended droughts or unusually wet periods impact water demands; the effects can be complex in urbanized areas such as the Chino Basin where statewide policies[17] can influence the response to extreme conditions. Moreover, uncertainty surrounding future climate conditions, including the potential for more frequent and extreme weather events due to climate change, further complicates efforts to accurately forecast long-term water demand.

5.4.2.2.4 Impacts of Demand Deviations on Groundwater Levels and Net Recharge

Water demand is subject to considerable uncertainty due to factors such as growth, regulatory responses, and climate variability. Factors that could lead to higher-than-expected demand include:

- Greater-than-expected growth due to economic or other conditions
- The scale of the response to the Conservation Regulation is less than anticipated (e.g., less stringent enforcement, weaker consumer response)
- Extended periods of below-average precipitation compared to current assumptions for future climate

An increase in demand would likely result in greater utilization of one or more water-supply sources. If this additional demand is met through increased groundwater pumping, it could lead to declining groundwater levels. In turn, lower groundwater levels may increase net recharge through mechanisms such as enhanced recharge along the SAR due to increased hydraulic gradients and reduced discharge of rising groundwater in the Prado Basin. Additionally, if outdoor irrigation demand remains elevated due to limited response to the Conservation Regulation, associated DIPAW would also remain elevated, potentially affecting groundwater levels.

[16] An average hydrologic year is a representative year in which precipitation, temperature, and other hydrologic conditions reflect the long-term historical average for Chino Basin.

[17] E.g., the 2015 Statewide mandatory water reductions

Conversely, factors that could lead to lower-than-expected demand include:

- Slower-than-expected growth due to economic or other conditions
- The scale of the response to the Conservation Regulation is greater than anticipated (e.g., more stringent enforcement, stronger consumer response)
- Extended periods of above-average precipitation compared to current assumptions for future climate

A reduction in demand would likely decrease the utilization of one or more water supply sources. If this results in reduced groundwater pumping, it could lead to higher groundwater levels. The higher groundwater levels could lower net recharge by decreasing infiltration along the SAR and increasing discharge of rising groundwater in Prado Basin. Additionally, if outdoor irrigation demand declines in response to the Conservation Regulation, associated DIPAW would also decrease, which could further reduce net recharge and affect groundwater levels.

5.4.2.3 Groundwater Utilization

Groundwater utilization (GWU) represents the amount of Chino Basin groundwater that the parties use to satisfy their water demands. When projecting future groundwater utilization, parties consider both current conditions and anticipated trends. Key factors influencing these projections include:

- Regional hydrologic conditions
- Pumping capacity
- Groundwater quality and treatment infrastructure
- Policy
- Conveyance infrastructure
- The cost of groundwater compared to other water supplies

Factors that could lead to higher-than-expected groundwater utilization include:

- Unanticipated improvements to infrastructure for treatment, pumping, and conveyance that would increase accessibility to groundwater
- The timing and scale of new groundwater regulations (e.g., quality) and the responses to these regulations that result in fewer disruptions to projected pumping activities than expected
- Greater-than-expected recharge (either natural or managed) that would increase groundwater availability locally or basin-wide through a combination of greater pumping rights and greater pumping capacity because of higher groundwater levels

The probable effect of higher-than-expected groundwater utilization would be decreased utilization of supplemental water supplies, potentially resulting in lower groundwater levels and higher net recharge.

Factors that could lead to lower-than-expected groundwater utilization include:

- Unexpected groundwater-quality, regulatory, or infrastructure challenges that prevent or increase costs of pumping in the near-term or long-term
- Less-than-expected recharge (either natural or managed) that would decrease groundwater availability locally or basin-wide through a combination of reduced pumping rights and reduced pumping capacity because of lower groundwater levels

The probable effect of lower-than-expected groundwater utilization would be increased utilization of supplemental water supplies, potentially resulting in higher groundwater levels and lower net recharge.

5.4.2.4 Imported Water Utilization

Imported water utilization (IWU) represents the amount of imported water that the parties use to satisfy their water demands. When projecting their expected IWU, parties evaluate both current conditions and anticipated trends. Key factors influencing these projections include:

- Cost and availability of imported water
- Imported water reliability estimates documented by the Metropolitan Water District of Southern California (MWD)
- Regional hydrologic conditions
- Water-quality challenges with their other water supplies
- Infrastructure
- Policy

IWU also depends on the volume of wet-water recharge used to satisfy replenishment obligations. Pursuant to the Judgment, Watermaster levies and collects assessments each year in amounts sufficient to purchase replenishment water to replace pumping by a Pool during the preceding year in excess of that Pool's allocated share of Safe Yield (Overlying Agricultural and ONAPs) or Operating Safe Yield (Appropriative Pool). Each party's obligation is determined after accounting for any transfers or recovery of stored water.

With Watermaster approval, parties in the Overlying Non-Agricultural and Appropriative Pools may transfer stored water and/or unused Safe Yield rights among themselves to reduce their replenishment obligations. After the end of each fiscal year, Watermaster compiles pumping and transfer data from all parties to determine the final replenishment obligations for that year.

Projected future replenishment obligations are influenced by several factors, including current and projected Safe Yield, augmentation of production rights (e.g., Reoperation credits from pumping at Chino Desalter Authority wells), and transfer activity among parties.

Factors that could lead to an increase in expected IWU include:

- MWD's successful planning and implementation of infrastructure and operations to improve imported water supply reliability greater and/or faster than expected

- Relatively wetter and cooler conditions across the western U.S. (i.e., California and the Colorado River watershed)
- The percentage of replenishment obligations met via wet-water recharge is greater than anticipated

The probable effect of higher-than-expected IWU would be to reduce groundwater pumping and increase the use of supplemental water for recharge, potentially leading to higher groundwater levels and lower net recharge.

Factors that could lead to a decrease in the expected IWU include:

- MWD's planning and implementation of infrastructure and operations necessary to improve imported water supply reliability is less and/or slower than expected
- Relatively drier and warmer conditions across the region (i.e., California and the Colorado River watershed)
- The percentage of replenishment obligations met via wet-water recharge is less than anticipated

It is important to note that MWD's planning efforts and regional hydrologic conditions are not necessarily correlated; MWD's successful planning and implementation of imported water infrastructure may still result in higher imported water availability even under drier Climate Scenarios.

The probable effect of lower-than-expected IWU would be to increase groundwater pumping and reduce the use of supplemental water for recharge, potentially leading to lower groundwater levels and higher net recharge.

5.4.3 Water Plan Scenarios

Building on the preceding analysis, three Water Plan Scenarios were formulated to bracket the plausible range of future cultural conditions (i.e., water demands, groundwater utilization, and imported water use) and to evaluate their resulting effects on net recharge and groundwater levels in the Chino Basin:

- **Expected Demand Scenario:** Represents the most likely estimate of the future water demands and the mix of water supplies required to meet them.
- **High Demand Scenario:** Assumes higher-than-expected demands, higher-than-expected groundwater utilization, and lower-than-expected IWU. This scenario results in the highest total demand and groundwater pumping, which would likely lead to lower groundwater levels and higher net recharge compared to the Expected Demand Scenario.
- **Low Demand Scenario:** Assumes lower-than-expected demands, lower-than-expected groundwater utilization, and higher-than-expected IWU. This scenario results in the lowest total demand and groundwater pumping, which would likely lead to higher groundwater levels and lower net recharge compared to the Expected Demand Scenario.

Figure 5-6 presents a flowchart illustrating the process that was used to develop the three Water Plan Scenarios and Table 5-3 summarizes the differences between the scenarios. This section describes the development of the Water Plan Scenarios.

Table 5-3. Water Plan Scenario Descriptions

Water Plan Scenario	Description			Approximate Buildout Year	Response to Conservation Regulation (Major AP Retailers)		Utilization Adjustment for Major AP Retailers[b]	Change in CDA Pumping Relative to Reference Plans	Change in Pumping for Other Parties[c] Relative to Reference Plans	Water Supply Plan (Average, 2025-2045)			Minimum Percentage of Replenishment Obligations Met with Wet-Water (Imported Water) Recharge
	Demand	Groundwater Utilization (GWU)	Imported Water Utilization (IWU)		Minimum Residential Conservation Reductions Met	Minimum CII w/ DIMs Conservation Reductions Met				Total Demand (afy)	Percentage of Demands met with Chino Basin Groundwater	Percentage of Demands met with Imported Water	
1	Expected	Expected	Expected	2040	60%	70%	0%	0%	0%	319,000	49%	22%	7%
2	High	High	Low	2037	35%	50%	+8%	0%	+5%	332,000	51%	21%	0%
3	Low	Low	High	2045	80%	90%	-8%	0%	-5%	310,000	46%	25%	20%

(a) Percentages are relative to the nominal reductions calculated for each party.
(b) Utilization adjustment is the percentage of the Chino Basin groundwater pumping (based on the party's Reference Water Plan) that is added to the pumping for each of the major AP retailers; the same volume is subtracted from imported water use.
(c) Other parties include all parties in the Overlying Ag Pool (active wells only), Overlying Non-Ag Pool, and AP parties not included in the major AP retailers.

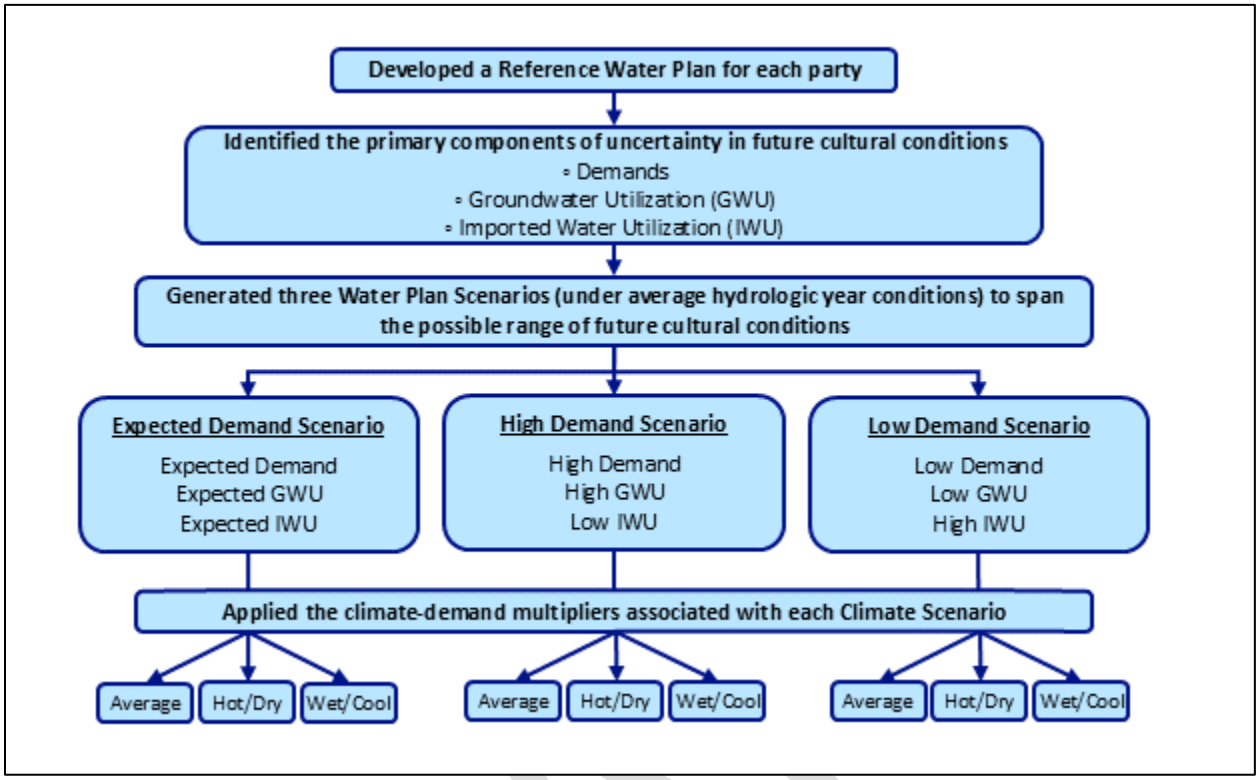


Figure 5-6. Process to Develop the Water Plan Scenarios

5.4.3.1 Response to the Conservation Regulation

To construct the three Water Plan Scenarios, we first estimated the required reductions in water demand for the major AP retailers, relative to their respective Reference Water Plans, to reflect varying levels of compliance with the Conservation Regulation. The methodology for projecting responses and calculating associated demand reductions is detailed in Appendix C and summarized below.

For each major AP retailer, nominal water use objectives were calculated for residential uses (including indoor, outdoor, and residential agriculture) and for outdoor irrigation at CII properties with DIMs. The reductions required to meet these objectives were then determined for each retailer. The total projected demand reductions needed to achieve the nominal objectives across all major AP parties are presented in Table 5-4.

Table 5-4. Reductions in Demand Required to Meet the Water Use Objectives

Water Use Objective	Reductions, afy				
	2025	2030	2035	2040	2045
Residential Uses	3,400	8,800	20,500	26,500	27,100
CII with Dims	0	5,600	12,400	18,100	18,100
Total	**3,400**	**14,400**	**32,900**	**44,600**	**45,200**

To address the uncertainty surrounding the impact of the Conservation Regulation on future water demands, we worked closely with the parties to develop three potential response scenarios, summarized in Table 5-5, that represent a range of possible outcomes. The Expected Demand Scenario represents the parties' anticipated level of compliance with the Conservation Regulation. The High Demand Scenario assumes a limited response, leading to higher-than-expected demand. The Low Demand Scenario assumes a robust response, resulting in lower-than-expected demand. Based on input from the parties, all demand reductions are assumed to result in an equivalent decrease in the use of imported water, with two exceptions: the City of Chino and the City of Upland, which indicated that all demand reductions will instead be met through decreased groundwater pumping.

Table 5-5. Summary of Conservation Regulation Responses in Water Plan Scenarios

Water Plan Scenario	Minimum percentage of the reductions required to meet nominal objectives in residential water uses	Minimum percentage of the reductions required to meet nominal objectives in CII w/DIMs	Reduction in Demand, afy				
			2025	2030	2035	2040	2045
Expected Demand	60	70	2,000	9,200	20,900	28,600	28,900
High Demand	35	50	1,200	5,900	13,300	18,300	18,500
Low Demand	80	90	2,700	12,000	27,500	37,500	38,000

5.4.3.2 Groundwater and Imported Water Utilization

Next, we adjusted GWU and IWU for the major AP retailers. For each major AP retailer, 8 percent of their Chino Basin groundwater pumping, as outlined in their Reference Water Plans, was calculated. In the High Demand Scenario (High GWU/Low IWU), this volume was shifted from imported water use to groundwater pumping. Conversely, in the Low Demand Scenario (Low GWU/High IWU), the same volume was shifted from groundwater pumping to imported water use. No changes were made to the Expected Demand Scenario.

5.4.3.3 Pumping Adjustments for Other Parties

This category encompasses all parties within the Agricultural Pool (with active wells), the ONAP, and AP parties not classified as major AP retailers. In the Expected Demand Scenario, pumping levels remained consistent with those outlined in the Reference Water Plans. For the High Demand Scenario, pumping in the Reference Water Plans was increased by 5 percent. For the Low Demand Scenario, pumping in the Reference Water Plans decreased by 5 percent.

5.4.3.4 Buildout

To address the uncertainty of the effect of the growth on demands, we adjusted the rate that demands will increase over time by varying the assumed buildout year across scenarios. The Expected Demand Scenario assumes demand increases at the same rate as in the Reference Water Plans with buildout at approximately 2040. The High Demand Scenario assumes a faster-than-expected buildout (approximately 2037). The Low Demand Scenario assumes a slower-than-expected buildout (approximately 2045).

5.4.3.5 Replenishment Obligation

Finally, varying assumptions were developed for how parties would satisfy their replenishment obligations using managed storage and imported water recharge. Managed storage is calculated based on water rights (including Safe Yield, Reoperation, supplemental water recharge, and other credits), groundwater production, and the expected behavior of the parties to satisfy replenishment obligations. A replenishment obligation arises when a party's groundwater production exceeds its production rights. Parties can satisfy this obligation either by drawing from their managed storage accounts (if available) or by paying Watermaster to procure imported water for wet-water recharge. Historical data gathered from Watermaster's Assessment Packages indicates that the parties have used managed storage to meet about 80 percent of replenishment obligations.[18]

During the scenario design process, Watermaster requested projections from the AP parties on the anticipated method to satisfy replenishment obligations. The average response of the AP parties, weighted by managed storage volume, indicated that the parties expect to satisfy about 93 percent of their replenishment obligations via use of managed storage and 7 percent via wet-water recharge. These findings were used to develop the following assumptions:

- The Expected Demand Scenario (Expected Demand/Expected GWU/Expected IWU) assumes parties will satisfy 7 percent of their obligations via wet-water recharge and 93 percent through managed storage.
- The High Demand Scenario (High Demand/High GWU/Low IWU) assumes parties will satisfy 100 percent of their obligations via managed storage.
- The Low Demand Scenario (Low Demand/Low GWU/High IWU) assumes parties will satisfy 20 percent of their obligations via wet-water recharge and 80 percent through managed storage.

If managed storage accounts are insufficient to satisfy the projected replenishment obligation, the balance will be accounted for with wet-water recharge. Projected managed storage is an iterative calculation. Initial estimates for the scenarios are refined and updated based on groundwater-flow model results, as these are necessary to project net recharge and Safe Yield. Additional details on managed storage for the Projection Scenarios are provided in Section 6.

[18] See Section 7.3.1.2 of the 2020 SYR Report

5.4.3.6 Variability of Demands due to Climate Scenarios

The projected demands in the three Water Plans described above are based on average hydrologic year conditions. When each Water Plan Scenario is combined with a Climate Scenario to form a Projection Scenario, the associated demands are further adjusted to account for the specific precipitation and ET_o patterns of that Climate Scenario. The effects of precipitation and temperature on demand are assumed to be independent. Additionally, the demand for individual supplies (e.g., Chino Basin groundwater) is expected to adjust proportionally to changes in other supplies.

5.4.3.6.1 Variability of Demands due to Precipitation

Water demands tend to vary with annual precipitation, largely due to the impact of weather on outdoor irrigation. Historical data (Figure 5-5) show that total demands can be up to 7 percent lower than average in wet years and up to 5 percent higher in dry years. In its 2020 Urban Water Management Plan (UWMP), IEUA estimated that extended dry periods (lasting three or more years) could result in demand increases of approximately 9 percent by 2040[19]. These projections are consistent with findings from other regional studies[20] and many of the 2020 UWMPs developed by the parties in Chino Basin.

Recent data and experience suggest that conservation measures, such as local or statewide mandates[21], can mitigate the typical increase in water demand during dry years. However, the demand adjustment methodology used in this analysis does not directly incorporate these potential reductions, leading to a broader plausible range in future demands. The uncertainty regarding the impact of future conservation measures is addressed by the three Water Plan Scenarios, which reflect varying levels of response to the Conservation Regulation. The potential for low-demand/dry-year scenarios is thus captured within the broader range of future conditions evaluated in the proposed Projection Scenarios.

To reflect how demand responds to changes in precipitation, the methodology applies adjustment factors, referred to as "precipitation-demand multipliers", to the projected demands under average hydrologic year conditions. These multipliers are determined based on the classification of years as Dry, Wet, or Normal, using the projected precipitation time series. Year types are defined using thresholds derived from historical annual precipitation data:

- **Dry years:** precipitation falls below the 33rd percentile.
- **Wet years**: precipitation exceeds the 66th percentile.
- **Normal years**: precipitation falls between the 33rd and 66th percentiles.

Precipitation-demand multipliers are applied based on the number of consecutive dry or wet years, as follows:

- The precipitation-demand multipliers for a single dry or wet year are 1.03 and 0.97, respectively, representing a ±3 percent change in demand.

[19] Section 2.6 of IEUA's 2020 UWMP

[20] Miro, Michelle E., David G. Groves, David Catt, and Benjamin M. Miller, Estimating Future Water Demand for San Bernardino Valley Municipal Water District. Santa Monica, CA: RAND Corporation, 2018. https://www.rand.org/pubs/working_papers/WR1288.html

[21] E.g., Executive Order N-7-22

- The precipitation-demand multipliers for a second consecutive dry or wet year are 1.06 and 0.94, respectively, representing a ±6 percent change in demand.
- The precipitation-demand multipliers for a third (or more) consecutive dry or wet year are 1.09 and 0.91, respectively, representing a ±9 percent change in demand.

Figure 5-7 demonstrates this approach applied to projected water demands in the Chino Basin under the Average Climate Scenario. The highest adjustment occurs in 2033, where demand is projected to increase by approximately 28,500 acre-feet, or 9 percent above the projected demand for an average hydrologic year. The lowest adjustment occurs in 2039 and 2050, where demand is projected to decrease by about 19,600 acre-feet, or 6 percent below the projected demand for an average hydrologic year.

5.4.3.6.2 Variability of Demands due to Temperature

Temperature drives water demands, primarily by influencing ET_o demands for irrigated landscapes and crops. IEUA estimates that a 3.6 °F increase in temperature may result in a 4.3 percent increase in demand (about 1.2 percent per °F).[22]

The parties that have developed 2020 UWMPs incorporate assumptions regarding the effects of future climate change on demand, as required by the California Water Code.[23] Accordingly, it is assumed that the Reference Water Plans already account for temperature-related impacts on demand under the Average Climate Scenario. Therefore, demands in the Water Plan Scenarios that are paired with the Average Climate Scenario were not adjusted for temperature.

For the Water Plan Scenarios paired with the Hot/Dry and Cool/Wet Climate Scenarios, the following steps were performed to account for the effect of temperature on demand:

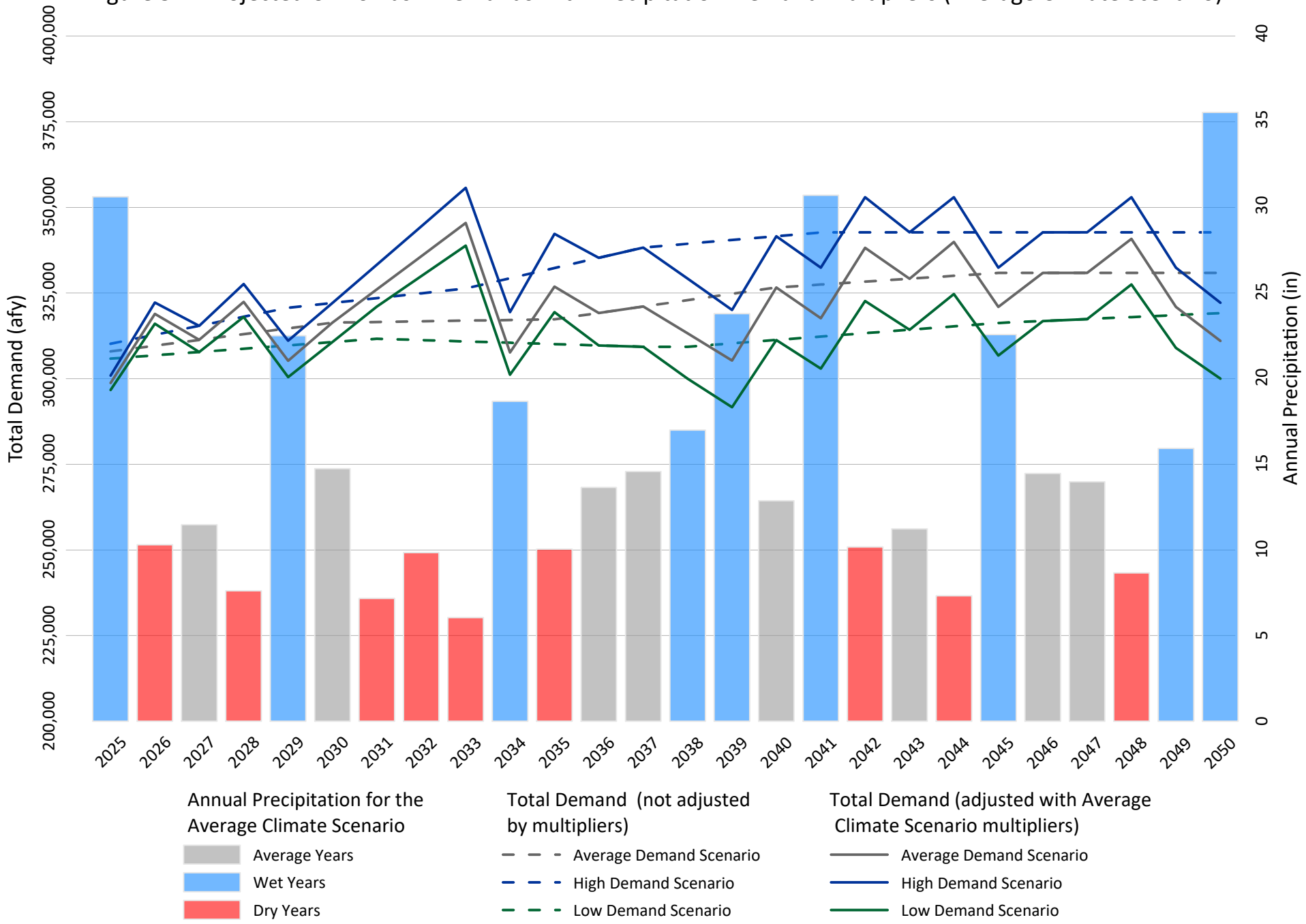
1. Conducted a regression analysis to quantify the relationship between temperature and reference ET_o. This was necessary because the R4 model uses ET_o as the sole temperature-related climate variable.
2. Estimated the average annual temperature for each year between 2024 and 2080 for each Climate Scenario based on the regression results.
3. Calculated the annual difference in temperature between the Average Climate Scenario and the Hot/Dry and Cool/Wet Climate Scenarios, respectively.
4. Adjusted demand in the Water Plan Scenarios:
    a. For the Hot/Dry Climate Scenario, demand was increased by 1.2 percent per °F difference relative to the Average Climate Scenario.
    b. For the Cool/Wet Climate Scenario, demand was decreased by 1.2 percent per °F difference relative to the Average Climate Scenario.

For the Water Plan Scenarios paired with the Hot/Dry and Cool/Wet Climate Scenarios, demands are projected to change by approximately ±1.5 percent by 2050, and up to ±2.8 percent by 2080.

[22] Table 2-3 of IEUA's 2015 IRP

[23] Appendix I. Considering Climate Change Impacts (ca.gov)

Figure 5-7. Projected Chino Basin Demands with Precipitation-Demand Multipliers (Average Climate Scenario)



5.4.3.7 Comparison of Water Plan Scenarios

Tables 5-6a, 5-6b, and 5-6c show the aggregate Water Plans for the three Water Plan Scenarios under average hydrologic year conditions (i.e., without applying multipliers for interannual variability in precipitation or ET). Individual Water Plans Scenarios for each of the nine major AP retailers are included in Appendix C. The key differences between the Scenarios are summarized below.

5.4.3.7.1 Demand

Figure 5-8 shows the projected total demand for the three Water Plan Scenarios under average hydrologic year conditions, compared to the 2020 SYR projections and the Reference Water Plans. The projected demand ranges for each scenario are as follows:

- Expected Demand Scenario: 308,000 af to 331,000 af
- High Demand Scenario: 310,000 af to 343,000 af
- Low Demand Scenario: 306,00 af to 316,000 af

5.4.3.7.2 Groundwater Utilization

Figure 5-9 shows the total projected Chino Basin groundwater pumping for the three Water Plan Scenarios under average hydrologic year conditions, alongside the 2020 SYR projections and the Reference Water Plans. Table 5-7 shows the historical and projected future pumping by party and scenario, also based on average hydrologic year conditions.

The projected range of Chino Basin GWU and the corresponding percentages of total demand met by groundwater for each scenario are as follows:

- Expected Demand Scenario (expected GWU):
  147,000 af (48 percent) to 163,000 af (49 percent)
- High Demand Scenario (greater-than-expected GWU):
  154,000 af (50 percent) to 177,000 af (52 percent)
- Low Demand Scenario (less-than-expected GWU):
  139,000 af (46 percent) to 148,000 af (47 percent)

5.4.3.7.3 Imported Water Utilization

Figure 5-10 shows the projected IWU for the three Water Plan Scenarios under average hydrologic year conditions, alongside the 2020 SYR projections and the Reference Water Plans. The projected range of IWU and the corresponding percentages total demand met by imported water for each scenario are as follows:

- Expected Demand Scenario (expected IWU):
  71,000 af (23 percent) to 73,000 af (22 percent)
- High Demand Scenario (less-than-expected IWU):
  65,000 af (21 percent) to 70,000 af (21 percent)
- Low Demand Scenario (greater-than-expected IWU):
  76,000 af (24 percent) to 78,000 af (25 percent)

DRAFT

Table 5-6a. Aggregate Water Plans for the Expected Demand Scenario (Expected Demands, Expected Groundwater Utilization, Expected Imported Water Utilization)					
Category	2025	2030	2035	2040	2045
Volume (afy)					
Chino Basin Groundwater	146,986	153,496	153,822	160,673	163,434
Non-Chino Basin Groundwater	51,317	51,032	50,586	50,652	50,878
Local Surface Water	13,154	13,154	13,154	13,118	13,154
Imported Water	71,398	71,583	71,376	72,198	72,925
Recycled Water for Direct Use	25,091	27,088	28,385	29,982	30,482
Total	307,946	316,353	317,323	326,624	330,873
Percentage					
Chino Basin Groundwater	48%	49%	48%	49%	49%
Non-Chino Basin Groundwater	17%	16%	16%	16%	15%
Local Surface Water	4%	4%	4%	4%	4%
Imported Water	23%	23%	22%	22%	22%
Recycled Water for Direct Use	8%	9%	9%	9%	9%
Total	100%	100%	100%	100%	100%

Table 5-6b. Aggregate Water Plans for the High Demand Scenario (High Demands, High Groundwater Utilization, Low Imported Water Utilization)					
Category	2025	2030	2035	2040	2045
Volume (afy)					
Chino Basin Groundwater	154,306	162,948	169,251	175,976	176,797
Non-Chino Basin Groundwater	52,262	51,959	51,720	51,919	51,972
Local Surface Water	13,154	13,154	13,136	13,145	13,154
Imported Water	65,366	66,631	69,015	70,192	70,288
Recycled Water for Direct Use	25,091	27,412	29,184	30,357	30,482
Total	310,179	322,105	332,306	341,589	342,693
Percentage					
Chino Basin Groundwater	50%	51%	51%	52%	52%
Non-Chino Basin Groundwater	17%	16%	16%	15%	15%
Local Surface Water	4%	4%	4%	4%	4%
Imported Water	21%	21%	21%	21%	21%
Recycled Water for Direct Use	8%	9%	9%	9%	9%
Total	100%	100%	100%	100%	100%

Table5-6c. Aggregate Water Plans for the Low Demand Scenario (Low Demands, Low Groundwater Utilization, High Imported Water Utilization)					
Category	2025	2030	2035	2040	2045
Volume (afy)					
Chino Basin Groundwater	139,427	142,583	142,887	144,146	147,907
Non-Chino Basin Groundwater	50,447	50,598	50,054	49,644	49,694
Local Surface Water	13,154	13,154	13,154	13,144	13,118
Imported Water	77,724	77,591	76,389	75,523	75,562
Recycled Water for Direct Use	25,091	26,755	27,829	28,841	29,982
Total	305,843	310,681	310,314	311,298	316,263
Percentage					
Chino Basin Groundwater	46%	46%	46%	46%	47%
Non-Chino Basin Groundwater	16%	16%	16%	16%	16%
Local Surface Water	4%	4%	4%	4%	4%
Imported Water	25%	25%	25%	24%	24%
Recycled Water for Direct Use	8%	9%	9%	9%	9%
Total	100%	100%	100%	100%	100%

Table 5-7 Historical and Projected Pumping for the Chino Basin Parties
(afy)

Party	Historical Pumping													Projected Pumping - Expected Demand, Expected GWU, Expected IWU[a]					Projected Pumping - Low Demand, Low GWU, High IWU						Projected Pumping - High Demand, High GWU, Low IWU				
											Statistics (2019-2023)																		
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Min	Max	Mean	2025	2030	2035	2040	2045	2025	2030	2035	2040	2045	2051	2025	2030	2035	2040	2045
Agricultural Pool																													
Aggregate Agricultural Pool Pumping	22,063	17,361	16,904	17,786	18,827	15,652	15,793	15,022	14,159	11,343	11,343	15,793	14,394	11,081	8,607	6,744	5,249	4,000	10,527	8,568	7,165	6,001	4,987	3,800	11,635	8,548	6,296	4,528	4,200
Overlying Non-Agricultural Pool																													
9W Halo Western OpCo L.P.	37	26	28	20	21	23	26	29	27	26	23	29	26	26	26	26	26	26	25	25	25	25	25	25	27	27	27	27	27
California Speedway Corporation	436	454	300	410	438	389	427	388	403	274	274	427	376	274	274	274	274	274	260	260	260	260	260	260	288	288	288	288	288
California Steel Industries, Inc.	1,417	1,279	1,187	1,298	1,266	1,419	1,065	1,302	671	1,058	671	1,419	1,103	1,103	1,103	1,103	1,103	1,103	1,048	1,048	1,048	1,048	1,048	1,048	1,158	1,158	1,158	1,158	1,158
General Electric Company	1,626	1,355	917	1,667	957	1,320	784	1,018	647	809	647	1,320	916	916	916	916	916	916	870	870	870	870	870	870	961	961	961	961	961
GenOn California South, LP	290	221	204	211	212	18	2	0	0	0	0	18	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riboli Family and San Antonio Winery, Inc.	10	7	4	5	6	26	26	43	16	2	2	43	22	22	22	22	22	22	21	21	21	21	21	21	24	24	24	24	24
TAMCO	18	29	30	25	18	10	20	15	2	0	0	20	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Overlying Non-Agricultural Pool Pumping	*3,834*	*3,371*	*2,670*	*3,636*	*2,919*	*3,204*	*2,350*	*2,795*	*1,767*	*2,168*	*1,618*	*3,277*	*2,457*	*2,341*	*2,341*	*2,341*	*2,341*	*2,341*	*2,224*	*2,224*	*2,224*	*2,224*	*2,224*		*2,458*	*2,458*	*2,458*	*2,458*	*2,458*
Appropriative Pool																													
BlueTriton Brands, Inc.	379	426	356	367	308	285	279	271	252	277	252	285	273	273	273	273	273	273	259	259	259	259	259	259	286	286	286	286	286
Chino, City Of	6,725	6,546	5,010	4,972	5,162	4,315	5,173	6,133	6,193	5,569	4,315	6,193	5,477	7,348	10,008	10,381	10,946	12,935	6,760	8,605	8,966	9,048	9,268	10,775	7,642	10,834	11,811	14,035	14,641
Chino Hills, City Of	7,522	3,745	1,633	2,246	2,839	1,608	1,472	2,529	2,694	2,218	1,472	2,694	2,104	2,315	2,315	2,315	2,315	2,315	2,130	2,130	2,130	2,130	2,130	2,130	2,500	2,500	2,500	2,500	2,500
Norco, City Of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ontario, City Of	21,980	17,676	22,849	24,840	26,280	20,722	18,395	21,751	19,670	16,933	16,933	21,751	19,494	26,358	29,612	30,222	37,187	37,187	24,249	26,508	27,066	28,913	33,333	33,333	28,467	32,544	37,234	41,116	41,116
Pomona, City Of	12,909	12,520	9,964	8,067	9,286	10,840	10,551	9,192	10,184	10,197	9,192	10,840	10,193	10,858	11,685	12,543	13,376	14,238	9,989	10,623	11,201	11,759	12,306	13,099	11,727	12,851	13,996	15,144	15,377
Upland, City Of	2,822	3,416	2,601	1,260	1,764	2,381	2,449	2,177	1,473	808	808	2,449	1,858	3,133	2,808	2,232	1,979	2,005	2,799	2,444	1,938	1,516	1,277	1,312	3,519	3,219	2,876	2,808	2,812
Cucamonga Valley Water District	16,122	14,640	20,537	16,562	6,838	9,624	23,318	26,226	27,281	13,515	9,624	27,281	19,993	13,900	13,400	12,400	10,400	10,400	13,333	12,853	12,201	11,237	9,868	9,868	14,467	13,786	11,974	10,932	10,932
Fontana Water Company	15,378	13,344	15,317	13,250	11,392	9,961	10,427	13,565	16,387	8,721	8,721	16,387	11,812	9,278	9,983	11,128	12,293	13,183	8,536	9,076	9,786	10,544	11,310	12,128	10,020	11,091	12,647	13,997	14,238
Jurupa Community Services District	18,407	12,805	9,284	11,498	15,286	13,894	12,760	11,161	12,094	7,522	7,522	13,894	11,486	10,131	12,414	13,011	14,002	14,002	9,408	10,016	10,568	11,041	11,417	10,723	10,858	13,967	16,118	16,880	16,880
Marygold Mutual Water Company	1,315	1,250	753	619	944	950	860	841	944	560	560	950	831	1,322	1,403	1,484	1,565	1,727	1,256	1,320	1,377	1,432	1,487	1,641	1,388	1,494	1,601	1,771	1,813
Monte Vista Irrigation Company	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monte Vista Water District[b]	7,163	7,402	8,371	7,086	6,483	6,631	6,710	7,674	7,185	5,293	5,293	7,674	6,699	6,500	6,500	6,500	6,500	6,500	5,980	5,980	5,980	5,980	5,980	5,980	7,020	7,020	7,020	7,020	7,020
Niagara Bottling, LLC	1,343	1,860	1,775	1,532	1,571	1,683	1,760	1,752	1,684	1,401	1,401	1,760	1,656	1,656	1,656	1,656	1,656	1,656	1,573	1,573	1,573	1,573	1,573	1,573	1,739	1,739	1,739	1,739	1,739
San Antonio Water Company	1,159	1,479	1,031	538	428	376	614	677	402	459	376	677	506	592	592	592	592	592	562	562	562	562	562	562	622	622	622	622	622
San Bernardino, County of (Shooting Park)	16	11	9	13	11	11	8	17	20	18	8	20	15	15	15	15	15	15	14	14	14	14	14	14	16	16	16	16	16
Santa Ana River Water Company	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden State Water Company	736	720	807	850	148	0	640	1,074	1,066	922	0	1,074	740	800	800	900	900	980	696	696	746	783	783	853	904	932	1,017	1,085	1,107
West End Consolidated Water Company	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West Valley Water District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Appropriative Pool Pumping	*113,976*	*97,842*	*100,297*	*93,699*	*88,740*	*83,280*	*95,418*	*105,040*	*107,529*	*74,412*	*74,412*	*107,529*	*93,136*	*94,479*	*103,464*	*105,652*	*113,999*	*118,008*	*87,546*	*92,661*	*94,368*	*96,791*	*101,566*	*104,250*	*101,174*	*112,903*	*121,458*	*129,952*	*131,100*
Chino Desalter Authority																													
Total Desalter Pumping[c]	29,282	30,022	28,191	28,284	30,088	31,233	35,630	40,156	40,566	39,815	31,233	40,566	37,480	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Total Pumping	169,155	148,596	148,061	143,405	140,574	133,368	149,190	163,013	164,021	127,737	118,605	167,165	147,466	147,902	154,412	154,738	161,589	164,349	140,297	143,453	143,757	145,016	148,777	148,050	155,267	163,910	170,213	176,938	177,758
Less GE Injection	-1,626	-1,355	-917	-1,667	-957	-1,320	-784	-1,018	-647	-809	-1,320	-647	-916	-916	-916	-916	-916	-916	-870	-870	-870	-870	-870	-870	-961	-961	-961	-961	-961
Projected Net Total Basin Pumping														146,986	153,496	153,822	160,673	163,434	139,427	142,583	142,887	144,146	147,907	147,180	154,306	162,948	169,251	175,976	176,797
2020 SYR Projected Net Total Basin Pumping														144,596	151,808	164,600	173,805	173,805	144,596	151,808	164,600	173,805	173,805	173,806	144,596	151,808	164,600	173,805	173,805
Change in Projected Net Total Basin Pumping from the 2020 SYR														2,390	1,688	-10,778	-13,132	-10,371	-5,169	-9,225	-21,713	-29,659	-25,898	-26,626	9,710	11,140	4,651	2,171	2,992

[a] GWU = Groundwater utilization; IWU = Imported water utilization

[b] Projected pumping includes projected wholesale deliveries to Chino Hills originating from MVWD wells and assumes that MVWD does not pump any of Chino Hills' pumping rights via MVWD wells.

[c] Includes pumping from San Bernardino County wells that will come online in FY 2026 to remediate the Chino Airport plume and supplement Desalter Pumping.

Figure 5-8. Total Demands for Water Plan Scenarios

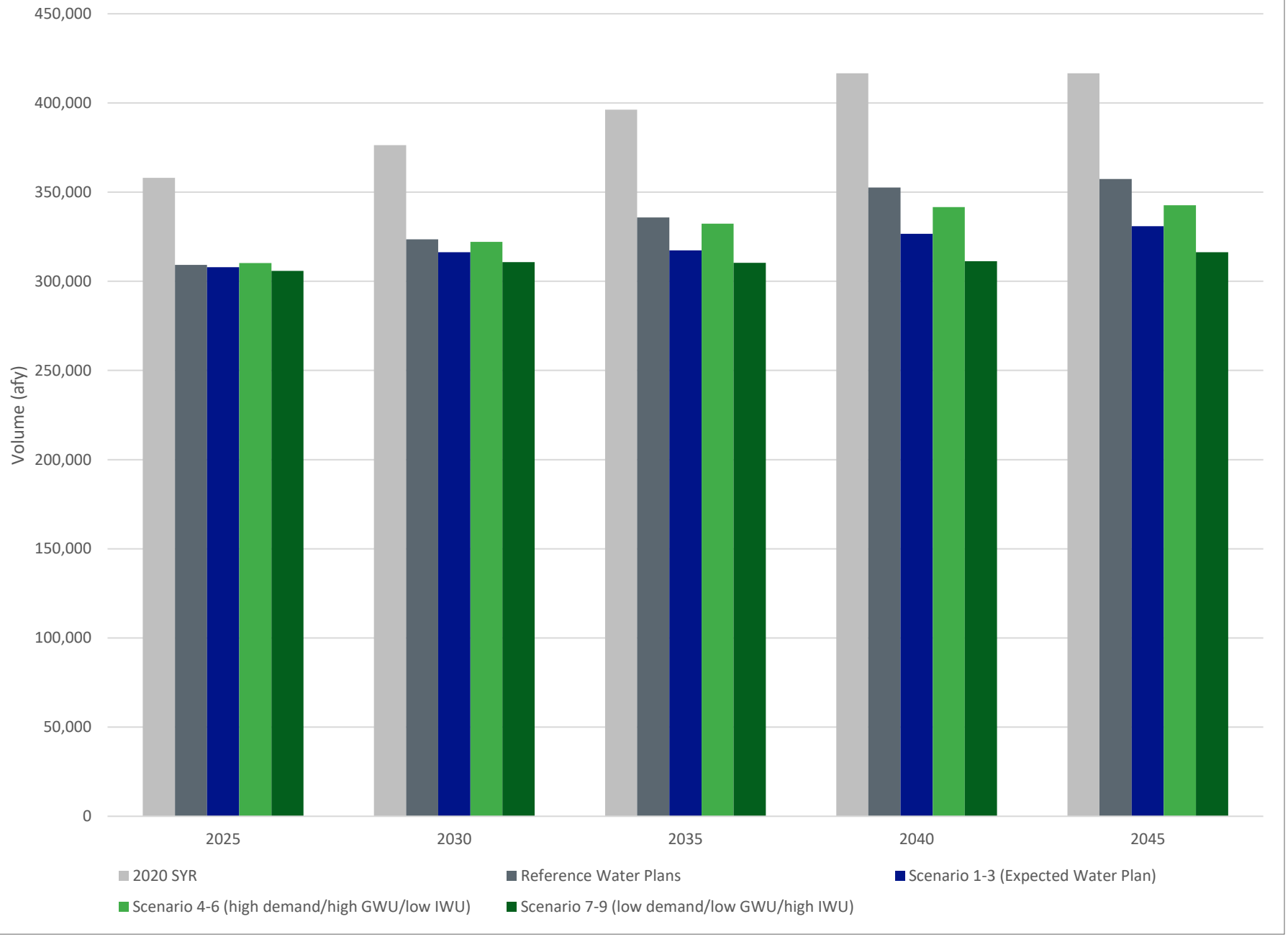


Figure 5-9. Total Chino Basin Groundwater Pumping Demands for Water Plan Scenarios

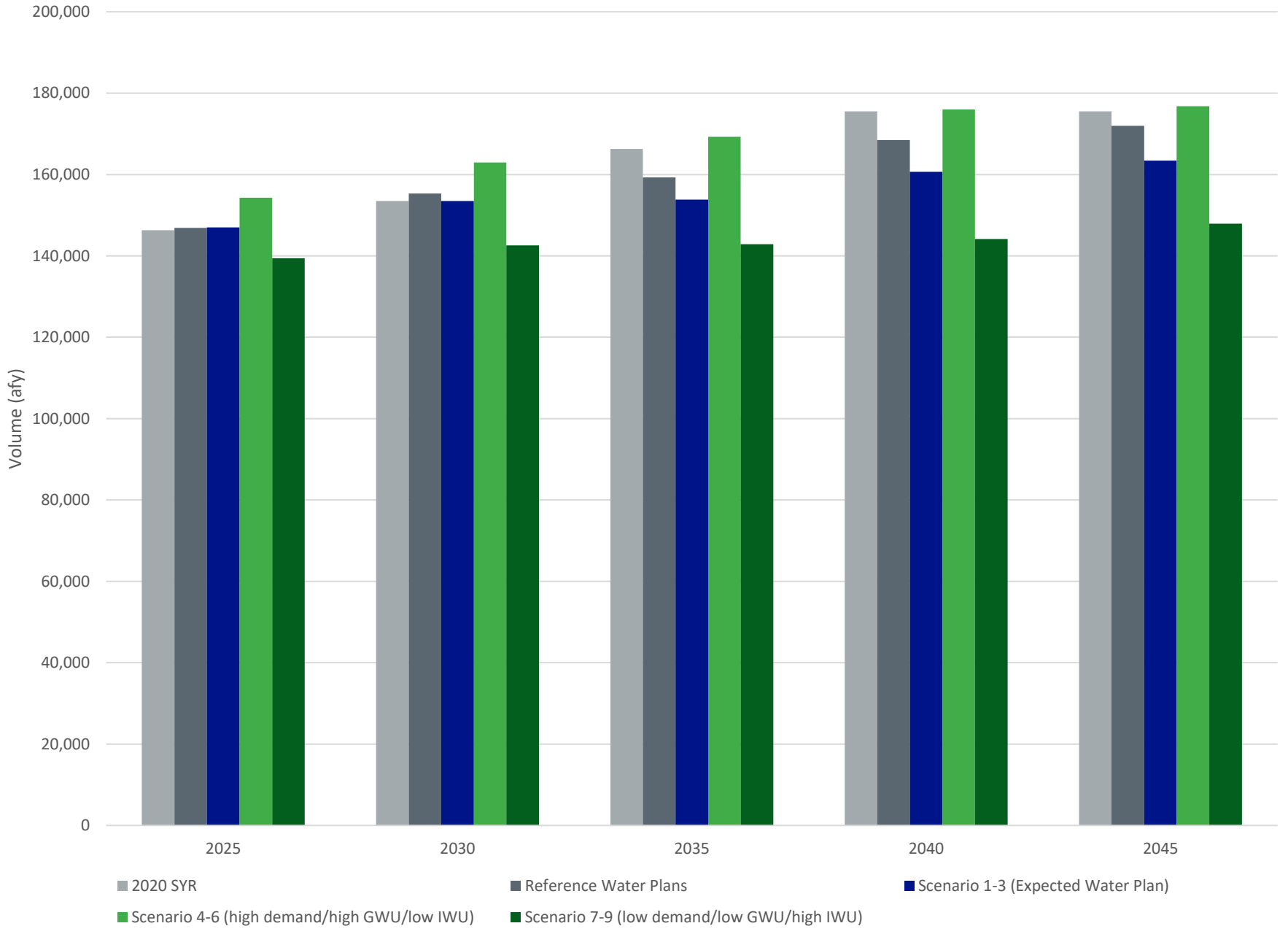
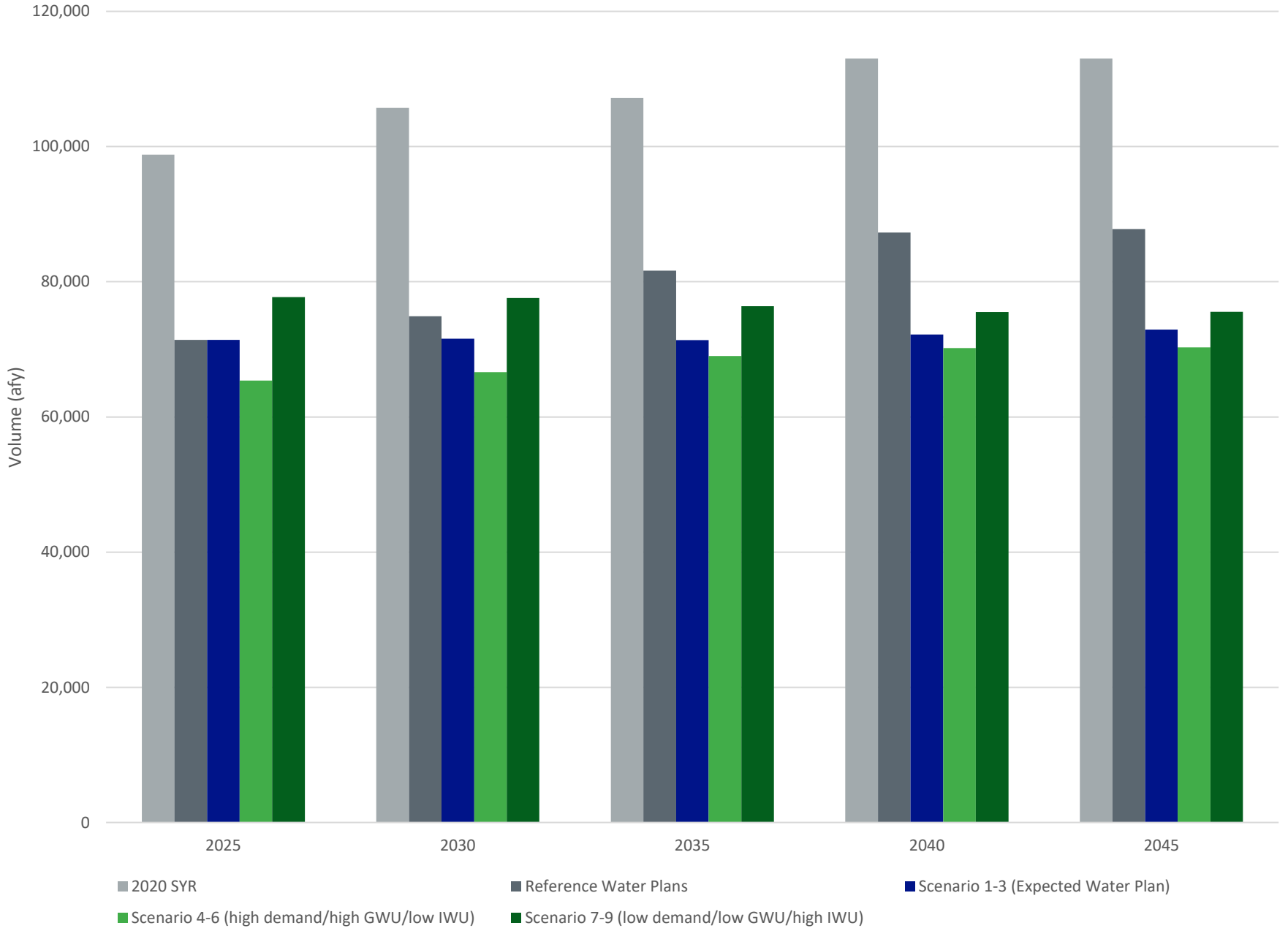


Figure 5-10. Total Imported Water Demands for Water Plan Scenarios



5.5 SUMMARY OF PROJECTION ENSEMBLE

Table 5-8 summarizes the nine Projection Scenarios, each representing a unique combination of three Climate Scenarios and three Water Plan Scenarios. These scenarios are designed to capture a broad range of plausible future conditions related to demand, groundwater utilization, and IWU.

Table 5-8. Projection Ensemble

Projection Scenario	Rationale	Water Plan Scenario[a]			Climate Scenario
		Demand	Groundwater Utilization	Imported Water Utilization	
1	Expected/Baseline	Expected	Expected	Expected	Average
2	Hot/Dry Climate	Expected	Expected	Expected	Hot/dry
3	Cool/Wet Climate	Expected	Expected	Expected	Cool/wet
4	Impact Of High Demands	High	High	Low	Average
5	Low Groundwater Levels	High	High	Low	Hot/dry
6	High Net Recharge	High	High	Low	Cool/wet
7	Impact Of Low Demands	Low	Low	High	Average
8	Low Net Recharge	Low	Low	High	Hot/dry
9	High Groundwater Levels	Low	Low	High	Cool/wet

(a) Each Water Plan Scenario is adjusted to reflect the unique precipitation and evapotranspiration (ET_o) patterns of the corresponding Climate Scenario as described in Section 5.4.3.2.

Scenario 1 serves as the "baseline" scenario and reflects expected conditions for both Water Plans and average future climate/hydrology.

Scenarios 2 and 3 modify the baseline to isolate the impacts of climate variability. Scenario 2 evaluates the effects of a hotter/drier climate, while Scenario 3 simulates a cooler and wetter future. Together, these scenarios characterize the influence of climatic uncertainty on net recharge and groundwater levels.

Scenarios 4 and 7 focus on the effects of future uncertainty in Water Plans, specifically how changes in demand and supply portfolios influence groundwater pumping, net recharge, and groundwater levels. Scenario 4 assumes high demands and high groundwater utilization with low IWU. Scenario 7 assumes low demands and low groundwater utilization with high IWU. Both scenarios use the average climate conditions.

Scenarios 5 and 9 explore the potential range of future groundwater levels. Scenario 5 represents a worst-case combination of high demand, high groundwater utilization, low IWU, and a hot/dry climate, likely resulting in the lowest groundwater levels. Conversely, Scenario 9 combines low demand, low groundwater utilization, high IWU, and a cool/wet climate, which is expected to result in the highest groundwater levels.

Scenarios 6 and 8 examine the plausible range in net recharge. Scenario 6, with high demands, high groundwater utilization, low IWU, and a Cool/wet climate, is likely to yield the highest net recharge of any Projection Scenario. Scenario 8 represents the opposite, with low demands, low groundwater utilization, high IWU, and a hot/dry climate, likely producing the lowest net recharge of any Projection Scenario.

Other combinations of Water Plan and Climate Scenarios are not expected to result in conditions (e.g., net recharge or groundwater levels) beyond the range captured by these nine scenarios.

5.6 LIKELIHOODS

Step 5 of the 2022 Safe Yield Reset Methodology directs Watermaster to "[a]ssign likelihoods to each scenario in the Projection Ensemble." This step acknowledges that not all Projection Scenarios have the same probability of occurrence, and that the simulated Basin responses should be evaluated within this probabilistic context. For example, if a single Projection Scenario with a low likelihood of occurrence is projected to result in MPI, it may warrant less concern than a higher-likelihood scenario with a similar impact.

To incorporate scenario likelihoods into the analysis, scalar weighting factors are applied independently to the Water Plan Scenario and Climate Scenario components of each Projection Scenario. If all scenarios are considered equally likely, each component is assigned a weight of 1. If a component is believed to be twice as likely as another, it is assigned a weight of 2. The total likelihood weight for each Projection Scenario is calculated as the product of the Water Plan Scenario weight and the Climate Scenario weight.

The Expected Demand Water Plan Scenario (which includes expected demand, expected groundwater utilization and expected IWU) is considered more likely than either the High Demand or Low Demand Water Plan Scenarios. Therefore, a scalar weight of 2 is applied to the Expected Demand Water Plan Scenario (Projection Scenarios 1, 2, and 3), while a weight of 1 is applied to the High and Low Demand Water Plan Scenarios (Projection Scenarios 4 through 9). This implies that the Expected Demand Water Plan Scenario is twice as likely to occur as either the High or Low Demand Water Plan Scenarios occurring.

Similarly, the Average Climate Scenario is considered more likely than the Hot/Dry or Cool/Wet Climate alternatives. A scalar weight of 2 is assigned to the Average Climate Scenario, and a weight of 1 is assigned to both the Hot/Dry and Cool/Wet Climate Scenarios.

Table 5-9 summarizes the Projection Ensemble with the assigned likelihood weights. The total likelihood weight for each Projection Scenario is the product of its assigned Water Plan Scenario weight and Climate Scenario weight. For example, Scenario 1, which includes the Expected Demand Water Plan Scenario and the Average Climate Scenario, is assigned a total weight of 4 (Water Plan weight of 2 times Climate Scenario weight of 2).

DRAFT

Table 5-9. Projection Ensemble with Likelihood Weights

Projection Scenario	Water Plan Scenario			Climate Scenario	Likelihood Weights		
	Demand	Groundwater Utilization	IWU		Water Plan Scenario (a)	Climate Scenario (b)	Total (c) = (a) * (b)
1	Expected	Expected	Expected	Average	2	2	4
2	Expected	Expected	Expected	Hot/dry	2	1	2
3	Expected	Expected	Expected	Cool/wet	2	1	2
4	High	High	Low	Average	1	2	2
5	High	High	Low	Hot/dry	1	1	1
6	High	High	Low	Cool/wet	1	1	1
7	Low	Low	High	Average	1	2	2
8	Low	Low	High	Hot/dry	1	1	1
9	Low	Low	High	Cool/wet	1	1	1

DRAFT

SECTION 6
2025 Determination of Tentative Safe Yield

6.1 BACKGROUND AND METHODS

Sections 6 and 7 present the findings of the 2025 Safe Yield Reevaluation and document the execution of Steps 6 through 9 of the 2022 SYRM:

6. *Simulate the range for the potential future water budget and groundwater conditions in the Chino Basin over no less than a 50-year future period. This is accomplished by using:*
   i. *The range of calibrated models [i.e., the chosen calibrated realizations], and*
   ii. *The Projection Ensemble as model input data.*
7. *Using the results of [6.] above, characterize the range in the model results for:*
   i. *Groundwater conditions, including: groundwater elevations, groundwater in storage, and groundwater flow directions, and*
   ii. *The water budget, including: basin inflows, outflows, change in storage, and net recharge.*
8. *Using the set of net recharge results from [7.ii], determine a Tentative Safe Yield as the likelihood-weighted average net recharge over the 10-year prospective period for which the Safe Yield is being redetermined (Tentative Safe Yield).*
9. *Evaluate whether the groundwater production at the Tentative Safe Yield estimated in [8] above will cause or threaten to cause "undesirable results" or "Material Physical Injury." If groundwater production at Tentative Safe Yield will cause or threaten to cause "undesirable results" or "Material Physical Injury," then Watermaster will identify and implement prudent measures necessary to mitigate "undesirable results" or "Material Physical Injury," set the value of Safe Yield to ensure there is no "undesirable results" or "Material Physical Injury," or implement a combination of mitigation measures and a changed Safe Yield.*

Section 6 describes the methods to implement Steps 6 through 9 and the results of Steps 6 through 8. Section 7 describes the results and conclusions of the execution of Step 9, including the determination of the viability of groundwater production at the Tentative Safe Yield (TSY).

6.1.1 Methods

Figure 6-1 shows a flowchart of Steps 6 through 9 of the 2022 SYRM. Steps 6 through 8 include the simulation of the Initial and TSY Ensemble and the calculation of the TSY for the 10-year period (FY 2021-2030). The assumed Safe Yield of the Chino Basin is a factor that determines the projections for managed storage, and therefore the imported wet-water recharge that is used to satisfy replenishment obligations when groundwater production exceeds production rights. Imported water recharge, in turn, impacts the water budget and groundwater levels in the Chino Basin, impacting net recharge and Safe Yield calculations for future decades. This feedback loop of net recharge, Safe Yield, managed storage, and imported water recharge requires that the modeling process be iterative to result in a stable net recharge volume. The Initial Projection Ensemble is necessary to ensure the TSY converges to a stable value to use in the TSY Ensemble. The managed storage for all realizations of the Initial Projection Ensemble assumes that managed storage is identical to historical managed storage through FY 2024, when the total balance was about 709,000 af.

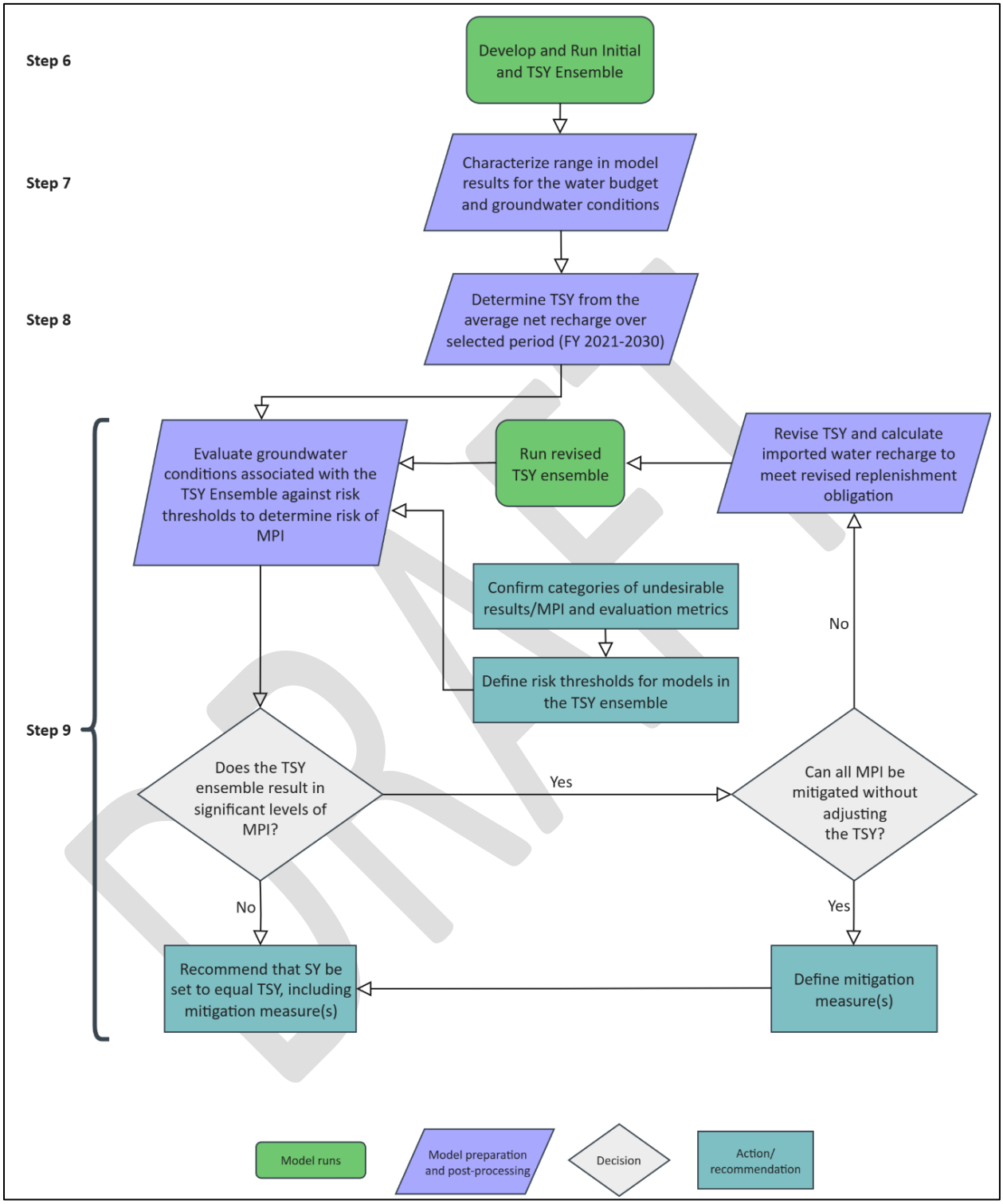


Figure 6-1. Flowchart Characterizing Steps 6 through 9 of 2022 Safe Yield Reset Methodology

6.1.2 Development of the TSY Ensemble

The TSY Ensemble is identical to the Initial Projection Ensemble except for revised calculations of managed storage and imported water recharge. Managed storage must be calculated using the TSY for FY 2021-2030 to calculate the imported water recharge to meet any replenishment obligations in FY 2021-2030.

6.1.2.1 Managed Storage

Managed storage for the TSY Ensemble is calculated using the following assumptions:

- Managed storage for all Projection Realizations is identical to the historical managed storage through FY 2024, when the managed storage was about 709,000 af. This includes about 45,900 af in the balance of the DYYP.
- Pumping of water in the DYYP accounts is assumed to occur in FY 2026 through 2028, leaving a zero balance in the DYYP account at the end of FY 2028.
- For all Projection Realizations in the TSY Ensemble, the Safe Yield assumed for FY 2021-2030 is the TSY.
- For subsequent decades, the Safe Yield is assumed to be the average net recharge for that decade in that projection realization.
- Recycled water recharge is assumed to occur as projected by the IEUA as of 2023—16,850 afy of recharge.
- Reoperation water is allocated to the replenishment of desalter production, as provided in the Peace II Agreement and by a 2017 agreement among members of the AP following Court approval of the Safe Yield in 2017. Reoperation water will be allocated to the replenishment of desalter production through 2030.
- Managed storage is calculated based on comparing aggregate pumping to aggregate pumping rights; that is, individual parties' rights and replenishment obligations are not calculated. If aggregate pumping is greater than aggregate pumping rights, the difference is the replenishment obligation. This is handled as follows:
  - If aggregate pumping rights are greater than the projected aggregate pumping, then the under-pumping is credited to storage accounts and there is no wet-water recharge for replenishment.
  - If projected aggregate pumping exceeds aggregate pumping rights, a replenishment obligation exists. 80 to 100 percent of this obligation is debited from managed storage accounts, with the remainder fulfilled by wet-water recharge. The percentage debited to managed storage accounts is determined by the scenario (see Section 5).
  - If the calculated debit to managed storage accounts for the replenishment obligation exceeds available managed storage, the shortfall is added to wet-water recharge. For instance, a 30,000 af debit with only 20,000 af of managed storage available means 10,000 af will be added to wet-water recharge, leaving zero managed storage.

DRAFT

Figure 6-2 shows the projected managed storage for the TSY Ensemble, depicting the range of projected managed storage due to the demand scenarios under the Expected Climate Scenario (i.e., Scenarios 1, 4, and 7), with the range between them shown in dark purple. The lighter purple shading encompasses the total range of projected managed storage for the entire TSY Ensemble.

At the end of FY 2030, total managed storage ranges from 490,000 af (Scenario 5) to 647,000 af (Scenario 9), with Scenario 1 resulting in about 574,000 af of managed storage. In Scenario 5 (High Demand, High GWU, Low IWU, Hot/Dry Climate), managed storage is projected to reach zero at around 2042. By 2050, total managed storage ranges from 0 (Scenarios 4 through 6) to 453,000 af (Scenario 9), with Scenario 1 resulting in about 152,000 af.

6.1.2.2 Imported Water Recharge

The only imported water recharge assumed in the TSY Ensemble in the Chino Basin is wet-water recharge due to replenishment obligations. For each year a replenishment obligation is accrued, the calculated volume of imported water recharge is assumed to occur in the following year. Imported water recharge is allocated to recharge basins for each month based on (1) the recommended pattern of supplemental recharge described in the 2023 Recharge Master Plan Update[1] (2023 RMPU) and (2) the assumed monthly availability of the recharge basins due to the competing uses of stormwater and recycled water recharge.

Section 6.4 of the 2023 RMPU included a recommendation for Watermaster to prioritize supplemental water recharge in the basins in OBMP Management Zone 1 (MZ-1) up to its recharge capacity, then to MZ-3, and finally to MZ-2. The distribution of recharge was calculated monthly until all imported water was allocated to recharge basins for the year.

Figures 6-3, 6-4, and 6-5 show the projected imported water recharge and managed storage for Scenarios 1, 5, and 9, respectively, showing the scenarios with the central tendency (Scenario 1), highest (Scenario 5), and lowest (Scenario 9) imported water recharge. The highest one-year imported water recharge occurs in Scenario 5 in FY 2073, where 50,500 af of imported water was recharged to satisfy the replenishment obligation that accrued in FY 2072.

6.2 RESULTS OF TSY ENSEMBLE

This subsection describes the range of projected groundwater conditions associated with the results of the TSY Ensemble. The naming convention to identify each member of the TSY Ensemble is the letter of the CVM realization (A through E) followed by the number of the Projection Scenario (1 through 9). Table 6-1 below lists the nine Projection Scenarios.

[1] 2023 Recharge Master Plan Update

Figure 6-2
Projected Managed Storage
2020 SYR and 2025 SYR

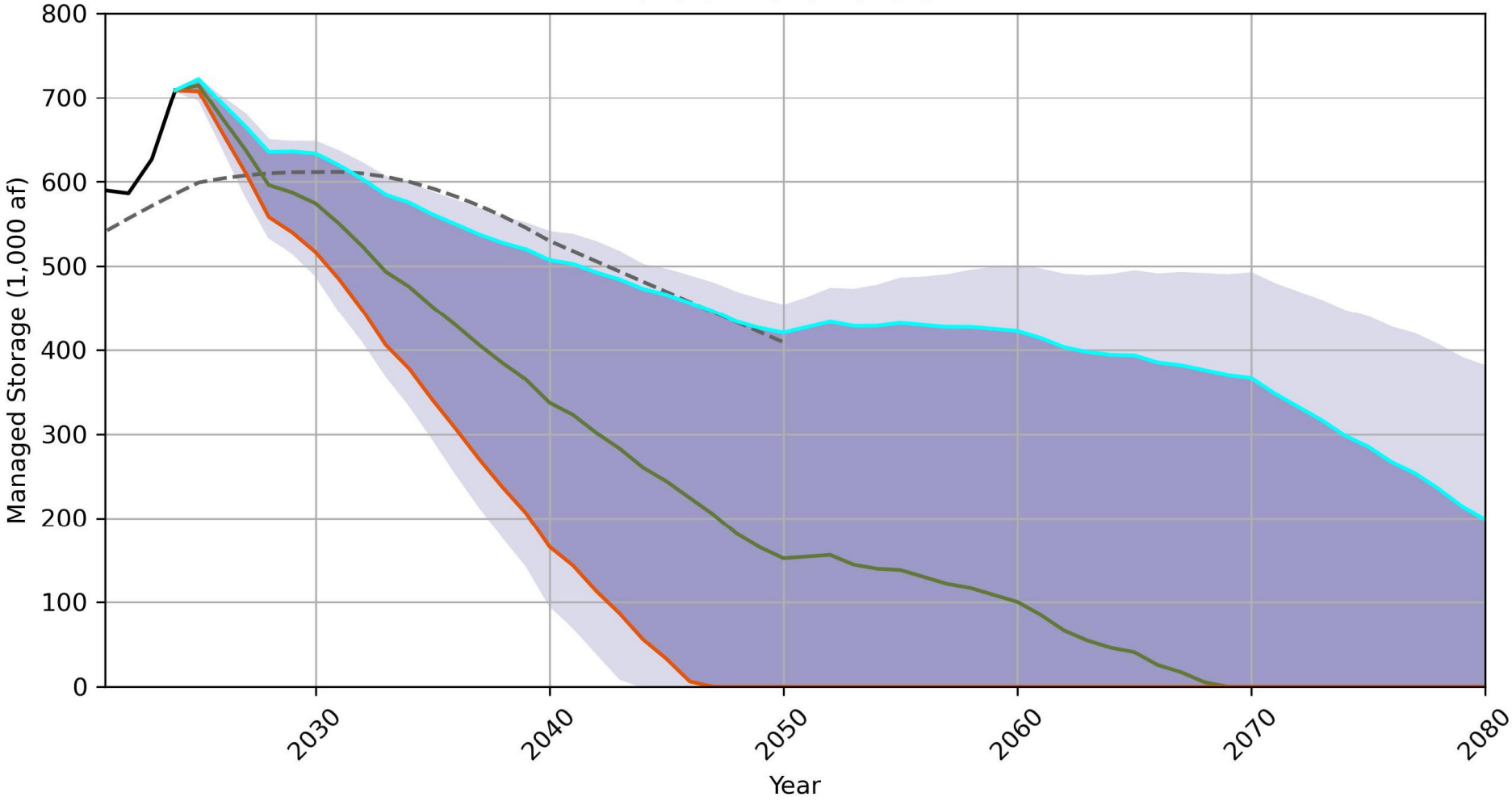


Figure 6-3. Projected Imported Water Recharge, TSY Ensemble Scenario 1

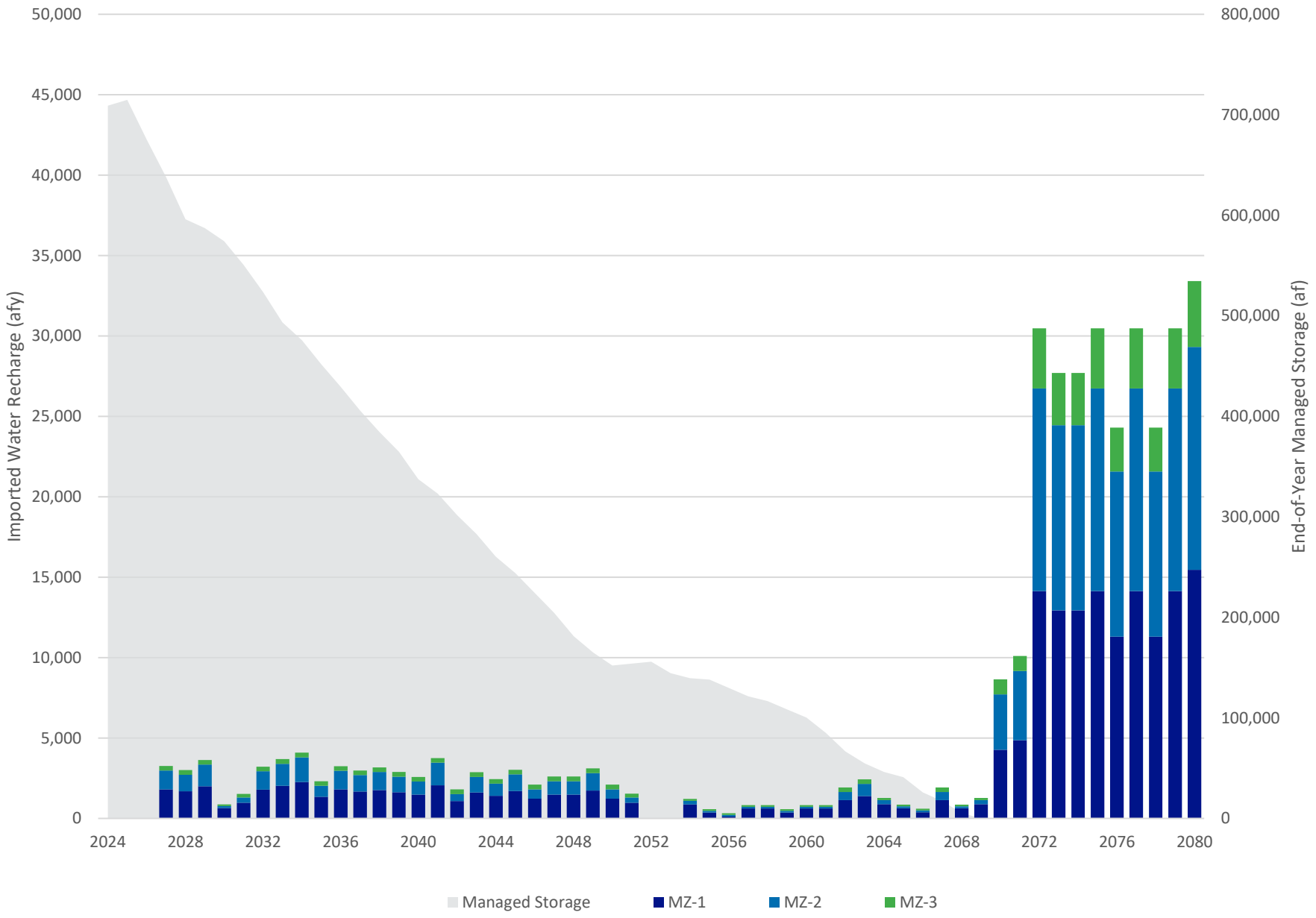


Figure 6-4. Projected Imported Water Recharge, TSY Ensemble Scenario 5

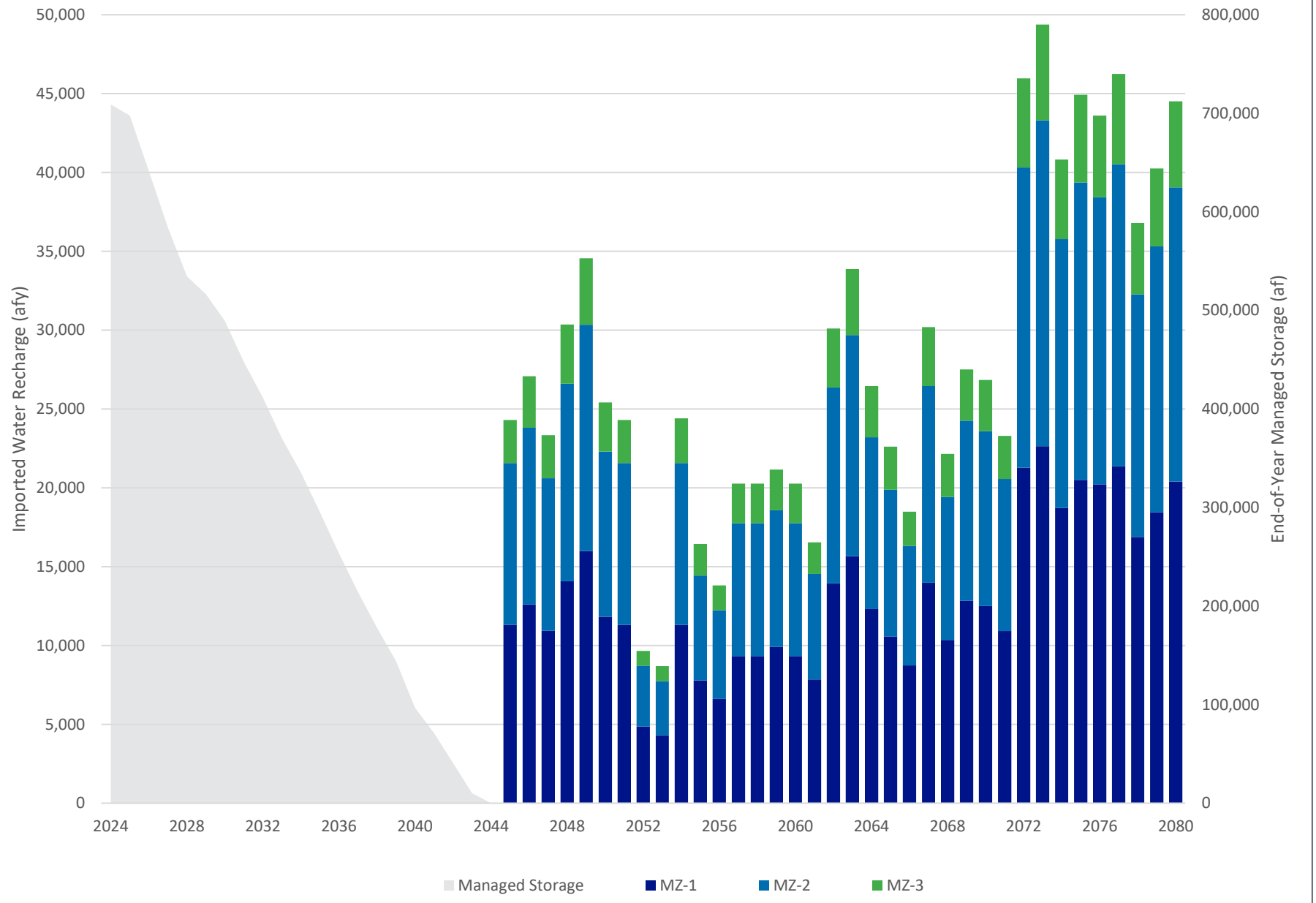


Figure 6-5. Projected Imported Water Recharge, TSY Ensemble Scenario 9

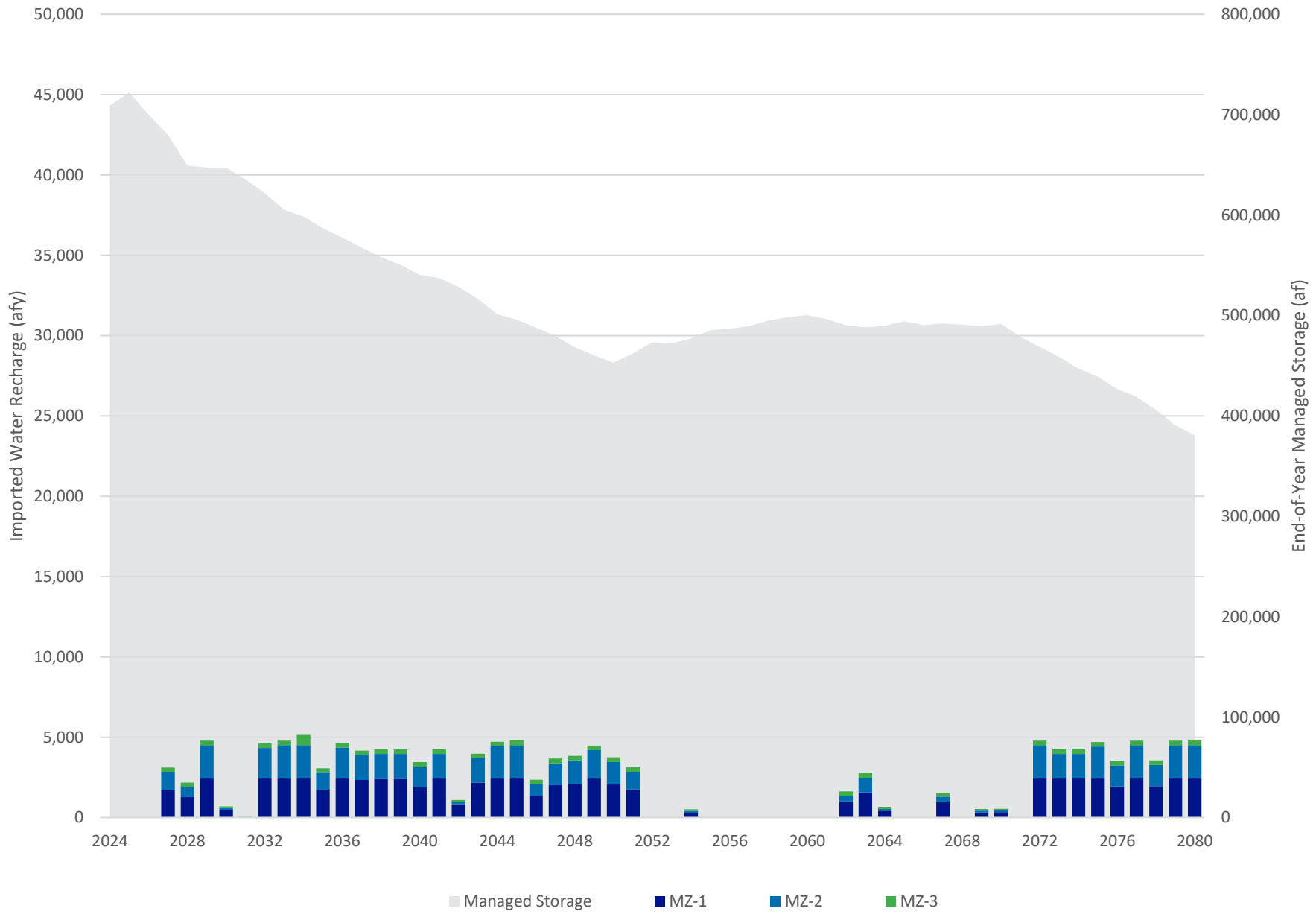


Table 6-1. Projection Ensemble

Projection Scenario	Rationale	Water Plan Scenario[(a)]			Climate Scenario
		Demand	Groundwater Utilization	Imported Water Utilization	
1	Expected/Baseline	Expected	Expected	Expected	Average
2	Hot/Dry Climate	Expected	Expected	Expected	Hot/dry
3	Cool/Wet Climate	Expected	Expected	Expected	Cool/wet
4	Impact Of High Demands	High	High	Low	Average
5	Low Groundwater Levels	High	High	Low	Hot/dry
6	High Net Recharge	High	High	Low	Cool/wet
7	Impact Of Low Demands	Low	Low	High	Average
8	Low Net Recharge	Low	Low	High	Hot/dry
9	High Groundwater Levels	Low	Low	High	Cool/wet

(a) Each Water Plan Scenario is adjusted to reflect the unique precipitation and evapotranspiration (ET_o) patterns of the corresponding Climate Scenario as described in Section 5.4.3.2.

6.2.1 Water Budgets

Table 6-2 and Figure 6-6 show the water budget for Scenario D1 of the TSY Ensemble for FY 2021 through 2080. Water budgets for the other members of the TSY Ensemble can be found in Appendix D. The description of the recharge and discharge components and how each component was computed is described below or referenced in prior Sections. For each component where multipliers were applied to a time series during the uncertainty analysis (see Section 4), the average multiplier from the calibration period for that realization was used for the projection period. For example, if the average multiplier for a subsurface inflow time series from the calibration period was 1.2, the entire time series for future subsurface inflow was multiplied by 1.2 for all scenarios based on that calibrated realization.

The bullets below outline the water budget components shown in Figures 6-7 through 6-14, which depict for FY 1992 through 2080: the minimum and maximum range, 20th to 80th percentile range, and the likelihood-weighted average flows from the TSY Ensemble and the flows simulated in the 2020 SYR (1992-2050).

The projection period assumptions for FY 2023 through FY 2080, and the primary differences relative to the 2020 SYR, are summarized below:

- **Subsurface inflow (Figure 6-7):** Subsurface inflows were computed for the projection period using the same assumptions as the calibration period. The specified head boundary from the Riverside Basin through the Bloomington Divide was held equal to the monthly groundwater head values calculated along that boundary for FY 2022. Subsurface inflows remain relatively constant during the projection period. Differences from the 2020 SYR reflect the combined effects of updates to the model domain and boundary representation, recalibration, and the uncertainty analysis described in Sections 3 and 4.

- **DIPAW to the saturated zone (Figure 6-8):** DIPAW was calculated using the same general methods described for the calibration and uncertainty analysis in Section 4 and in greater detail in the 2020 SYR Report. This process includes using the R4 model to estimate the DIPAW to the vadose zone and applying lag time through the vadose zone to estimate the DIPAW to the saturated zone, which is an input to the MODFLOW model.

  DIPAW in the 2025 SYR is lower than in the 2020 SYR during FY 2021 through FY 2030 for several reasons: adjustment to the Chino Basin boundaries, recalibration and uncertainty analysis, addition of recent historical data, and revised projection assumptions. These drivers are summarized below and discussed in greater detail in Section

  - *Adjustment to Chino Basin boundaries*. As discussed in Section 3, updates to the Chino Basin model boundary based on new hydrogeologic data reduced the modeled Basin area by about one percent, which reduced the area contributing to DIPAW.
  - *Recalibration and uncertainty analysis*. As discussed in Section 4, the recalibration and uncertainty analysis changed the CVM simulation of the magnitude and spatial distribution of DIPAW to the saturated zone relative to the 2020 SYR.
  - *Recent historical data (FY 2019 through 2023)*. Historical data added since the 2020 SYR reflect recent hydrologic and water-use conditions that were generally drier and included less urban outdoor water use than was assumed for FY 2019-23 in the 2020 SYR.
  - *Revised projections for FY 2024 through 2080*. As discussed in Section 5 and Appendix C, the 2025 SYR projections incorporate updated water supply plans, assumptions regarding urban irrigation practices and continued conservation-related reductions in outdoor water use, and variable hydrology. These assumptions resulted in less projected applied-water infiltration than was assumed in the 2020 SYR for the period FY 2024-30. From FY 2031-80, projected DIPAW varies with hydrology and water-plan assumptions and generally fluctuates around a lower range than was projected in the 2020 SYR.

- **Managed aquifer recharge (Figure 6-9):** Managed aquifer recharge comprises stormwater, recycled water, and imported water. The calculation of these components is described in Section 5, and for imported water recharge associated with replenishment obligations, in Section 6.1.2.2. The upper end of the projected range of managed aquifer recharge is higher than in the 2020 SYR after about FY 2040. This occurs primarily in the High Demand scenarios, where managed storage accounts are projected to approach or reach zero. Once managed storage is reduced or depleted, a greater portion of replenishment obligations is satisfied through wet-water recharge, increasing projected imported water recharge.
- **Streambed infiltration (Figure 6-10):** Differences in streambed infiltration between the 2020 SYR and 2025 SYR reflect recalibration of groundwater/surface-water interaction, updates to model parameters and boundary conditions, and the use of variable future hydrology in the 2025 SYR.
- **Groundwater ET (Figure 6-11):** Differences between the 2020 SYR and 2025 SYR reflect updates to the ET representation in the 2025 CVM, including the updated treatment of riparian vegetation extent and density, as well as the recalibration and uncertainty analysis described in Section 4.

DRAFT

- **Rising groundwater (Figure 6-12):** Differences between the 2020 SYR and 2025 SYR reflect recalibration of groundwater/surface-water interaction, updates to model parameters and boundary conditions, and the use of variable future hydrology in the 2025 SYR.
- **Net recharge (Figure 6-13):** See 6.2.1.11 below.
- **Annual change in storage (Figure 6-14):** The 2025 SYR shows greater year-to-year variability in change in storage than the 2020 SYR because the 2025 SYR uses variable hydrology and an ensemble of future climate and water-plan conditions, whereas the 2020 SYR relied on expected-value average hydrology for the projection period.
- **Cumulative change in storage from FY 1992-2080 (Figure 6-15):** Figure 6-15 shows six panels, one for each of the five calibrated realizations (showing all Projection Scenarios), and one for all Projection Realizations. The final panel shows the cumulative change in storage for three selected Projection Realizations: Scenarios D1, E9, and A5. These represent the median, maximum (smallest decline), and minimum (greatest decline) cumulative changes in storage over the period from FY 2021 to 2050, respectively.

  The cumulative change in storage over the modeled period (FY 1992 through 2080) ranges from -990,000 af (Scenario A2) to -14,000 af (Scenario E9). The likelihood-weighted average change in storage over this period is -595,000 af.

Projected storage declines occur primarily because projected groundwater production exceeds projected production rights in most scenarios and most years (see Figure 6-2 and Section 5). All Projection Scenarios assume that overproduction is satisfied primarily through debits to managed storage when managed storage is available. When overproduction is debited to managed storage rather than satisfied through wet-water recharge, the replenishment obligation is met, but no new water is added to the Basin. This results in a decline in physical groundwater storage until managed storage balances are reduced or depleted, at which point wet-water recharge increases to satisfy a larger portion of replenishment obligations (e.g., Scenario A5, where managed storage is depleted in the 2040s).

6.2.1.1 Net Recharge and TSY

Table 6-3 summarizes the recharge and discharge components, change in storage, and net recharge over the FY 2021-2030 period for the TSY Ensemble and the 2020 SYR. The values for the TSY Ensemble represent the likelihood-weighted average.

DRAFT

Table 6-3. Water Budget Components for 2020 SYR and 2025 SYR TSY Ensemble, FY 2021-2030 (afy)[a]

Water Budget Component	2020 SYR	2025 SYR (Likelihood-Weighted Average)	2025 SYR minus 2020 SYR
Recharge Components			
Subsurface Inflow*	37,900	33,400	-4,500
DIPAW*	75,800	65,200	-10,600
Streambed Infiltration*	36,600	45,500	8,900
MAR - Stormwater*	13,500	13,800	300
MAR - Recycled and Imported	15,200	22,100	6,900
Total	**179,600**	**180,000**	**400**
Discharge Components			
Groundwater Pumping	148,500	151,900	3,400
Riparian ET*	18,700	12,600	-6,100
Rising Groundwater*	15,200	24,000	8,800
Total	**182,400**	**188,600**	**6,200**
Aggregate Components			
Change in Storage	-2,700	-8,600	-5,900
Net Recharge[b]	130,600	121,200	-9,400

(a) For clarity, values are rounded to the nearest 100 afy and may not sum precisely.
(b) Net recharge is calculated from the net volume of only those recharge and discharge components designated with an asterisk.

DRAFT

Figure 6-6. Water Budget for the Chino Basin - Scenario D1

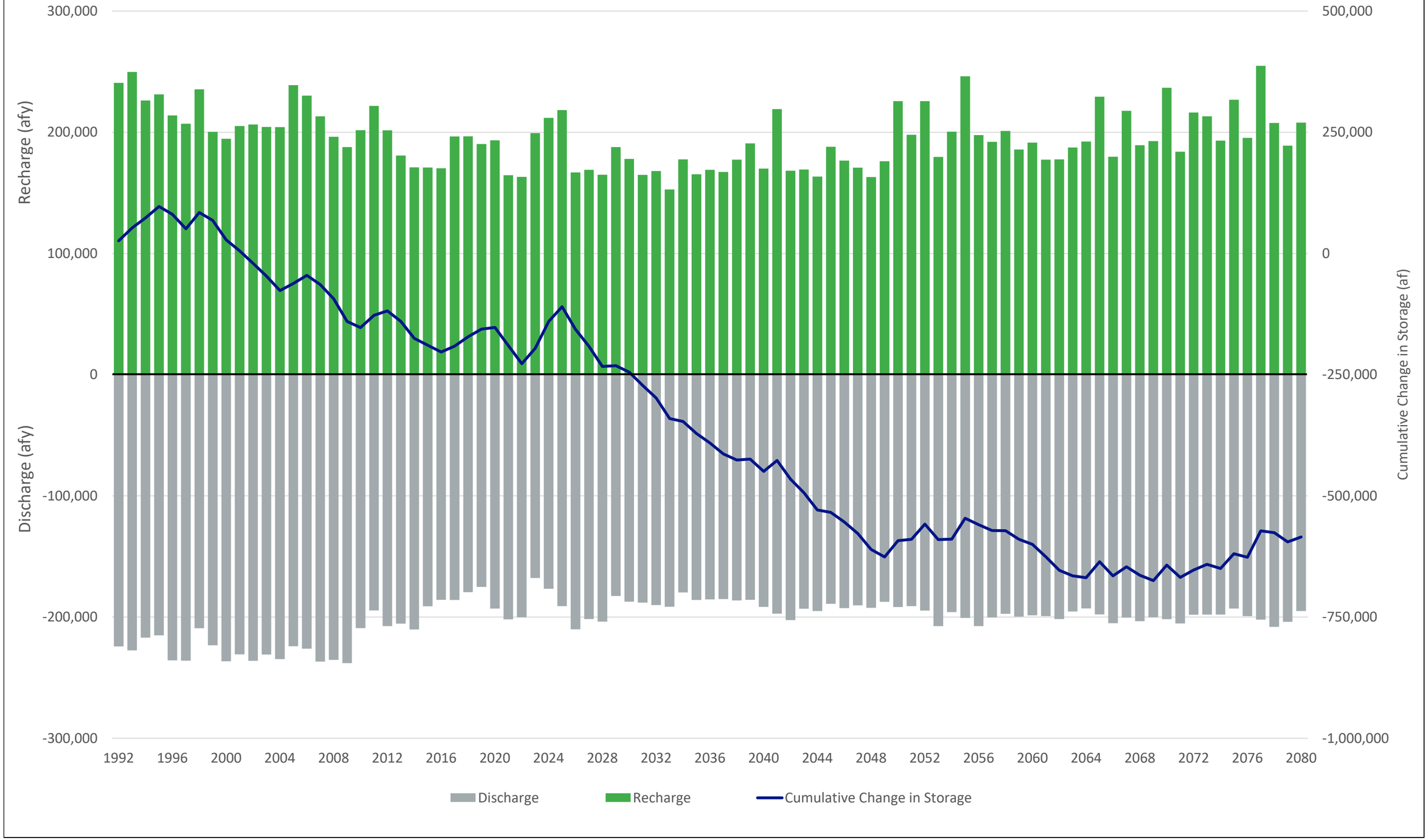


Figure 6-7
Comparison of Subsurface Inflows
2020 SYR and 2025 SYR

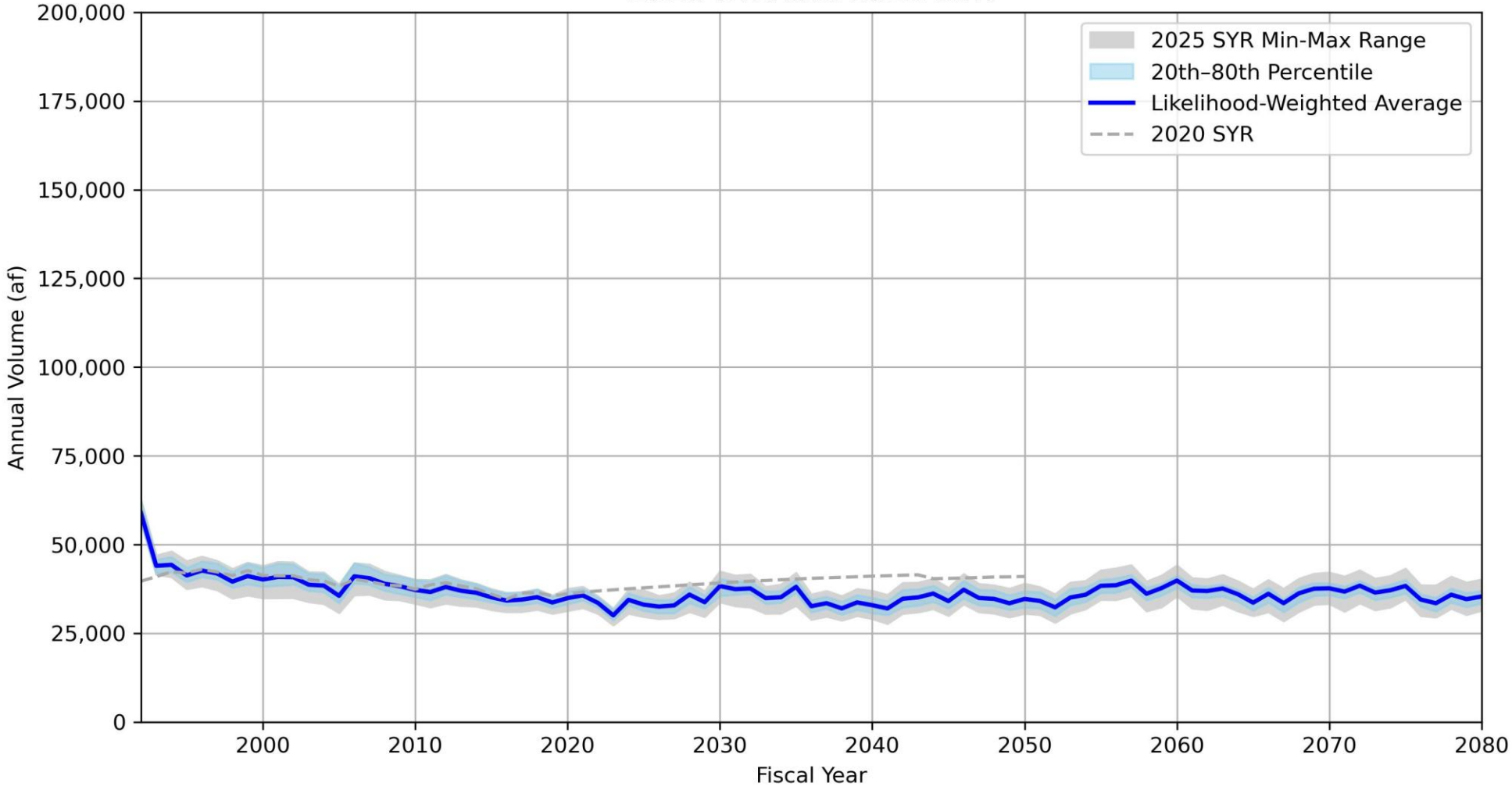


Figure 6-8
Comparison of DIPAW
2020 SYR and 2025 SYR

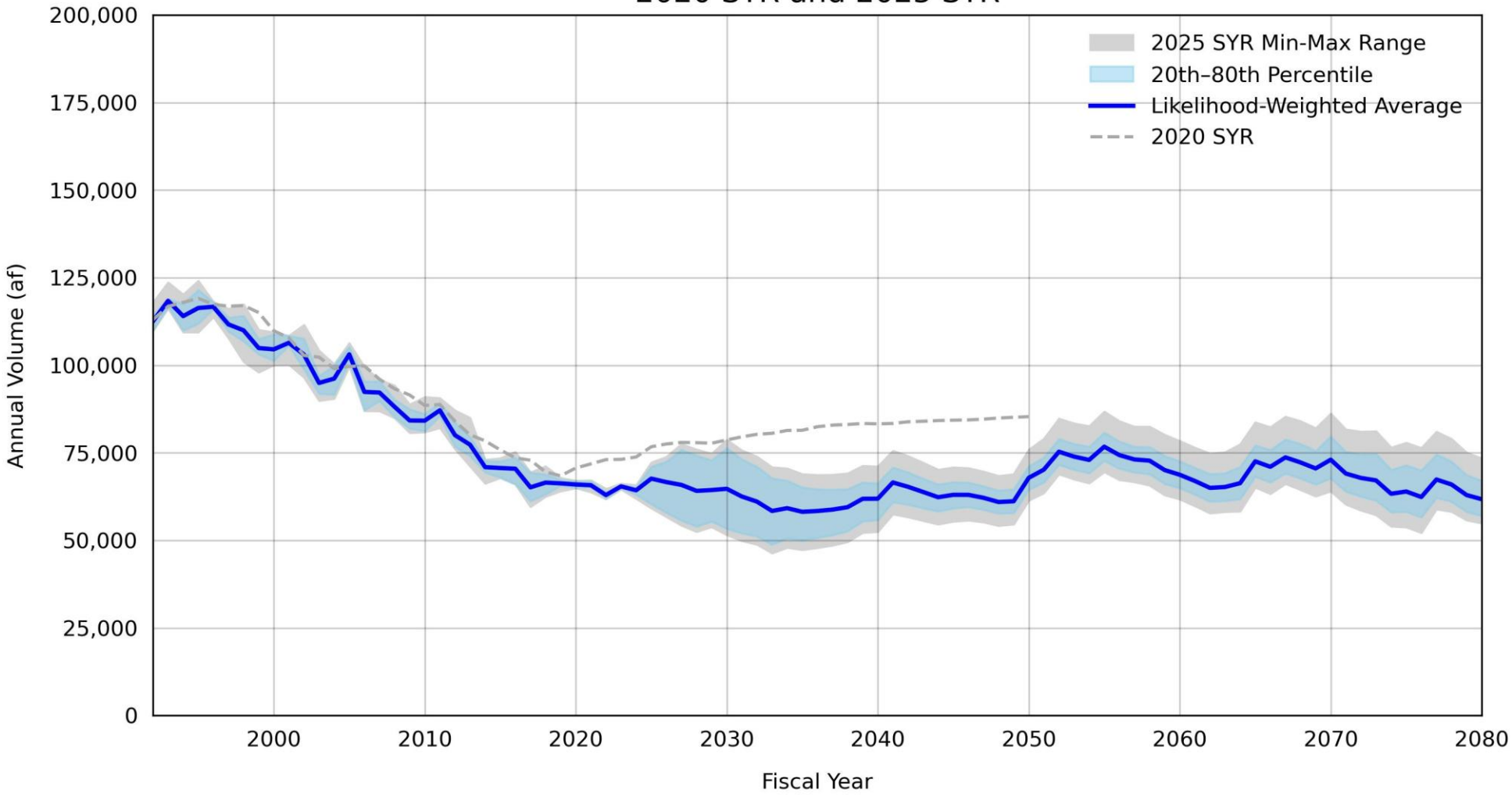


Figure 6-9
Comparison of Managed Aquifer Recharge
2020 SYR and 2025 SYR

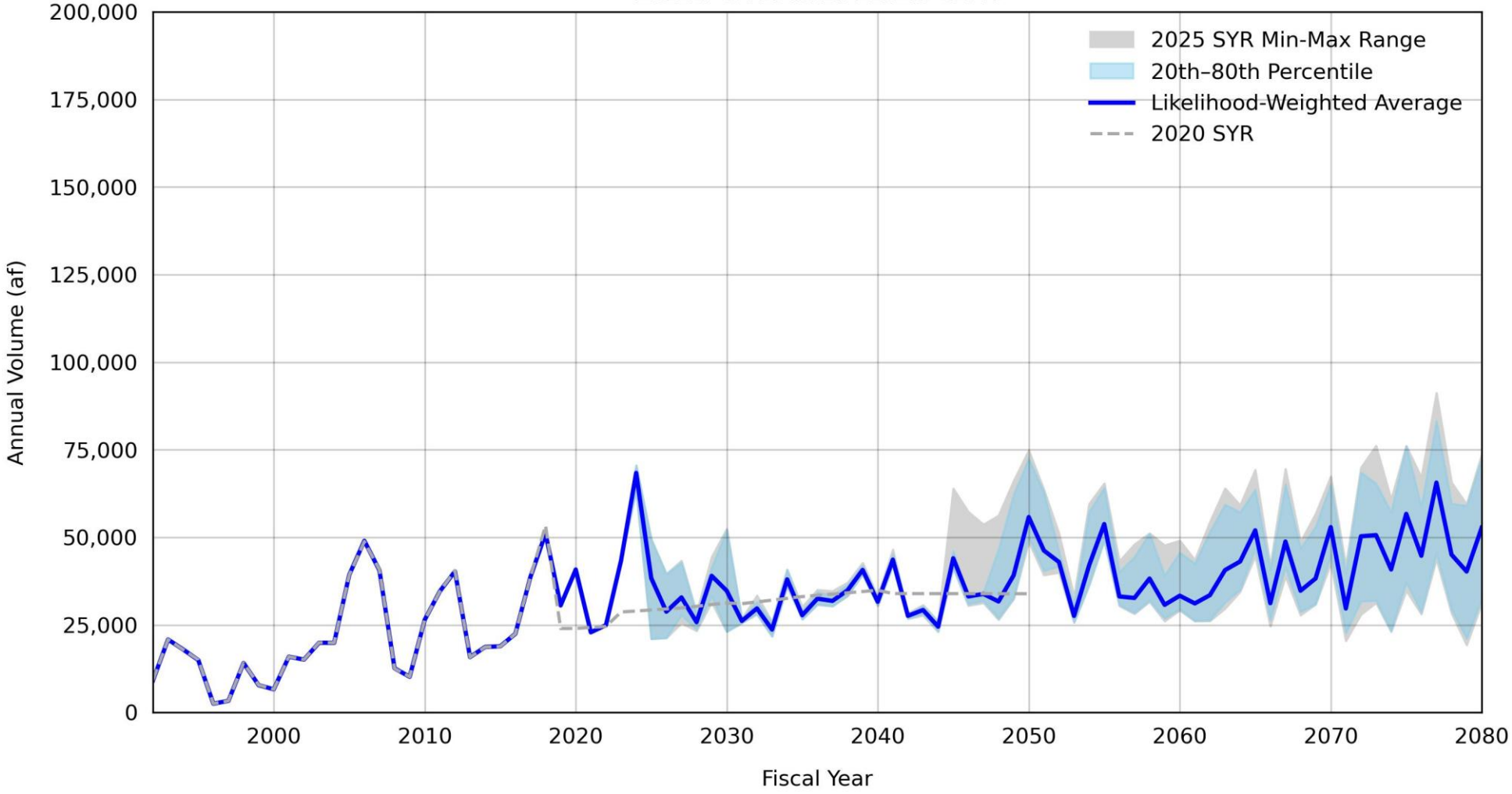


Figure 6-10
Comparison of SAR Infiltration
2020 SYR and 2025 SYR

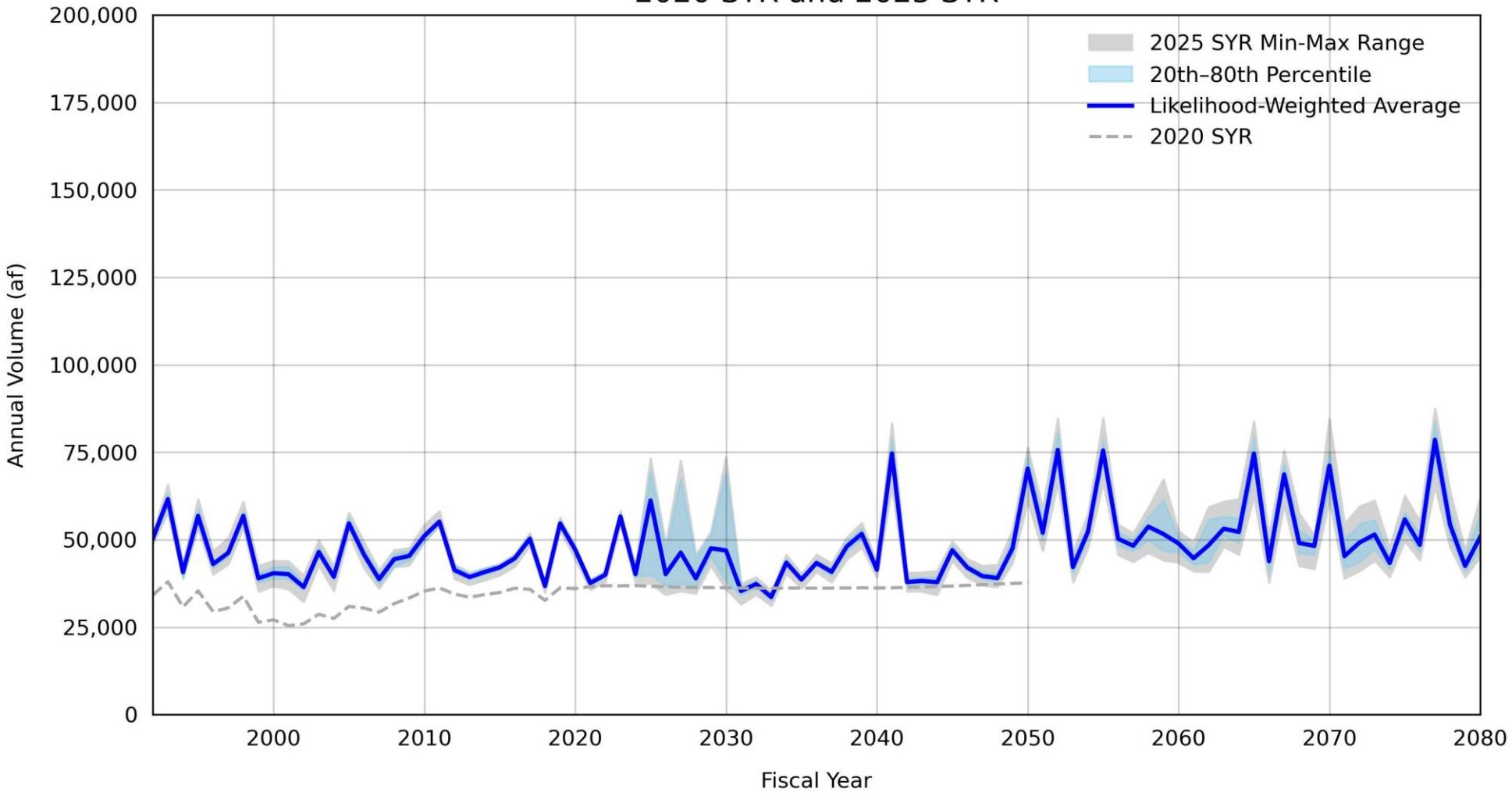


Figure 6-11
Comparison of ET
2020 SYR and 2025 SYR

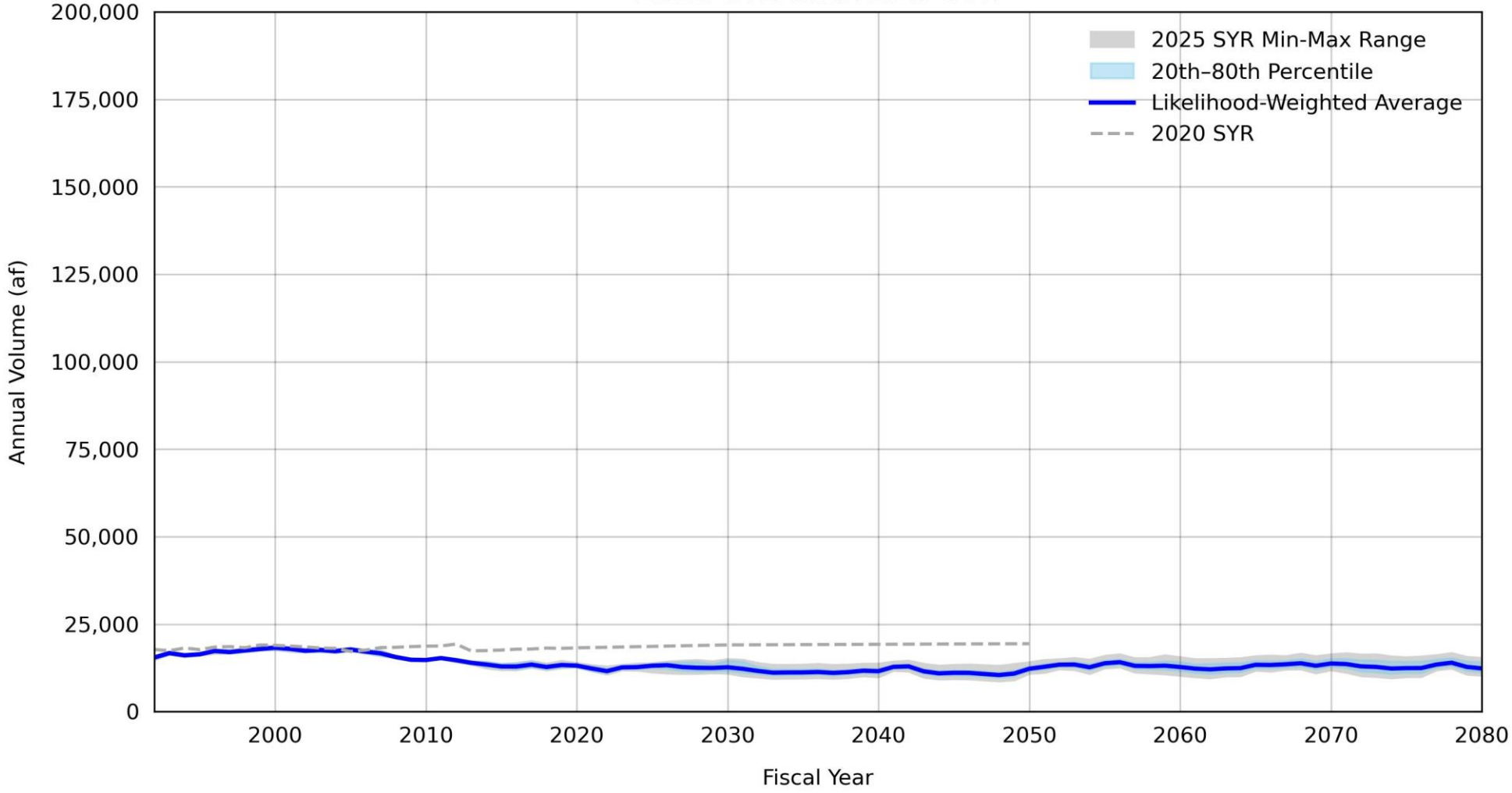


Figure 6-12
Comparison of Rising Groundwater
2020 SYR and 2025 SYR

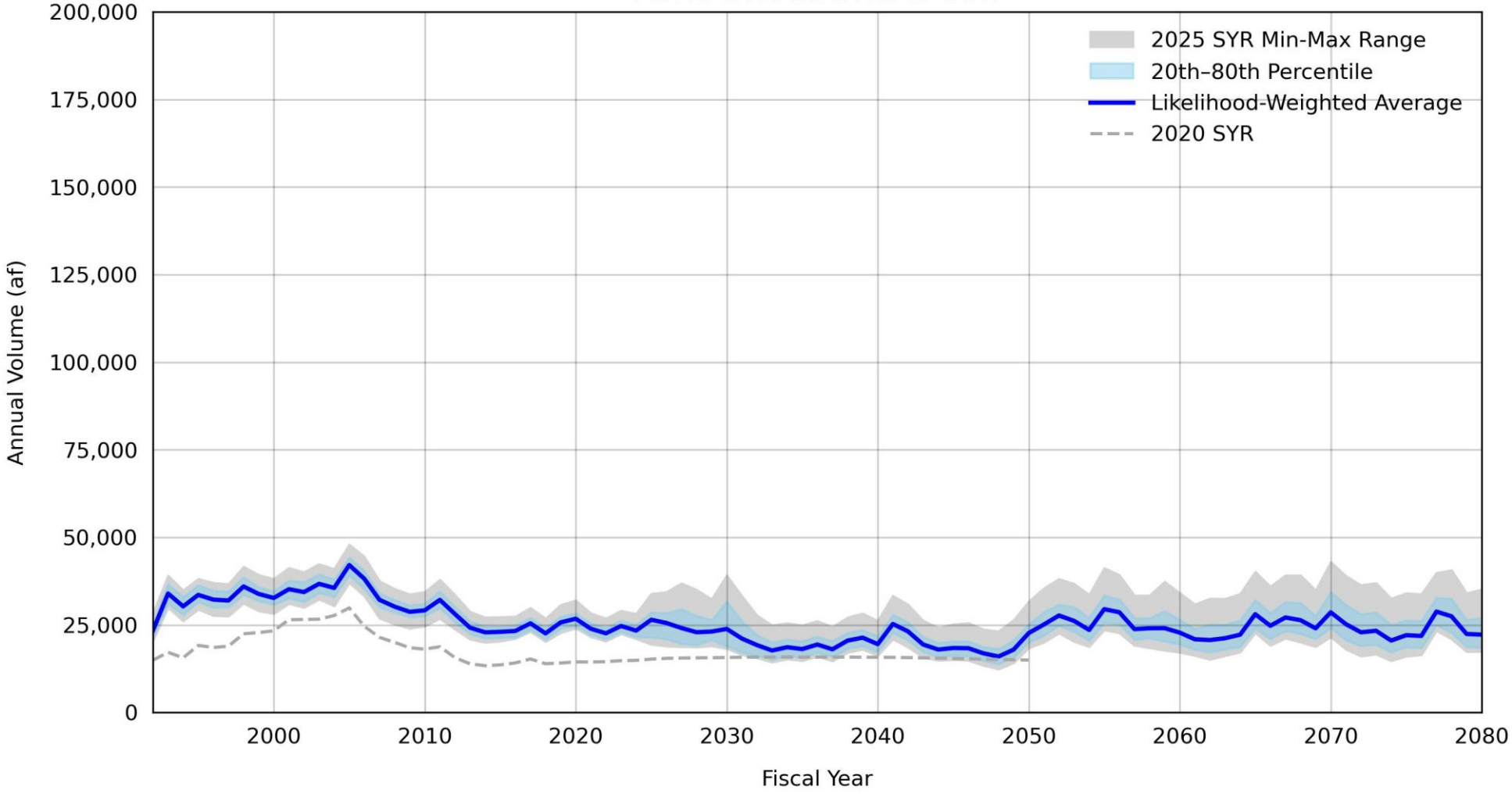


Figure 6-13
Comparison of Net Recharge
2020 SYR and 2025 SYR

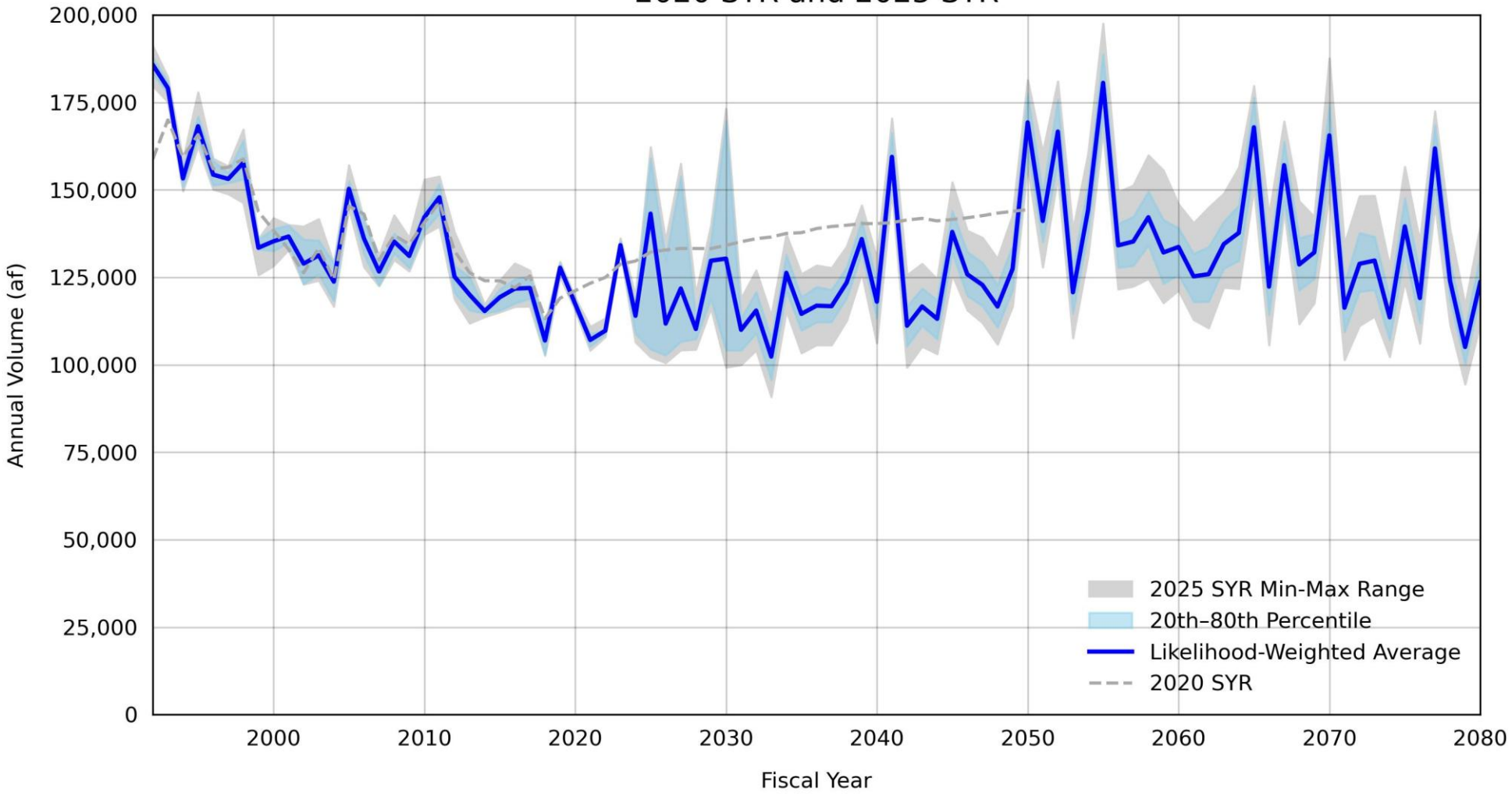


Figure 6-14
Comparison of Change in Storage
2020 SYR and 2025 SYR

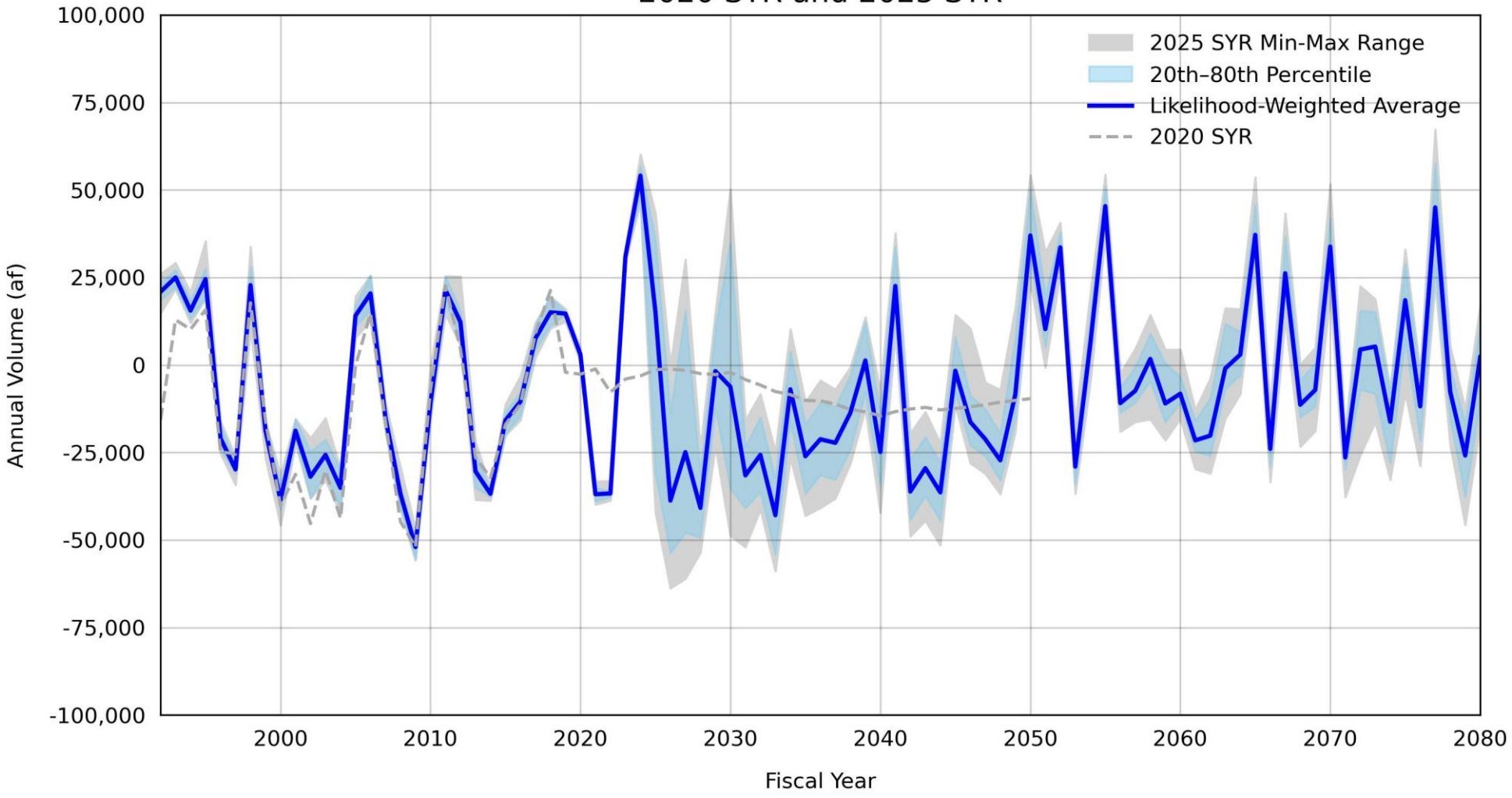
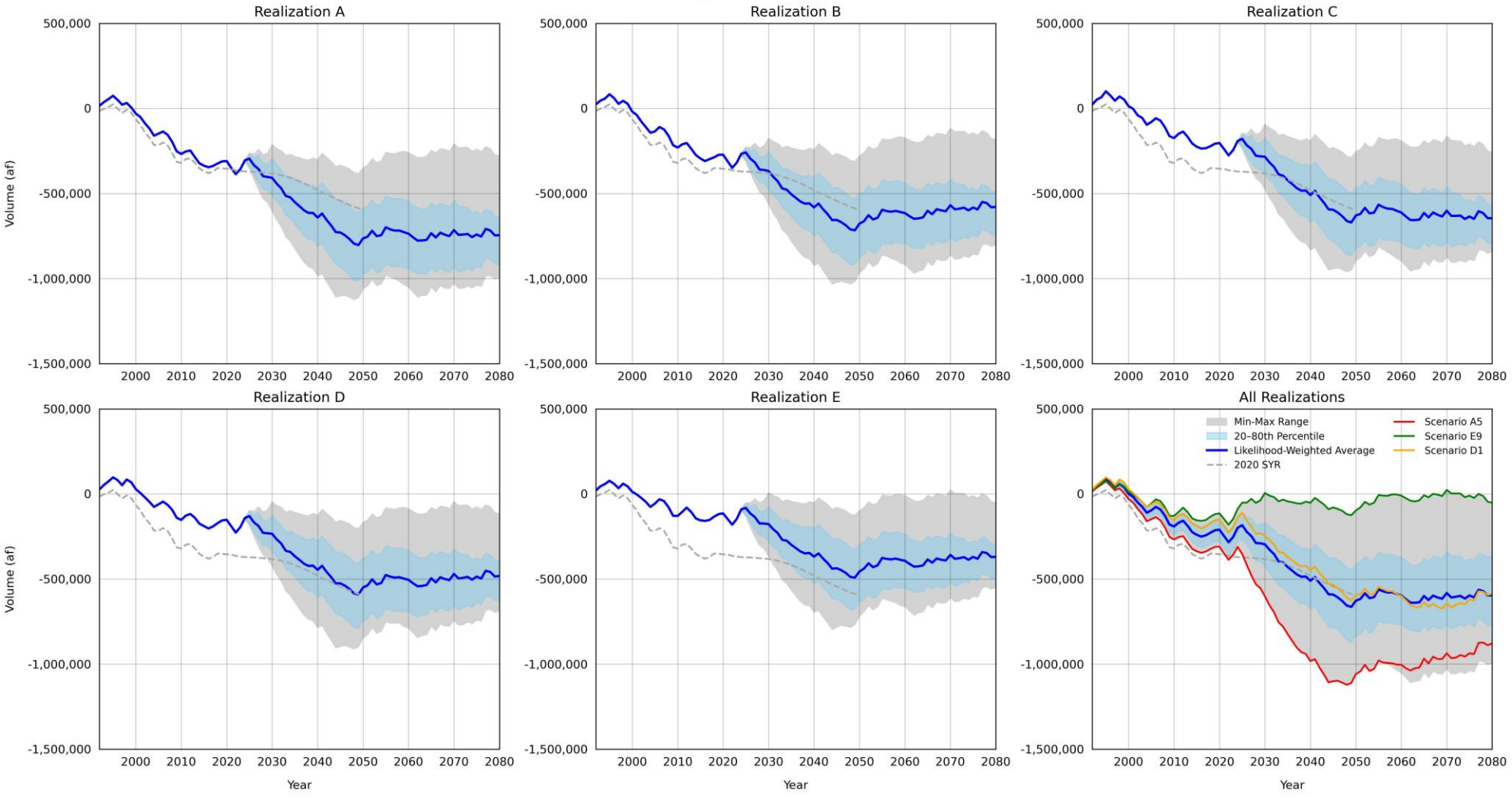


Figure 6-15
Cumulative Change in Storage - TSY Ensemble



The differences between the water budget components reflect a combination of the model recalibration and uncertainty analysis (see Section 4), the three years of historical pumping and recharge data (FY 2021-2023), and revised pumping and recharge assumptions. **The TSY for the 2025 Safe Yield Reevaluation is 121,200 afy, which is the likelihood-weighted average net recharge for the TSY Ensemble for the FY 2021-2030 period.**

Compared to the 2020 SYR, the 2025 SYR likelihood-weighted average net recharge is lower by 9,400 afy. This difference reflects the combined effects of all recharge and discharge components shown in Table 6-3; however, the largest individual reduction is the decrease in DIPAW. Because DIPAW is both the largest recharge component included in the net recharge calculation and the largest negative difference between the 2020 SYR and 2025 SYR, the primary drivers of the difference in DIPAW are discussed below.

6.2.1.2 Drivers of the Difference in DIPAW Between the 2020 SYR and 2025 SYR

A primary reason that the TSY is lower than the Safe Yield calculated in the 2020 SYR is the reduction in DIPAW. As shown in Table 6-3, the likelihood-weighted average DIPAW for the 2025 SYR is 65,200 afy for FY 2021 through FY 2030, which is 10,600 afy lower than the 75,800 afy simulated in the 2020 SYR for the same period. This reduction accounts for more than the total 9,400 afy reduction in net recharge because the lower DIPAW is partly offset by increases in other net recharge components, including streambed infiltration and stormwater recharge, and by lower riparian ET.

The four drivers described in Section 6.2.1 do not act independently and cannot be apportioned exactly from the TSY Ensemble results. The updated Basin boundary, recalibration, and uncertainty analysis affect the same DIPAW time series that are then combined with updated historical hydrology, updated water-use data, and revised projection assumptions. Therefore, the following attribution is intended as an approximate screening-level comparison rather than a strict causal decomposition.

Over the common historical comparison period of FY 1992 through FY 2018, the combined effects of the Basin boundary adjustment, recalibration, and uncertainty analysis reduced simulated DIPAW by about 3,900 afy relative to the 2020 SYR. This model-update effect is equivalent to about 37 percent of the 10,600 afy difference in DIPAW between the 2020 SYR and 2025 SYR for FY 2021 through FY 2030. The remaining difference, about 6,700 afy, or 63 percent, is attributable to updated historical and projected conditions, including the addition of recent historical hydrology and water-use data and the revised projection assumptions for hydrology, water demands, and urban outdoor water use.

This apportionment is approximate because DIPAW is affected by interacting model and scenario assumptions and because recharge to the saturated zone is delayed by travel time through the vadose zone. The reduction in DIPAW is the largest single factor contributing to the lower 2025 TSY, but it is not the only factor affecting net recharge. The TSY is determined from the full net recharge calculation for the TSY Ensemble, including changes in subsurface inflow, streambed infiltration, stormwater recharge, riparian ET, and rising groundwater.

6.2.1.3 Average Net Recharge Across the TSY Ensemble

The reduction in DIPAW is the largest single factor contributing to the lower 2025 TSY, but it is not the only factor affecting net recharge. The net recharge result also reflects changes in subsurface inflow, streambed infiltration, stormwater recharge, riparian ET, and rising groundwater.

Figure 6-16 shows a heatmap to demonstrate the range of average net recharge volumes for the TSY Ensemble for FY 2021-2030. Average net recharge ranges from 108,000 afy (Scenario A8) to 135,800 afy (Scenario E6). This chart reveals several patterns to guide the future analysis of the TSY Ensemble:

- Average net recharge is generally lowest in Calibrated Realization A, and highest in Calibrated Realization E, consistent with the patterns shown over the calibration period (see Section 4 and Figure 4-24).
- The Hot/Dry Climate Scenarios (2, 5, and 8) indicate lower net recharge compared to the Average and Cool/Wet Climate Scenarios. There is high variability of the net recharge between the Climate Scenarios compared to the Water Plan Scenarios. This is due to the high variability of precipitation simulated for this period compared to the smaller changes in Water Plans.

DRAFT

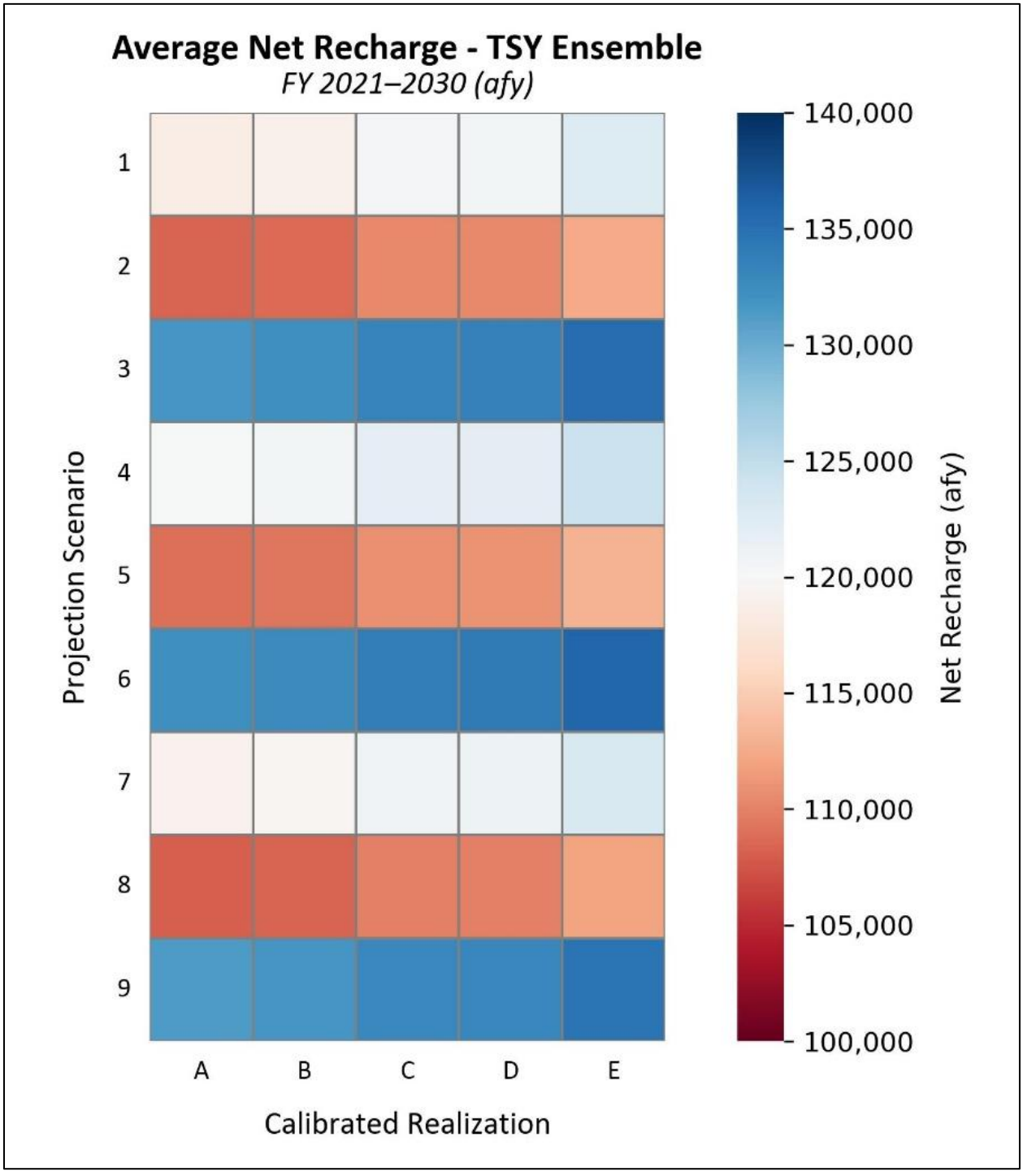


Figure 6-16. Average Net Recharge for the TSY Ensemble, FY 2021-2030

Figure 6-17 is a likelihood-weighted exceedance curve for the average net recharge of the TSY Ensemble over the period of FY 2021-2030. Figure 6-17 indicates the likelihood-weighted average net recharge (121,200 afy) and the current Safe Yield (131,000 afy). 33 percent of the TSY Ensemble (15 Projection Realizations) have an average net recharge above the current Safe Yield.

Table 6-4 compares the likelihood-weighted average water budget components of the TSY Ensemble for FY 2021-2030, FY 2031-2040, and FY 2041-2050. The average net recharge for FY 2031-2040 (118,000 afy) is less than FY 2021-2030 due to the relatively dry period of precipitation assumed for this period (i.e., FY 1959-1968). Average net recharge for FY 2041-2050 is greater than FY 2021-2030 due to (1) the relatively greater assumed precipitation over this period and (2) lower groundwater levels and increased pumping resulting in greater streambed infiltration.

DRAFT

Figure 6-17. Likelihood-Weighted Exceedance Curve
Average Net Recharge for TSY Ensemble, FY 2021-2030

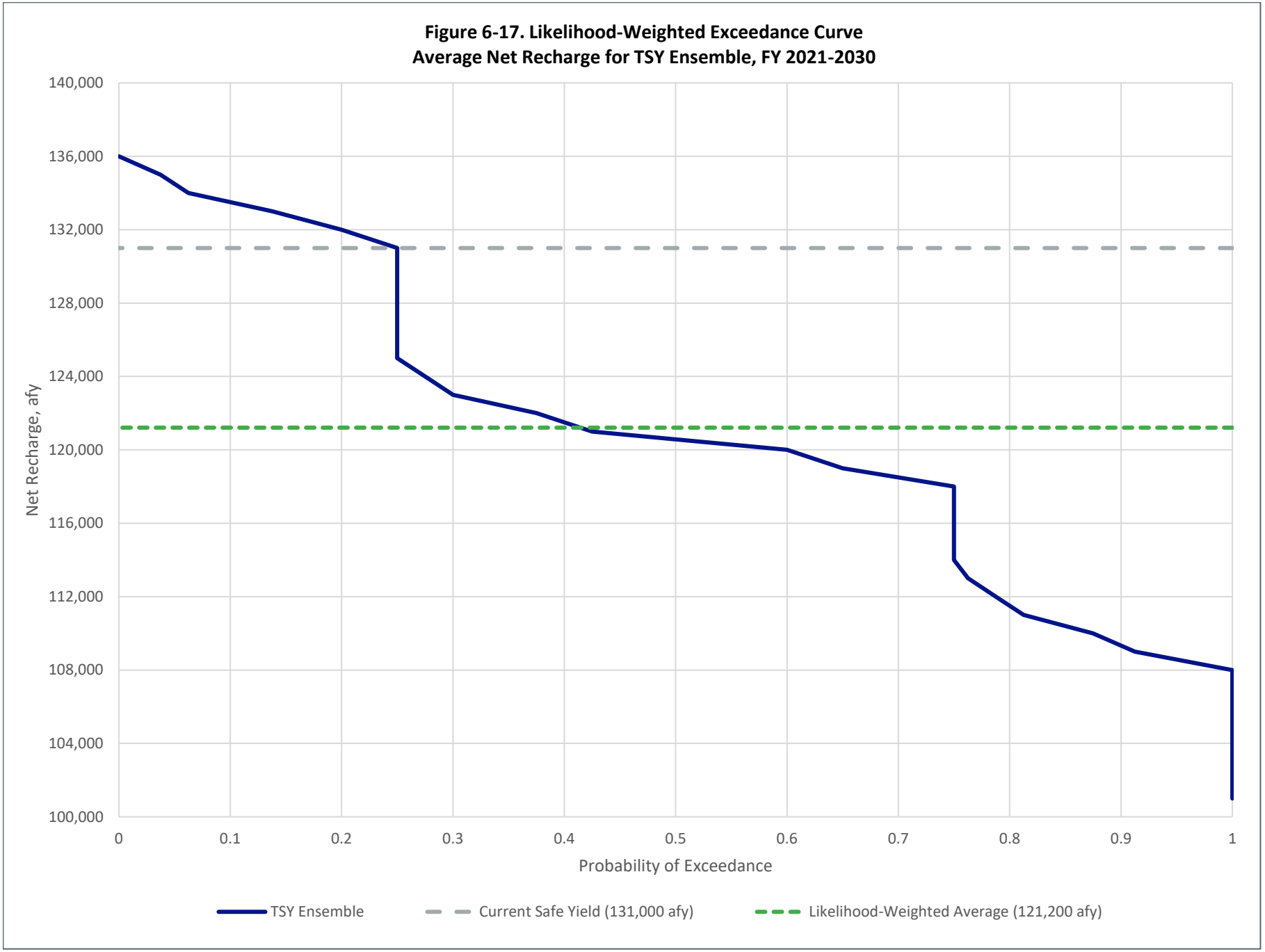


Table 6-4. Decadal Average Water Budget Components for 2025 SYR TSY Ensemble (afy)[a]

Water Budget Component	FY 2021-2030	FY 2031-2040	FY 2041-2050
Recharge Components			
Subsurface Inflow*	33,400	34,200	34,100
DIPAW*	65,200	60,000	63,600
Streambed Infiltration*	45,500	41,300	47,400
MAR - Stormwater*	13,800	13,200	15,900
MAR - Recycled and Imported	22,100	18,400	20,300
Total	**180,000**	**167,200**	**181,400**
Discharge Components			
Groundwater Pumping	151,900	157,800	162,100
Riparian ET*	12,600	11,400	11,500
Rising Groundwater*	24,000	19,400	19,600
Total	**188,600**	**188,600**	**193,100**
Aggregate Components			
Change in Storage	-8,600	-21,400	-11,700
Net Recharge[b]	121,200	118,000	130,000

(a) For clarity, values are rounded to the nearest 100 afy and may not sum precisely.
(b) Net recharge is calculated from the net volume of only those recharge and discharge components designated with an asterisk.

6.2.2 Groundwater Conditions

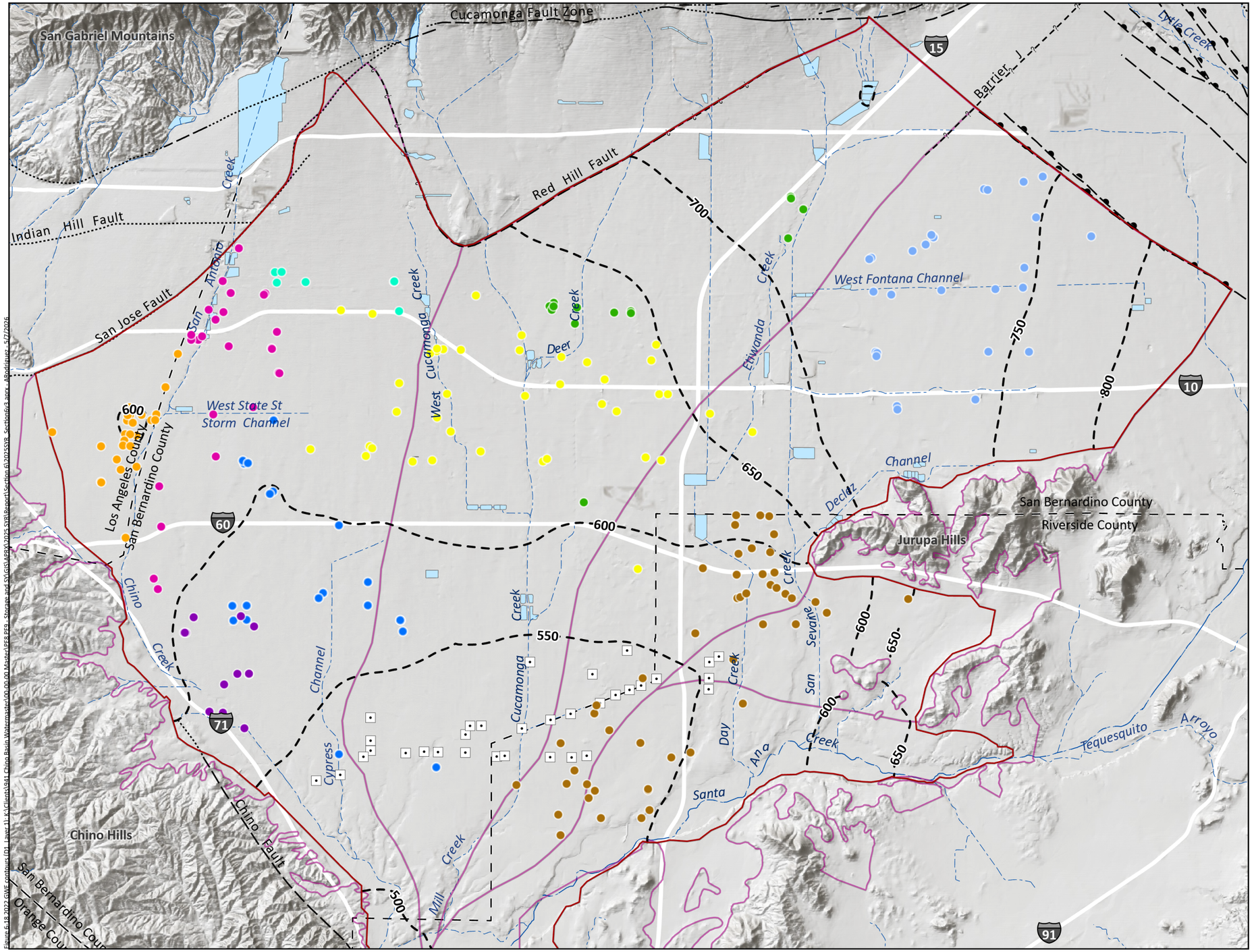
This subsection describes the range in potential future groundwater conditions for all members of the TSY Ensemble but only includes maps for the three Projection Realizations that span the range of results (Scenarios D1, E9, and A5), as indicated on Figure 6-15.

6.2.2.1 Groundwater Levels

Figures 6-18 through 6-20 show the simulated groundwater levels at the beginning of the projection period (July 1, 2022) for Scenario D1 and Layers 1, 3, and 5, respectively. While there are differences between the groundwater levels for each of the calibrated realizations, the groundwater levels shown here are representative of the simulated conditions at the beginning of the projection period.

6.2.2.1.1 Groundwater Level Changes, FY 2022 to 2030

Table 6-5 summarizes the changes in groundwater levels for each of the Projection Realizations, indicating the minimum, maximum, and average groundwater level elevations in July 1, 2030, and the average difference in groundwater levels between July 1, 2022 and July 1, 2030.



Hydraulic Head Contours (ft-amsl)

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

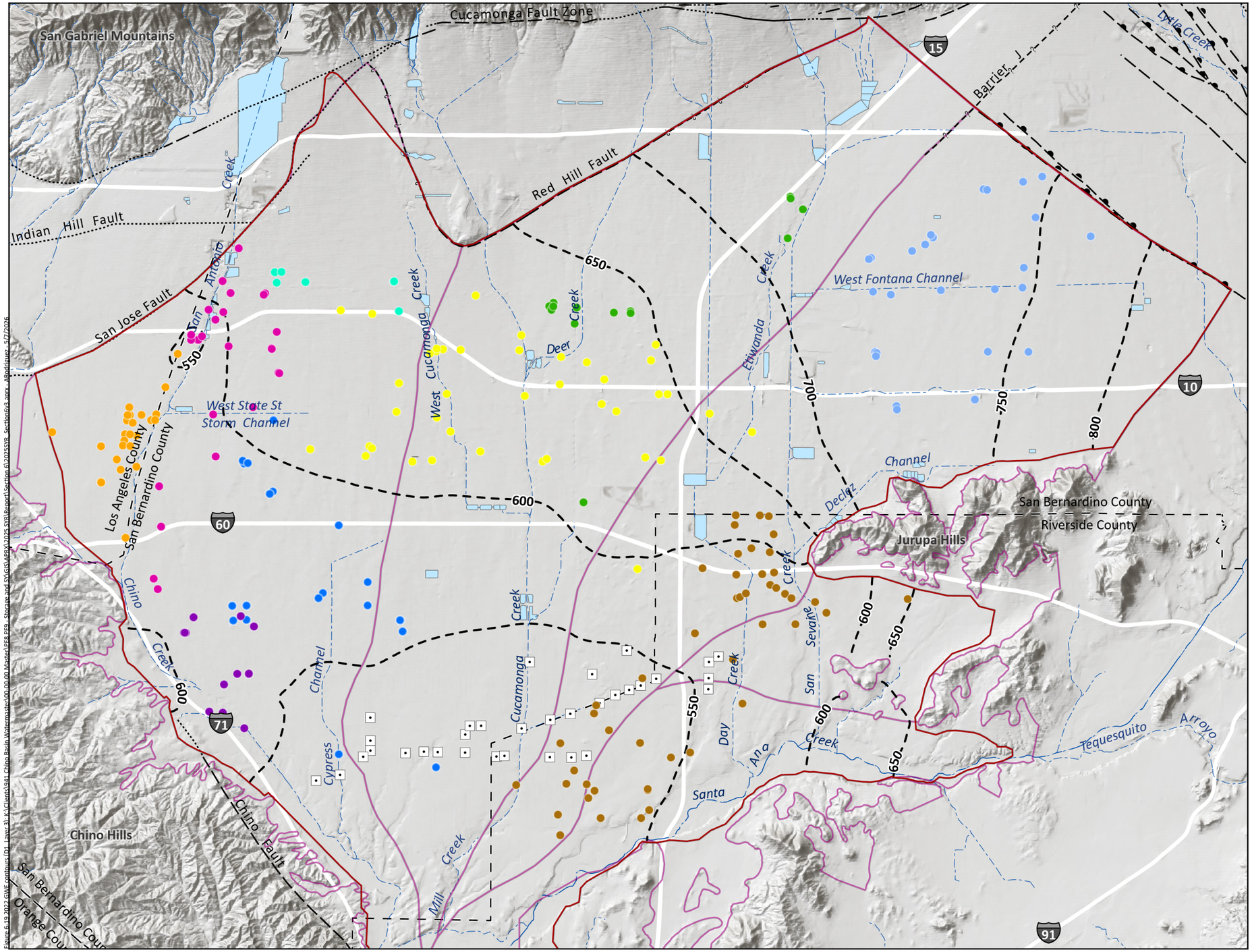
N

0 2 4 Miles

0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Hydraulic Head Contours -- Layer 1
Scenario D1 - July 2022
Figure 6-18



Hydraulic Head Contours (ft-amsl)

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

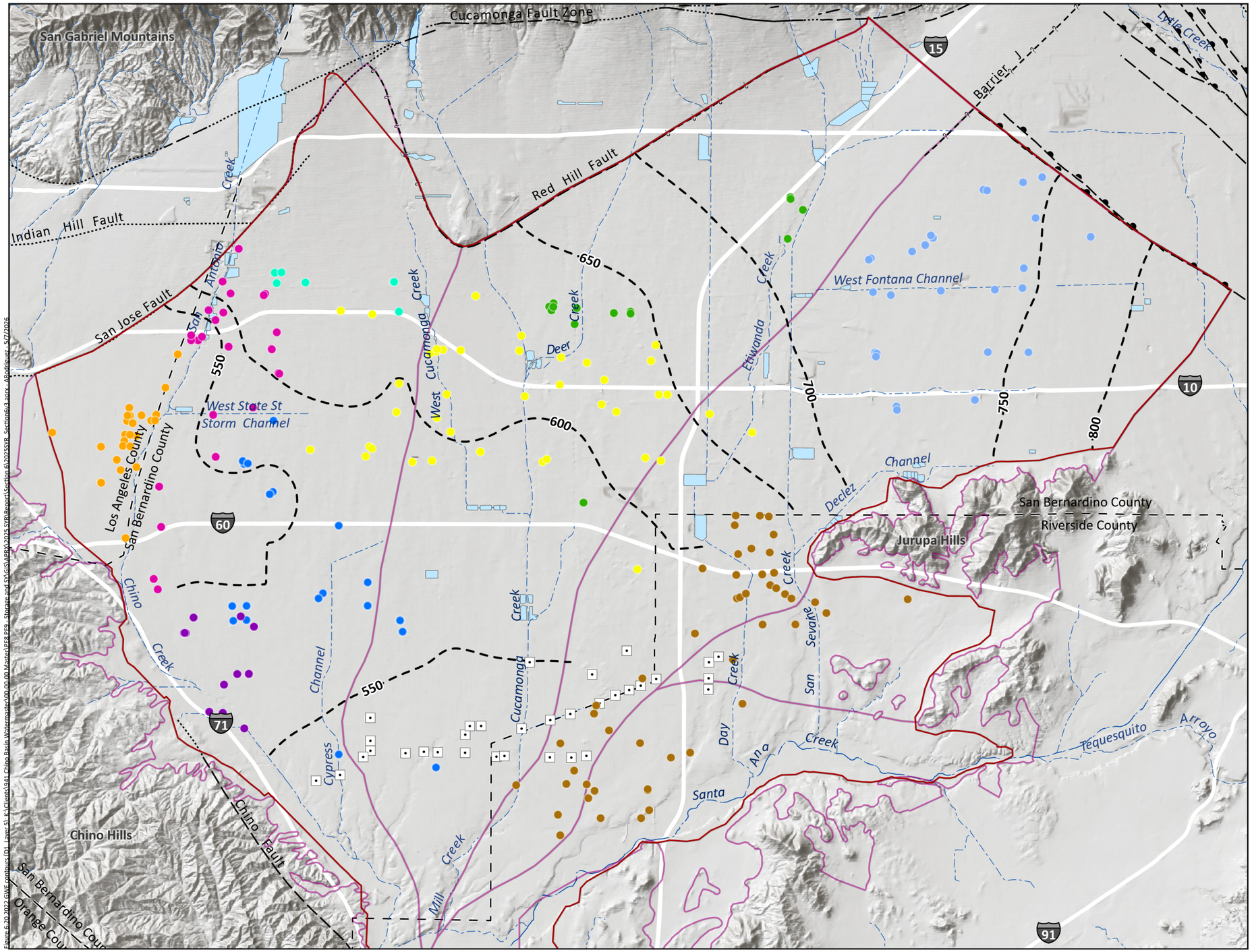
N

0 2 4 Miles

0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Hydraulic Head Contours -- Layer 3
Scenario D1 - July 2022
Figure 6-19



Hydraulic Head Contours (ft-amsl)

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

N

0 2 4 Miles

0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Hydraulic Head Contours -- Layer 5
Scenario D1 - July 2022
Figure 6-20

Table 6-5. Summary of Groundwater Elevations Selected Projection Realizations, July 2030 (ft-amsl)			
Statistic	Scenario D1	Scenario E9	Scenario A5
Minimum Groundwater Elevation	480	480	477
Maximum Groundwater Elevation	840	841	844
Average Groundwater Elevation	624	635	608
Average Difference Compared to 2022	-0.1	13	-9

Figures 6-21 through 6-23 show the simulated changes in groundwater levels for the period of July 1, 2022 to July 1, 2030 for Layer 1 of Scenarios D1, E9, and A5, respectively.

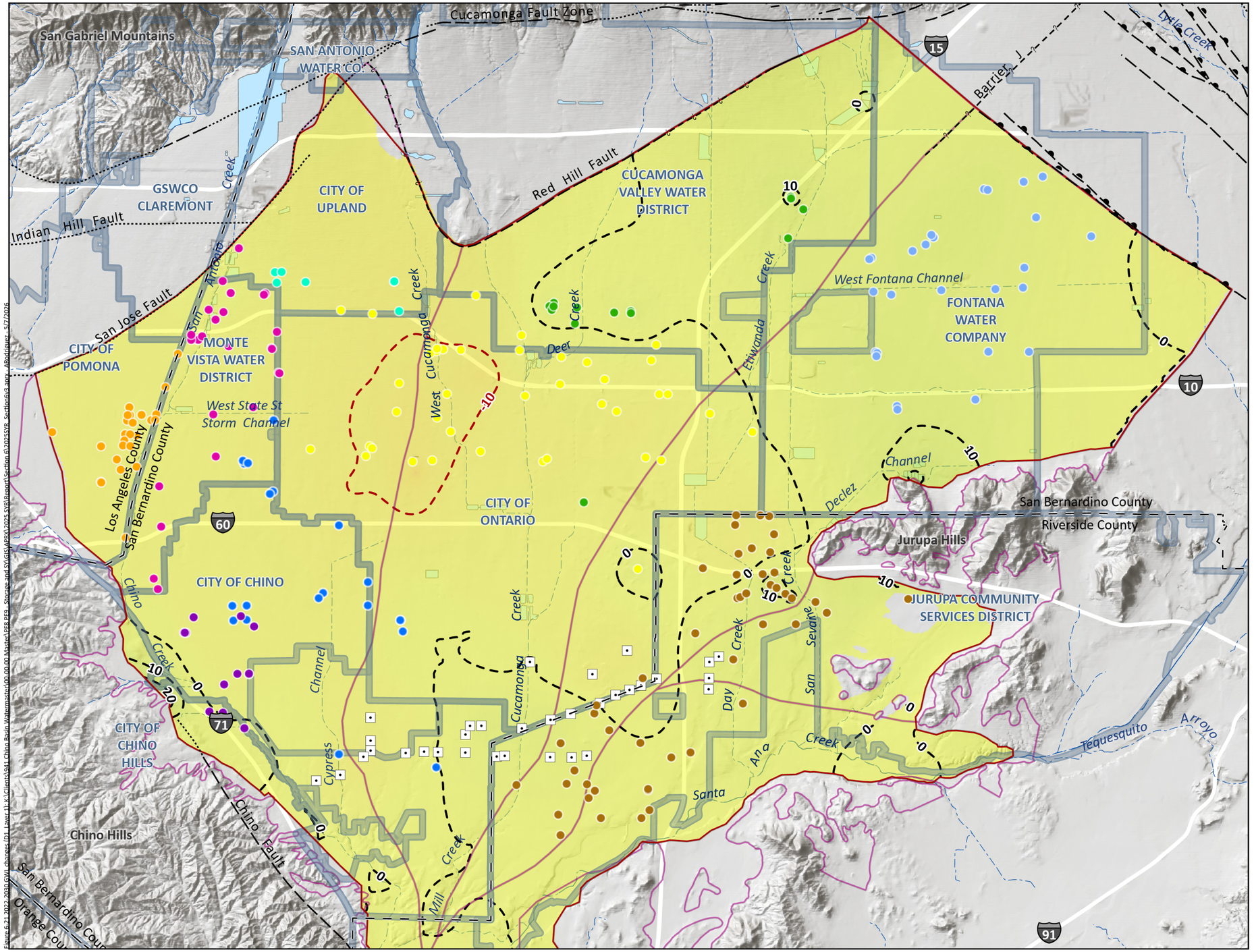
- In Scenario D1 (Figure 6-21), groundwater levels average about the same as 2022. Groundwater levels generally remain within 10 feet of their levels in 2022.
- In Scenario E9 (Figure 6-22), groundwater levels average about 13 feet higher than 2022. Increases in groundwater levels are consistent across most of the Basin except for the western portion of the CDA wellfield near where the remediation wells near the Chino Airport are projected to begin pumping in FY 2027.
- In Scenario A5 (Figure 6-23), groundwater levels average about 9 feet lower than 2022. Groundwater level declines are focused in the western Chino Basin near the Ontario and Pomona wellfields, and near where the remediation wells near the Chino Airport are projected to begin pumping in FY 2027.

6.2.2.1.2 Groundwater Level Changes, FY 2022 to 2050

Table 6-6 summarizes the changes in groundwater levels for each of the Projection Realizations, indicating the minimum, maximum, and average groundwater level elevations on July 1, 2050, and the average difference in groundwater levels between July 1, 2022 and July 1, 2050.

Table 6-6. Summary of Groundwater Elevations Selected Projection Realizations, July 2050 (ft-amsl)			
Statistic	Scenario D1	Scenario E9	Scenario A5
Minimum Groundwater Elevation	467	477	447
Maximum Groundwater Elevation	840	841	844
Average Groundwater Elevation	609	629	588
Average Difference Compared to 2022	-16	7	-29

DRAFT



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2030

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2030

Hydraulic Head Change (ft) July 2022 to 2030

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier

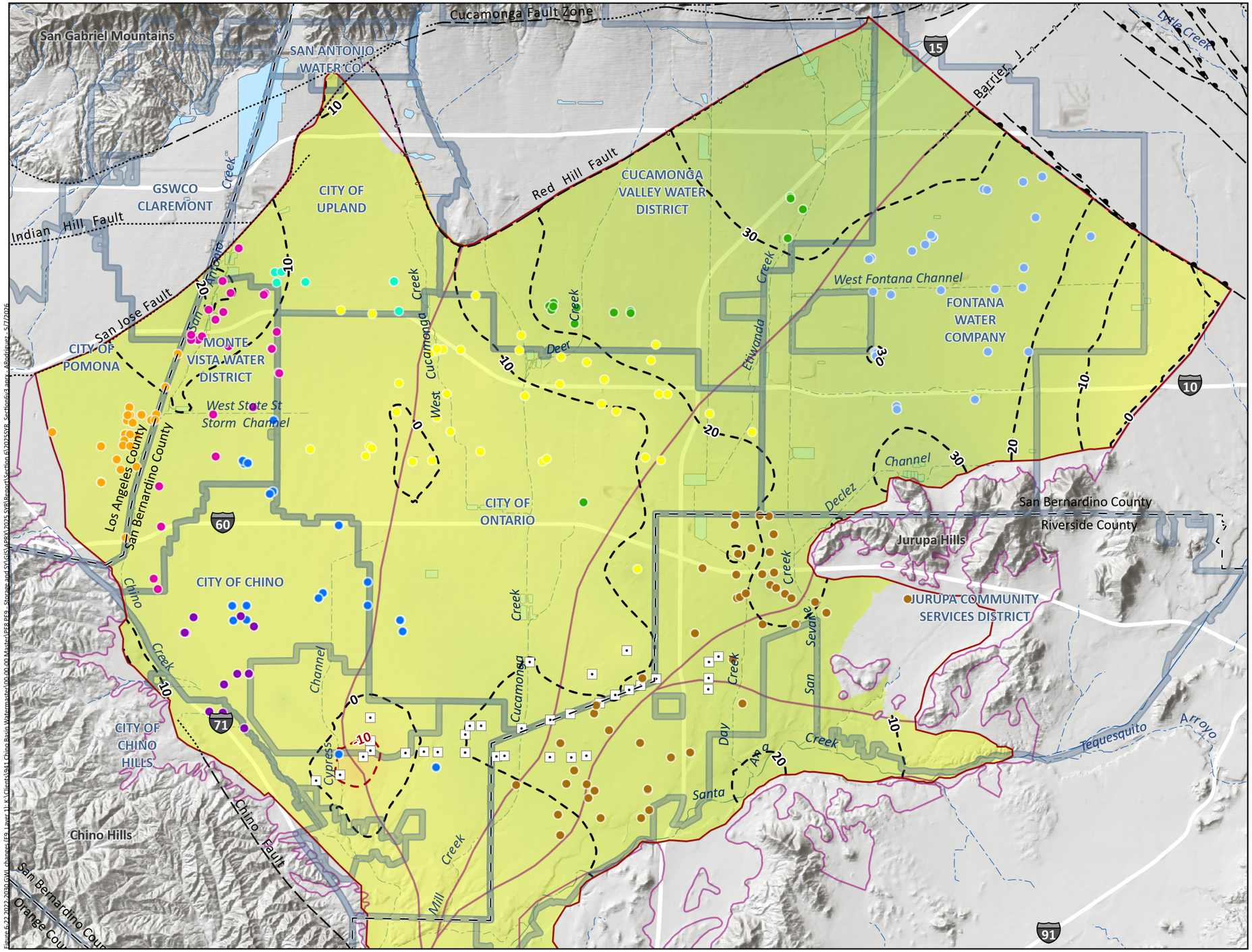


Prepared by:
WEST YOST

0 2 4 Miles
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario D1 - July 2030 minus July 2022
DRAFT
Figure 6-21



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2030

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2030

Hydraulic Head Change (ft) July 2022 to 2030

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier

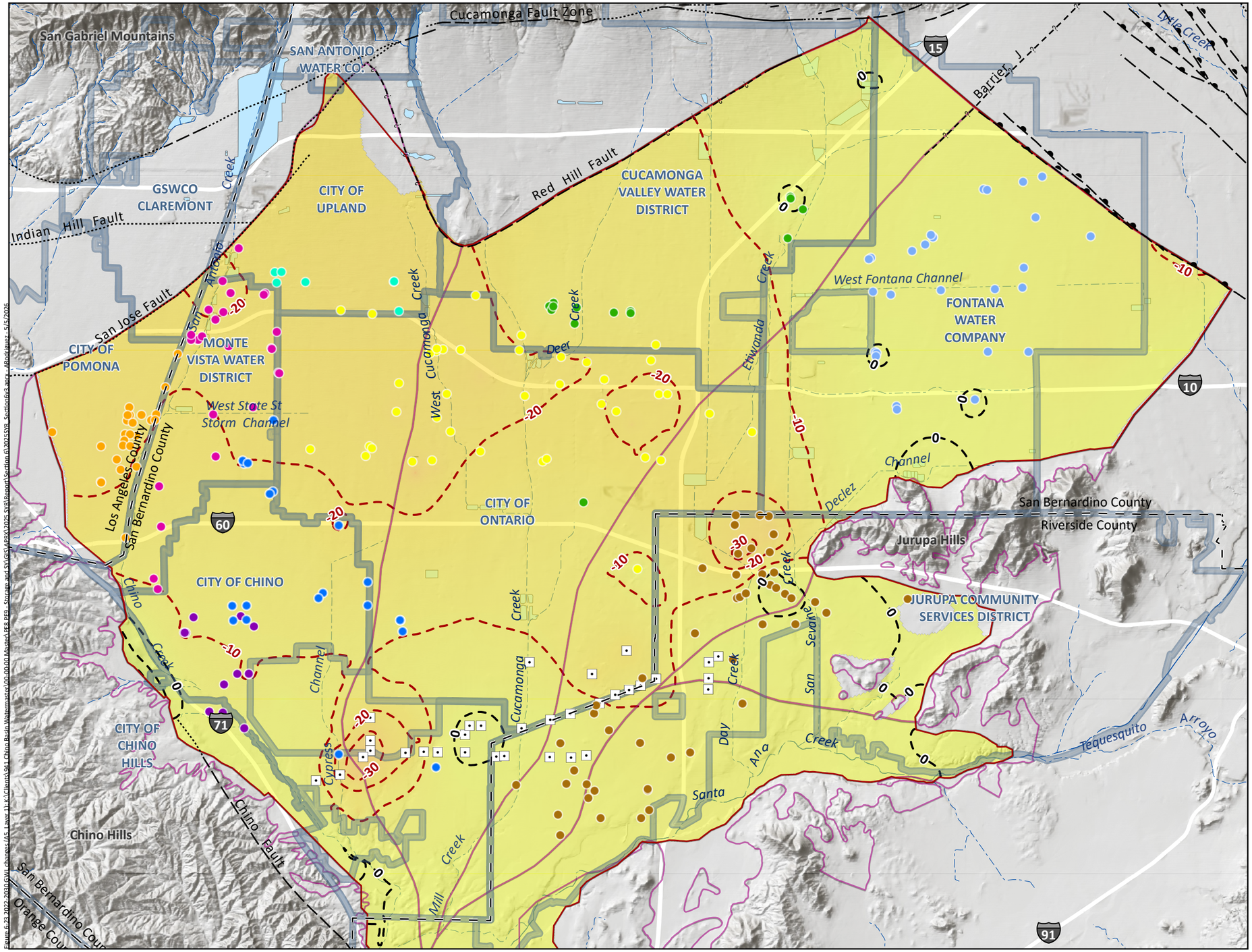


Prepared by:
WEST YOST

0 2 4 Miles
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario E9 - July 2030 minus July 2022
DRAFT
Figure 6-22



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2030

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2030

Hydraulic Head Change (ft) July 2022 to 2030

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by:
WEST YOST

0 2 4 Miles
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario A5 - July 2030 minus July 2022
DRAFT
Figure 6-23

Figures 6-24 through 6-26 show the simulated changes in groundwater levels for the period of July 1, 2022 to July 1, 2050 for Layer 1 of Scenarios D1, E9, and A5, respectively.

- In Scenario D1 (Figure 6-24), groundwater levels average about 16 feet lower than 2022. Groundwater levels generally remain within 10 feet of their levels in 2022 in MZ-3, while groundwater level declines of up to 60 feet occur across the boundary between MZ-1 and MZ-2.
- In Scenario E9 (Figure 6-25), groundwater levels average about 7 feet higher than 2022. Increases in groundwater levels are consistent across most of the Basin except for central MZ-1 and near the Chino Airport, where declines are up to about 30 feet.
- In Scenario A5 (Figure 6-26), groundwater levels average about 29 feet lower than 2022. Groundwater level declines occur across the entire Basin, exceeding 90 feet near the boundary between MZ-1 and MZ-2.

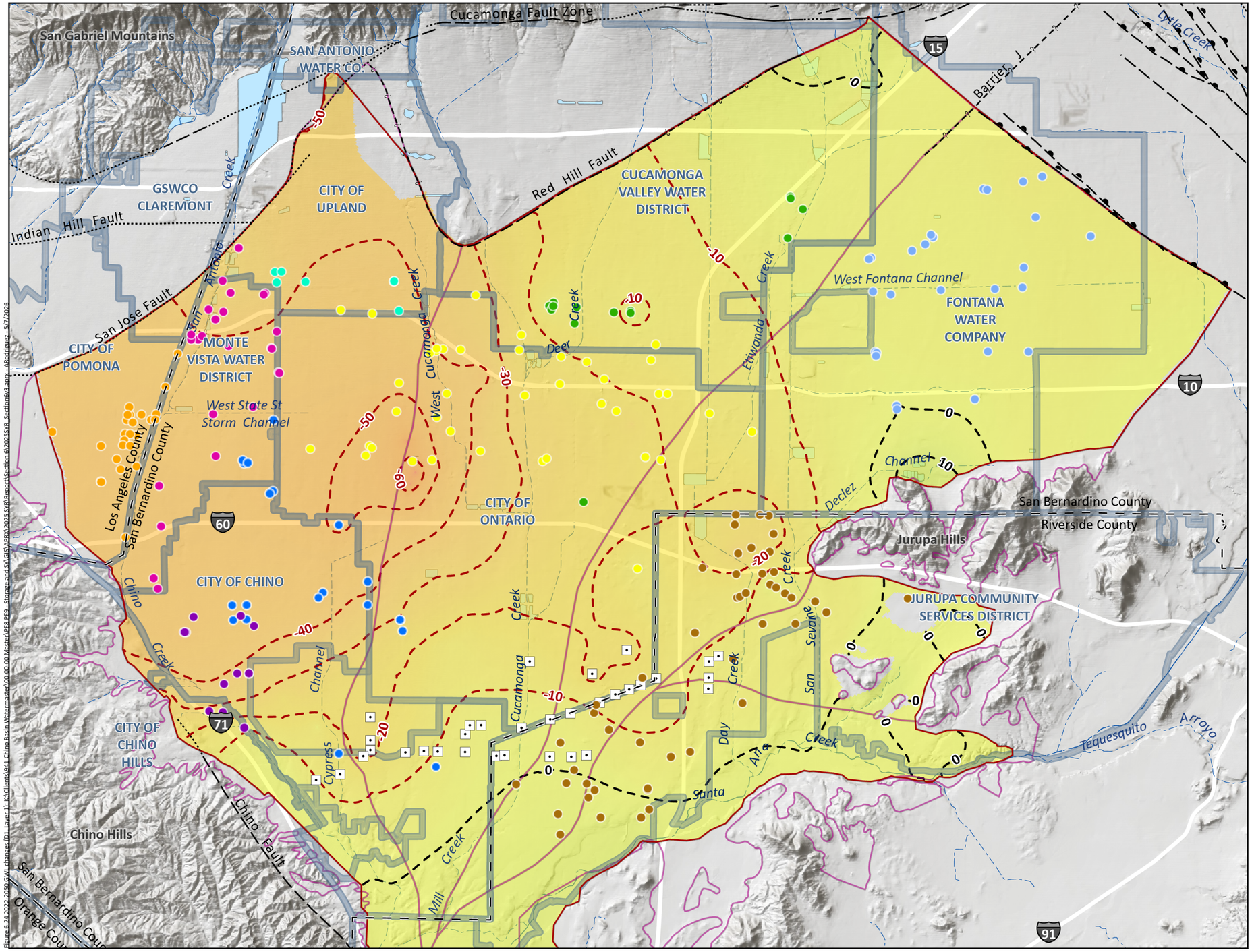
6.2.2.2 Groundwater Flow Patterns

Groundwater flow patterns vary over time for members of the TSY Ensemble. Figures 6-27 through 6-29 show the simulated groundwater velocity vectors on July 1, 2030 for Layer 1 of Scenarios D1, E9, and A5, respectively. Figures 6-30 through 6-32 show the simulated groundwater velocity vectors on July 1, 2050 for Layer 1 of Scenarios D1, E9, and A5, respectively.

Overall, groundwater flow patterns mimic surface drainage patterns, flowing from the areas of high elevation in the north and east flanking the San Gabriel and Jurupa Mountains towards pumping wells and areas of discharge near the Santa Ana River within Prado Basin. The CDA wellfield draws groundwater from the upgradient Chino Basin and the Santa Ana River, weakening the Chino Basin's hydraulic connection to the Santa Ana River.

By 2050 in Scenario D1, groundwater flows in Layer 1 tend to focus on local minima in groundwater levels near the Ontario wellfield (see Figure 6-30).

DRAFT



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2050

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2050

Hydraulic Head Change (ft) July 2022 to 2050

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier

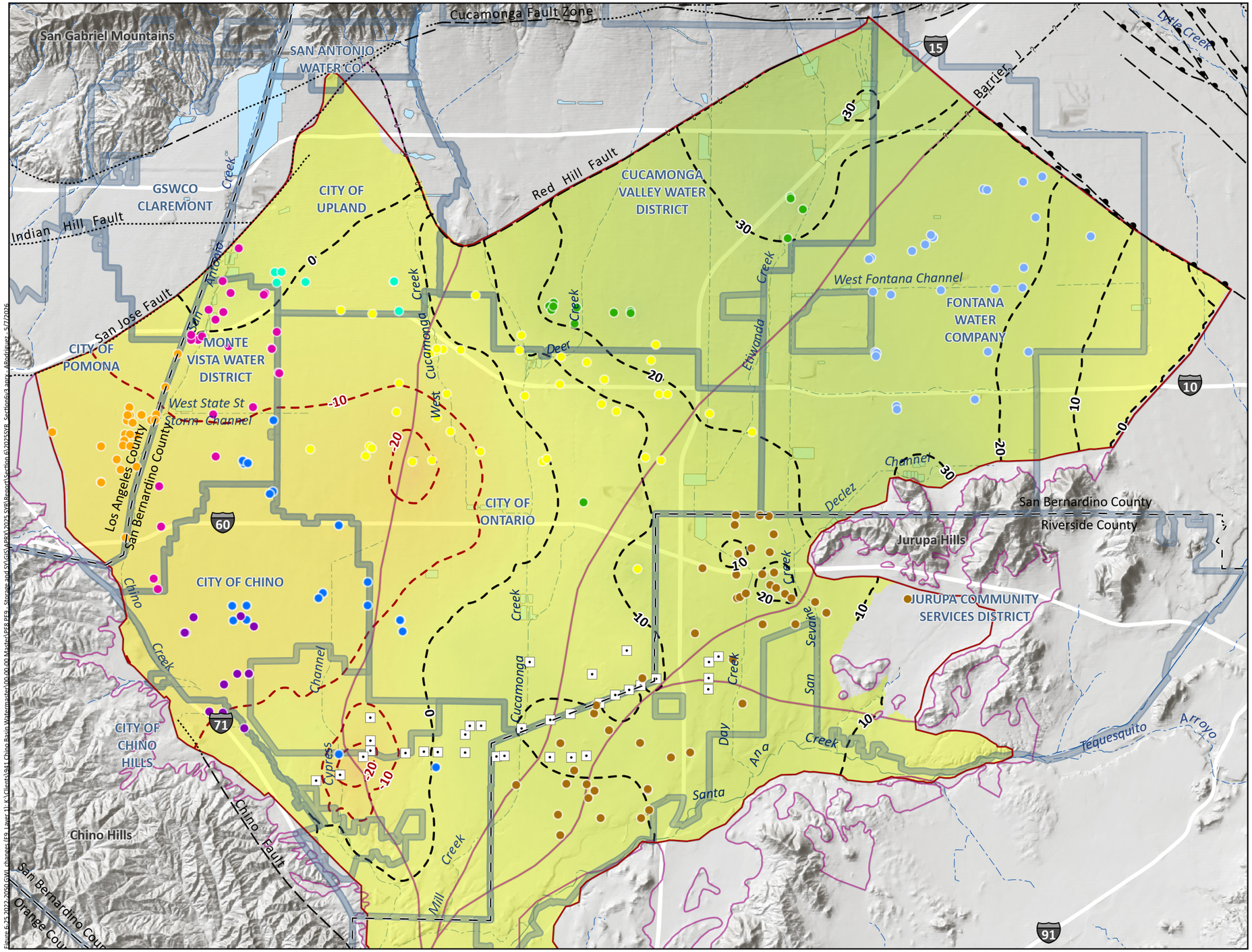


Prepared by:
WEST YOST

0 2 4 Miles
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario D1 - July 2050 minus July 2022
DRAFT
Figure 6-24



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2050

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2050

Hydraulic Head Change (ft) July 2022 to 2050

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

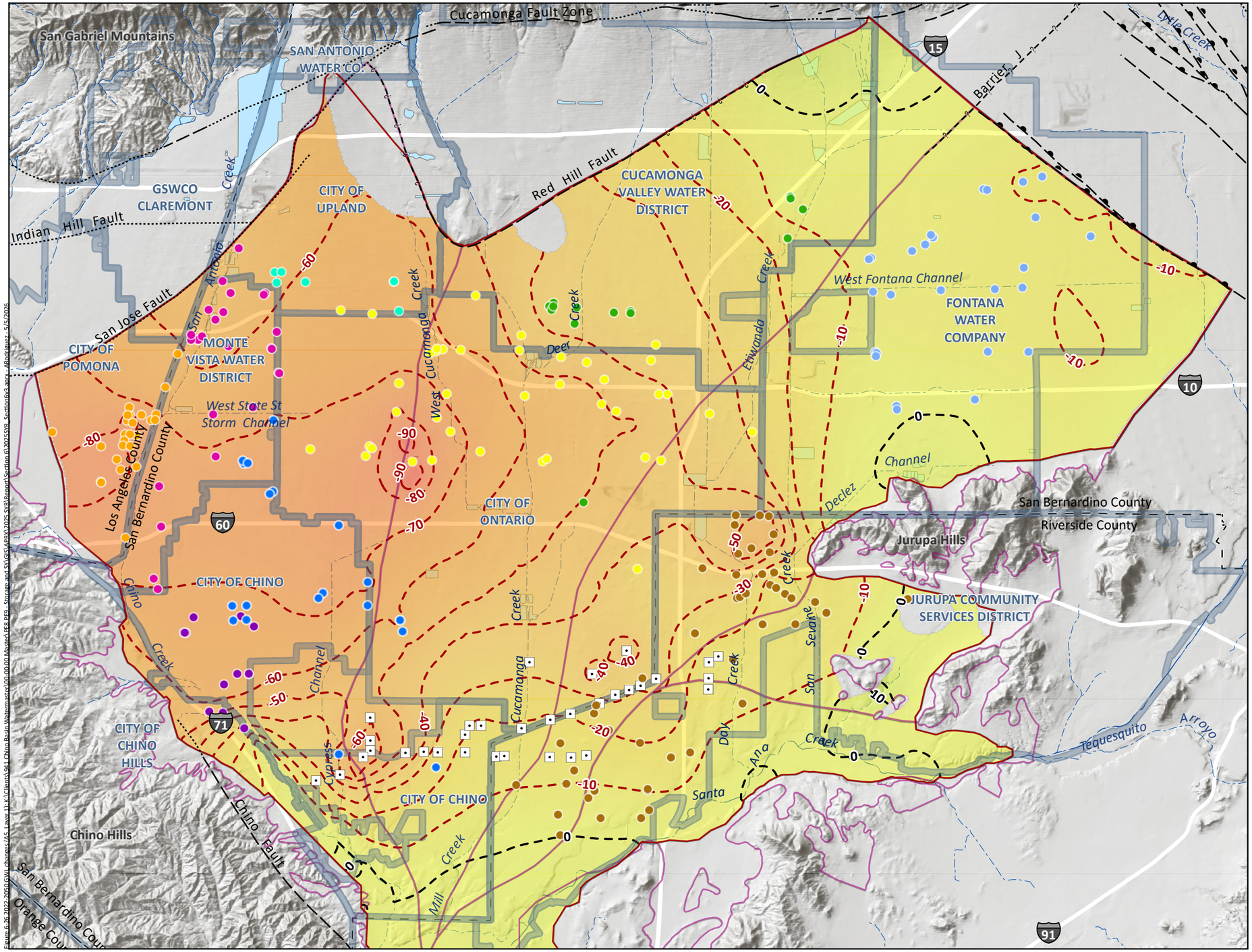
N

0 2 4 Miles

0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario E9 - July 2050 minus July 2022
DRAFT
Figure 6-25



Hydraulic Head Change (ft-amsl) Positive Change
July 2022 to July 2050

Hydraulic Head Change (ft-amsl) Negative Change
July 2022 to July 2050

Hydraulic Head Change (ft) July 2022 to 2050

100 — Increase

-100 — Decrease

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

Water Service Area



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier

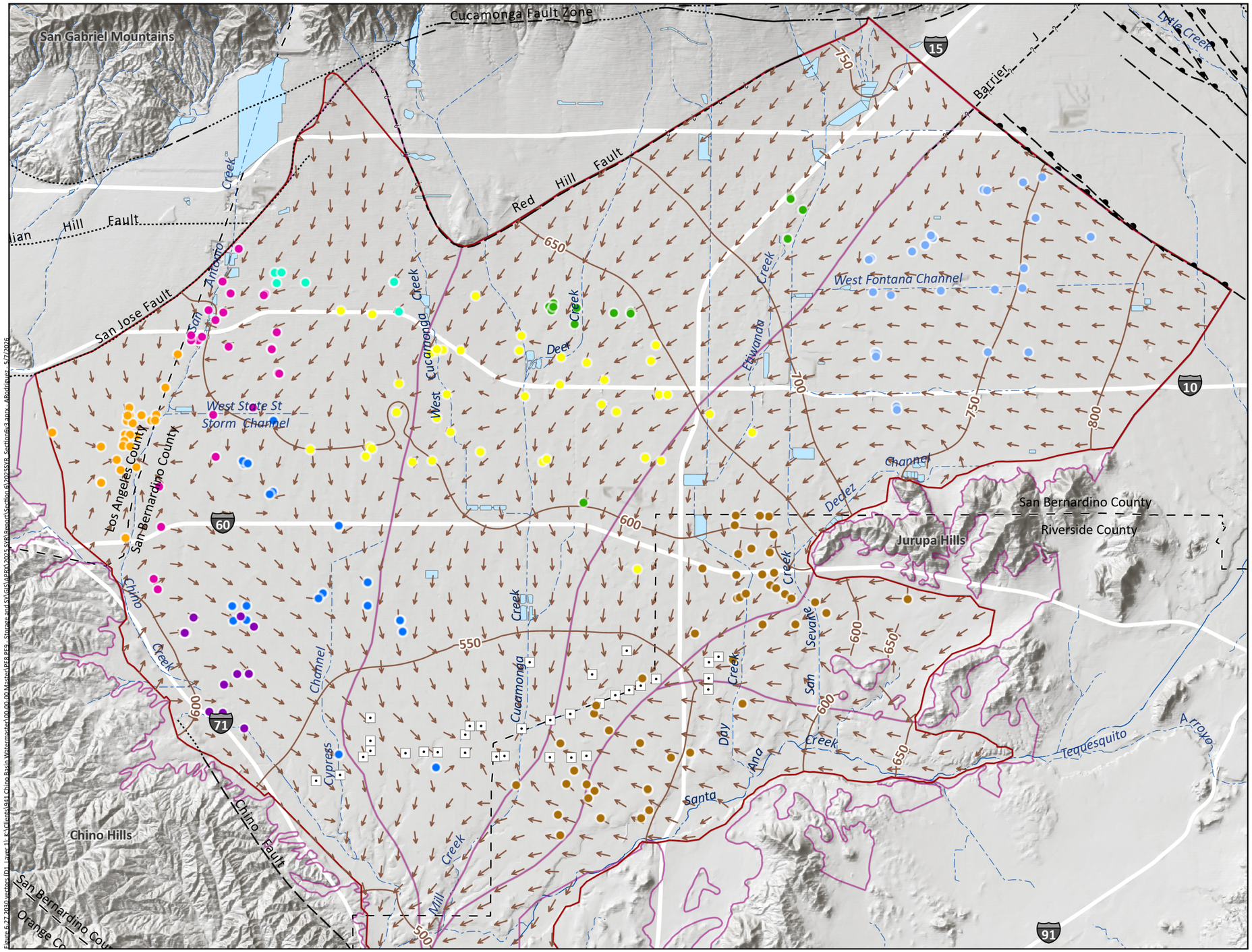


Prepared by:
WEST YOST

0 2 4 Miles
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Hydraulic Head Change -- Layer 1
Scenario A5 - July 2050 minus July 2022
DRAFT
Figure 6-26



2030 Groundwater Flow Vector - Model Layer 1

800 2030 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by: WEST YOST

N

0 2 4 Miles

0 3 6 Km

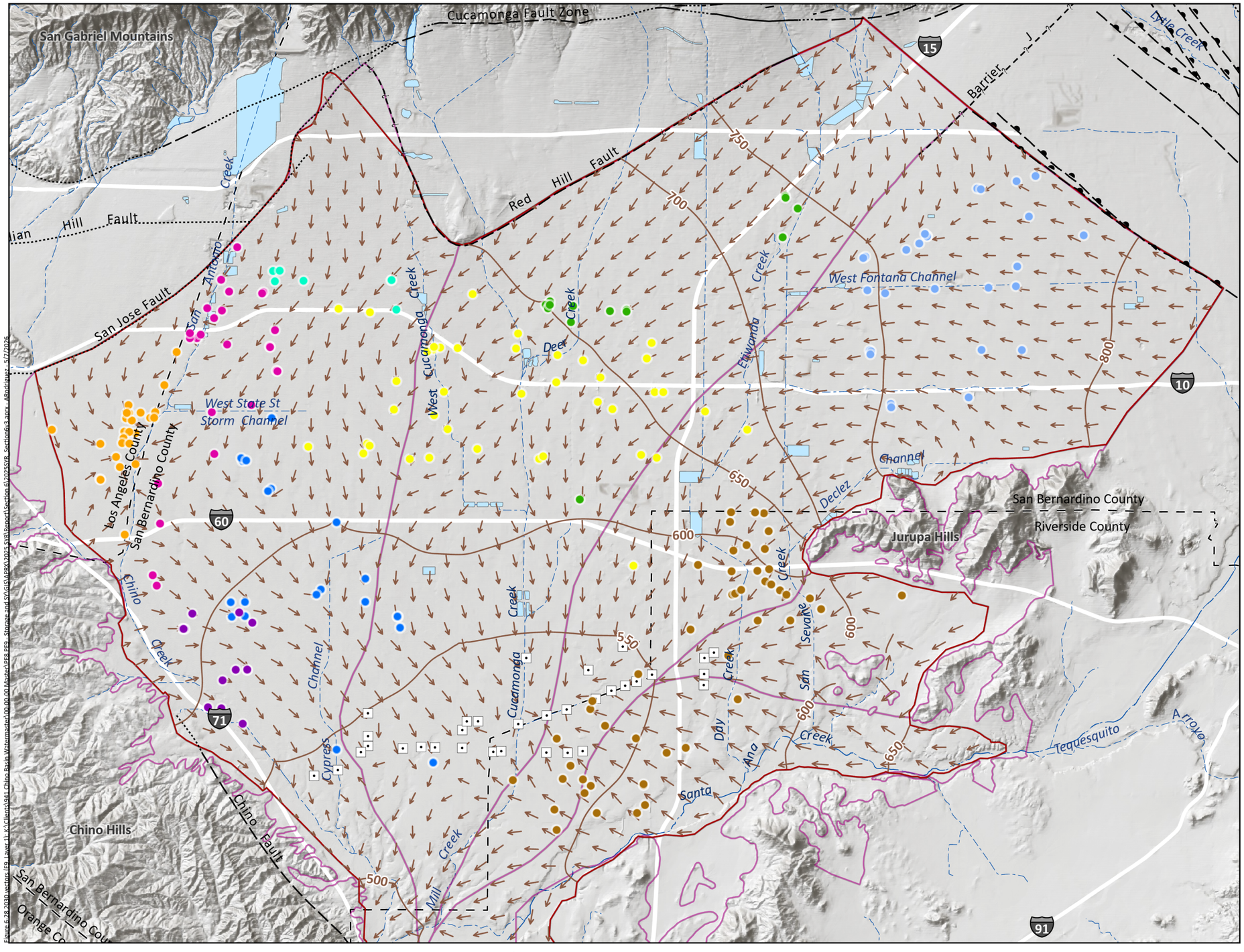
Prepared for: Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2030

Scenario D1, Layer 1

DRAFT

Figure 6-27



2030 Groundwater Flow Vector - Model Layer 1

2030 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

0 2 4 Miles

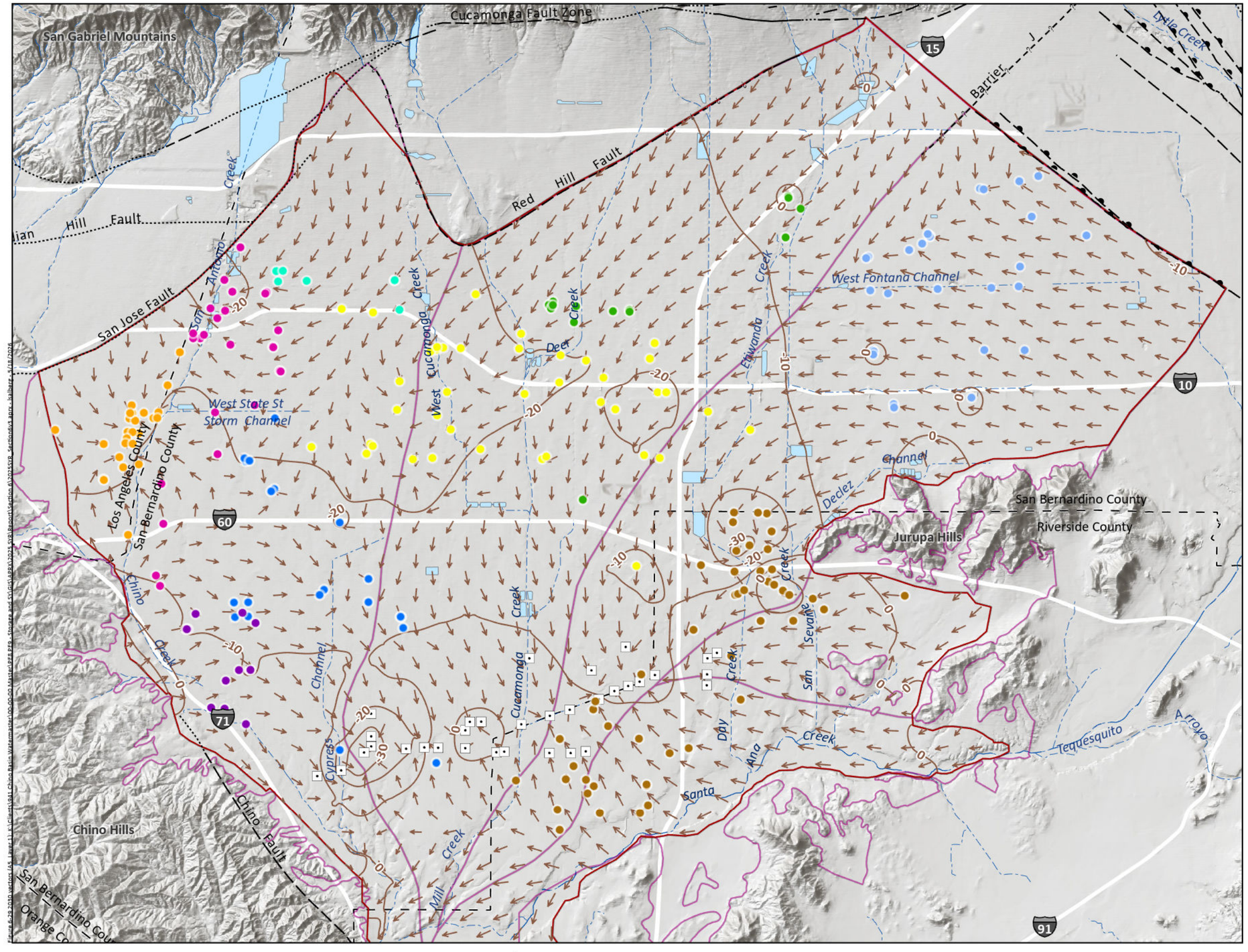
0 3 6 Km

Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2030
Scenario E9, Layer 1

DRAFT

Figure 6-28



2030 Groundwater Flow Vector - Model Layer 1

2030 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by: WEST YOST

0 2 4 Miles

0 3 6 Km

Prepared for: Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2030

Scenario A5, Layer 1

DRAFT

Figure 6-29

2050 Groundwater Flow Vector - Model Layer 1

2050 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins

OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by: WEST YOST

N

0 2 4 Miles

0 3 6 Km

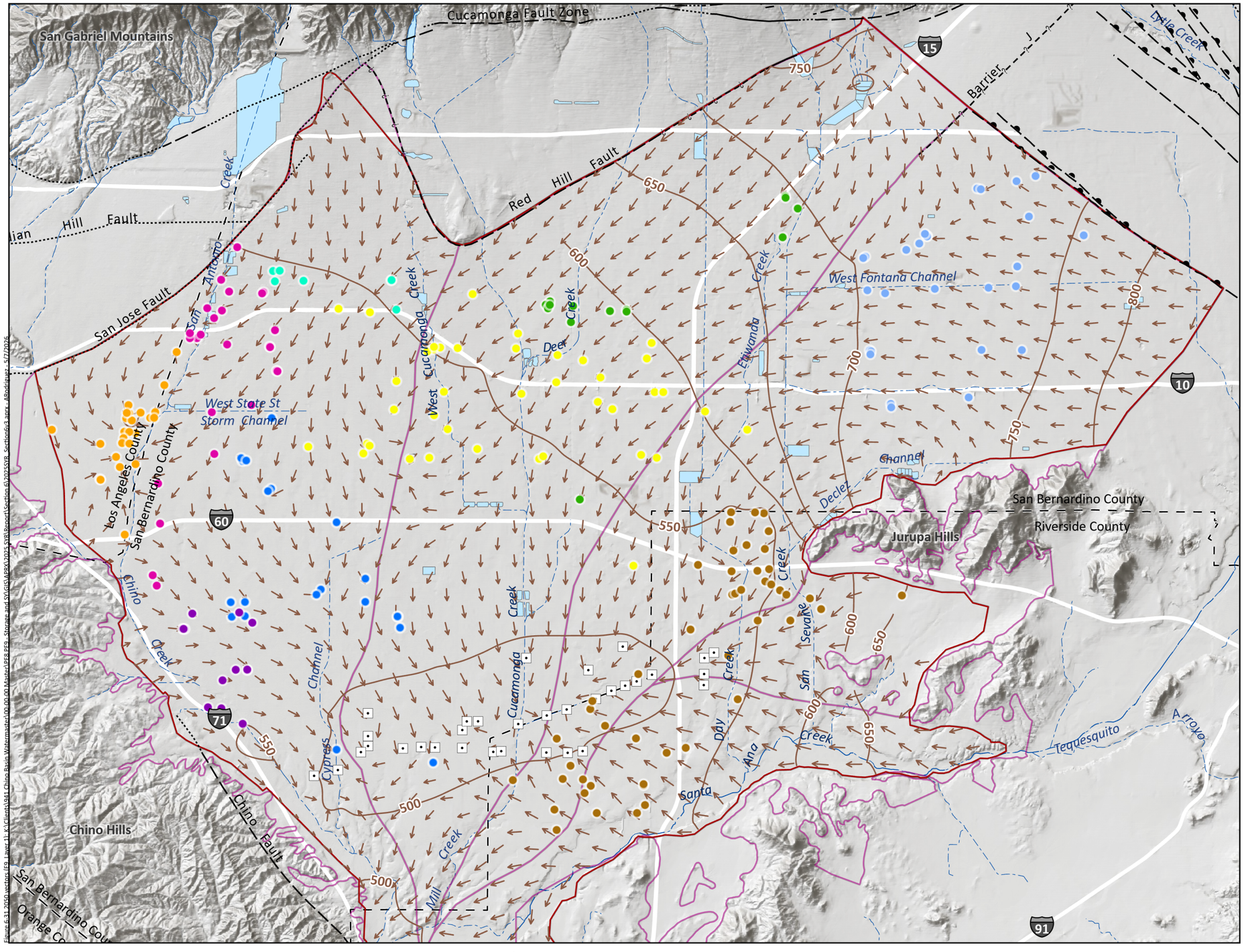
Prepared for: Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2050

Scenario D1, Layer 1

DRAFT

Figure 6-30



2050 Groundwater Flow Vector - Model Layer 1

2050 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by:

WEST YOST

0 2 4 Miles

0 3 6 Km

N

Prepared for:

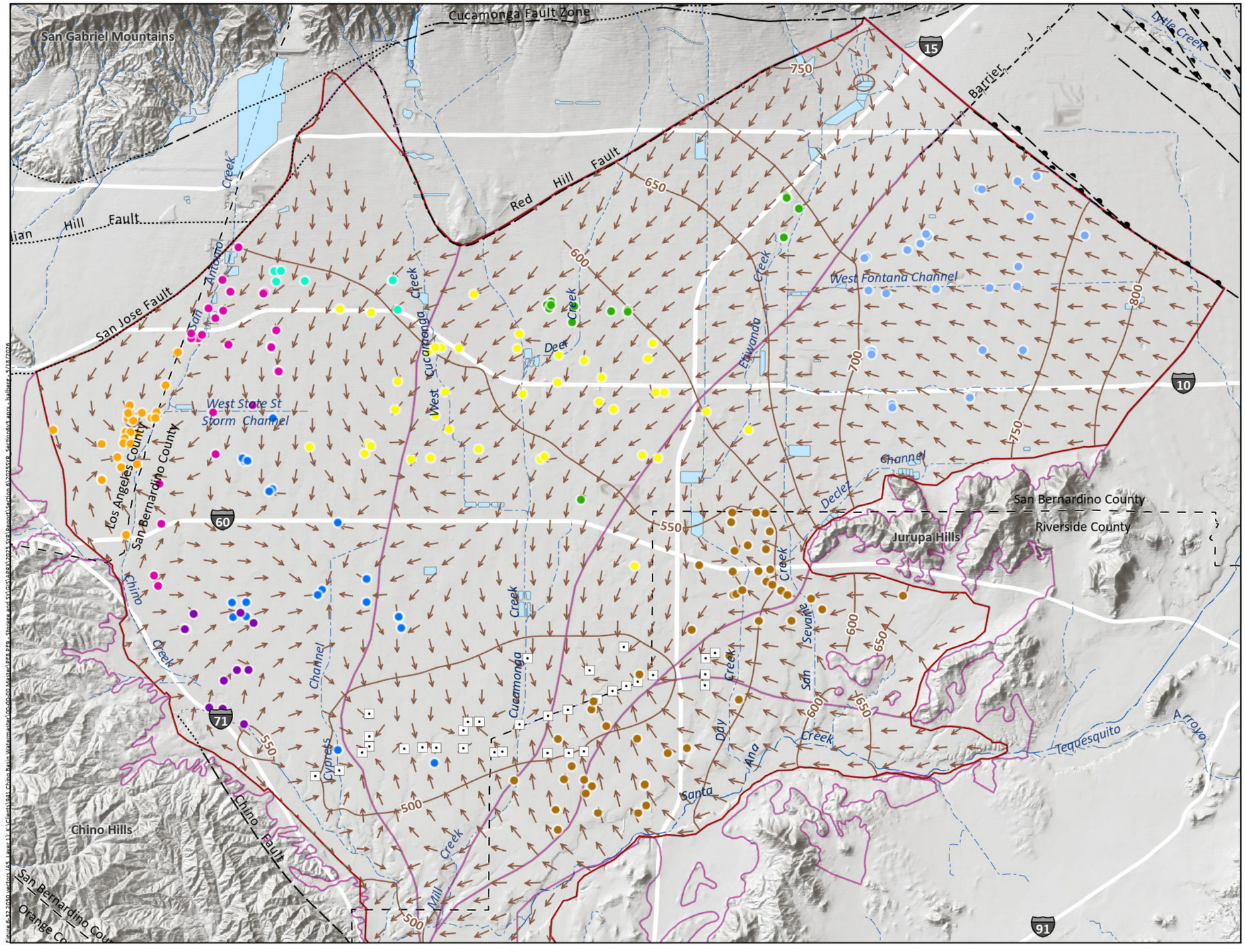
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2050

Scenario E9, Layer 1

DRAFT

Figure 6-31



2050 Groundwater Flow Vector - Model Layer 1

800 2050 Groundwater Elevation Contours (ft-amsl) - Model Layer 1

Appropriative Pool Pumping Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District

Chino Desalter Well

Rivers and Streams

Flood Control and or Conservation Basins



OBMP Management Zones

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



Prepared by: WEST YOST

0 2 4 Miles

0 3 6 Km

Prepared for: Chino Basin Watermaster
2025 Safe Yield Reevaluation

Projected Groundwater Level Elevations and Flow Vectors for July 2050

Scenario A5, Layer 1

DRAFT

Figure 6-32

SECTION 7
2025 Safe Yield Reevaluation

7.1 BACKGROUND AND OBJECTIVES

This section presents the findings of the 2025 Safe Yield Reevaluation and documents the execution of Step 9 of the 2022 SYRM:

> 9. *Evaluate whether the groundwater production at the Tentative Safe Yield estimated in [8] above will cause or threaten to cause "undesirable results" or "Material Physical Injury." If groundwater production at Tentative Safe Yield will cause or threaten to cause "undesirable results" or "Material Physical Injury," then Watermaster will identify and implement prudent measures necessary to mitigate "undesirable results" or "Material Physical Injury," set the value of Safe Yield to ensure there is no "undesirable results" or "Material Physical Injury," or implement a combination of mitigation measures and a changed Safe Yield.*

Although the term "undesirable result" is referenced in the Judgment definition of Safe Yield, it is not explicitly defined. Common law defines "undesirable result" as "a gradual lowering of the ground water levels resulting eventually in depletion of the supply."[1] However, prior Safe Yield recalculations have consistently assessed groundwater conditions based on the definition of Material Physical Injury (MPI), which effectively captures and addresses the risks associated with undesirable results. Therefore, the MPI framework will be used to encompass both "undesirable results" as used in the Judgment and MPI as defined in the Peace Agreement.

7.1.1 Categories of Material Physical Injury

The Peace Agreement defines MPI as "[…] *material injury that is attributable to Recharge, Transfer, storage and recovery, management, movement or Production of water or implementation of the OBMP, including, but not limited to, degradation of water quality, liquefaction, land subsidence, increases in pump lift and adverse impacts associated with rising groundwater*." Watermaster has used this definition to guide the scope of prior Safe Yield recalculations,[2] considering the potential for MPI from operating at the Safe Yield. The following lists each category of MPI and describes whether and how Watermaster will evaluate for MPI in Step 9 for 2025 SYR:

- **Degradation of water quality:** The Safe Yield is the sustainable pumping rate from the Chino Basin, and by itself, does not influence groundwater quality. Therefore, water quality is not analyzed herein as potential MPI that could be caused by the Safe Yield. Instead, the Watermaster addresses water quality challenges through other forums:
  - The Watermaster's responsibilities to manage groundwater quality are defined by the Optimum Basin Management Program (OBMP) with the advice of the Advisory and Pool Committees. The current forum by which water quality challenges are identified and addressed is the Water Quality Management Program (WQMP).
  - Salt and nutrient management in groundwater is regulated by the Regional Water Quality Control Board through the Chino Basin Maximum Benefit Program.

[1] See *City of Los Angeles v. City of San Fernando* (1975) 14 Cal.3d 199, 278 (disapproved of on other grounds by *City of Barstow v. Mojave Water Agency* (2000) 23 Cal.4th 1224); see also *City of Pasadena v. City of Alhambra* (1949) 33 Cal.2d 908, 929.

[2] 2020 Safe Yield Recalculation Report

  - Point-source groundwater contamination plumes are regulated by the Regional Water Quality Control Board and monitored/mitigated by the responsible parties.

- **Liquefaction:** While operating at the Safe Yield may result in groundwater-level changes, the risk of liquefaction in the Chino Basin is considered insignificant because the water table is generally greater than 40 feet below the ground surface in areas with sensitive overlying infrastructure. Therefore, liquefaction is not analyzed herein as potential MPI that could be caused by the Safe Yield.
- **Land subsidence:** Operating at the Safe Yield may result in groundwater-level changes in areas of the Chino Basin that are prone to aquifer-system compaction, and hence, land subsidence and ground fissuring. Therefore, land subsidence is analyzed herein as potential MPI that could be caused by operating at the Safe Yield.
- **Increases in pump lift (i.e., pumping sustainability):** Operating at the Safe Yield may result in groundwater-level changes which could affect the ability of the parties to pump their wells in a manner to satisfy their water demands. Therefore, pumping sustainability is analyzed herein as potential MPI that could be caused by operating at the Safe Yield.
- **Adverse impacts associated with rising groundwater:** The primary adverse impact associated with rising groundwater is the potential loss of hydraulic control.[3] Operating at the Safe Yield may result in higher groundwater levels in the southern portion of the Chino Basin which could cause a loss of hydraulic control. Therefore, the potential loss of hydraulic control is analyzed herein as potential MPI that could be caused by operating at the Safe Yield.

Based on the above discussion, the 2025 Safe Yield Reevaluation will analyze the TSY Ensemble results for the MPI categories of: land subsidence; pumping sustainability; and the loss of hydraulic control.

7.1.2 MPI Analysis Methods

The general methods that were employed to evaluate the TSY Ensemble results for MPI included the following steps:

1. Characterize future groundwater conditions in the Chino Basin (*i.e.,* changes in groundwater levels and groundwater-flow directions) over the projection period (2023-2080) for each Projection Realization of the TSY Ensemble. The future groundwater conditions are described in Section 6.
2. Define the physical thresholds for the occurrence of MPI at representative monitoring locations for each MPI category (site-specific MPI threshold).

[3] The attainment of hydraulic control is measured by demonstrating, from groundwater elevation data, either that all groundwater north of the desalter well fields cannot pass through the CDA wellfields (total hydraulic containment standard) or that groundwater discharge through the CDA wellfields is, in aggregate, less than 1,000 afy (de minimis standard). The Regional Board has agreed that compliance with the de minimis standard will be determined from groundwater monitoring data and the results of periodic calibrations of the Watermaster groundwater model and interpretations of the calibration results.

3. Define the thresholds for the occurrence of MPI in each area or subarea of the basin (e.g., Areas of Subsidence Concern) based on the magnitude or ratio of site-specific MPI threshold exceedances for a Projection Realization (subarea MPI thresholds).
4. For each area or subarea, compare future groundwater conditions (from Step 1) against the site-specific MPI thresholds at representative monitoring locations (from Step 2) for each Projection Realization of the TSY Ensemble and determine whether MPI is predicted to occur using the subarea MPI thresholds (defined in Step 3).
5. For each area or subarea, determine if the potential for MPI (identified in Step 4) occurs in 50 percent or more likelihood-weighted Projection Realizations. If this occurs, describe the drivers of the MPI and discuss the potential methods to avoid the MPI, including mitigation measures and/or a changed Safe Yield.

7.2 MPI ANALYSIS FOR THE TSY ENSEMBLE

This subsection describes the analysis of MPI that could be caused by the projected groundwater conditions of the TSY Ensemble for the MPI categories of:

- Land Subsidence
- Pumping Sustainability
- Loss of Hydraulic Control

7.2.1 Land Subsidence

Historically, permanent land subsidence, accompanied in some places by damaging ground fissuring, occurred across the western portion of the Chino Basin. Subsequent studies determined that the primary subsidence mechanism was permanent compaction of the aquifer-system sediments due to declines of groundwater levels that exceeded historical lows in groundwater levels (i.e., preconsolidation stress).

Historical aquifer-system compaction and land subsidence have generally been confined to the western portion of the Chino Basin where the underlying aquifer system is relatively rich in compressible clay layers (i.e., aquitards of varying thickness and lateral extent). To avoid future permanent land subsidence and ground fissuring, the Watermaster developed and implements an adaptive Subsidence Management Plan that defined five Areas of Subsidence Concern across western Chino Basin. Figure 7-1 is a map showing the five Areas of Subsidence Concern.

The Subsidence Management Plan includes a monitoring/testing program to understand the occurrences and mechanisms of the aquifer-system compaction and land subsidence, and based on this understanding, provides guidance to the pumpers and the Watermaster for groundwater management activities to minimize or abate the future occurrences of aquifer-system compaction and land subsidence. The program has shown that recent aquifer-system compaction primarily occurs due to head declines in the deeper portions of the aquifer system in the Areas of Subsidence Concern.

In this study, the potential for MPI due to land subsidence is analyzed in each Area of Subsidence Concern via comparison of projected groundwater elevations versus historical lows in groundwater elevations (or elevations previously identified in the Subsidence Management Plan as the preconsolidation stress for an

DRAFT

Area). The analysis preferentially focuses on the deeper portions of the aquifer system based on the results and conclusions of the monitoring/testing program.

7.2.1.1 Site-Specific MPI Thresholds for Land Subsidence

The first step to analyze for MPI associated with land subsidence (Step 2 of the MPI Analysis Methods) was to establish site-specific MPI thresholds at selected wells—herein referred to as land subsidence thresholds (LSTs). An LST is set at the historical low groundwater elevation measured at a well (or estimated based on trends in groundwater elevations at nearby wells). This was chosen to assume that groundwater elevations declining below the LST will cause new aquifer-system compaction in the vicinity of the well. The wells were preferentially chosen: (i) with well screens that penetrate the deeper portions of the aquifer system (the depths most susceptible to compaction) and (ii) to achieve an even spatial distribution across the Areas of Subsidence Concern. The exception is the PA-7 piezometer at the Ayala Park Extensometer in the Managed Area where, through extensive testing and data analysis, a "Guidance Level" elevation has been established as the preconsolidation stress threshold in the Subsidence Management Plan. Figure 7-1 is a map that shows the chosen wells and LST elevations across the five Areas of Subsidence Concern.

7.2.1.2 Subarea MPI Thresholds for Land Subsidence

The potential for MPI is identified by subarea (i.e., Area of Subsidence Concern). Therefore, the next steps to analyze for MPI associated with land subsidence (Steps 3, 4, and 5 of the MPI Analysis Methods) were to define the statical thresholds for the occurrence of MPI in each Area of Subsidence Concern, for each Projection Realization, and for the entire TSY Ensemble:

- In each of the Areas of Subsidence Concern (excluding the Managed Area), MPI was identified if, by 2050, the projected groundwater elevation for CVM Layer 3 is below the LST at 50 percent or more of wells in 50 percent or more of the Projection Realizations in the TSY Ensemble.[4]
- For the Managed Area, MPI was identified if, by 2050, the projected groundwater elevation at the PA-7 piezometer is lower than the Guidance Level (399 ft-amsl) in more than 50 percent of the Projection Realizations in the TSY Ensemble.

The year 2050 was chosen for this MPI analysis because it reflects the time when managed storage is typically at or near zero in most projection realizations, and hence, groundwater levels are projected to be lowest. These criteria collectively account for the uncertainty in simulated groundwater elevations.

[4] Chino Well 15 was included with the wells used to evaluate MPI in Central MZ-1.

117°40'0"W

34°0'0"N

Well Name
550
Well with Land Subsidence Threshold (ft-amsl)

Area of Subsidence Concern

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Plio-Pleistocene Sedimentary Rocks

Cretaceous to Miocene Sedimentary Rocks

Pre-Tertiary Igneous and Metamorphic Rocks

Fault (solid where accurately located; dashed where approximately located or inferred; dotted where concealed)

Hydrology

Streams & Flood Control Channels

Flood Control & Conservation Basins



Produced by:

WEST YOST
Water. Engineered.

Author: LMS
Date: 7/14/2025
Document Name: LST Analysis

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Site-Specific MPI Thresholds for Land Subsidence

DRAFT

Figure 7-1

7.2.1.3 Results of MPI Analysis for Land Subsidence

Figures 7-2 through 7-5 are maps of each Area of Subsidence Concern (excluding the Managed Area) showing the likelihood-weighted average groundwater elevations for FY 2030 and 2050 relative to the LST for each monitoring well location. The wells are symbolized by color for distance above/below the LST. The figures also include:

- A "box-and-whiskers plot" that characterizes the distances above/below the LST for all wells by Projection Scenario (for all calibrated CVM realizations). Each dot represents one well in one Projection Realization. The red percentage at the bottom of the plot indicates the likelihood-weighted average percentage of groundwater elevations at all wells that are below the LST. These plots are useful in understanding the drivers of any identified MPI.
- A "heat map" of MPI by Projection Realization. Red squares indicate MPI associated with that Projection Realization. MPI for an Area of Subsidence Concern is identified if more than 50 percent of the Projection Realizations are determined to cause MPI (i.e., the projected groundwater elevation for CVM Layer 3 is below the LST at more than 50 percent of wells).

Figure 7-6 is a time-series chart of projected groundwater elevations at the PA-7 piezometer in the Managed Area for the TSY Ensemble and a heat map for all Projection Realizations. The chart shows that the likelihood-weighted average groundwater elevation at the PA-7 piezometer is always significantly higher (greater than 70 feet) than the Guidance Level (399 ft-amsl).

Based on the analysis above, the likelihood-weighted percentages of Projection Realizations that exceed the MPI threshold in FY 2050 for each Area of Subsidence Concern are:

- Central MZ-1: 7 percent
- **Northeast Area: 96 percent**
- Northwest MZ-1: 15 percent
- **Southeast Area: 97 percent**
- Managed Area: 0 percent

Hence, **the Northeast Area and the Southeast Area** have 50 percent or more likelihood-weighted Projection Realizations exceeding the subarea MPI threshold for land subsidence in FY 2050.

7.2.1.4 Discussion

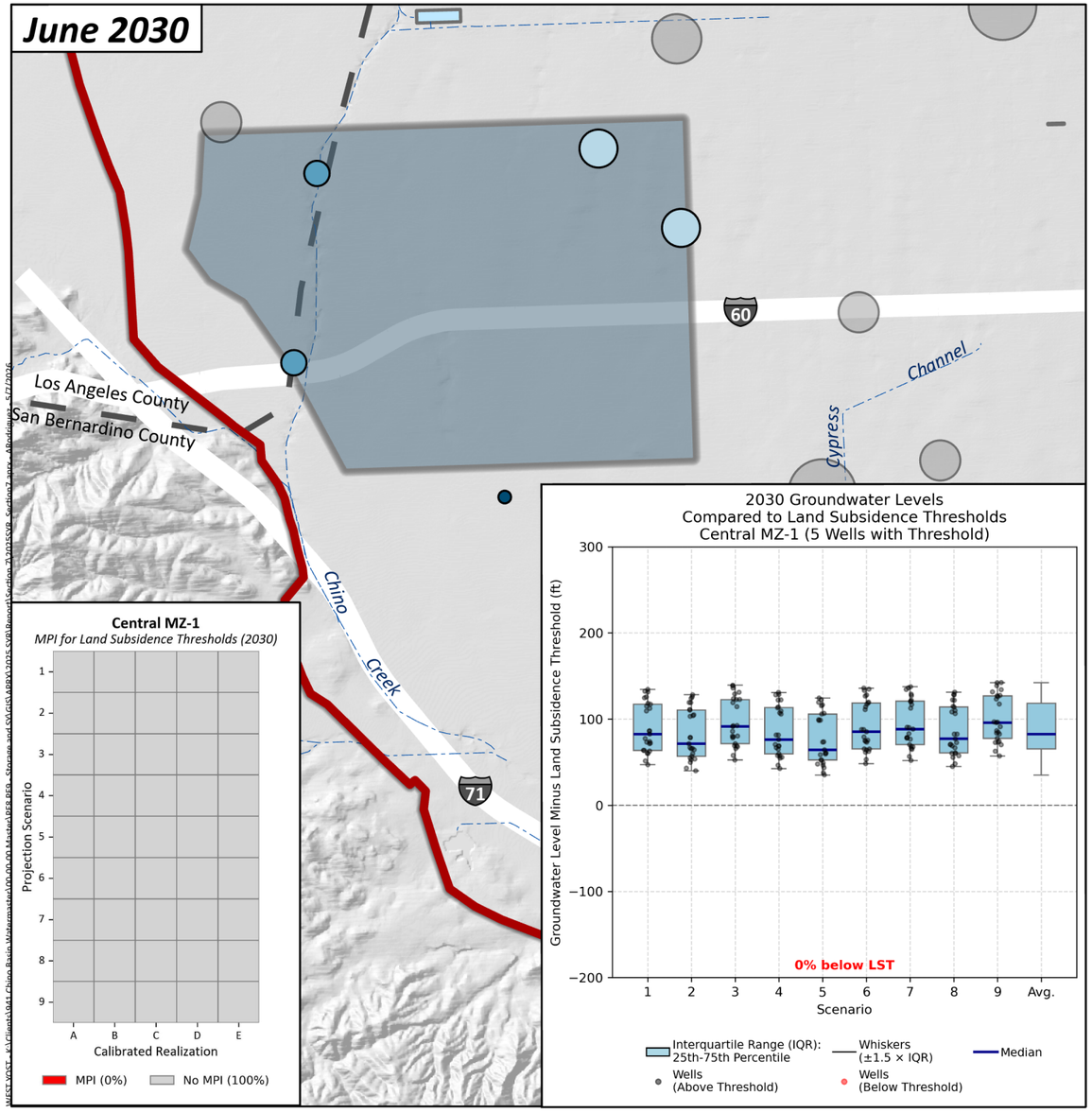
Table 7-1 summarizes the MPI analysis for land subsidence, indicating the number of wells that have LSTs in each region, the average percentage of wells exceeding the LST for each scenario, and the likelihood-weighted average percentage of wells exceeding the LST for the TSY Ensemble. Figure 7-7 shows two heatmaps for all Projection Realizations depicting the number of Areas of Subsidence Concern with MPI (0 through 5) in FY 2030 and 2050.

DRAFT

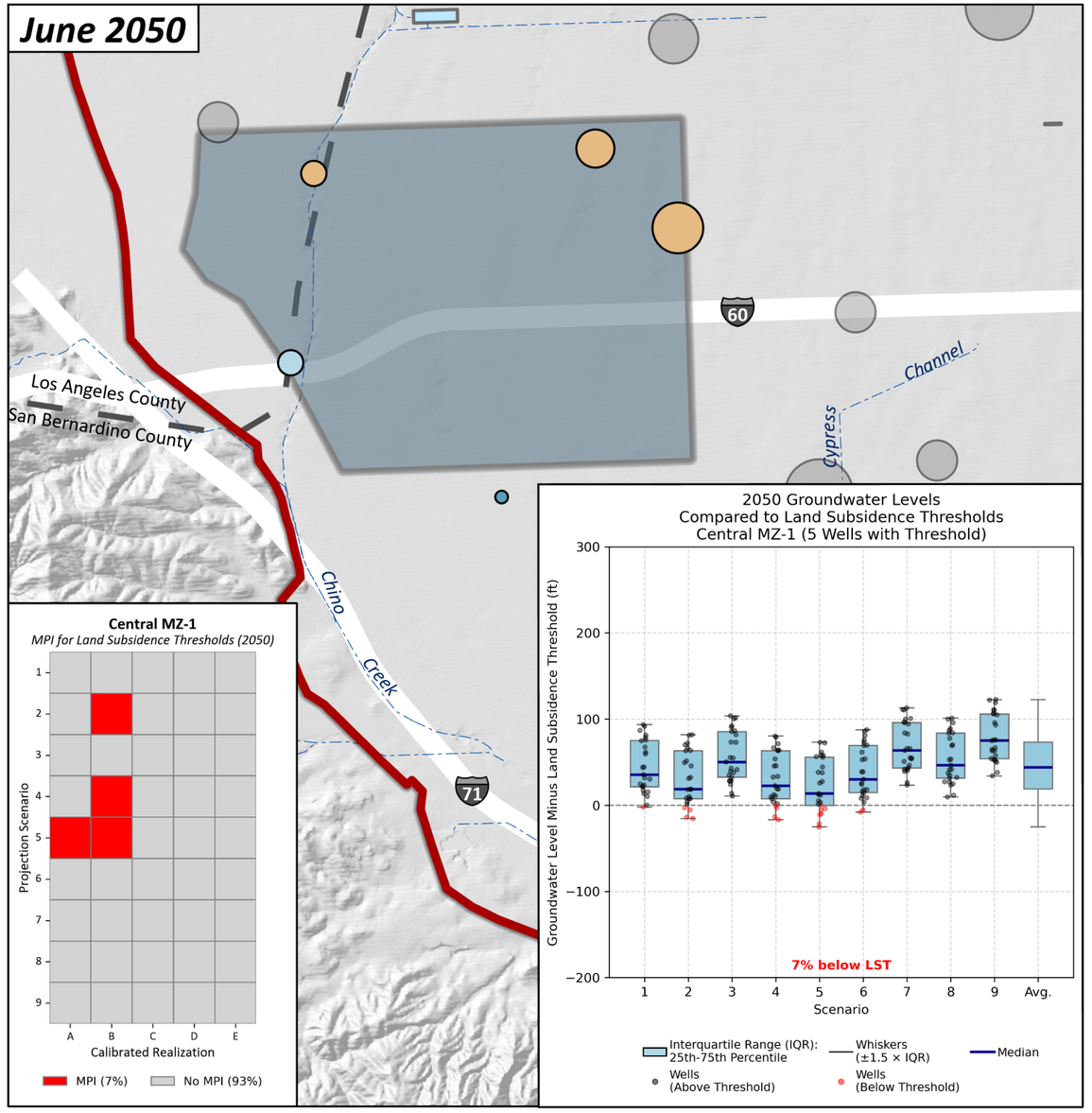
Table 7-1. Percentage of Wells Below Land Subsidence Thresholds, FY 2030 and FY 2050

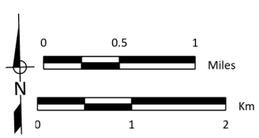
Scenario	Likelihood Weight	Area of Subsidence Concern									
		Central MZ-1 5 wells with LST Figure 7-2		Managed Area 1 well Figure 7-6		Northeast Area 11 wells Figure 7-3		Northwest MZ-1 8 wells Figure 7-4		Southeast Area 15 wells Figure 7-5	
		2030	2050	2030	2050	2030	2050	2030	2050	2030	2050
1	4	0	4	0	0	11	91	0	5	24	84
2	2	0	16	0	0	26	100	0	23	45	93
3	2	0	0	0	0	0	80	0	0	8	75
4	2	0	16	0	0	15	100	0	18	25	97
5	1	0	28	0	0	47	100	0	23	53	100
6	1	0	8	0	0	6	95	0	10	11	87
7	2	0	0	0	0	2	53	0	0	19	64
8	1	0	0	0	0	16	86	0	3	35	79
9	1	0	0	0	0	0	27	0	0	8	33
Likelihood-Weighted Average		0%	7%	0%	0%	12%	84%	0%	8%	25%	81%

June 2030



June 2050





Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Central MZ-1
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

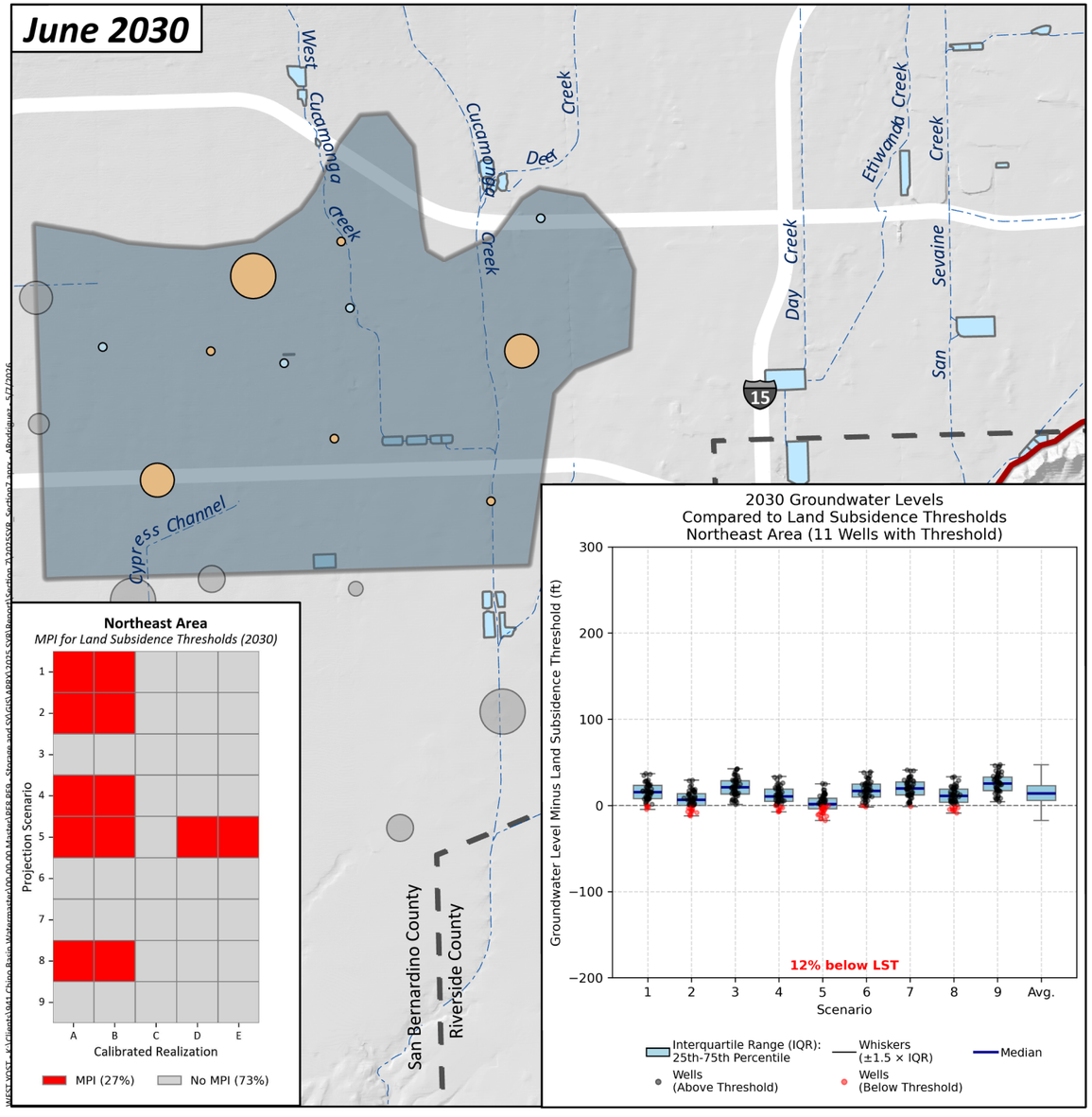
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Central MZ-1

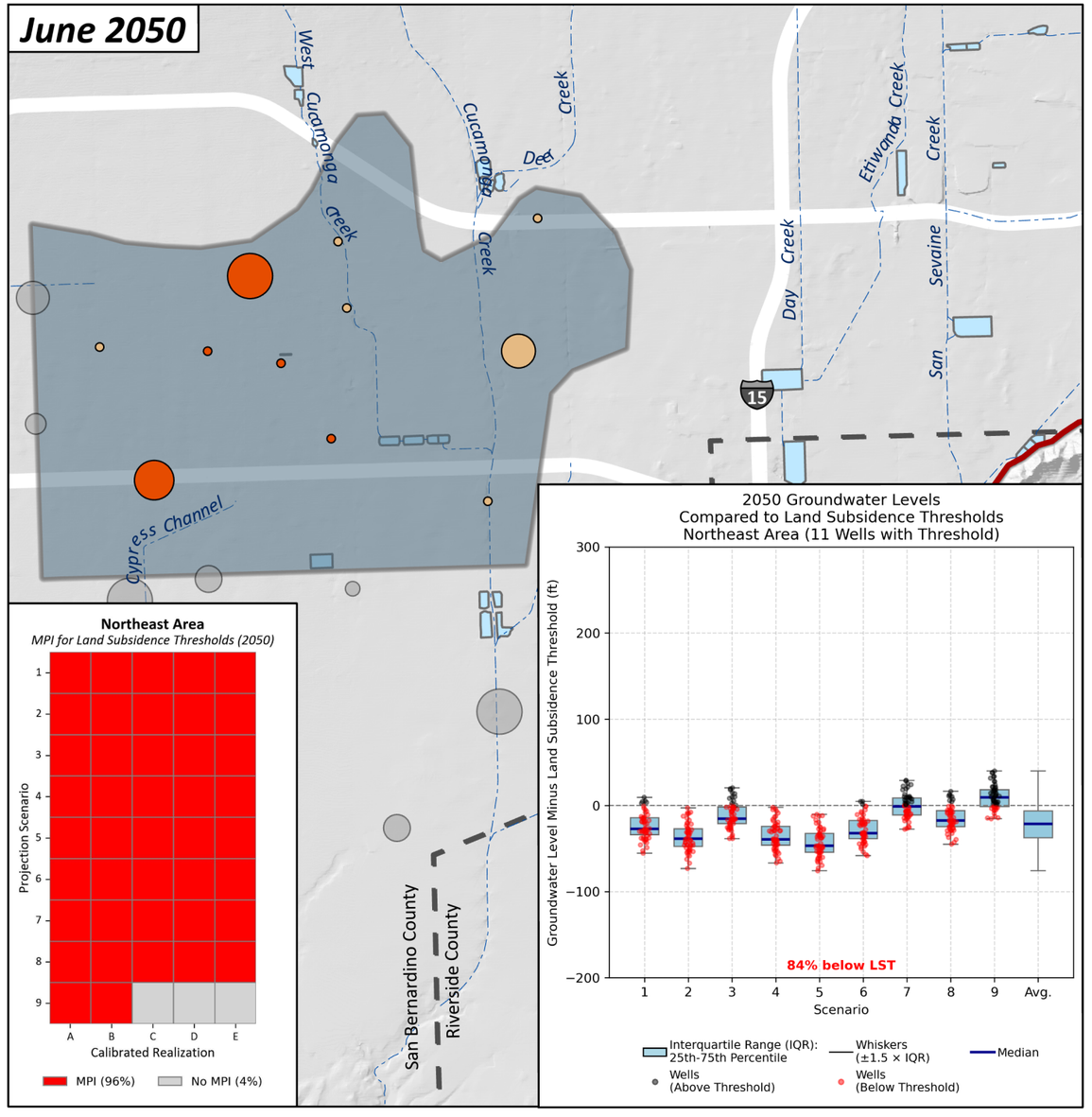
DRAFT

Figure 7-2

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Northeast Area
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared by: WEST YOST Water. Engineered.

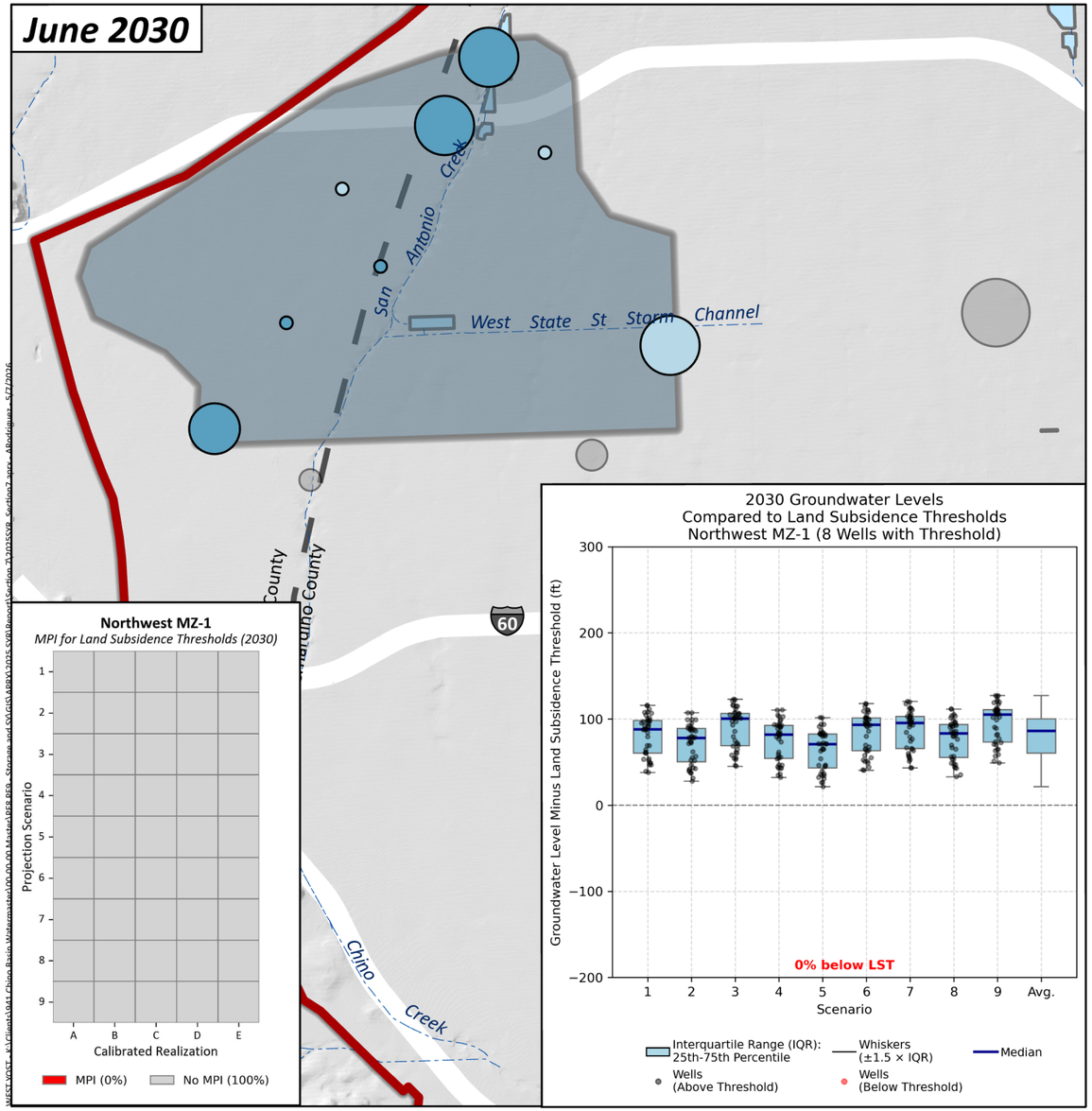
Prepared for: **Chino Basin Watermaster**
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Northeast Area

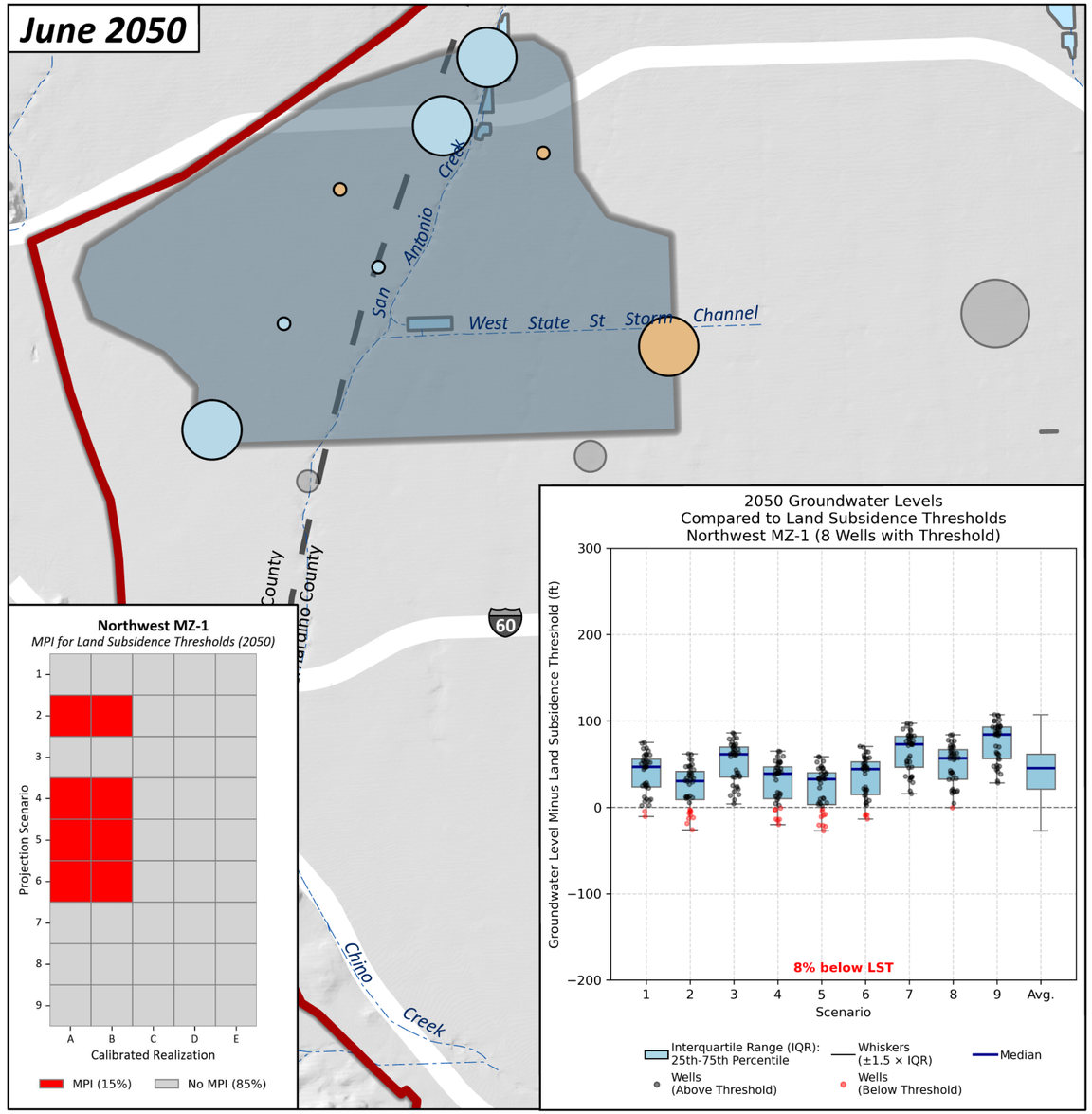
DRAFT

Figure 7-3

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Northwest MZ-1
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

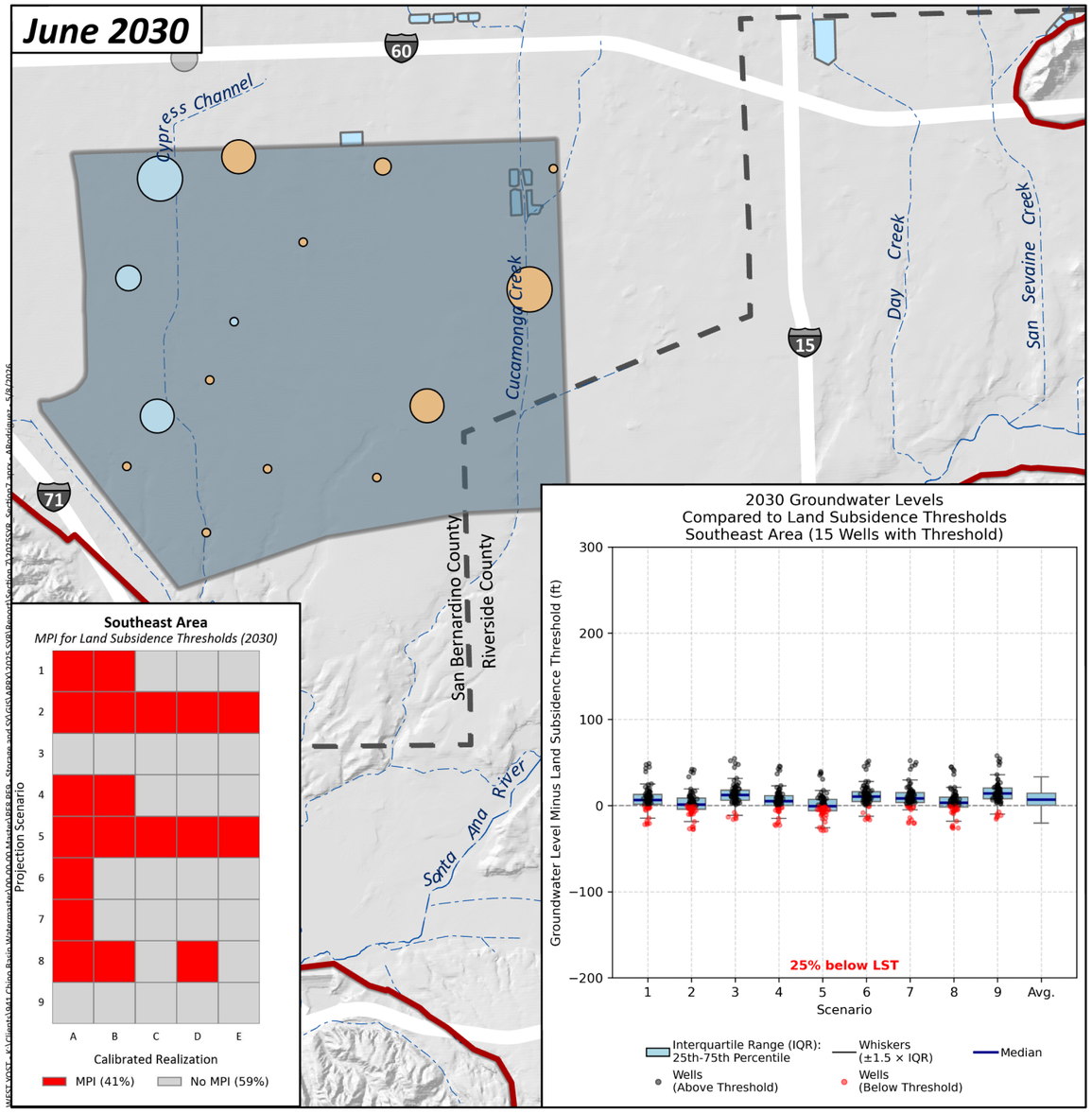
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Northwest MZ-1

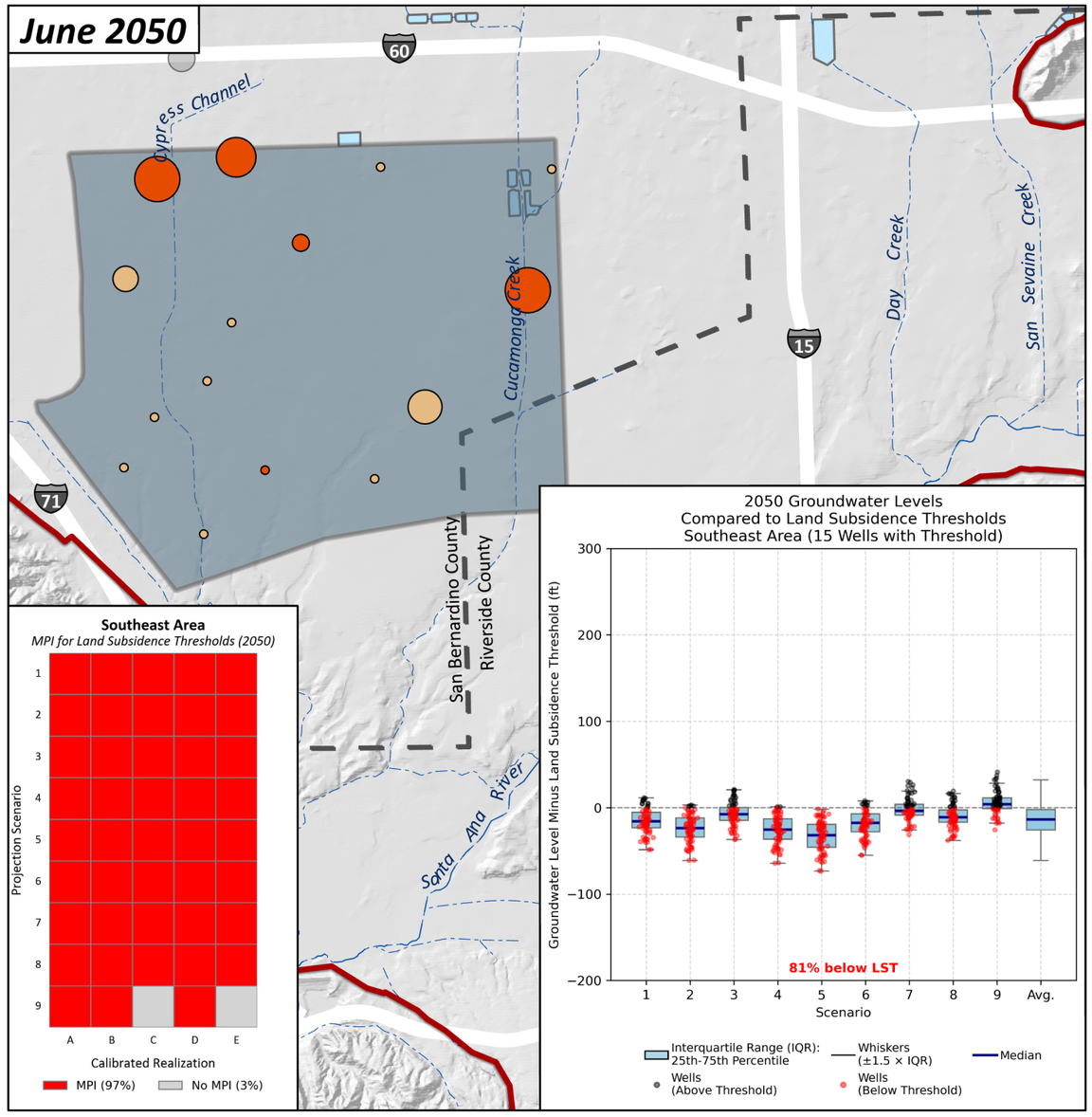
DRAFT

Figure 7-4

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Southeast Area
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared by: WEST YOST Water. Engineered.

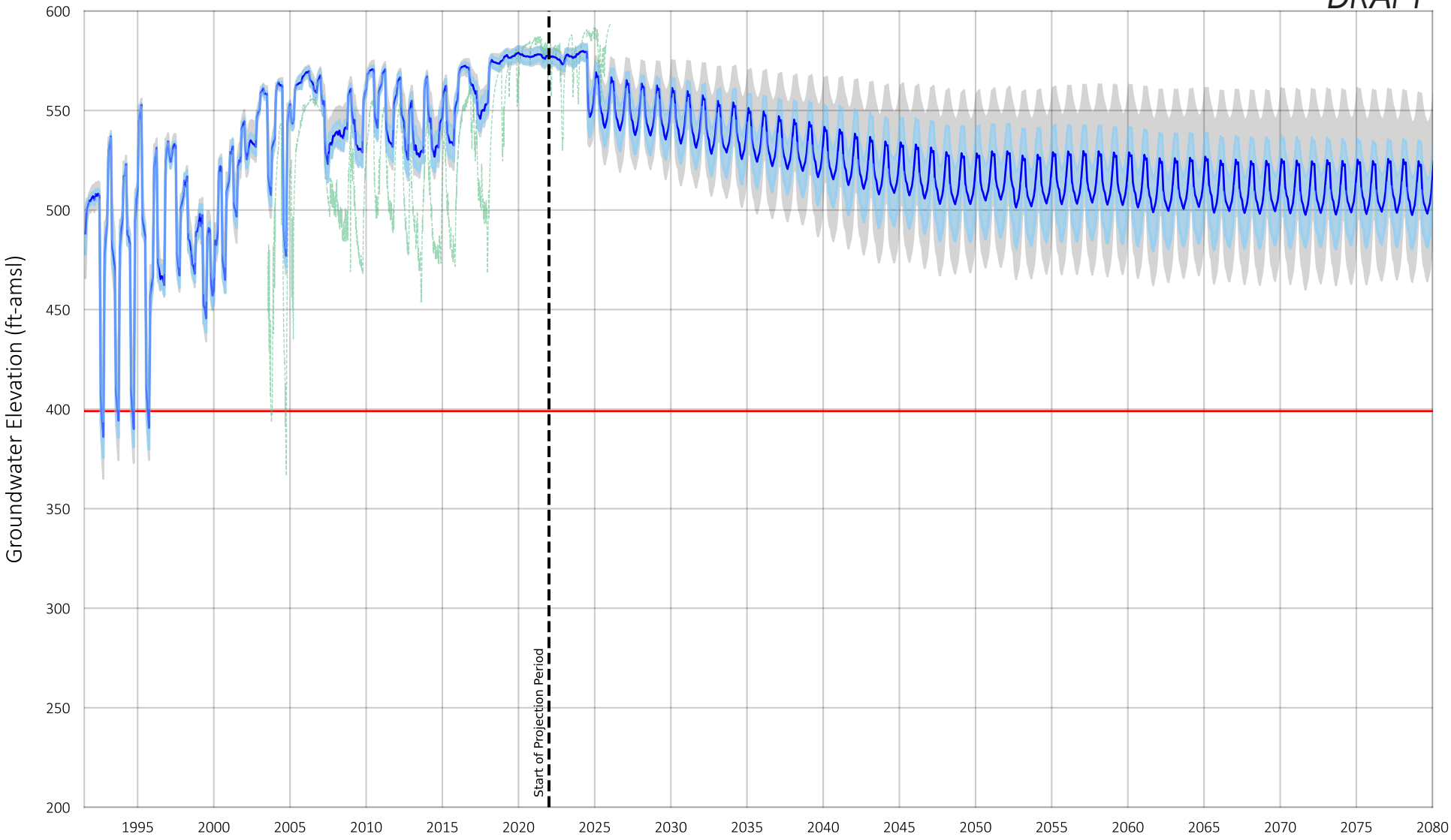
Prepared for: Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Southeast Area

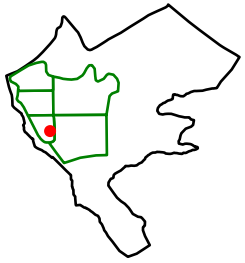
DRAFT

Figure 7-5

DRAFT



Well Location &
Areas of Subsidence Concern



Legend

- Guidance Level
- Measured Groundwater Elevation
- Likelihood Weighted Mean Groundwater Elevation
- Minimum/Maximum Range in Simulated Groundwater Elevations
- 20th to 80th Percentile of Simulated Groundwater Elevations

Prepared by:

WEST YOST
Water. Engineered.

Simulated Groundwater Levels
Well Name: AP-PA7
Well Owner: Chino Basin Watermaster
Screen Interval (ft-bgs): 438 - 448

Figure 7-6

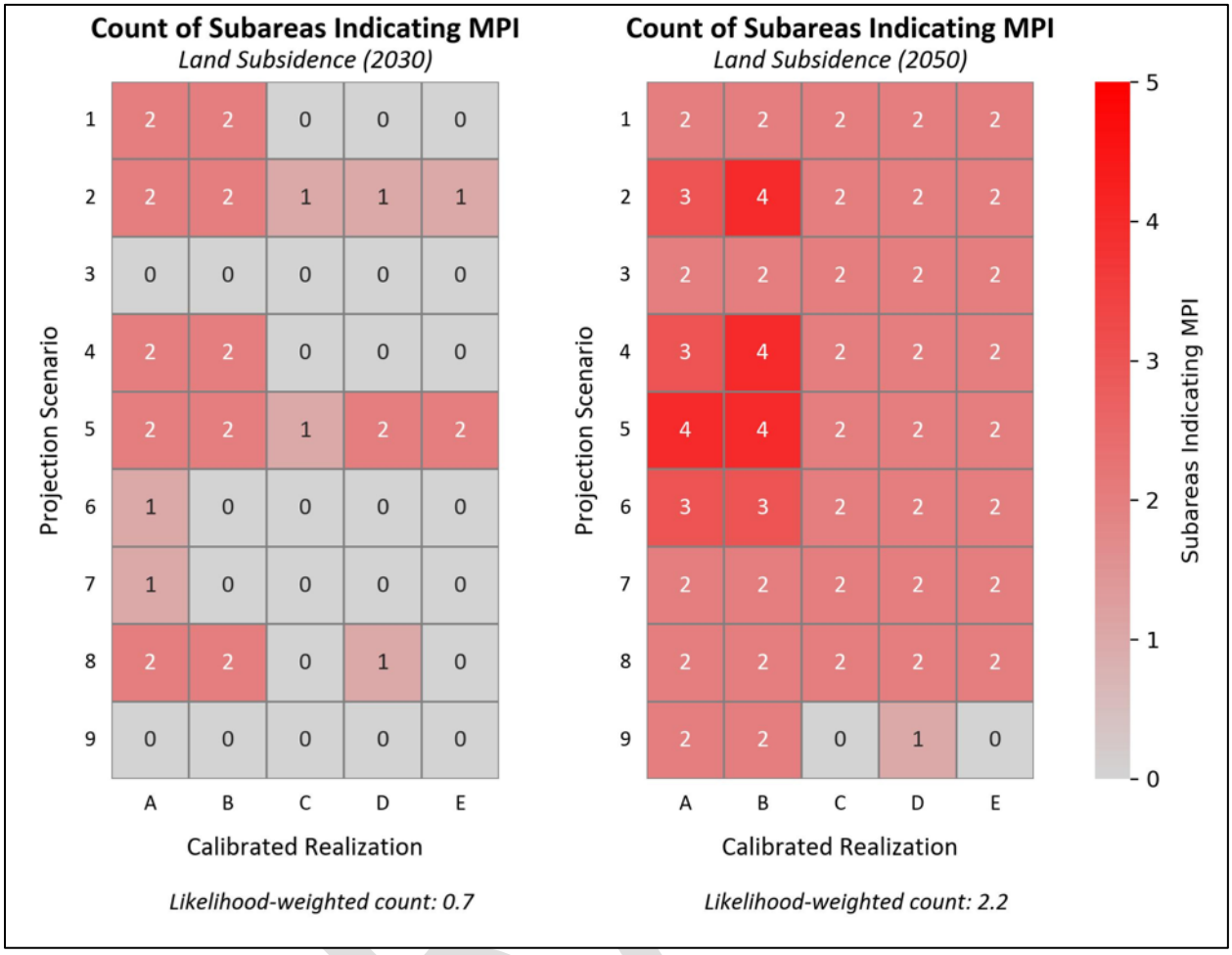


Figure 7-7. Count of Subareas Indicating MPI for Land Subsidence for the TSY Ensemble (FY 2030 and 2050).

Figure 7-7 shows that subsidence-related MPI increases from an average of 1.1 subareas in FY 2030 to 2.7 subareas in FY 2050. The degree of MPI varies between Projection Realizations, having the highest incidence in High Demand Scenarios (Projection Scenarios 4, 5, and 6) and the Hot/Dry Climate Scenarios (Scenarios 2 and 5).

7.2.1.4.1 Drivers of MPI for Land Subsidence

The primary drivers of MPI due to land subsidence are the extraction of water from managed storage (and high demand) and a hotter/drier climate.

Figure 7-8 shows the direct relationship between declining storage and the increasing MPI due to land subsidence, depicting the average change in storage from FY 2021-2050 versus the average number of subareas indicating MPI for land subsidence in FY 2050 for several subgroups of Projection Realizations.

- The High Demand Projection Realizations (Scenarios 4, 5, and 6) indicate MPI at an average of 3.3 subareas, compared to 1.5 subareas and 2.9 subareas for the Low Demand and Expected Demand Projection Realizations, respectively.

- The number of subareas indicating MPI increases by a factor of 0.6 (Low Demand) to 1.5 (Expected and High Demand) from FY 2030 to FY 2050.
- In all High Demand Projection Realizations, the balance of managed storage is zero by 2050, whereas the average managed storage is 380,000 af and 87,000 af in 2050 for the Low Demand and Expected Demand Projection Realizations, respectively.

Climate also drives subsidence-related MPI, but to a lesser degree than demand. The Hot/Dry Climate Projection Realizations (Scenarios 2, 5, and 8) indicate MPI at an average of 2.7 subareas, compared to 1.9 subareas and 2.3 subareas for the Cool/Wet and Average Climate Scenarios, respectively.

7.2.1.4.2 Potential Methods to Avoid or Mitigate MPI due to Land Subsidence

The analysis above indicates that the groundwater-level declines that could lead to subsidence-related MPI are mainly driven by future extractions of groundwater from managed storage. These extractions from managed storage may be accelerated under hot/dry climate conditions and/or greater than expected water demands, but the extractions from managed storage are predicted to be the primary driver of future land subsidence. As discussed below in Section 7.3.2, a changed Safe Yield ***is not*** the most effective method to mitigate the potential for subsidence-related MPI. Instead, the Watermaster has the ability to employ alternative methods to mitigate the potential for MPI due to land subsidence, which include: subsidence management planning and implementation; recharge master planning and implementation; and storage management planning and implementation for both local storage and regional storage and recovery programs. Each method is summarized below:

- **Subsidence Management**. The Watermaster implements a Court-approved, adaptive Subsidence Management Plan under the supervision and guidance of a technical advisory committee called the Ground-Level Monitoring Committee (GLMC). The Subsidence Management Plan includes an adaptive monitoring and reporting program and guidance for subsidence management in certain Areas of Subsidence Concern. For example, through an extensive aquifer-system monitoring and testing investigation, the Subsidence Management Plan includes a "guidance" groundwater elevation for the deep aquifer system in the Managed Area. Maintaining groundwater elevations above the "guidance" level will avoid future land subsidence. The Watermaster monitors and reports on groundwater elevations in the Managed Area, so the pumpers in this area can voluntarily modify their pumping patterns to keep groundwater elevations above the "guidance" level. Similar efforts could be employed in other Areas of Subsidence Concern to minimize or avoid subsidence-related MPI.
- **Recharge Master Planning**. The Watermaster periodically updates a Recharge Master Plan that designs, evaluates, and recommends recharge improvement projects with the goals to enhance basin yield, manage groundwater levels, and improve water quality. Future updates to the Recharge Master Plan could include projects that support groundwater levels in areas predicted to experience subsidence-related MPI. The Recharge Master Planning process also provides an avenue through which Watermaster can meet its Peace Agreement obligations to ensure sufficient recharge capacity and direct recharge in the Basin.[5]

[5] See Sections 5.1(e)(ii) and 5.1(e)(iii) of the Peace Agreement.

- **Storage Management**. The Judgment provides the Watermaster with the authority to manage and control storage for both local storage by the parties and regional storage and recovery programs. To guide Watermaster's efforts to manage storage pursuant to its obligations in the Judgment and Peace Agreement, the Watermaster has developed and periodically updates a Storage Management Plan. Future updates to the Storage Management Plan could include projects, programs, and/or provisions that support groundwater levels in areas predicted to experience subsidence-related MPI. In addition, the Storage Management Plan can help facilitate Watermaster to meet its Peace Agreement obligations to evaluate MPI due to transfers from storage.[6]

7.2.2 Pumping Sustainability

Pumping sustainability is the ability to produce groundwater from a specific well at a desired pumping rate, given the groundwater level at that well, the well construction details, and the current pumping equipment. Pumping sustainability thresholds (PSTs) are groundwater levels that are defined by the producer for each well. Watermaster collects this information from the larger Appropriative Pool parties and the Chino Basin Desalter Authority (CDA). The Appropriative Pool parties typically specify PSTs as an elevation representing a depth above the pump setting elevation of a well (e.g., 40 feet above the pump setting elevation). Groundwater pumping at a well is assumed to be sustainable if the groundwater elevation at that well remains above the PST. If the projected groundwater elevation declines below (exceeds) the PST, the well owner will either lower the pumping equipment in their well, reduce pumping, or a combination of the two. The PST is the site-specific MPI threshold for pumping sustainability.

7.2.2.1 Evaluation Criteria and Methods

MPI can be defined by a combination of the (1) number of impacted wells (i.e., wells that exceed the PST), (2) duration of impact, and/or (3) magnitude of impact (i.e., the difference between the projected groundwater level and the PST) within each management zone, area, or subarea. Because the concept of pumping sustainability is subjective and varies among different parties, it is necessary for Watermaster to develop a comprehensive definition of the pumping sustainability MPI thresholds.

7.2.2.1.1 Party Input to Develop Site-Specific and Subarea MPI Thresholds

The parties have discretion as to their individual definitions of pumping sustainability. Therefore, as part of this process, Watermaster requested responses to the following questions from 12 of the Appropriative Pool parties for which PSTs are defined[7]:

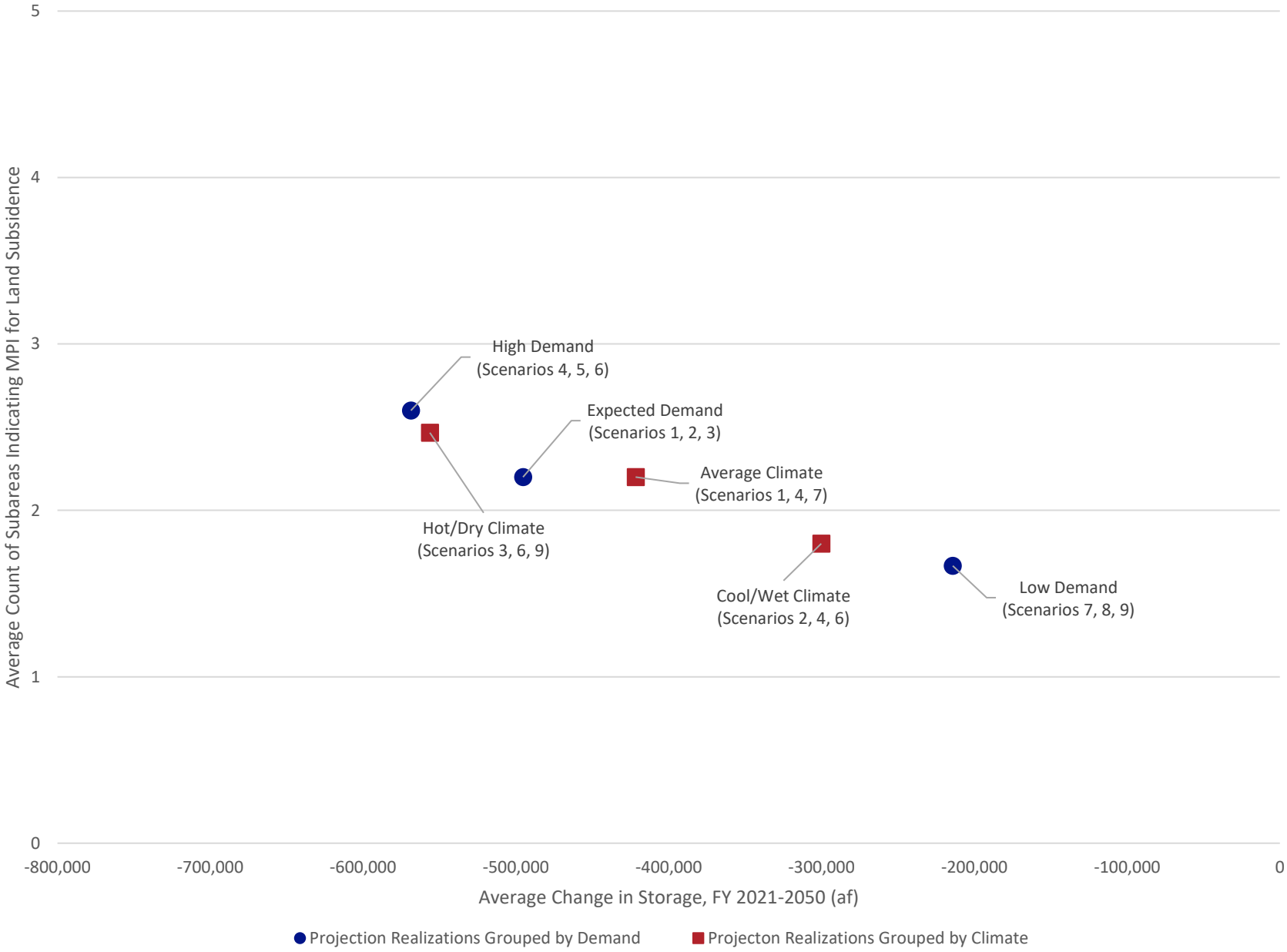
1. How many of your wells need to fall below the sustainability metric[8] before it becomes difficult to pump the desired amount of groundwater?
2. How long (in months or years) must the groundwater level at a single well remain below the sustainability metric before it becomes challenging to pump the desired amount of groundwater?

[6] See Section 5.1(e)(iv) of the Peace Agreement.

[7] Watermaster's Engineer contacted the Chino Desalter Authority, the cities of Chino, Chino Hills, Ontario, Pomona, and Upland, Monte Vista Water District, Jurupa Community Services District, Fontana Water Company, Cucamonga Valley Water District, Golden State Water Company, and San Antonio Water Company.

[8] This report uses the term "thresholds" to describe pumping sustainability, whereas the term "metrics" has been used historically by Watermaster and was used for the information request.

Figure 7-8. Change in Storage and Prevalence of MPI for Land Subsidence



Watermaster contacted the applicable Appropriative Pool parties to (1) answer the two questions above and (2) update or confirm information on their party's active production wells in the Chino Basin. Other parties (e.g., the State of California) were also invited to provide input related to the PSTs. A summary of the feedback from the parties is as follows:

- **Adaptive Management**: The parties employ various strategies to maintain production, such as adjusting pump settings, adding extensions, and regularly rehabilitating wells.
- **Uncertainty**: The parties indicated significant uncertainty in predicting the exact impact and duration of wells falling below sustainability thresholds. Challenges contributing to this uncertainty include water quality, demands, and availability of other supplies.
- **Mitigation Efforts**: The parties discussed measures like system resiliency and redundancy, to ensure continued pumping operations and groundwater supply.
- **Duration Below PST**: The time a well can remain below the PST before it becomes challenging to pump groundwater varies widely. Some parties indicate that wells can operate below the PST for years with careful monitoring, while others suggest that concerns arise within months, especially under different hydrologic conditions. The exact duration is often uncertain due to numerous influencing factors.

Table 7-2 documents the feedback received from the parties that responded to the request regarding pumping sustainability. Figure 7-9 shows the wells in the Chino Basin that have PSTs.

7.2.2.1.2 Subarea Threshold for MPI Due to Pumping Sustainability

The subareas for evaluating pumping sustainability are the wellfields for each of the AP parties for which PSTs are defined. The diversity of responses to questions regarding PSTs suggests that applying a single, generalized threshold to assess the risk of MPI due to pumping sustainability challenges may not be appropriate. Consequently, we evaluate the risk of MPI for the 12 retail AP parties using one of two approaches: (1) the party's individual definition of pumping sustainability, based on their responses to the above questions, or (2) if a party did not provide a clear response, by assessing the proportion of their well field that exceeds the PST for at least five consecutive years. Five years was chosen to acknowledge the uncertainty in simulated groundwater levels and ensure that short-term or anomalous conditions do not skew the assessment of sustainability.

Table 7-2 shows how the party feedback was interpreted to define criteria to evaluate MPI due to pumping sustainability for each party. The criteria include the minimum number of wells that exceed the PST and the consecutive time over which the wells must exceed the PST for MPI to occur. MPI for a party is identified if 50 percent or more Projection Realizations are determined to cause MPI based on the party-specific definition.

DRAFT

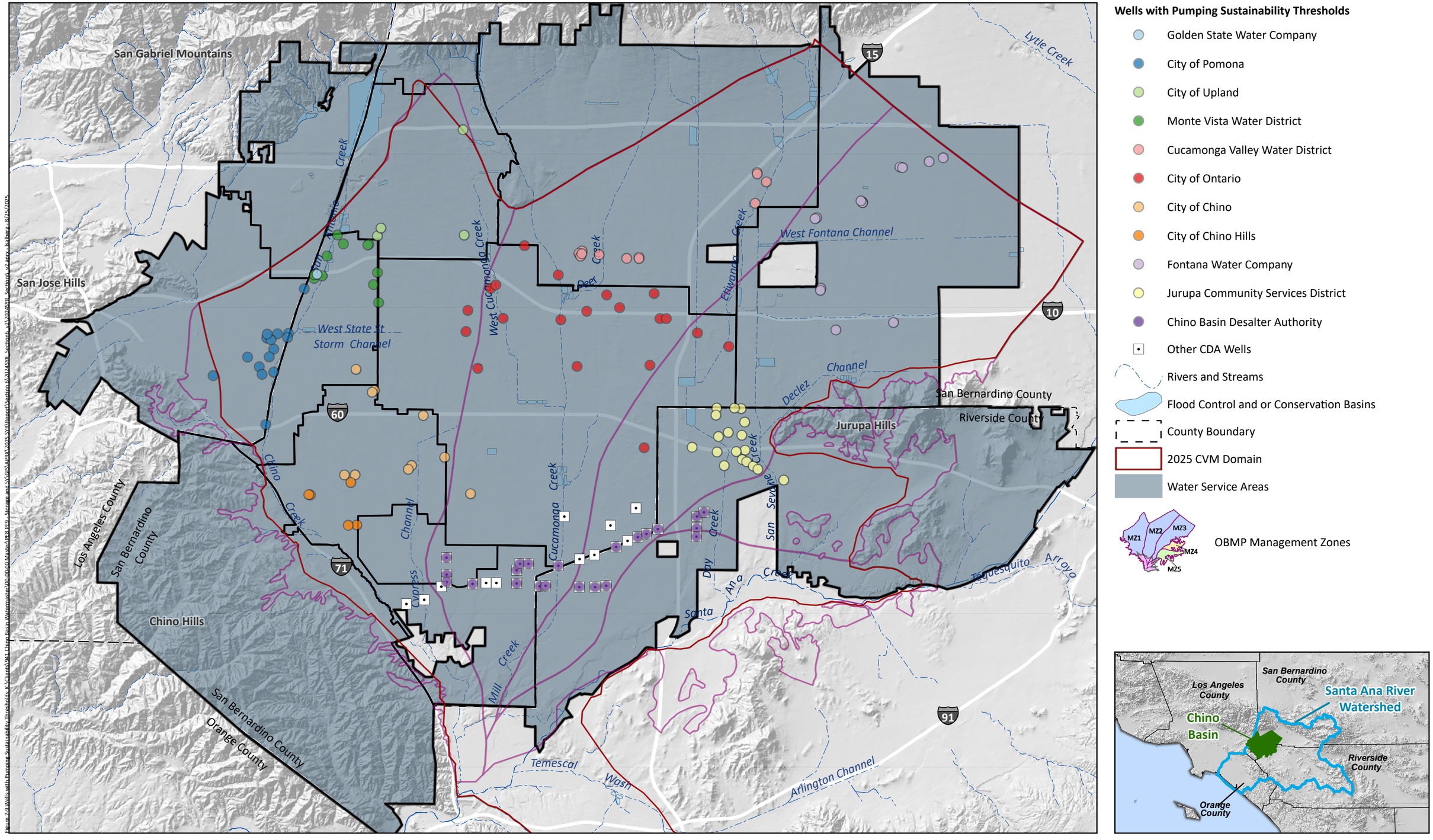


Figure 7-9 Wells with Pumping Sustainability Thresholds K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PER PF9 - Storage and SY\GIS\APRX\2025 SYR\Report\Section 6\2024SYR_Section6_v2\2024SYR_Section6_v2.aprx - lsalberg - 8/25/2025

Prepared by:

WEST YOST

N

0 2 4 Miles

0 3 6 Km

Page 462

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Wells with Pumping Sustainability Thresholds

DRAFT

Figure 7-9

Table 7-2. Summary of Party Responses to Pumping Sustainability Threshold Information Request

Party	Response to Questions[a]		MPI Threshold		
	How many of your wells need to fall below the sustainability metric before it becomes difficult to pump the desired amount of groundwater?	How long (in months or years) must the groundwater level at a single well remain below the sustainability metric before it becomes challenging to pump the desired amount of groundwater?	Number of wells with PST	Minimum number of wells exceeding PST in one year	Number of consecutive years of exceedance to indicate MPI
CDA	CDA has a number of wells at the Chino II facility that fall below the sustainability metric. Current condition puts most of the Chino II wells below the +25 ft. pump submergence, if there is a further drop in water levels, CDA will be required to reduce future production in those wells. To date, we've experienced as much as a 46 ft reduction in static water levels, which has resulted in a loss of approximately 5,745 gpm since the wells were drilled.	It's difficult to say a time period. The sustainability metric is 25 feet is the preferred amount of pump submergence. CDA has been operating some wells with less than the 25 feet of submergence for years. This requires that you pay more attention to the pumping level and only becomes a problem when the pumping level gets within a few feet of the pump.	22	4	5
Chino	Currently having two out of three wells that provide water to their respective water treatment facilities fall below the sustainability metric would make it difficult to pump the desired amount of groundwater to effectively and efficiently operate the water treatment system.	One well may not significantly impair our ability to operate our water treatment systems. However, I suppose if a single well was unable to produce groundwater for a considerable amount of time, a year or more, then our operations may be impacted. This would be due to the fact that maintenance or repair may need to be performed on the other remaining wells during this time.	10	3	3
Chino Hills	Unknown at this time, as wells have not been on for a few years. Use prior information.	Unknown at this time, as wells have not been on for a few years. Use prior information.	5	2	5
CVWD	CVWD's pumping sustainability is determined by production strategy, historical water levels, and pump performance. CVWD's production strategy involves estimating the amount of water needed to fulfill expected demands at a specific point in time, accounting for availability of water sources and cost to produce. Therefore, loss of any supply means CVWD must make it up elsewhere. For example, if imported water were not available, any loss of Chino Basin well supply would be considered "falling below the sustainability metric". An analysis of historical water levels across CVWD's Chino Basin wells showed that over the last 10 years, water levels have changed (in either direction) by 10 feet. To be conservative, CVWD doubled that number. The spreadsheet shows the sustainability metric as pump setting + 20 feet.	This depends on the well and hydrologic scenario. If water levels and pump performance were dropping during "normal" conditions, CVWD would be concerned at 6 months. However, during a drought, CVWD would track monthly water levels.	12	3	5
FWC	- We currently have 15 Chino basins wells two of which are not currently in service because they are not yet completed. - In addition to the two new wells that are not yet completed, we also have three wells F7A, F24A,F24A, and F31A that are impacted by Nitrate and/or perchlorate. This makes their availability difficult to rely on. - These wells are not equipped with well head treatment. - F17B has been out of service for some time and still needs additional work. - That would leave us with 8 wells remaining that could be utilized to meet system demands. - There are many factors that come into play when determining how many wells can fall below the sustainability metric and for what duration before it would be detrimental to meeting our systems demands. - Reviewing our 5, 10, and 15 year peak averages I think we would be considerably impacted if we lost three of the remaining eight wells especially during our peak months. The peak conditions can last 3-4 months a year.		13	3	5
JCSD	The simple answer is 1. The long answer depends on what well. Example is well 25 loses production, we will lose a blend and be in a bad spot. Well, 18 loses production, and it's just a loss in production.	Here is the challenge. We have been able to lower our pumps to mitigate the impacts we have seen. So, we are currently operating below the levels we show as impacted. Because the basin water levels in our area are decreasing, we are impacted as a district. This is also impacting our ability to drill more wells and increase production in these areas. To simplify, I don't have a time. It is more about supply than specific well.	18	1 (JCSD Well 25)	5
MVWD	Perhaps 3 wells falling below the metric would make things difficult, but this is just a guess at best. There are too many unknown variables to provide an accurate answer.	There are too many unknown variables to provide an accurate answer.	11	3	5
Ontario	Ontario does not foresee pump sustainability issues and can always drop the pump/add extension to produce the desired amount of groundwater. Furthermore, we maintain resiliency and redundancy of our system and rehabilitate wells on a regular schedule. If wells are not producing, they will be abandoned, and other wells can be utilized to meet demand.	Ontario has not had pump sustainability issues from a water elevation standpoint, but rather geologic limitations requiring the wells to be rehabilitated. A few wells have operated near the pump setting for several years without degradation of performance or causing cavitation.	20	6	5
Pomona	One well.	One month. This is based off our need to purchase imported water.	15	1	1
Upland	Currently the Currently the City of Upland has three pumps that are producing water from the Chino Basin. To make it difficult to pump the desired amount of groundwater from the Chino basin all three wells would need to fall below the sustainability metric elevation.	- Well 7A would need to fall below the sustainability metric for 2 months to cause challenges to pumping the desired amount of ground water. - Well 8 would need to fall below the sustainability metric for 10 months to cause challenges to pumping the desired amount of ground water. - Well 20 would need to fall below the sustainability metric for 10 months to cause challenges to pumping the desired amount of ground water.	4	3	5

(a) The TM uses the term "thresholds" to describe pumping sustainability, whereas the term "metrics" has been used historically by Watermaster, and was used for the information request. Watermaster is transitioning to "thresholds" because it is considered a more accurate and descriptive term.

7.2.2.2 Results

As an initial assessment of the extent of MPI due to pumping sustainability, a snapshot of pumping sustainability was taken at summer conditions at the end of the decade (July 1, 2030) and when managed storage approaches zero for many Projection Realizations (July 1, 2050). Figures 7-10 through 7-20 show these snapshots of conditions in FY 2030 and 2050 for each of the 11 AP retailers for which PSTs were developed. Each figure shows the following:

- Active pumping wells in the TSY Ensemble, with symbol sizes indicating the likelihood-weighted volume of pumping for that year. For the party featured in the figure, all wells are shown, even those that are not projected to be pumping in any scenario of the TSY Ensemble.
- The colors of the featured party's wells indicate the difference between the likelihood-weighted average groundwater elevation at that well compared to its PST. Red colors indicate wells that have water levels below the PST; blue colors indicate wells that have water levels above the PST.
- A "box-and-whiskers plot" that characterizes the distances above/below the PST for all wells by Projection Scenario (for all calibrated CVM realizations). Each dot represents one well in one Projection Realization. The red percentage at the bottom of the plot indicates the likelihood-weighted average percentage of groundwater elevations at all wells that are below the PST.
- A "heat map" of MPI by Projection Realization. Red squares indicate MPI associated with that Projection Realization.

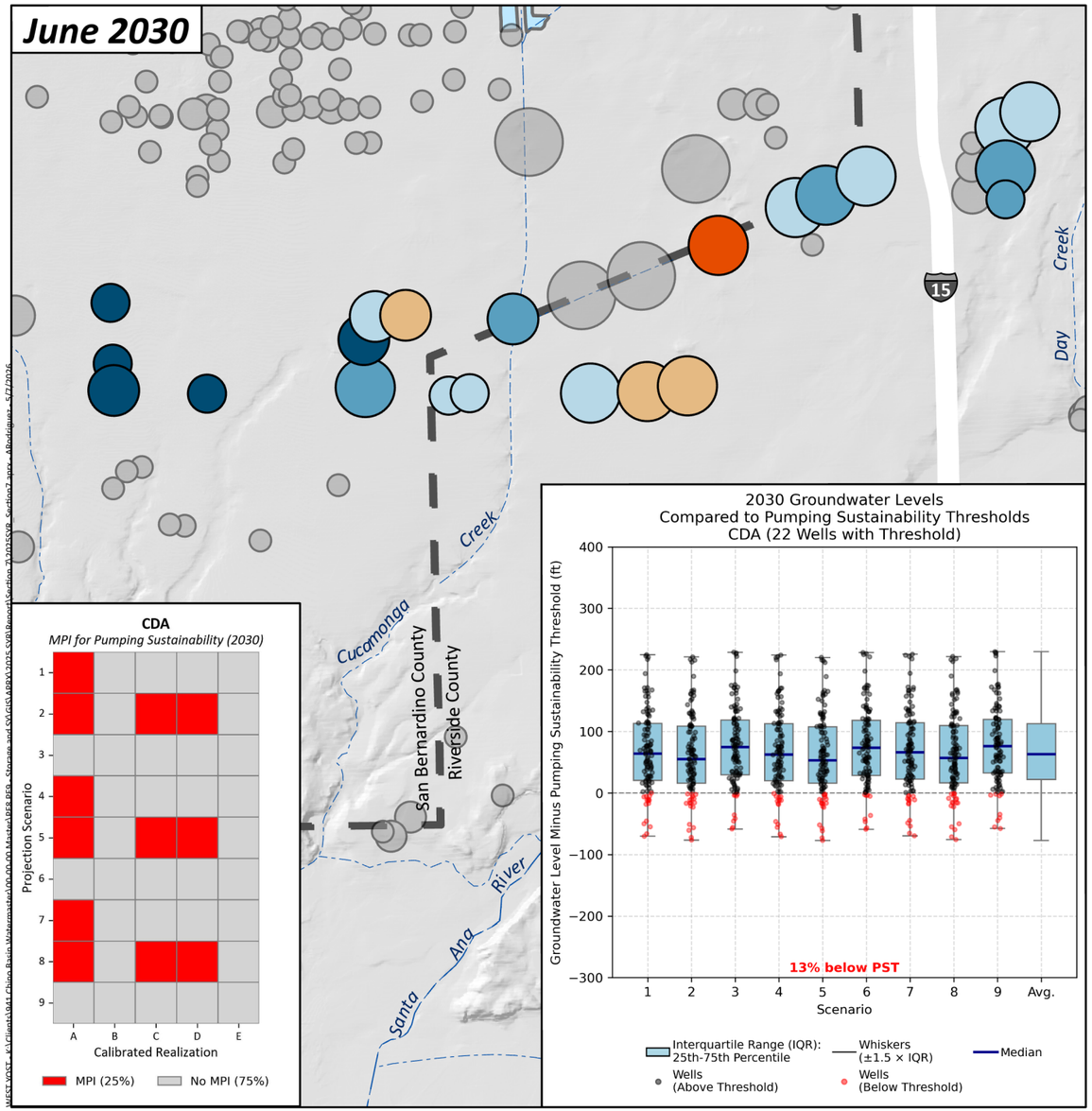
The likelihood-weighted percentage of Projection Realizations that meet the MPI threshold for pumping sustainability in FY 2050 for each subarea is:

- **CDA: 83 percent**
- Chino: 0 percent
- Chino Hills: 0 percent
- CVWD: 3 percent
- FWC: 33 percent
- GSWC: 6 percent
- **JCSD: 65 percent**
- MVWD: 0 percent
- Ontario: 0 percent
- **Pomona: 57 percent**
- **Upland: 100 percent**

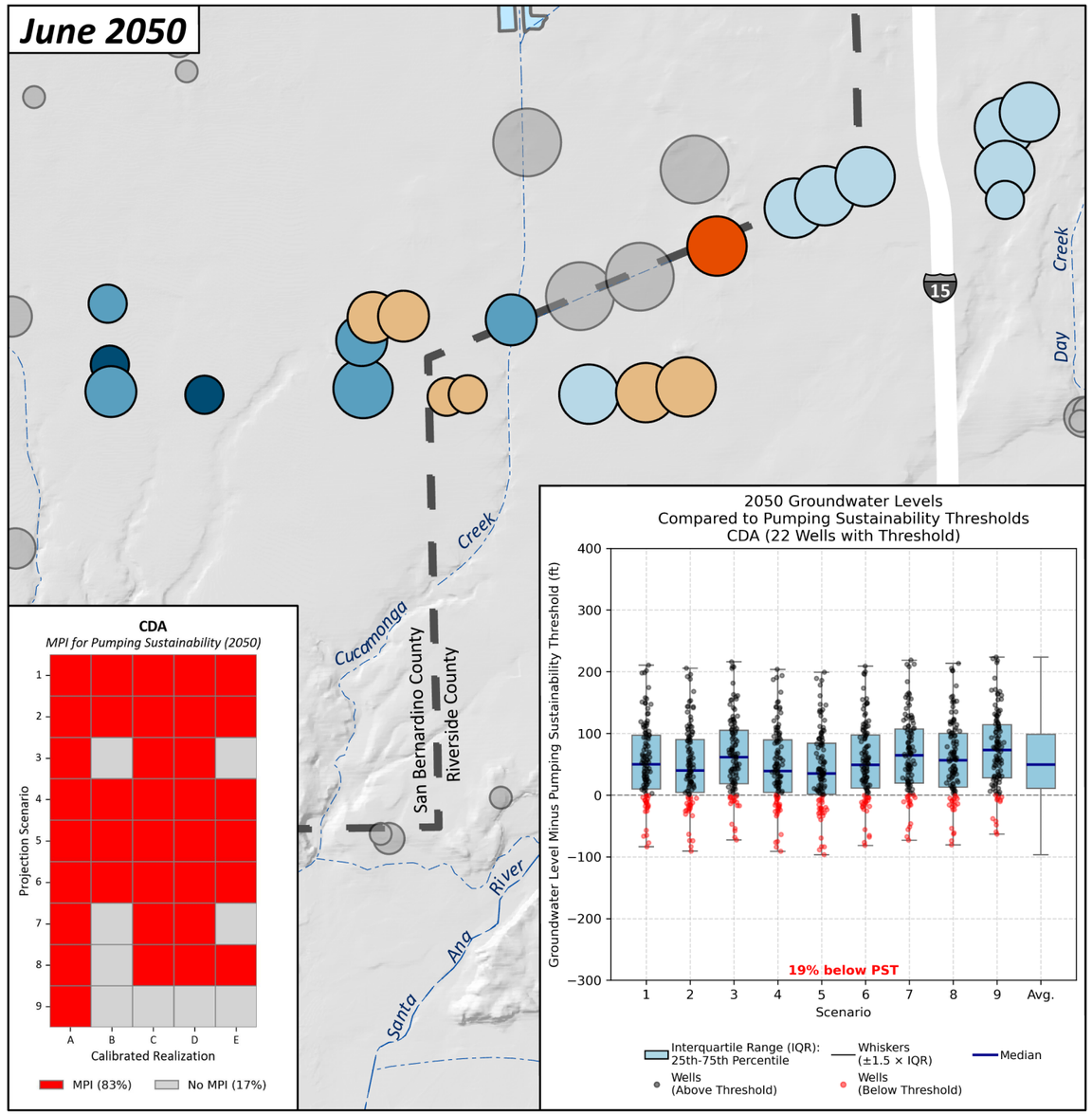
CDA, **JCSD**, **Pomona**, **and Upland** have 50 percent or more likelihood-weighted Projection Realizations meeting the subarea MPI threshold for land subsidence in FY 2050.

DRAFT

June 2030



June 2050



0 0.5 1 Miles
N
0 1 2 Km

Prepared by:
WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Pumping Sustainability Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

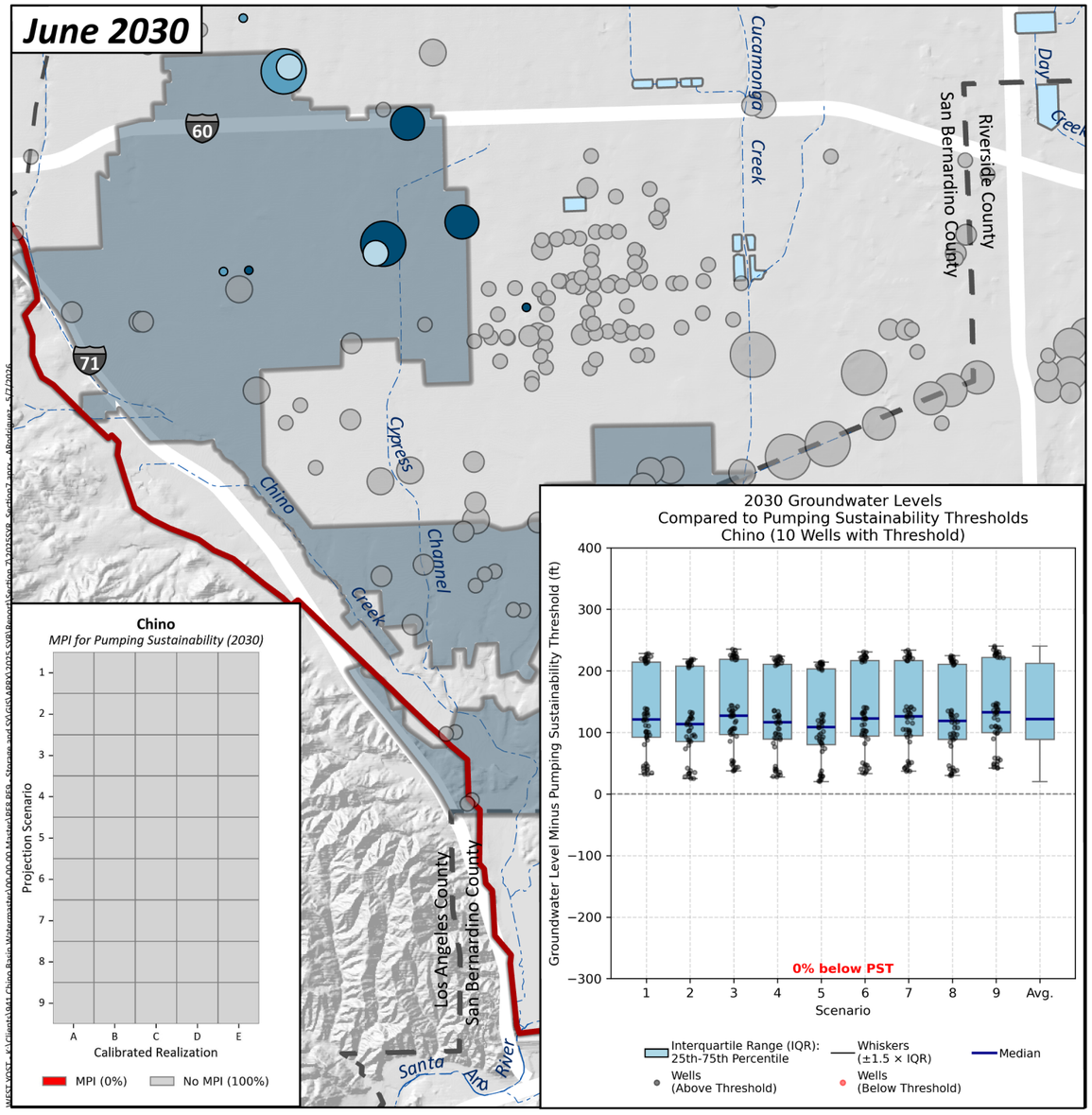
- Other Wells
- 2025 CVM Domain
- Rivers and Streams
- Flood Control and/or Conservation Basins

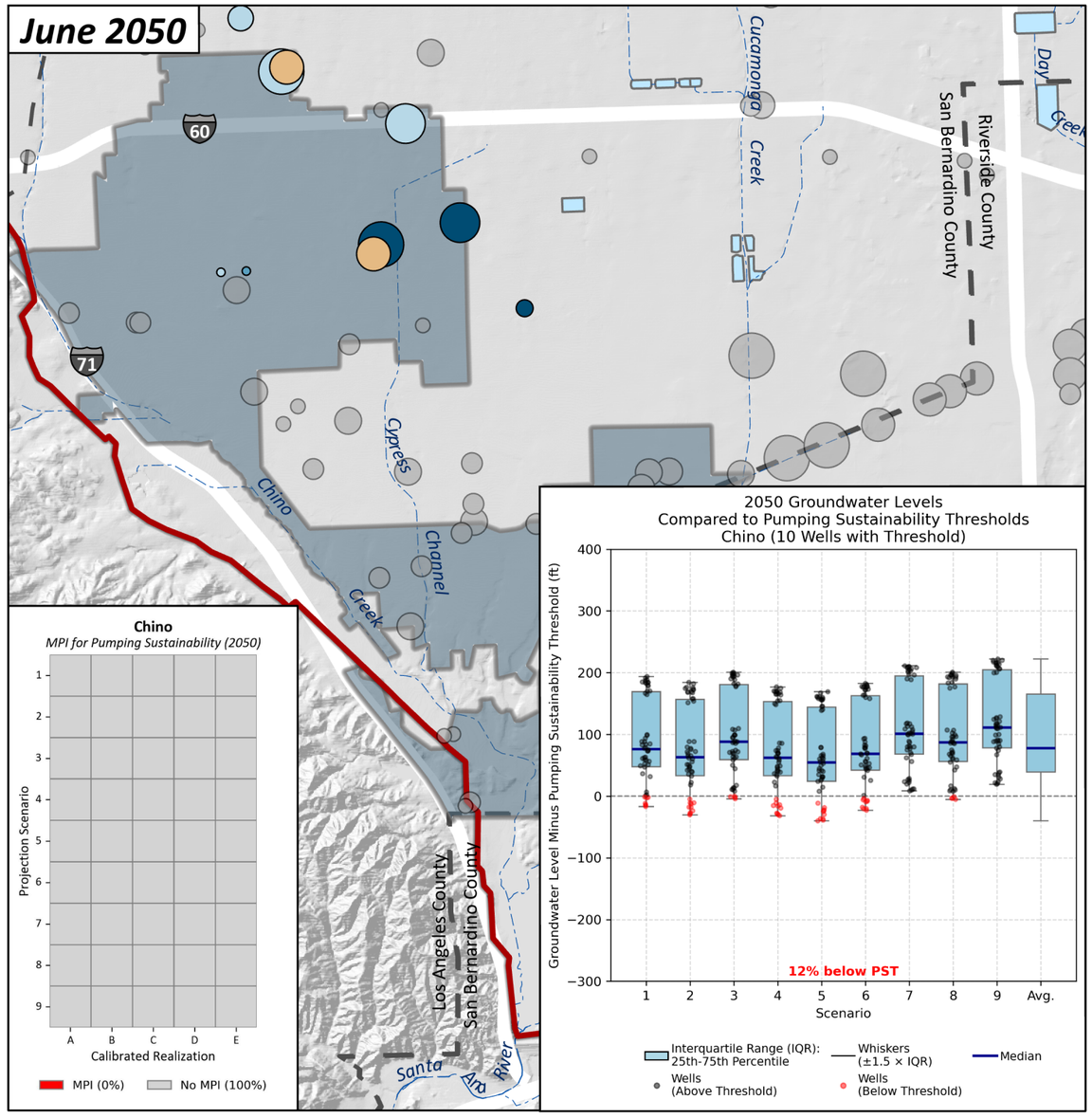
Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Chino Basin Desalter Authority

DRAFT

Figure 7-10





0 0.5 1 Miles

0 1 2 Km

N

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- City of Chino
- Rivers and Streams
- Flood Control and/or Conservation Basins

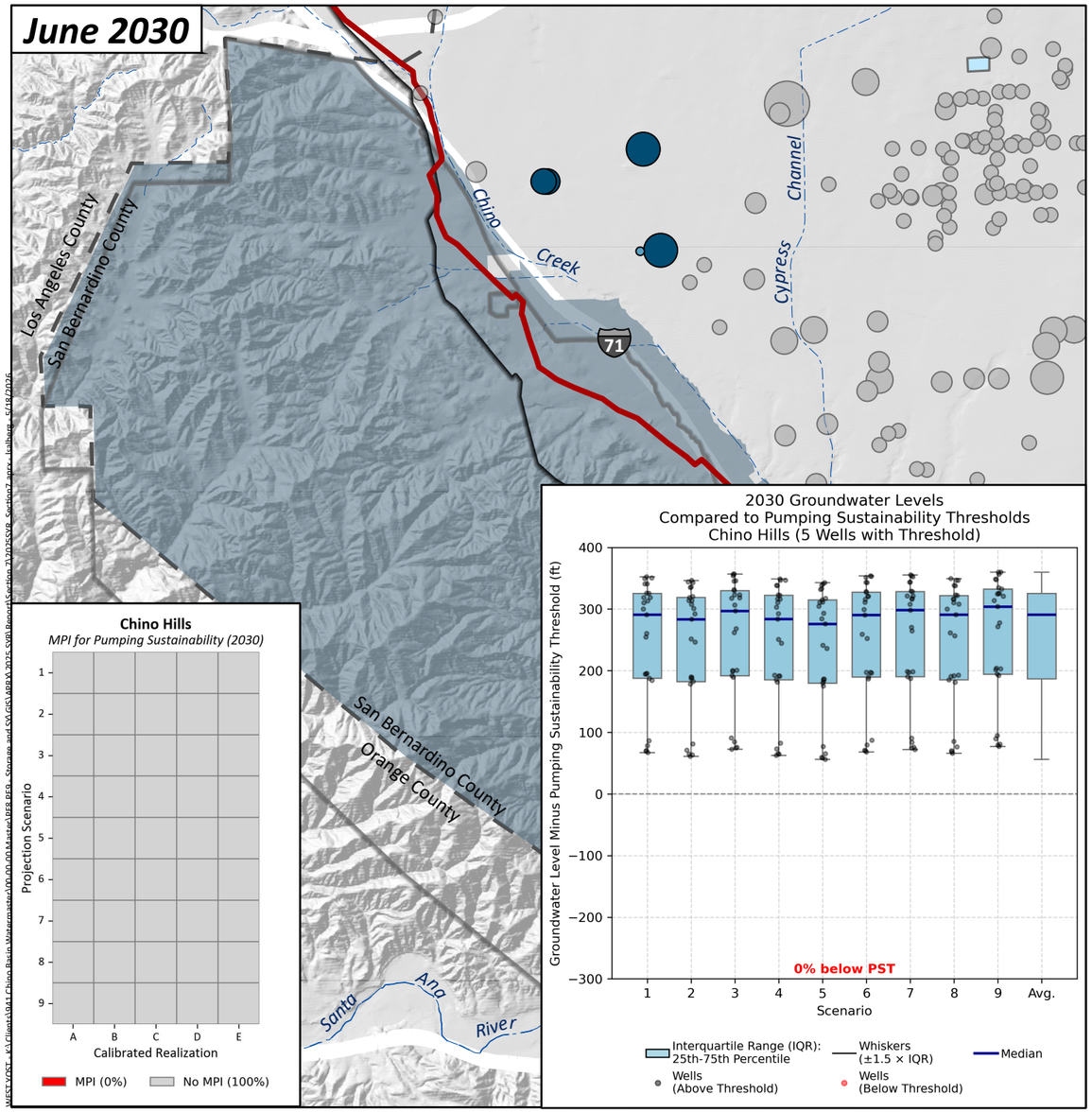
Prepared by: WEST YOST Water. Engineered.

Prepared for: **Chino Basin Watermaster**
2025 Safe Yield Reevaluation

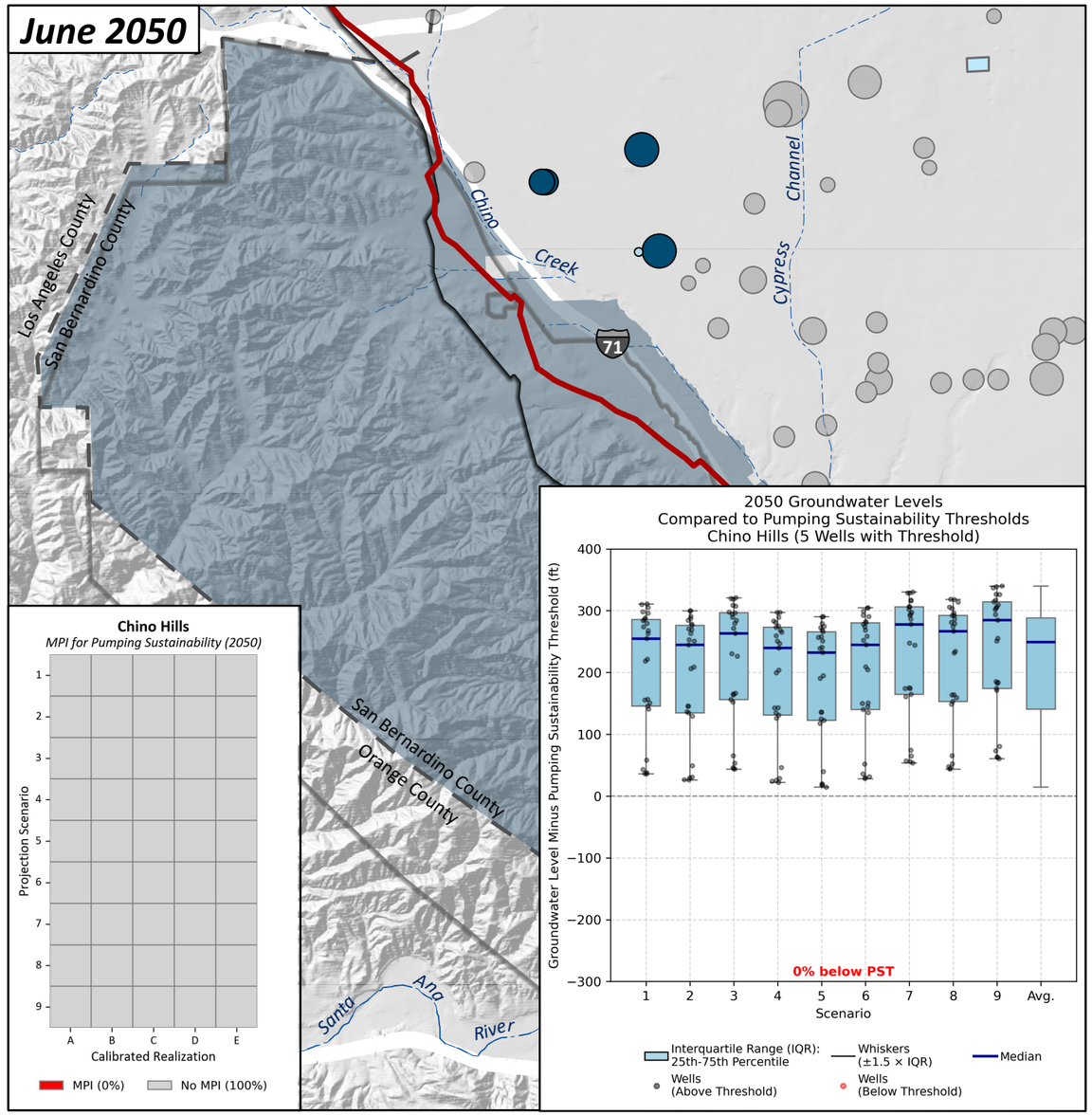
Assessment of MPI due to Land Subsidence
2030 and 2050
City of Chino

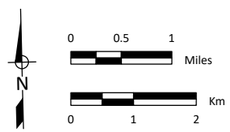
DRAFT **Figure 7-11**

June 2030



June 2050





Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- City of Chino Hills
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

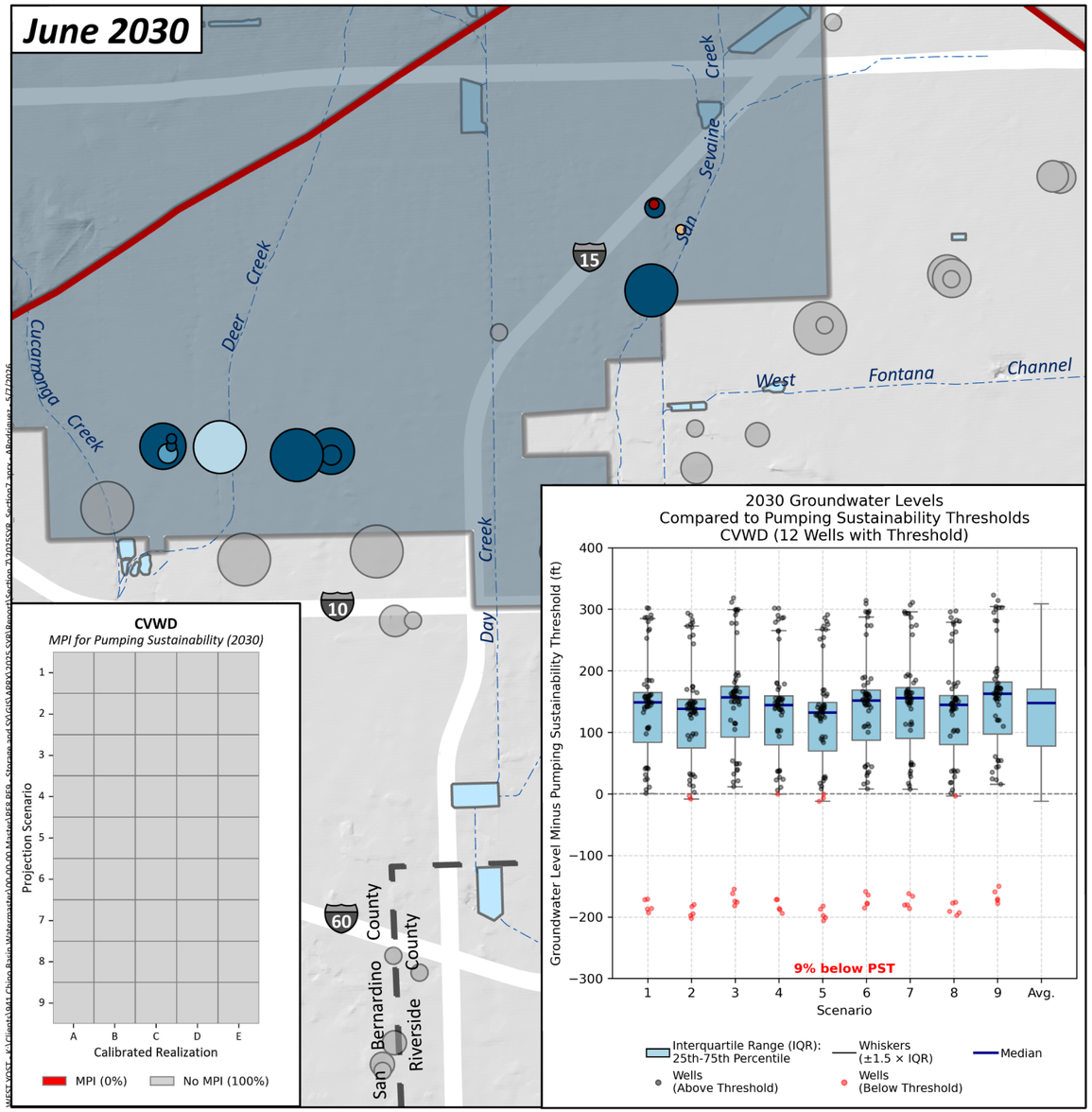
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
City of Chino Hills

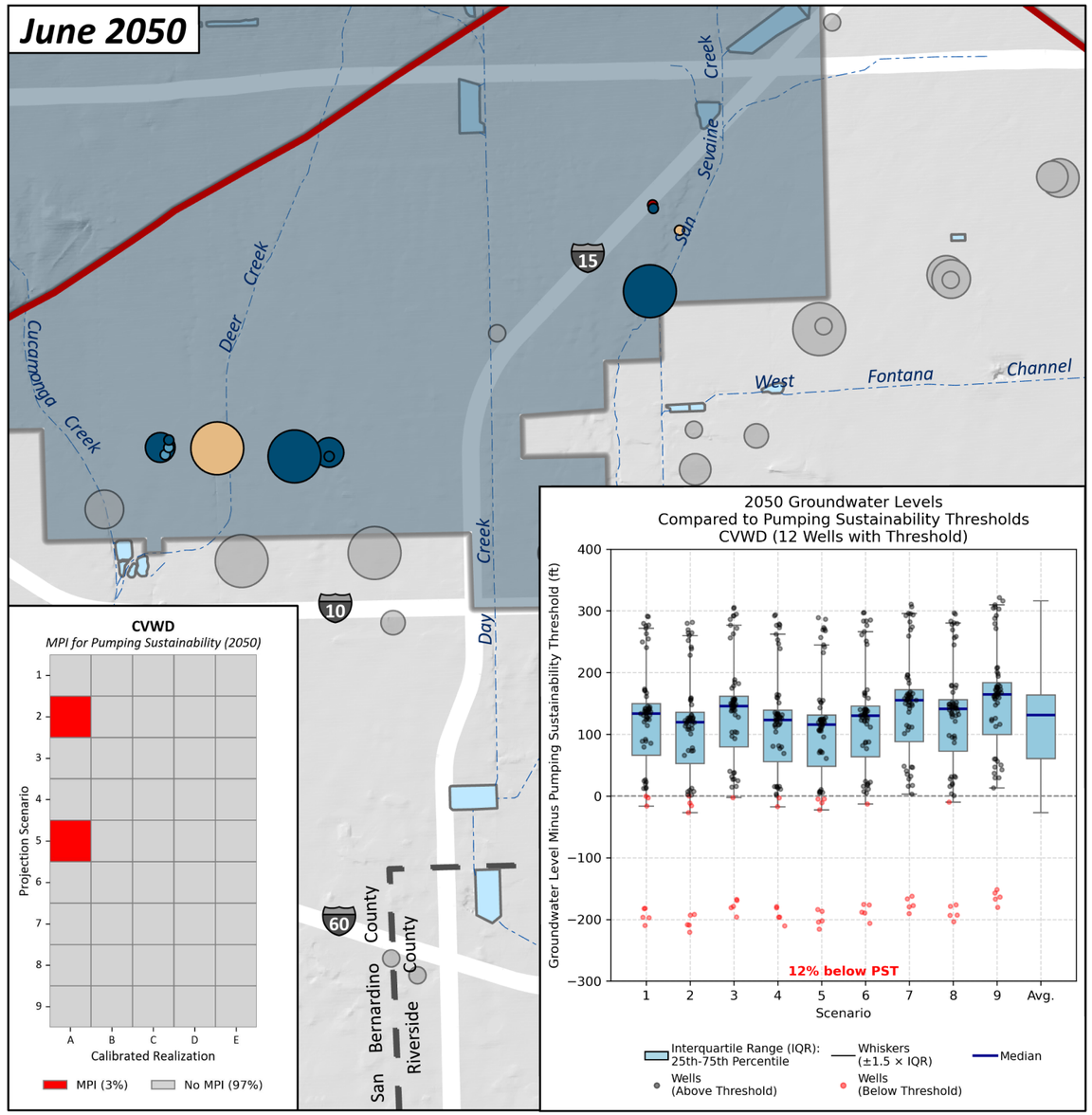
DRAFT

Figure 7-12

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Cucamonga Valley Water District
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

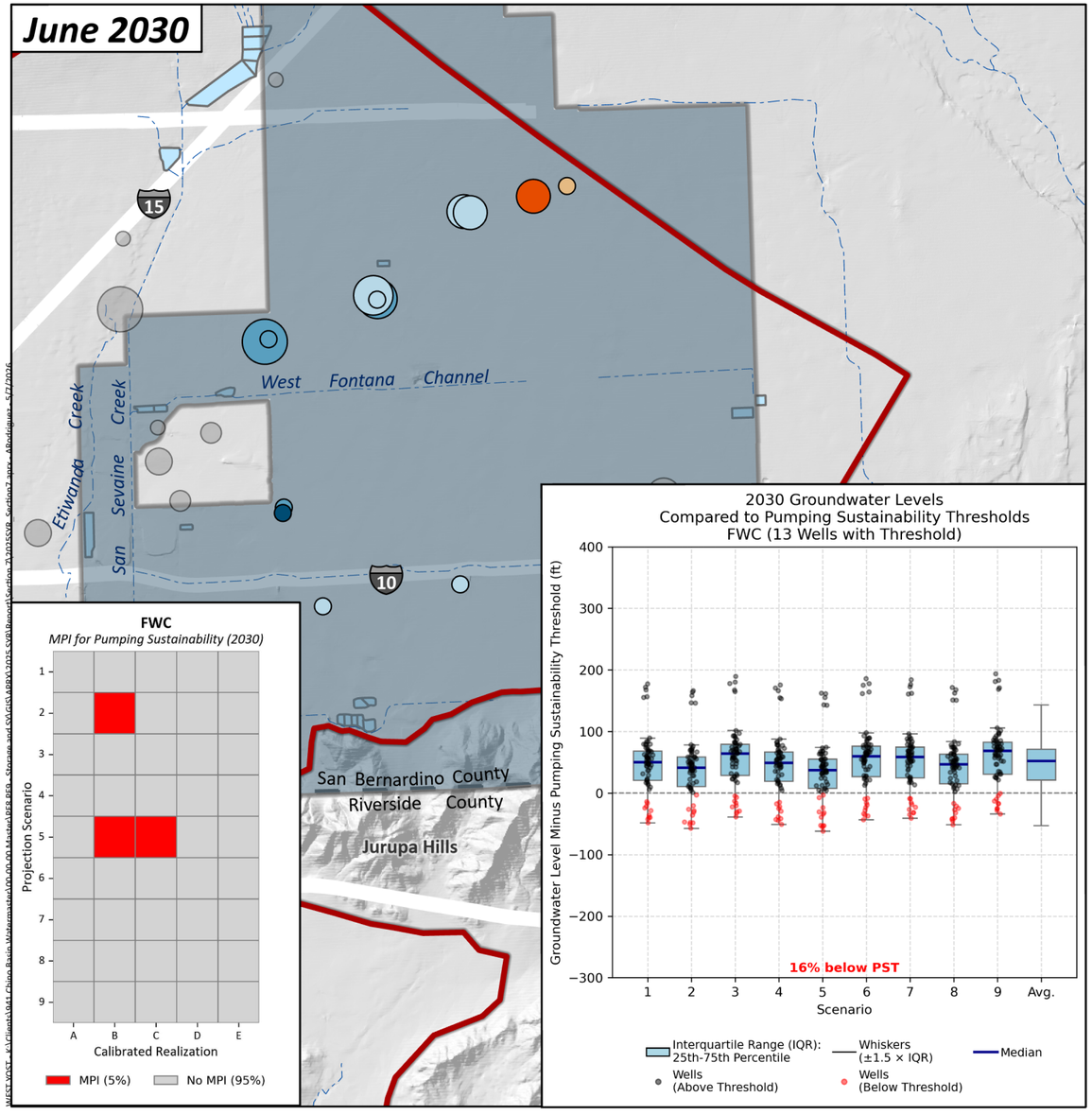
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence 2030 and 2050
Cucamonga Valley Water District

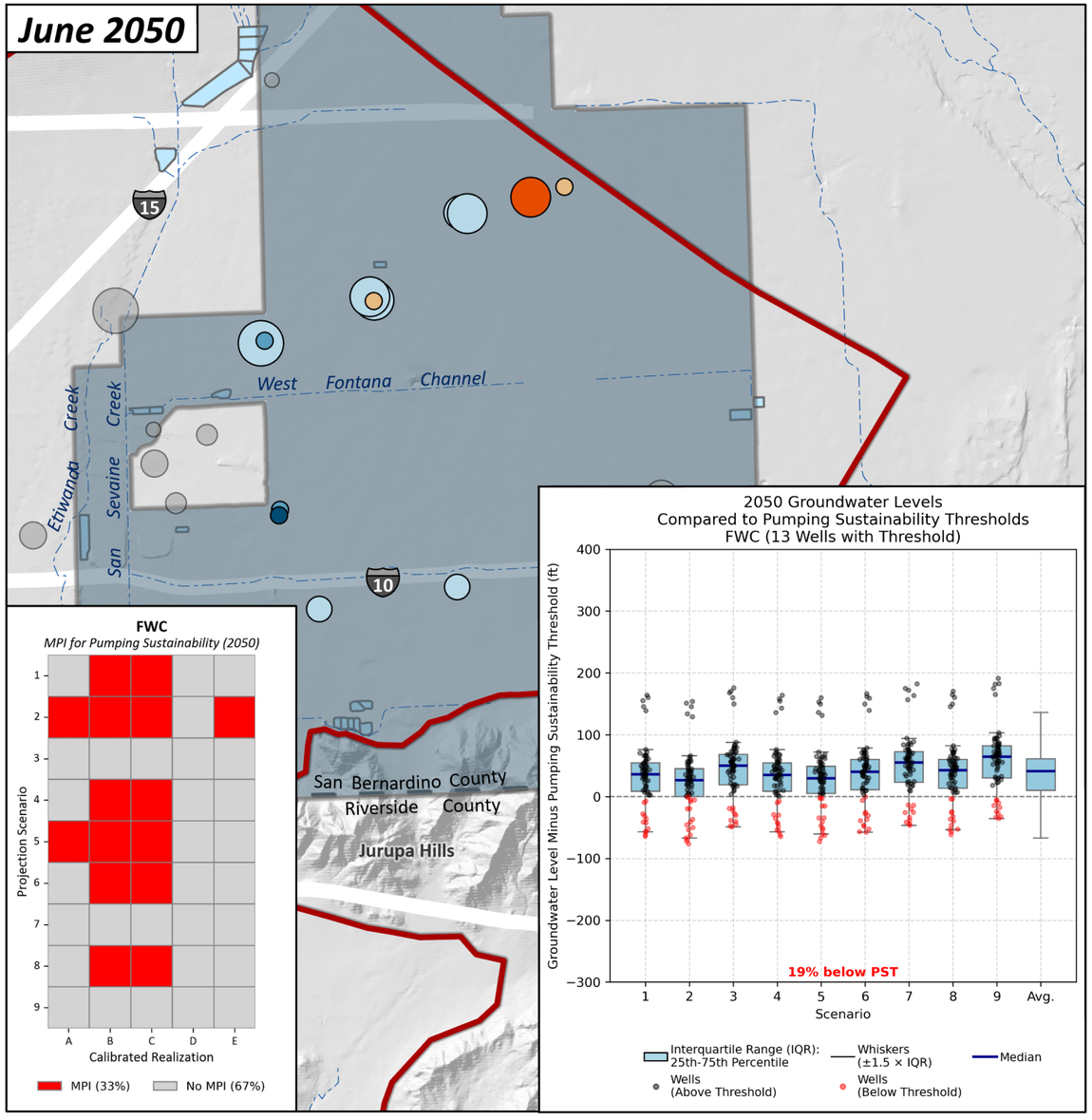
DRAFT

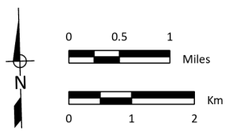
Figure 7-13

June 2030



June 2050





Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Fontana Water Company
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

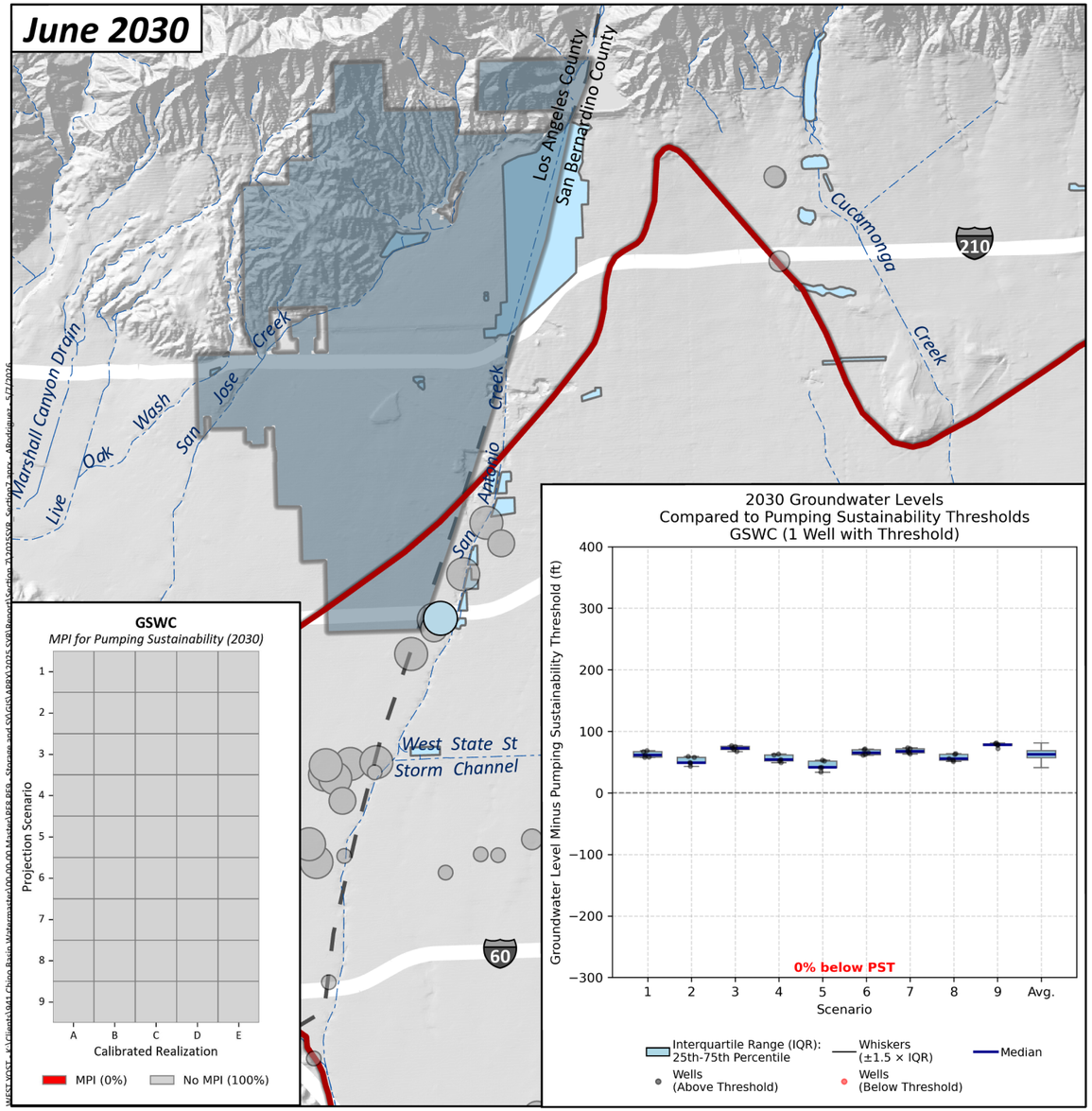
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Fontana Water Company

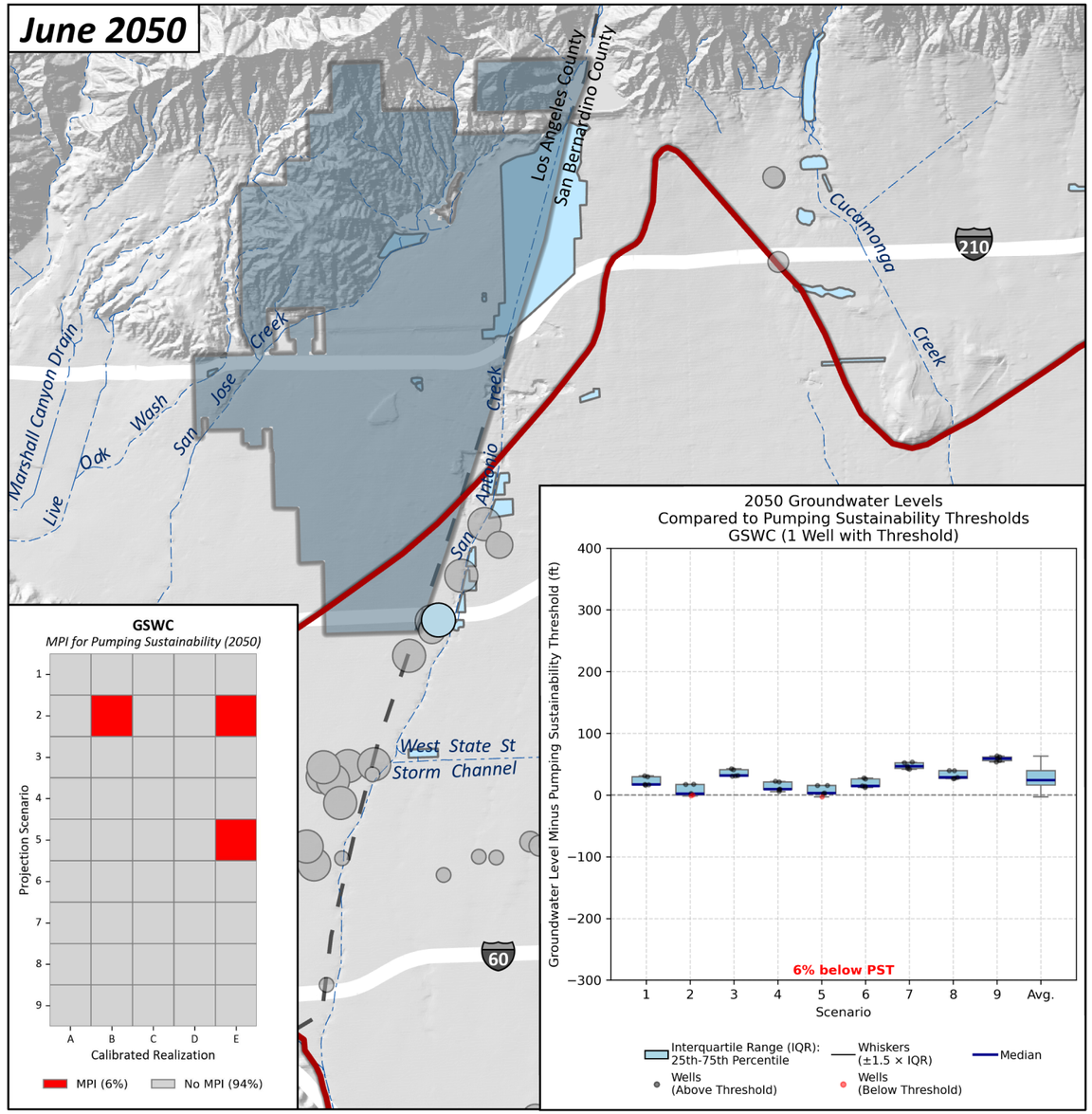
DRAFT

Figure 7-14

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Golden State Water Company
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

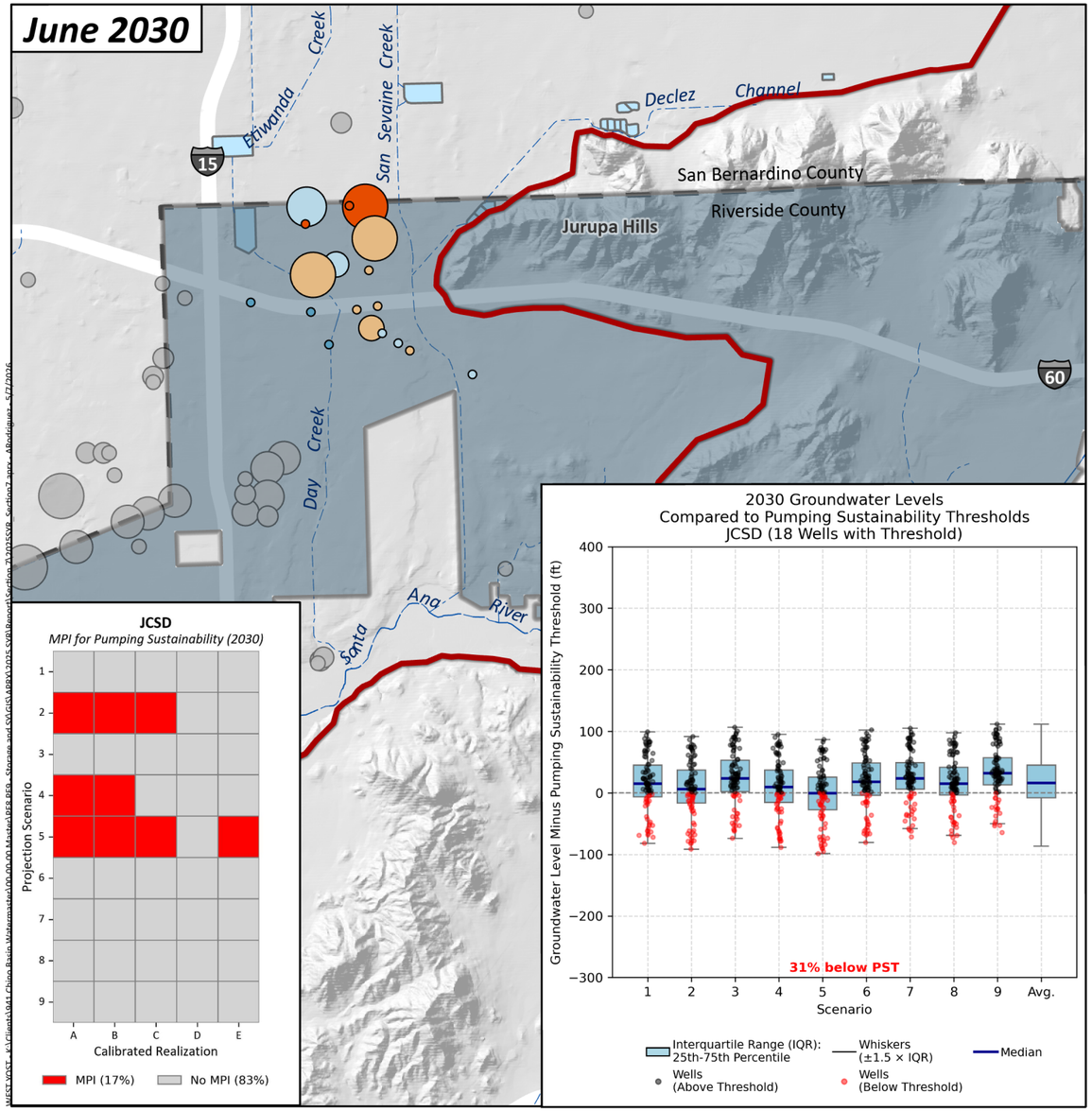
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Golden State Water Company

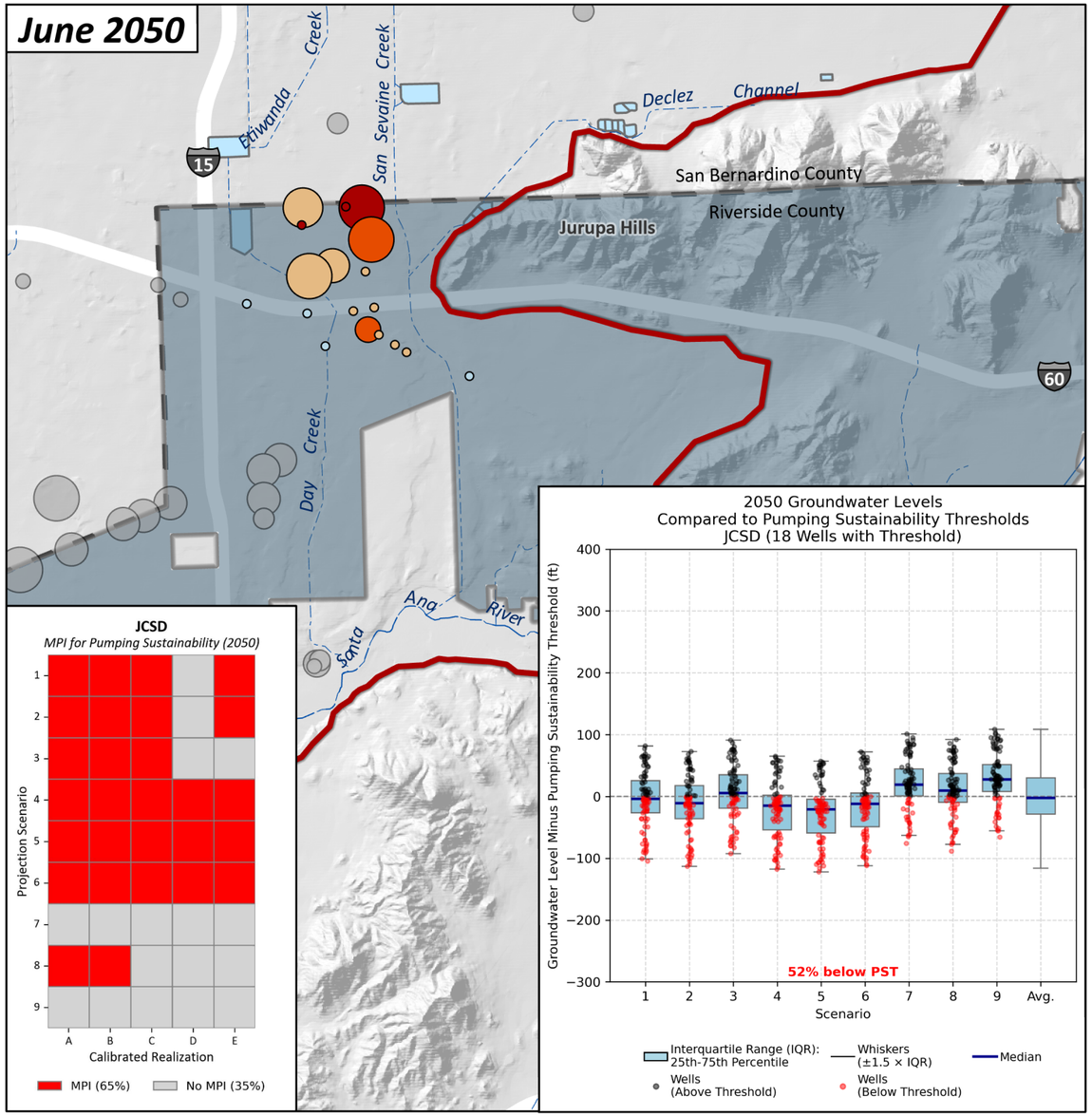
DRAFT

Figure 7-15

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Jurupa Community Services District
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

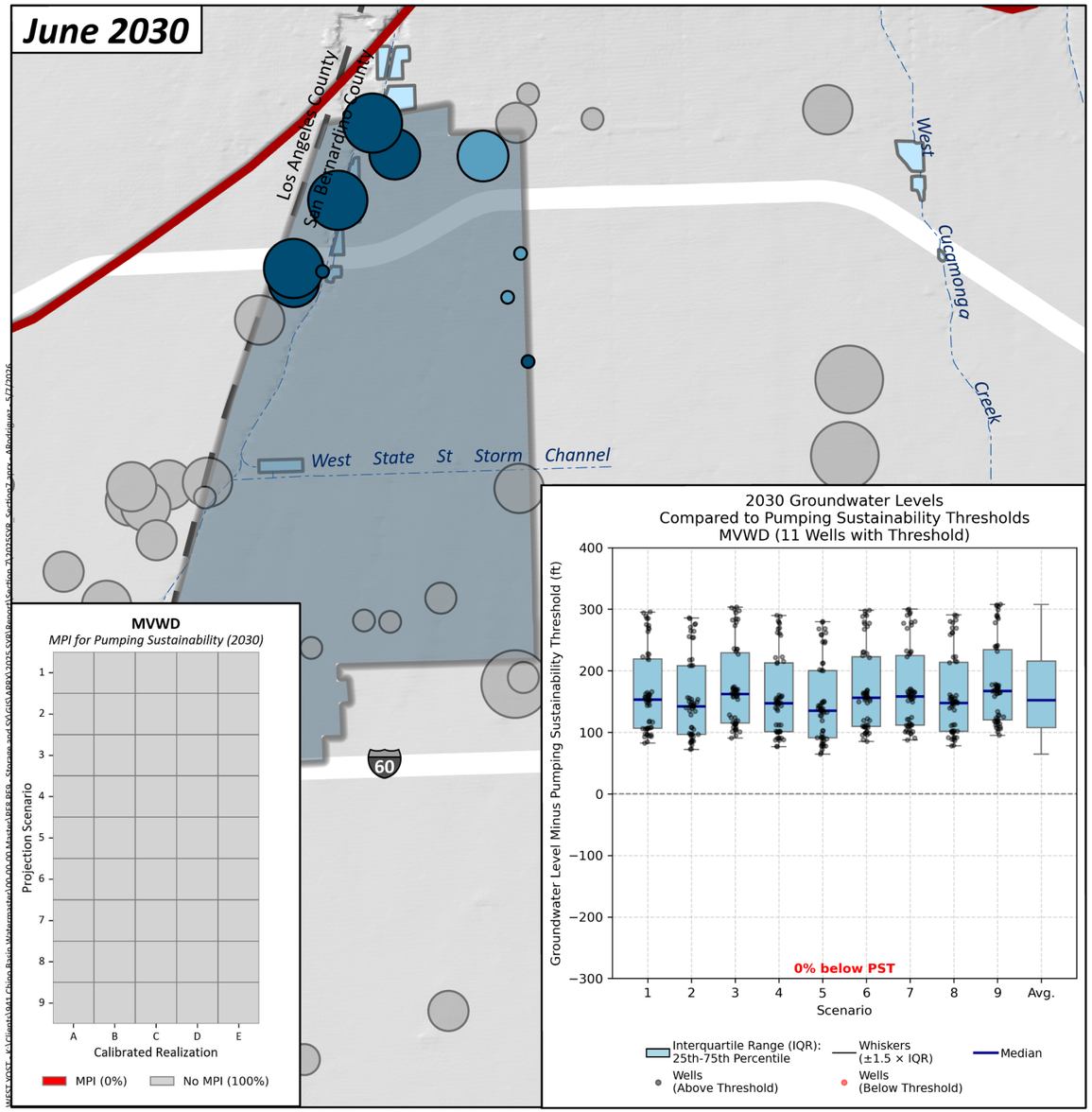
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Jurupa Community Services District

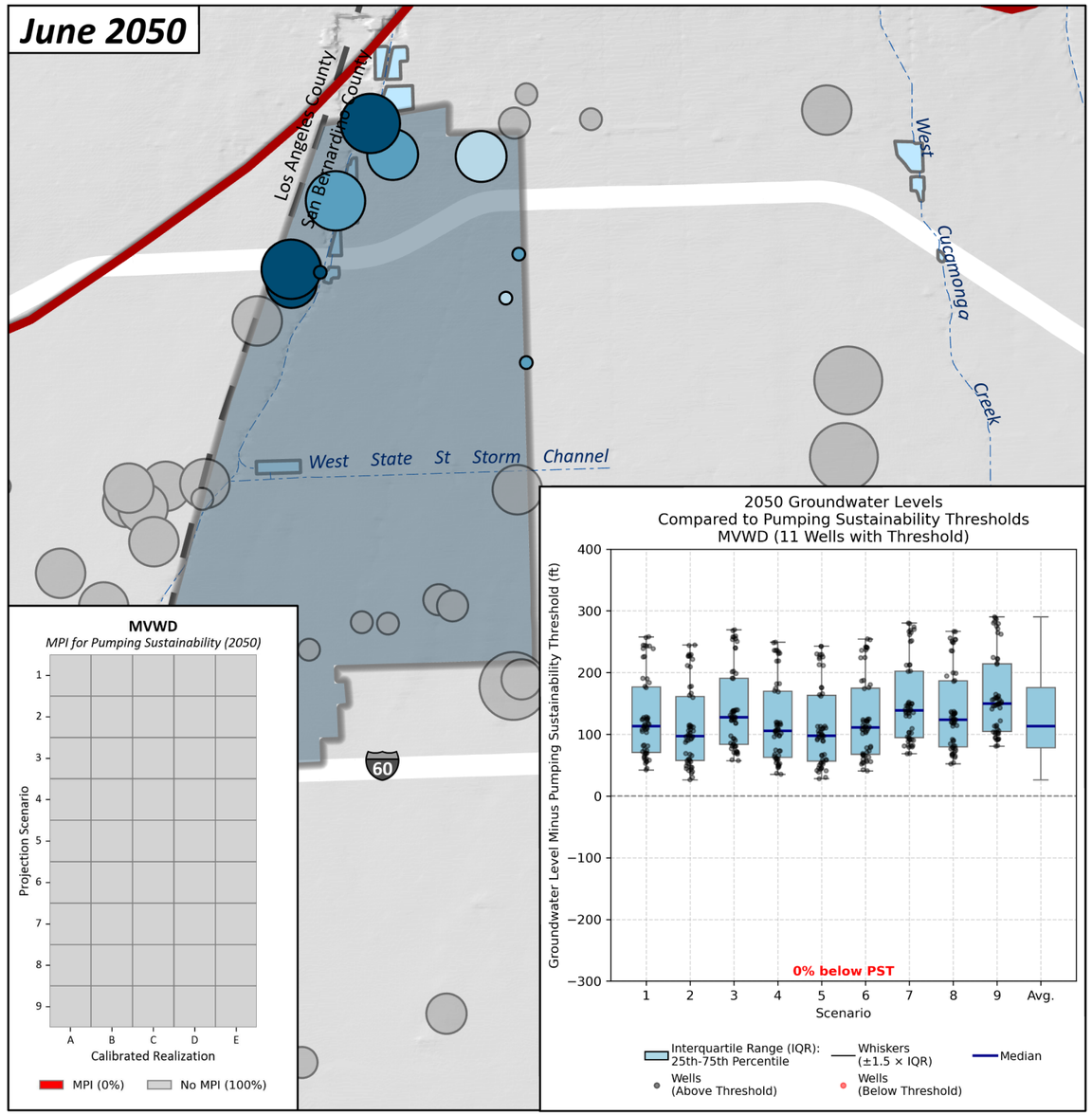
DRAFT

Figure 7-16

June 2030



June 2050



0 0.5 1 Miles
N
0 1 2 Km

Prepared by:
WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- Monte Vista Water District
- Rivers and Streams
- Flood Control and/or Conservation Basins

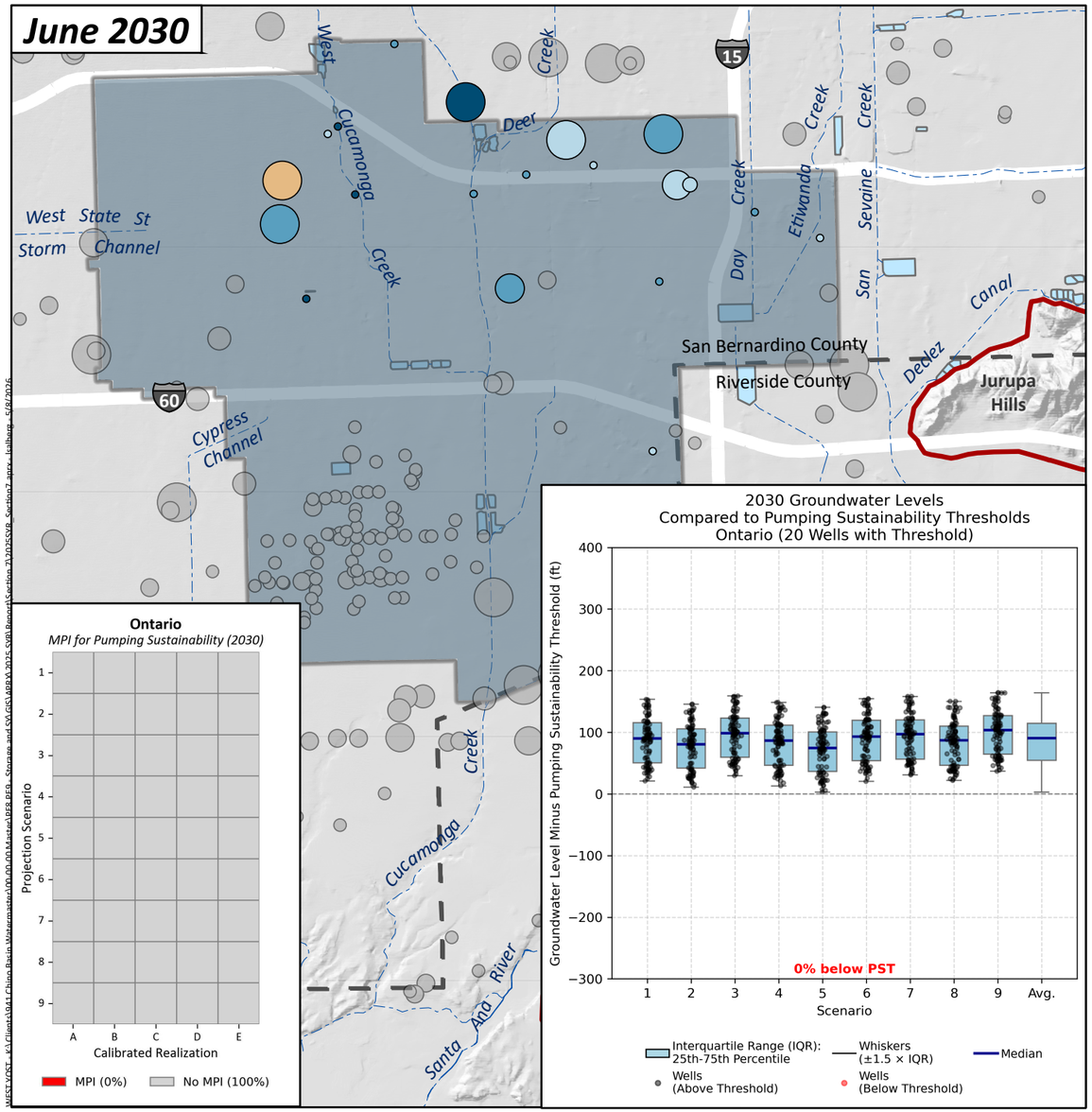
Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
Monte Vista Water District

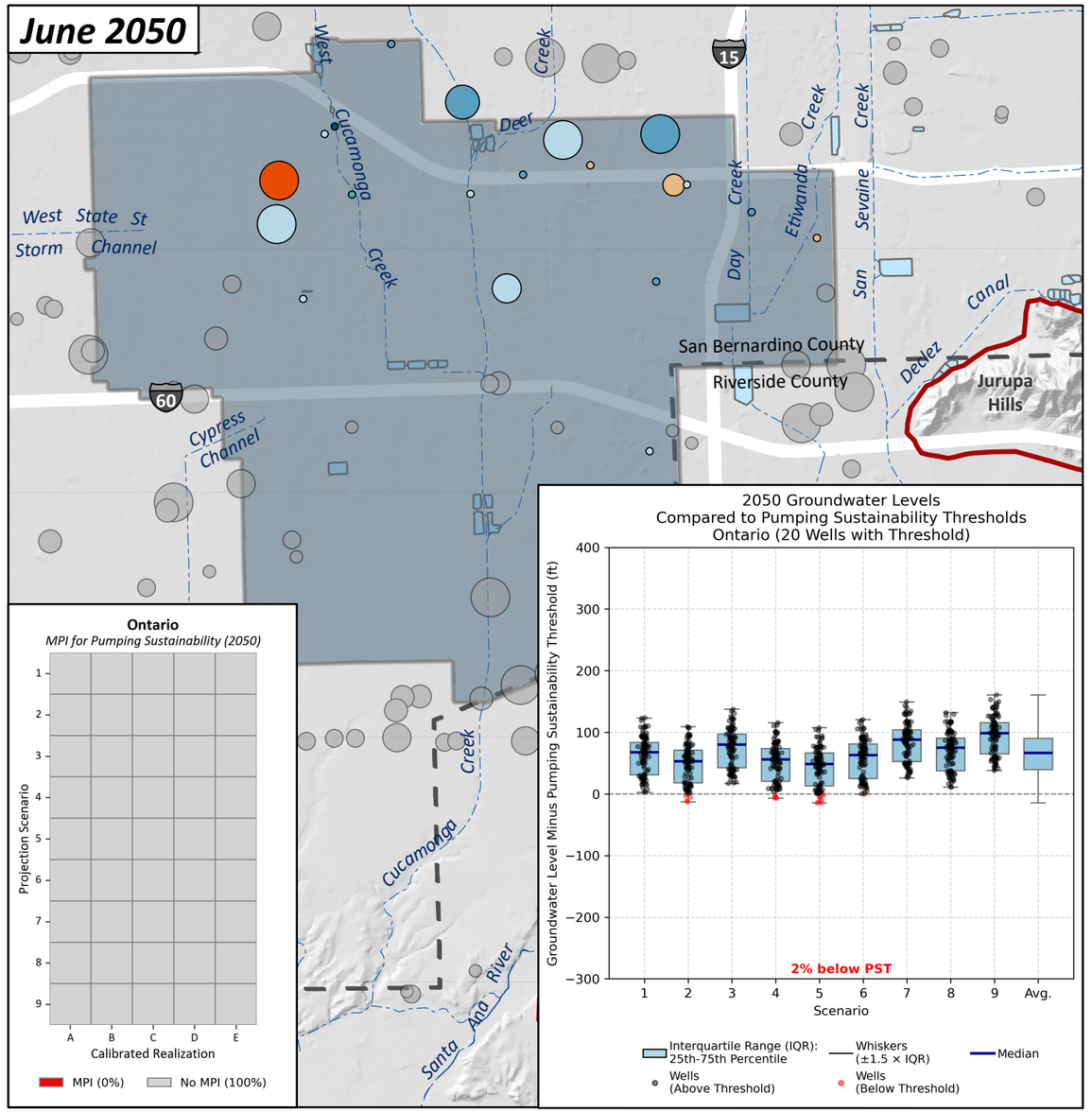
DRAFT

Figure 7-17

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- City of Ontario
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

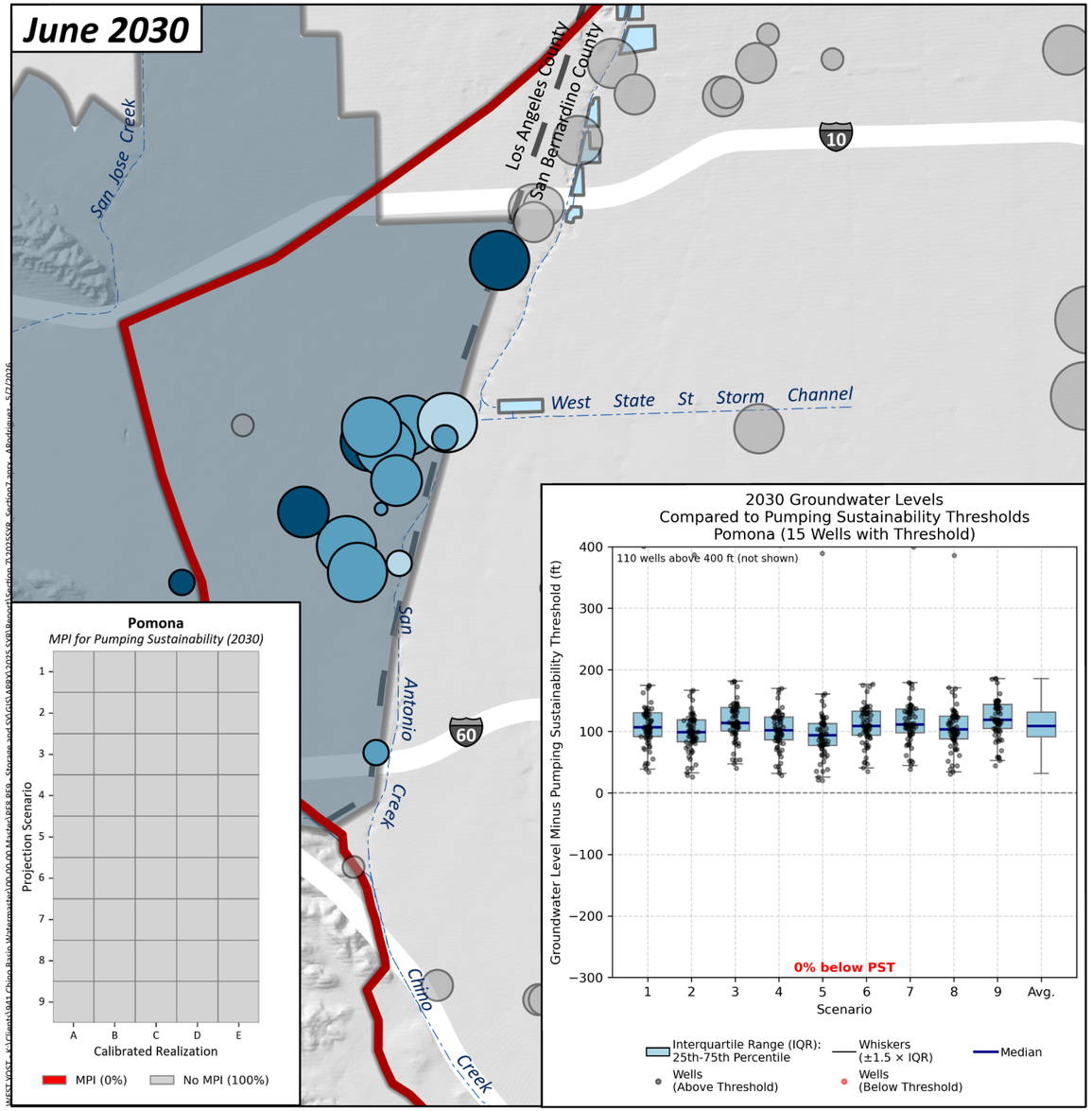
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
City of Ontario

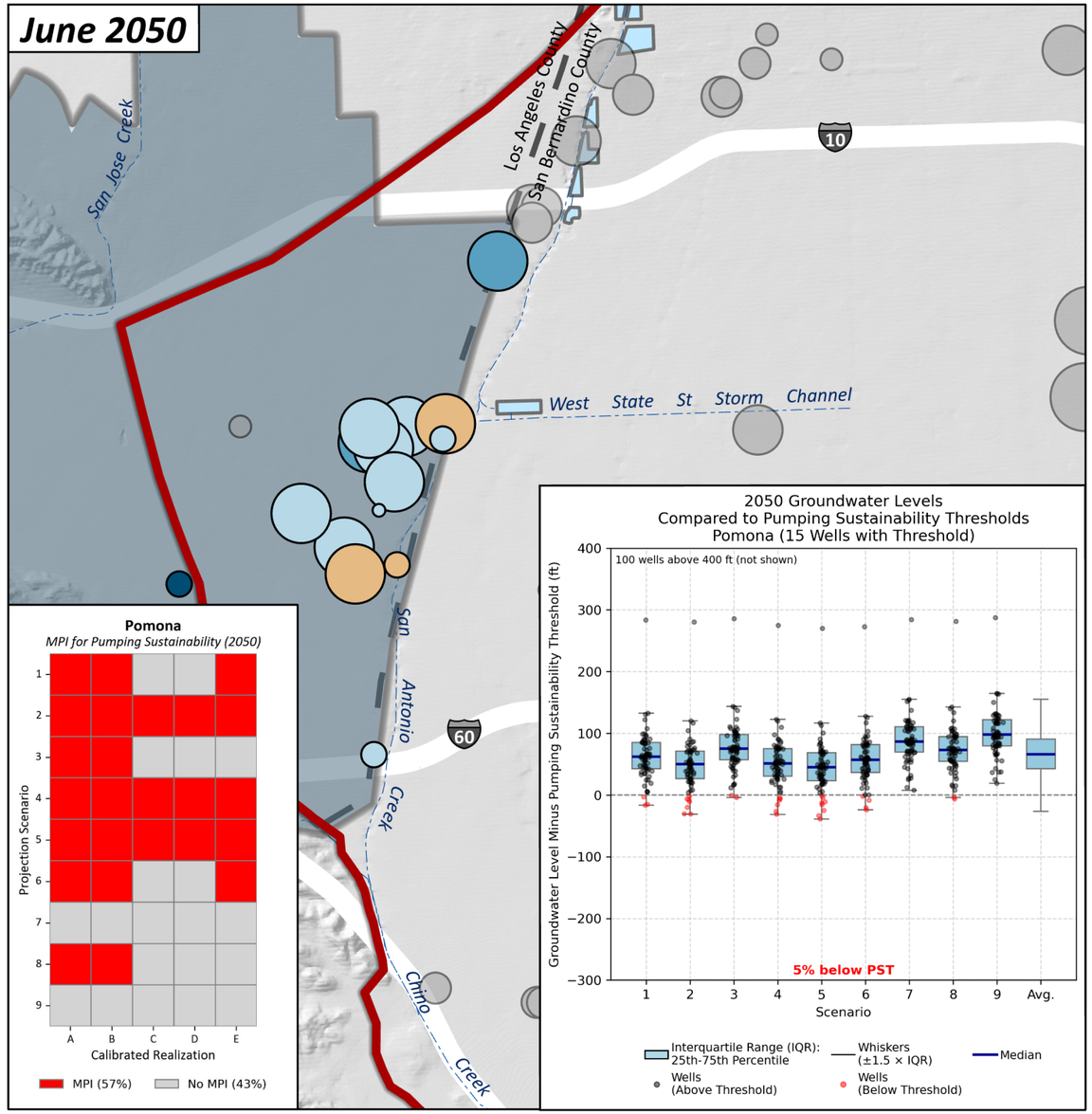
DRAFT

Figure 7-18

June 2030



June 2050



0 0.5 1 Miles
0 1 2 Km

N

Prepared by:
WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- City of Pomona
- Rivers and Streams
- Flood Control and/or Conservation Basins

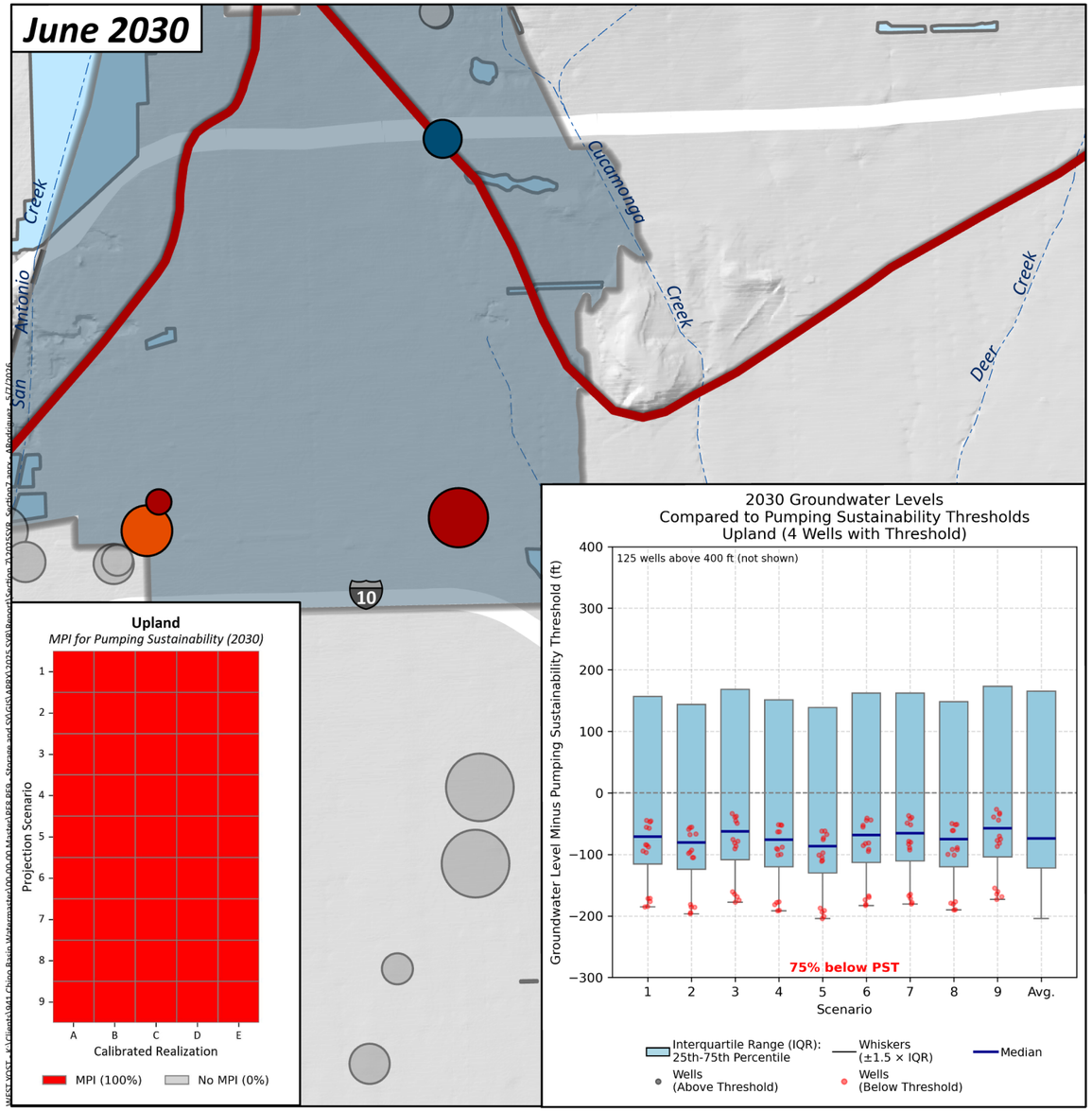
Prepared for:
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
City of Pomona

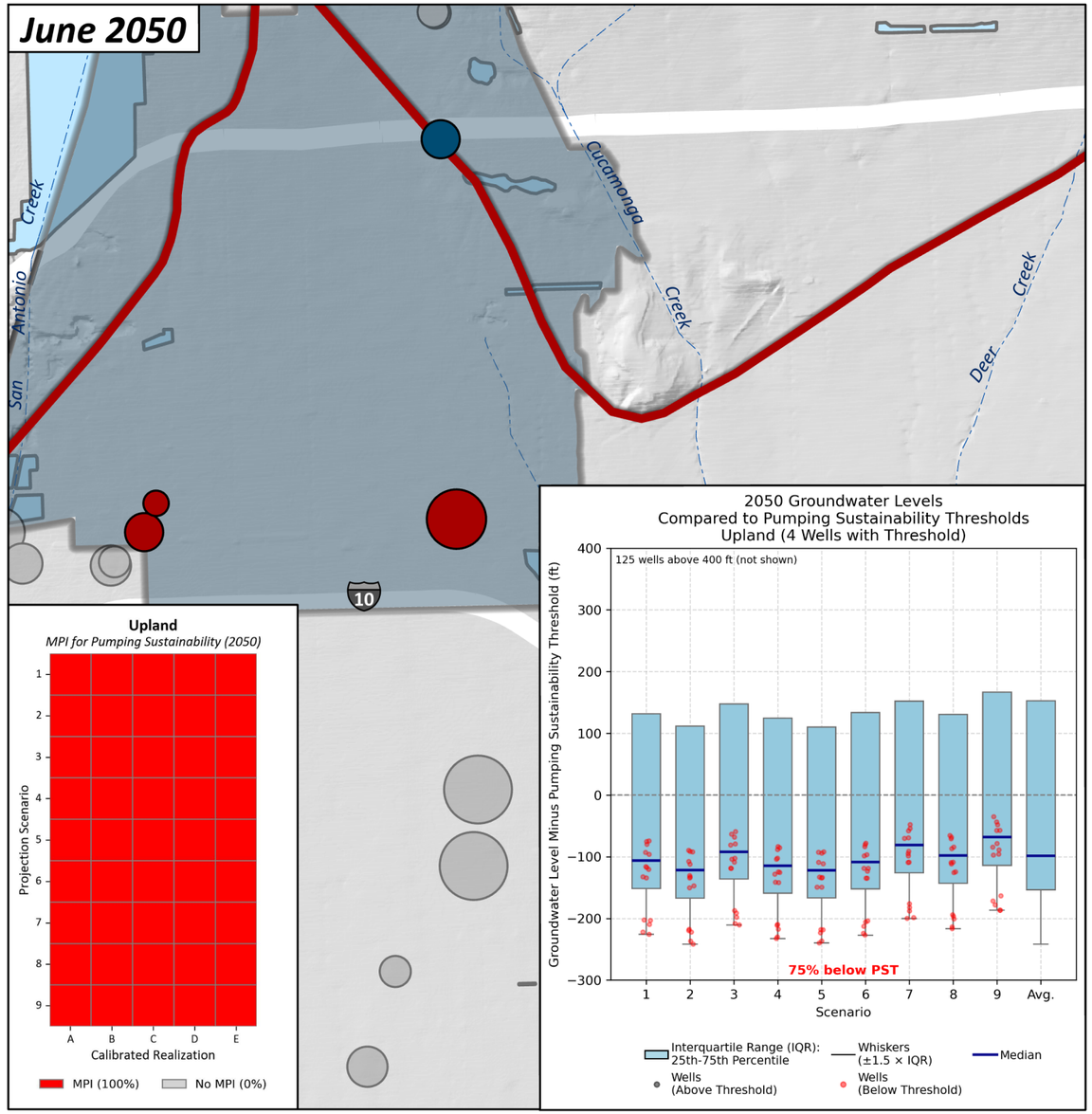
DRAFT

Figure 7-19

June 2030



June 2050



0 0.5 1 Miles

0 1 2 Km

N

Prepared by:

WEST YOST
Water. Engineered.

Likelihood-Weighted Average Groundwater Level Above/Below the Land Subsidence Threshold (ft)

- >100 ft
- 50–100 ft
- 0–50 ft
- 0 to -50 ft
- -50 to -100 ft
- <-100 ft

Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

Other Layers

- Other Wells
- 2025 CVM Domain
- City of Upland
- Rivers and Streams
- Flood Control and/or Conservation Basins

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

Assessment of MPI due to Land Subsidence
2030 and 2050
City of Upland

DRAFT

Figure 7-20

7.2.2.3 Discussion

Table 7-3 summarizes the pumping sustainability analysis, indicating the number of wells for which each party has PSTs, the average percentage of wells exceeding the PST for each scenario, and the likelihood-weighted average percentage of wells exceeding the PST for the TSY ensemble. A review of hydrographs confirms that a PST exceedance in 2050 meets the five-year duration criterion to be considered MPI, in the absence of an agency-provided definition.

Figure 7-21 shows that subsidence-related MPI increases from an average of 1.5 subareas in FY 2030 to 3.5 subareas in FY 2050. The degree of MPI varies between Projection Realizations, having the highest incidence in High Demand Scenarios (Projection Scenarios 4, 5, and 6) and the Hot/Dry Climate Scenarios (Scenarios 2 and 5).

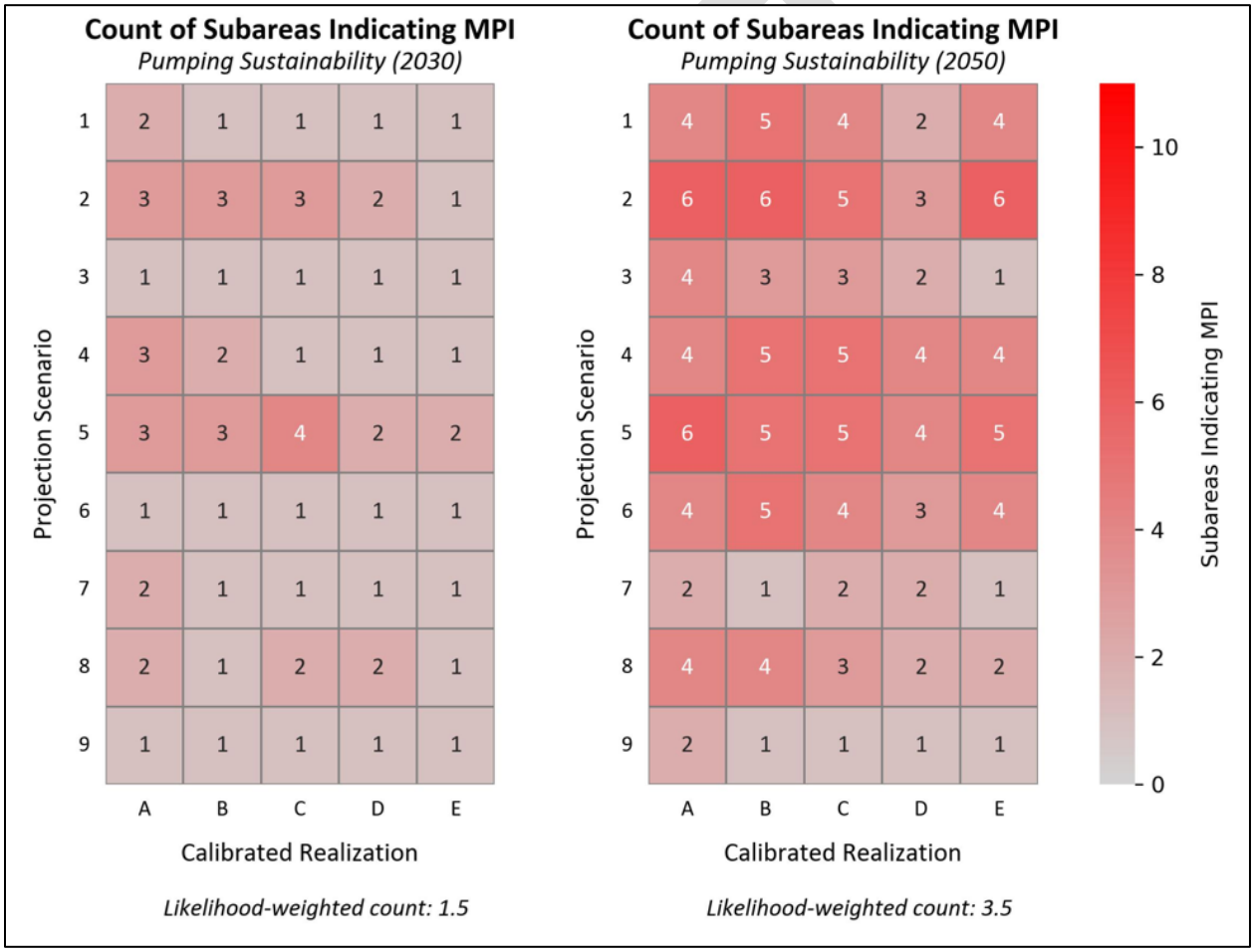


Figure 7-21. Count of Subareas Indicating MPI for Pumping Sustainability for the TSY Ensemble (FY 2030 and 2050).

7.2.2.3.1 Drivers of MPI for Pumping Sustainability

Based on the results presented above, the three primary drivers of MPI due to pumping sustainability are: extraction of water from managed storage; a hotter/drier climate; and the parties' localized well operations. In addition, there is significant uncertainty in the PSTs and groundwater levels in Upland's service area.

Table 7-3. Percentage of Wells Below Pumping Sustainability Thresholds, FY 2030 and FY 2050

		Party																					
		CDA 22 wells with PST Figure 7-9		Chino 10 wells 7-10		Chino Hills 5 wells 7-11		CVWD 12 wells 7-12		FWC 13 wells 7-13		GSWC 1 well 7-14		JCSD 18 wells 7-15		MVWD 11 wells 7-16		Ontario 20 wells 7-17		Pomona 15 wells 7-18		Upland 4 wells 7-19	
Scenario	Likelihood Weight	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050
1	4	14	21	0	14	0	0	8	13	15	19	0	0	30	56	0	0	0	0	0	4	75	75
2	2	16	23	0	20	0	0	12	15	17	26	0	40	41	66	0	0	0	4	0	9	75	75
3	2	8	16	0	8	0	0	8	10	15	15	0	0	24	41	0	0	0	0	0	3	75	75
4	2	14	24	0	20	0	0	10	12	15	19	0	0	38	74	0	0	0	4	0	8	75	75
5	1	16	24	0	20	0	0	13	15	19	23	0	20	51	77	0	0	0	8	0	11	75	75
6	1	8	21	0	18	0	0	8	10	15	19	0	0	29	71	0	0	0	1	0	5	75	75
7	2	13	16	0	0	0	0	8	8	15	15	0	0	24	24	0	0	0	0	0	0	75	75
8	1	16	18	0	8	0	0	10	10	15	19	0	0	28	36	0	0	0	0	0	3	75	75
9	1	8	11	0	0	0	0	8	8	15	15	0	0	19	22	0	0	0	0	0	0	75	75
Likelihood-Weighted Average		13%	19%	0%	12%	0%	0%	9%	12%	16%	19%	0%	6%	31%	52%	0%	0%	0%	2%	0%	5%	75%	75%

Figure 7-22 shows the direct relationship between declining storage and the increasing MPI due to pumping sustainability, depicting the average change in storage from FY 2021-2050 versus the average number of subareas indicating MPI for pumping sustainability in FY 2050 for several subgroups of Projection Realizations.

- The High Demand Projection Realizations (Scenarios 4, 5, and 6) indicate MPI at an average of 4.5 subareas, compared to 1.9 subareas and 3.9 subareas for the Low Demand and Expected Demand Projection Realizations, respectively.
- The number of subareas indicating MPI increases by a factor of 0.5 (Low Demand) to 1.5 (Expected and High Demand) from FY 2030 to FY 2050.
- In all High Demand Projection Realizations, the balance of managed storage is zero by 2050, whereas the average managed storage is 409,000 af and 146,000 af in 2050 for the Low Demand and Expected Demand Projection Realizations, respectively.

Climate also drives MPI, but to a lesser degree than demand. The Hot/Dry Climate Projection Realizations (Scenarios 2, 5, and 8) indicate MPI at an average of 4.4 subareas, compared to 2.6 subareas and 3.3 subareas for the Cool/Wet and Average Climate Scenarios, respectively.

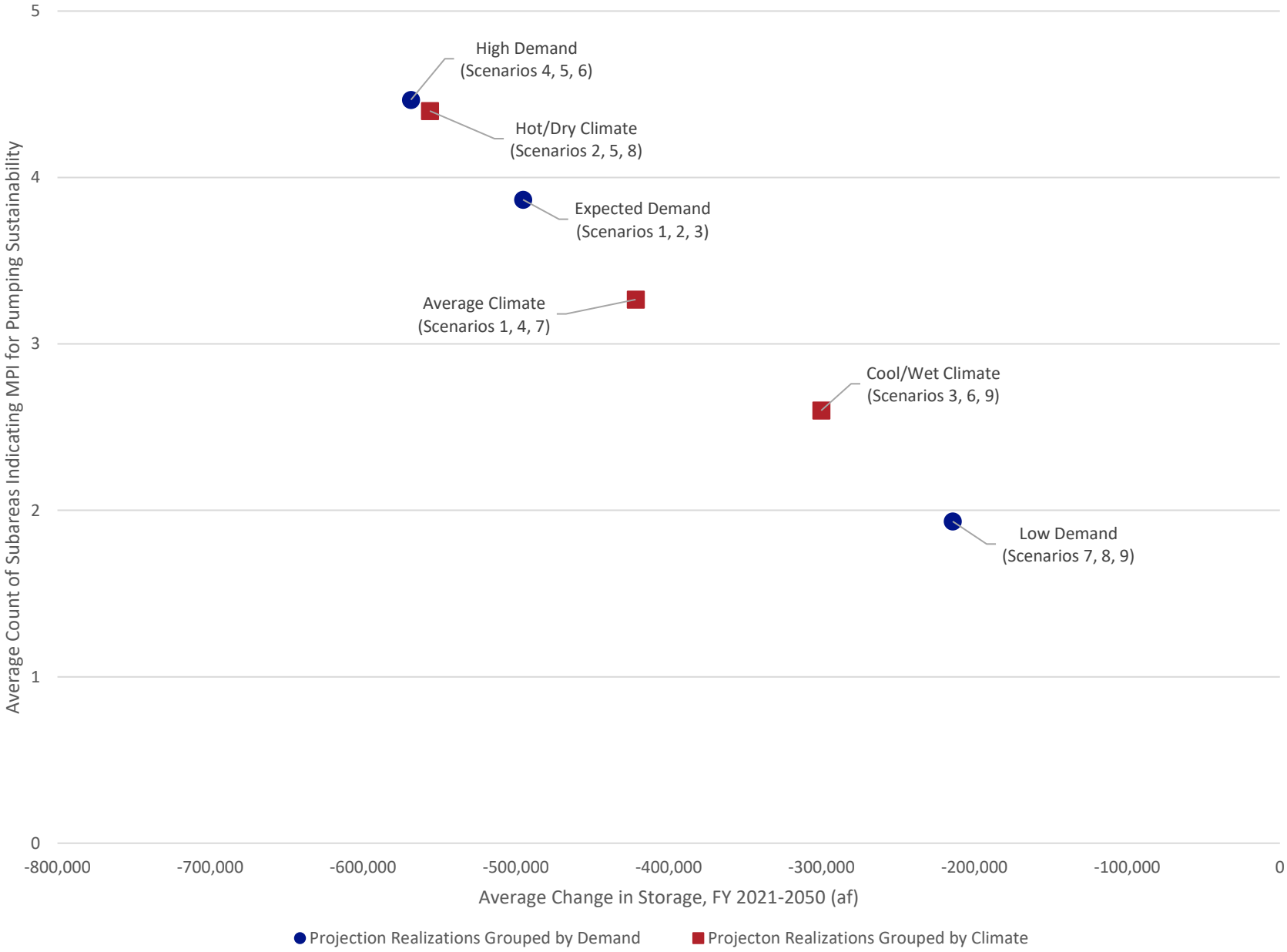
Localized operations of the CDA, JCSD, and Pomona wellfields also may have an impact on the MPI simulated in these subareas:

- **CDA:** The likelihood-weighted percentage of Projection Realizations indicating MPI for CDA increases from 25 percent in 2030 to 83 percent in 2050. This increase is not driven by CDAs pumping rates, which remain constant throughout the projection period. As shown in Figure 7-10, the wells indicating MPI are mostly in the center of the wellfield, near where more of CDAs pumping is concentrated. In several Projection Realizations, this pumping results in lower groundwater levels compared to the surrounding area. For example, Figure 6-26 shows groundwater level declines of over 40 feet near some of the future wells (II-13 and II-14) from 2022 to 2050, which is about 10 feet lower than the regional groundwater level declines in that area. This suggests that the MPI is driven by both regional changes in groundwater levels and the simulated pumping distribution in the CDA wellfield.
- **JCSD:** The likelihood-weighted percentage of Projection Realizations indicating MPI for JCSD increases from 17 percent in 2030 to 65 percent in 2050. This increase is driven by JCSD's pumping rates (especially those exceeding the Low Demand Water Plan Scenario [around 11,400 afy at buildout]), the broader basin-wide decline in groundwater levels, and the operational configuration of JCSD's wellfield. To support this finding, two of the 15 Projection Scenarios under the Low Demand Water Plan Scenarios indicated MPI (A8 and B8), while 11 of the Expected Water Plan Scenarios and all of the High Demand Water Plan Scenarios indicated MPI. Figure 7-16 shows that pumping is concentrated over about six wells within less than two miles of each other, suggesting that well interference may exacerbate drawdown at higher pumping rates.

- **Pomona:** The likelihood-weighted percentage of Projection Realizations indicating MPI for Pomona increases from 0 percent in 2030 to 57 percent in 2050. This increase is driven by Pomona's pumping rates (especially those exceeding the Low Demand Water Plan Scenario [around 12,300 afy at buildout]), the broader basin-wide decline in groundwater levels, and the operational configuration of Pomona's wellfield. To support this finding, only two of the 15 Projection Scenarios under the Low Demand Water Plan Scenarios indicated MPI, while 10 of the Expected Water Plan Scenarios and 13 of the High Demand Water Plan Scenarios indicated MPI. Figure 7-19 shows that pumping is concentrated over about 12 wells within less than 2 miles of each other, suggesting that well interference may exacerbate drawdown at higher pumping rates.

DRAFT

Figure 7-22. Change in Storage and Prevalence of MPI for Pumping Sustainability



The finding of MPI for Upland's pumping sustainability carries a low degree of certainty for two main reasons:

- Uncertainty in simulated groundwater levels: Groundwater data in this specific portion of the aquifer is sparse, leading to higher uncertainty in the simulated groundwater levels for this area.
- PSTs: Upland has not revised its PSTs for several years; the PSTs are based on their most recently collected pump settings. Upland has also not reported experiencing pumping sustainability challenges at existing groundwater levels.

Therefore, the MPI finding for Upland requires further examination and discussion with Upland before recommendations for mitigation can be made.

7.2.2.3.2 Potential Methods to Avoid or Mitigate MPI due to Pumping Sustainability

The analysis above indicates that the groundwater-level declines that could lead to pumping-sustainability-related MPI are mainly driven by future extractions of groundwater from managed storage and localized pumping patterns. These extractions from managed storage may be accelerated under hot/dry climate conditions and/or greater than expected water demands, but the extractions from managed storage are predicted to be the primary driver of future pumping sustainability challenges. As discussed below in Section 7.3.2, a changed Safe Yield ***is not*** the most effective method to mitigate the potential for pumping sustainability-related MPI. Instead, the Watermaster has the ability to employ alternative methods to mitigate the potential for MPI due to pumping sustainability, which include: recharge master planning and implementation; storage management planning and implementation for both local storage and regional storage and recovery programs; and pumping adjustments by the parties. Recharge master planning and storage management planning were described above as methods to address land subsidence. Pumping sustainability challenges can be mitigated within a wellfield by lowering pumping equipment, changing pumping patterns, or a combination of the two.

7.2.3 Hydraulic Control

The attainment of hydraulic control is measured by demonstrating, from results of a calibrated groundwater model (e.g., the 2025 CVM), either that all groundwater north of the CDA well fields does not discharge through the CDA well fields (total hydraulic containment standard) or that groundwater discharge through the CDA well fields is, in aggregate, less than 1,000 afy (de minimis standard). The Regional Board has agreed that compliance with the de minimis standard will be determined from groundwater monitoring data and the results of periodic calibrations of the Watermaster groundwater model and interpretations of the calibration results.

7.2.3.1 Methods to Evaluate the State of Hydraulic Control

Hydraulic control is evaluated based on calculating the total groundwater flow from north to south (southward flow) across a designated “line of hydraulic control.” This line is positioned approximately perpendicular to the regional groundwater flow direction across and area downgradient of the western portion of the CDA well field—an area which historically has shown incomplete capture of southward flowing groundwater by the CDA wells. The line of hydraulic control was originally delineated in the early

2000s based on model-simulated groundwater-flow vectors in the vicinity of the then-proposed CCWF.[9] Its purpose is to serve as a consistent boundary for simulating and quantifying the effectiveness of the CDA wellfield in minimizing quantity of groundwater flow from the Chino-North groundwater management zone to the Prado Basin management zone. Measured groundwater elevations at wells in the vicinity of the eastern portion of the CDA wellfield demonstrate the total hydraulic containment standard. Figures 7-23 and 7-24 show the pumping around the line of hydraulic control and the groundwater-flow vectors (D1) in Layer 1 for July 1, 2030 and July 1, 2050, respectively.

7.2.3.2 Results

Figure 7-25 is a six-panel chart showing the total southward flow across the line of hydraulic control for all the scenarios for the period of FY 2021 through 2080. Panels 1 through 5 show each of the five calibrated realizations, and the bottom-right panel shows the results from the entire TSY ensemble. Each chart shows time series of the mean flow (dark blue), the 20th to 80th percentile range (light blue shade), and the full range of data (gray shade) for the subset of models. Each panel also shows the de minimis threshold of 1,000 afy. Each of the panels also show the 2020 SYR projected flow through the CCWF for comparison (gray dashed line).

Under all members of the TSY Ensemble, the total southward flow through the CCWF declines in the latter half of the current decade when the Chino Airport remediation wells come online. For the FY 2021 through 2030 period, the likelihood-weighted average flow through the CCWF is approximately 530 afy, with a 20th to 80th percentile range of approximately 220 to 650 afy. While the upper bound of the full range exceeds the 1,000 afy threshold in some early years (with maximum values on the order of 1,300 to 1,800 afy in Realization D), the ensemble mean and central percentile range remain well below the de minimis threshold and show a declining trend through the decade.

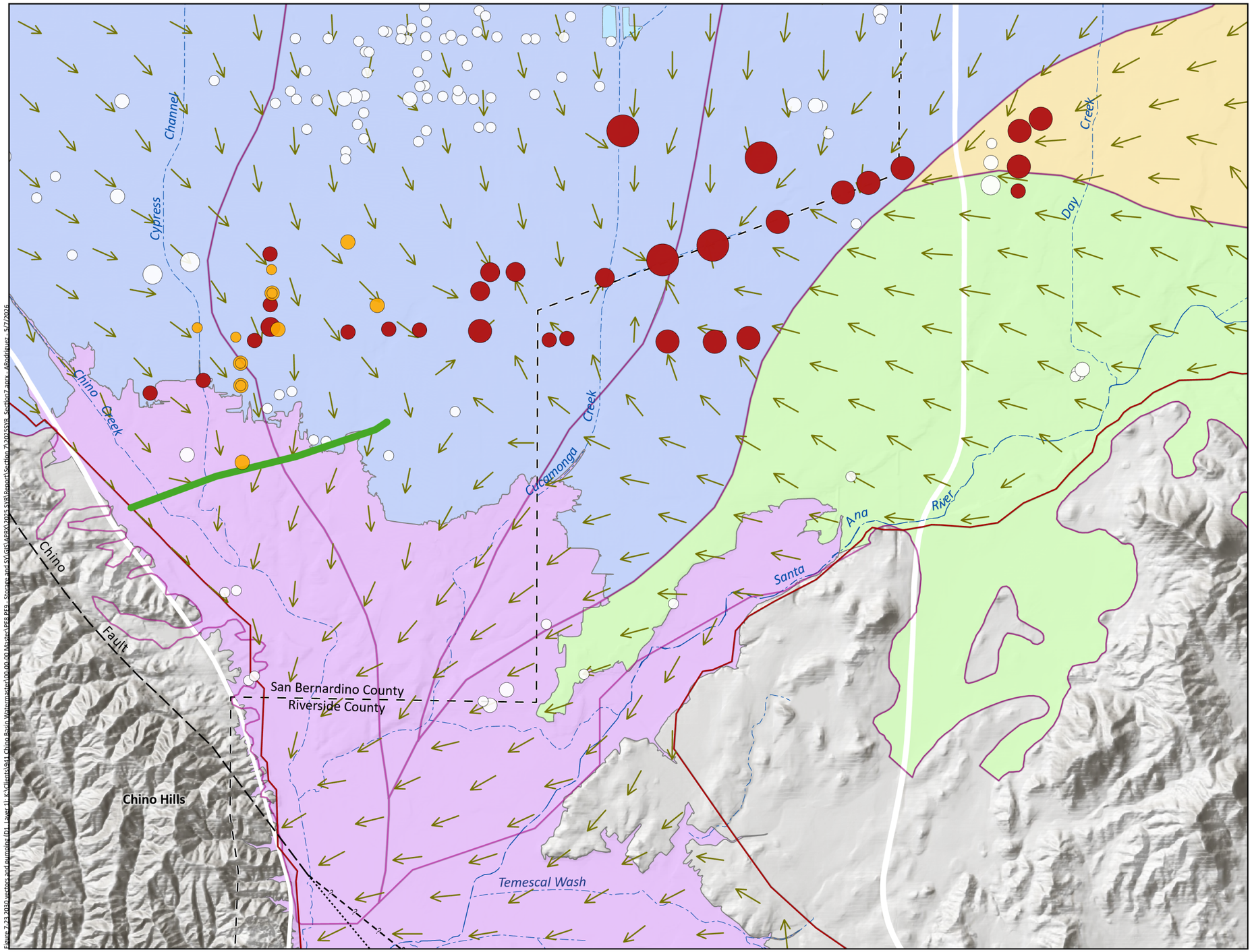
For the FY 2031 through 2080 period, simulated flows decrease substantially. The likelihood-weighted average flow is approximately 200 afy, with a 20t^{h} to 80th percentile range of approximately 60 to 270 afy. Most simulated values fall well below the 1,000 afy threshold, with only occasional exceedances in the upper bound of the full range in earlier years (Realization D), and most realizations remain below the threshold over time.

7.2.3.3 Discussion

Simulated flow through the CCWF remains below the de minimis threshold of 1,000 afy for all scenarios and time periods except for several scenarios based on Realization D. These exceedances represent extreme cases and are not reflected in the ensemble mean or central percentile range.

As indicated by the decline in flow across the CCWF for the entire TSY ensemble starting in the late 2020s, the operation of the new Chino Airport wells that are expected to come online in FY 2026 to FY 2029 is a significant driver in reducing the flow through the CCWF. This declining trend indicates that projected future conditions and management actions are not exacerbating southward flow across the line of hydraulic control. Hence, the risk of any member of the TSY ensemble resulting in a violation of hydraulic control is low, and there is no indication of MPI from the TSY ensemble.

[9] 2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description



Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

- Chino Basin Desalter Authority Wells
- Chino Basin Airport Wells
- Other Pumping Wells
- 2030 Groundwater Flow Vector- Model Layer 1
- Hydraulic Control Line
- Rivers and Streams
- Flood Control and or Conservation Basins

OBMP Management Zones



Chino Basin Maximum-Benefit Groundwater Management Zones

- Chino-North
- Chino-South
- Chino-East
- Prado Basin

Faults

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by:

WEST YOST

N

0 1 2 Miles

0 1.5 3 Km

Prepared for:

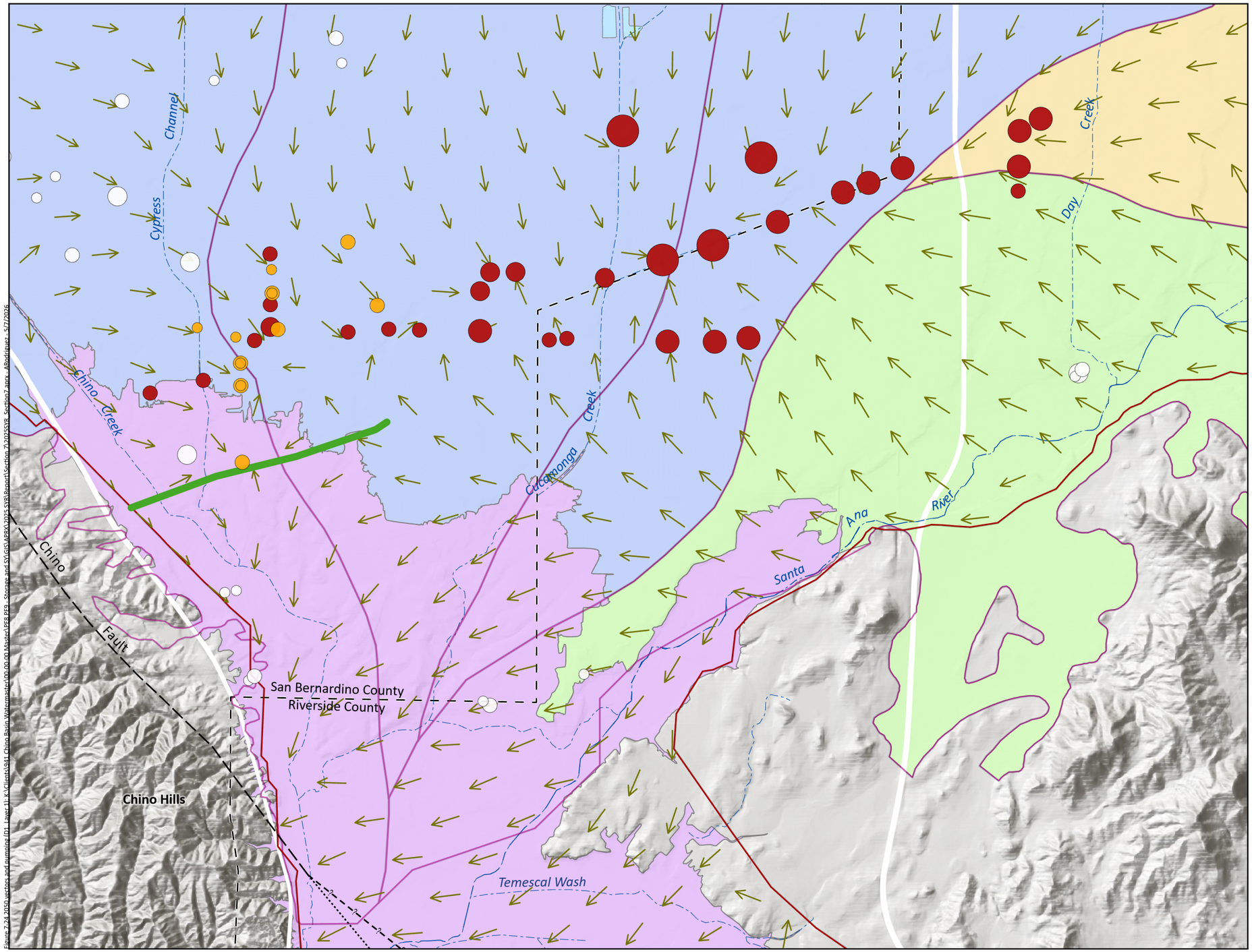
Chino Basin Watermaster
2025 Safe Yield Reevaluation

Groundwater-Flow Vectors and Groundwater Pumping near Line of Hydraulic Control

Scenario D1 - 2030

DRAFT

Figure 7-23



Likelihood-Weighted Average Pumping (afy)

- 0
- 1-100
- 101-500
- 501-1,000
- 1,001-2,000
- >2,000

- Chino Basin Desalter Authority Wells
- Chino Basin Airport Wells
- Other Pumping Wells
- 2030 Groundwater Flow Vector- Model Layer 1
- Hydraulic Control Line
- Rivers and Streams
- Flood Control and or Conservation Basins

OBMP Management Zones



Chino Basin Maximum-Benefit Groundwater Management Zones

- Chino-North
- Chino-South
- Chino-East
- Prado Basin

Faults

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier



Prepared by:

WEST YOST

N

0 1 2 Miles

0 1.5 3 Km

Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

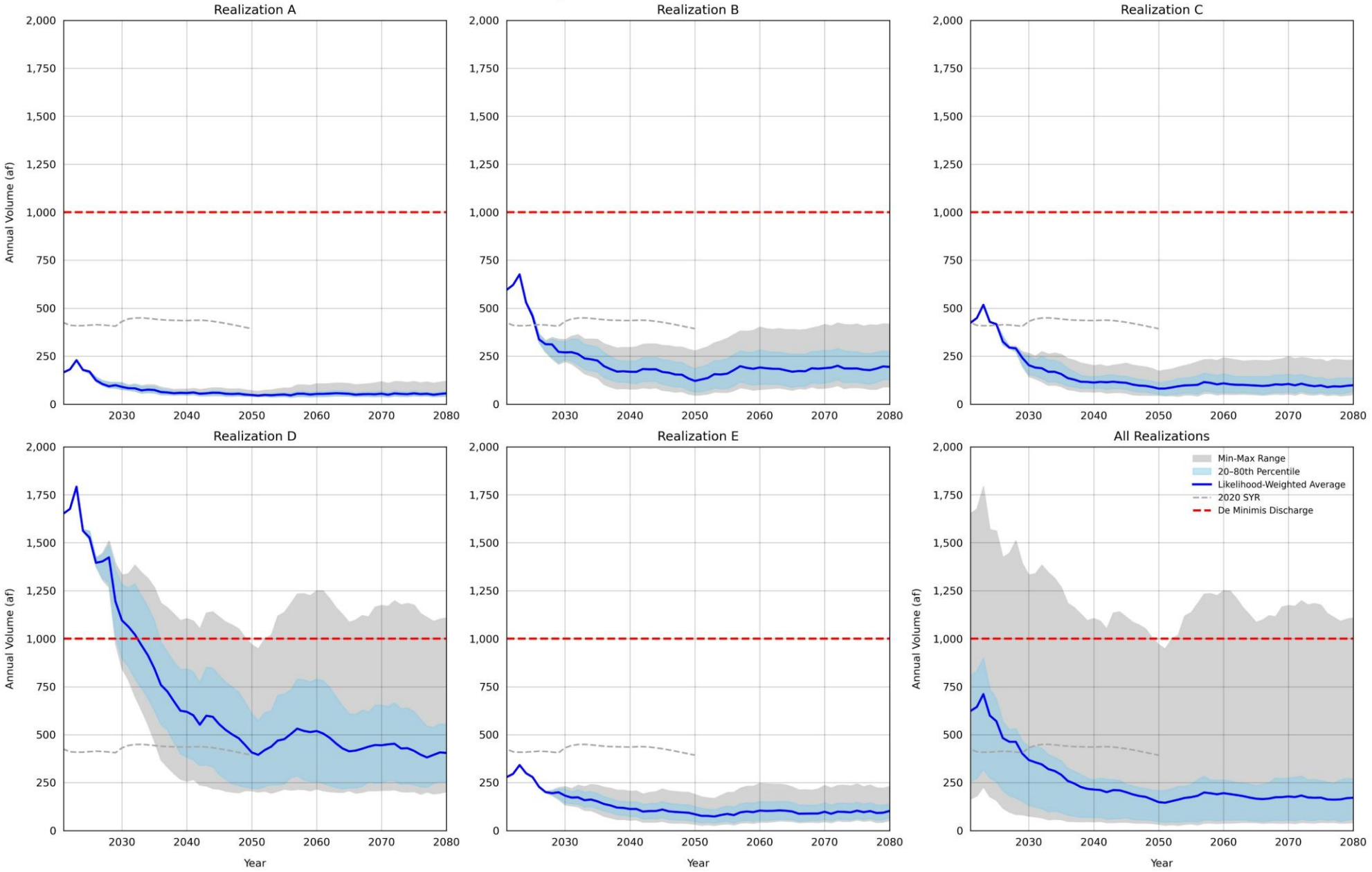
Groundwater-Flow Vectors and Groundwater Pumping near Line of Hydraulic Control

Scenario D1 - 2050

DRAFT

Figure 7-24

Figure 7-25
Flow through Chino Creek Well Field - TSY Ensemble



7.3 DETERMINATION OF VIABILITY OF TSY

This section describes the viability of production at the TSY based on the findings of the TSY Ensemble, the identification of drivers of potential future MPI, and potential mitigation methods, which completes Step 9 of the 2022 SYRM.

7.3.1 Summary of Findings

Figure 7-26 is a heatmap depicting all the Projection Realizations indicating the number of subareas indicating MPI. There are 17 subareas that were evaluated for MPI: 5 for land subsidence, 11 for pumping sustainability, and 1 for hydraulic control. Figure 7-26 shows that MPI across all categories increases from an average of 2.2 subareas in FY 2030 to 5.7 subareas in FY 2050. The degree of MPI varies between Projection Realizations, having the highest incidence in High Demand Scenarios (Projection Scenarios 4, 5, and 6) and the Hot/Dry Climate Scenarios (Scenarios 2 and 5).

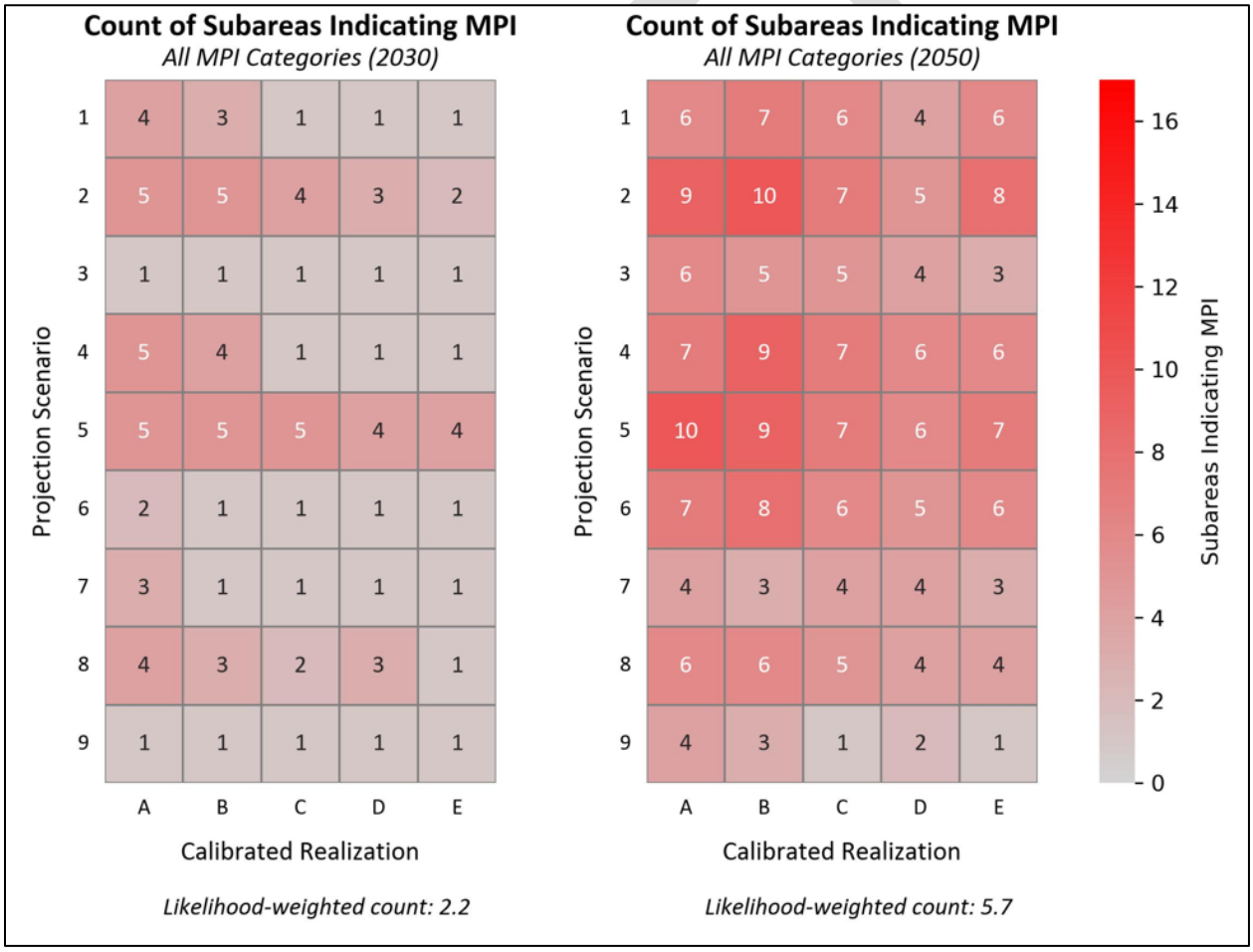
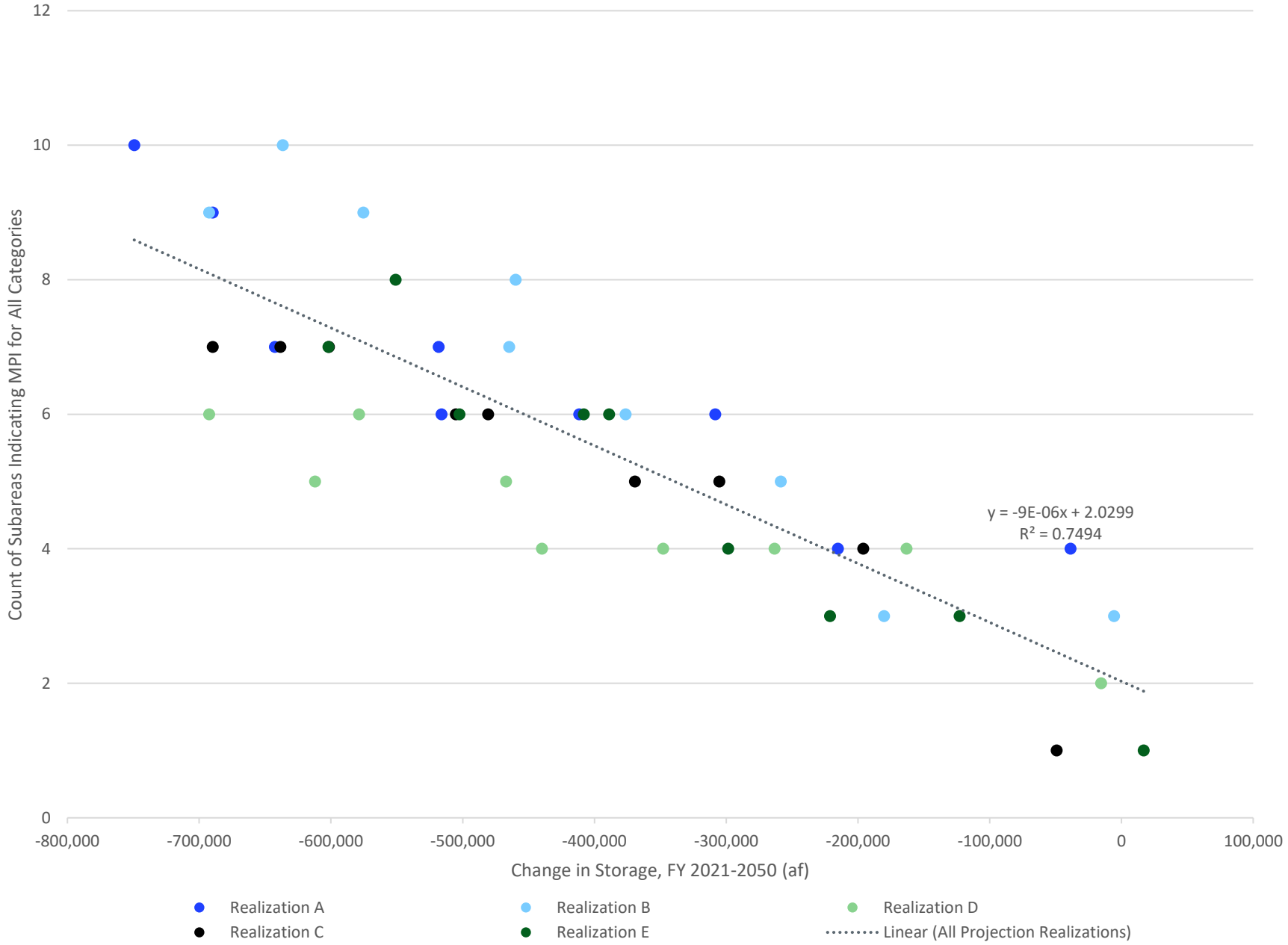


Figure 7-26. Count of Subareas Indicating MPI for All Categories for the TSY Ensemble (FY 2030 and 2050).

The risk of MPI increases as physical groundwater storage declines. Figure 7-27 is a scatter plot of change in physical storage (FY2021-2050) versus count of subareas indicating MPI for all categories for each Projection Realization. This plot shows a clear relationship between change in storage and MPI. While physical storage and managed storage are not identical, change in physical storage is a more direct indicator of changes in groundwater levels.

DRAFT

Figure 7-27. Change in Storage and Prevalence of MPI, TSY Ensemble



Managed storage is impacted by Reoperation credits (which are allocated to offset production from the Chino Basin Desalters through 2030) and the Safe Yield, which is determined as the 10-year averaged net recharge. Drawing water from managed storage means that parties are using their existing pumping rights or managed storage to offset pumping rather than acquiring "wet water" for replenishment. This enables groundwater pumping from the Chino Basin beyond the Safe Yield. If this pumping is greater than the net recharge, then it can result in a decline in physical storage. Therefore, the use of managed storage can increase the risk of MPI by causing groundwater levels to decline if pumping outpaces natural and artificial recharge. Figures 7-8 and 7-22 focus on the drivers of MPI for land subsidence and pumping sustainability, respectively, and demonstrate that high groundwater pumping and hot/dry climate conditions (which reduce natural recharge and increase demand) are primary drivers of reduced groundwater levels that can lead to MPI.

7.3.2 Evaluation of the Safe Yield

In Section 6, the TSY for the Chino Basin is estimated to be 121,200 afy for the period 2021-2030. Pursuant to Step 9 of the SYRM, the Watermaster must:

> 9. *Evaluate whether the groundwater production at the Tentative Safe Yield estimated in [8] above will cause or threaten to cause "undesirable results" or "Material Physical Injury." If groundwater production at Tentative Safe Yield will cause or threaten to cause "undesirable results" or "Material Physical Injury," then Watermaster will identify and implement prudent measures necessary to mitigate "undesirable results" or "Material Physical Injury," set the value of Safe Yield to ensure there is no "undesirable results" or "Material Physical Injury," or implement a combination of mitigation measures and a changed Safe Yield.*

In this section, the potential for future MPI associated with operating at the TSY was evaluated and shown to be localized and mainly driven by future extractions of groundwater from managed storage.

Reducing the Safe Yield from 121,200 afy would only have a minor effect on the potential for MPI, as the resulting increase in replenishment obligations would lead to more wet-water recharge, which in turn would result in localized higher groundwater levels that will spread to other regions of the basin over time. Even if the increases in recharge were to occur near locations with a higher risk of MPI, the increases may not be significant enough to mitigate MPI in these areas. Furthermore, some areas of projected MPI (e.g., JCSD) are not near recharge basins or are in areas where surface recharge has a limited effect on mitigating MPI.[10] Therefore, changing the Safe Yield ***is not*** the most effective method to mitigate the types of MPI indicated in the TSY Ensemble.

Recommendations for mitigating each category of MPI are described earlier in this section and include: subsidence management; recharge master planning; storage management; and adjusting localized pumping operations. Therefore, following the Court-ordered 2022 SYRM, **the Safe Yield is 121,200 afy for the 2021 through 2030 period**.

[10] See Section 3 of the 2013 Amendment to the 2010 Recharge Master Plan Update

7.3.2.1 Comparison to 2020 Safe Yield Recalculation Results

The reevaluated Safe Yield of 121,200 afy is 9,800 afy less than the current Court-approved Safe Yield of 131,000 afy for FY 2021 through FY 2030 (-7.5%). The detailed comparison of the 2020 SYR and 2025 SYR water-budget results is presented in Section 6.2.1.1. That section summarizes the changes in individual recharge and discharge components for FY 2021 through FY 2030, including the effects of the 2025 CVM updates, recalibration and uncertainty analysis, recent historical hydrology and water-use data, and revised Projection Ensemble assumptions.

As described in Section 6, the lower 2025 TSY is not attributable to a single factor. The largest difference for an individual water-budget component is lower DIPAW to the saturated zone, which is partly offset by increases in other net recharge components and decreases in some discharge components. Component-level differences between the 2020 SYR and 2025 SYR are discussed in detail in Section 6.

7.3.2.2 Contribution from Conservation Regulations

The difference between the current Safe Yield and the reevaluated Safe Yield exceeds the 2.5 percent threshold that allows the Watermaster to recommend to the Court to reset the Safe Yield. Watermaster's discretion on resetting the Safe Yield for the 2021-2030 period is defined in the April 2017 and July 2020 Court Orders, which are incorporated into the 2025 Rules and Regulations[11] (2025 R&R). Section 6.5(c) of the 2025 R&R states that in addition to the 10-year scheduled resets (the next one of which will occur by 2030), "*the Safe Yield may be reset in the event that:*

(i) with the recommendation and advice of the Pools and Advisory Committee and in the exercise of prudent management discretion described in Section 6.5(e)(iii), below, Watermaster recommends to the court that the Safe Yield must be changed by an amount greater (more or less) than 2.5% of the then-effective Safe Yield. [Court's Order, dated April 28, 2017; Court's Findings and Order, dated March 15, 2019 at 2.]

(ii) The California State Water Resources Control Board develops water conservation measures prior to June 30, 2030, that result in a reduction in urban irrigation in the Chino Basin (i.e., reduced Evapotranspiration Adjustment Factors), as required by Water Code § 10609, et seq., that is reasonably likely to materially reduce recharge in the Chino Basin and such measures are determined to change the Safe Yield by more than 2.5% of the then-effective Safe Yield, and Watermaster moves the Court to reset the Safe Yield accordingly. [Court's Orders, dated July 31, 2020 at 15.]"

As discussed in Section 5, the Conservation Regulation is projected to reduce aggregate water demands by about 1,200 to 2,700 afy in 2025, which is less than one percent of total demand, and by about 5,700 to 11,700 afy in 2030, which is about three percent of total demand. The effect of these demand reductions on net recharge during FY 2021 through FY 2030 would be smaller and delayed for several reasons. First, the Conservation Regulation went into effect in 2025, halfway through the ten-year period used to calculate the Safe Yield. Second, only the portion of reduced demand associated with outdoor irrigation affects DIPAW; reductions in other water uses do not translate directly to reduced DIPAW. Third, even where reduced outdoor irrigation lowers deep percolation past the root zone, the effect on recharge to the saturated zone is delayed by vadose-zone travel time for years or decades. Therefore, the

[11] 2025 Chino Basin Watermaster Rules and Regulations

Conservation Regulation is not reasonably likely to materially reduce saturated-zone recharge in the Chino Basin by enough to change the Safe Yield by more than 2.5 percent of the current Safe Yield for FY 2021 through FY 2030.

Therefore, our technical opinion is that the State Board's "water conservation measures" (i.e., Conservation Regulations) that were adopted prior to June 30, 2030, are *not* reasonably likely to materially reduce recharge in the Chino Basin to the degree that it would impact the Safe Yield by more than 2.5 percent of the current Safe Yield for the period of FY 2021 through 2030.

The primary drivers of the -7.5% difference between the current Safe Yield and the reevaluated Safe Yield are recent historically dry conditions and declines in historical and projected urban outdoor water use that are independent of the Conservation Regulation.

7.4 RECOMMENDATIONS

This section describes the recommendations resulting from the findings of the 2025 Safe Yield Reevaluation for: addressing data gaps to improve of the CVM; implementing mitigation measures for potential MPI identified in the TSY ensemble; and future operational optimization studies based on the 2025 CVM and TSY Ensemble results.

7.4.1 Addressing Data Gaps and Improving CVM

Through the development of the 2025 CVM and its calibration and uncertainty analysis, the 2025 CVM demonstrated statistical improvements in simulating historical groundwater behavior compared to the 2020 CVM, as described in Sections 2 through 4. The following recommendations could further improve the CVM as a decision-making tool for Watermaster and the parties:

- **Collect additional data in areas of the CVM with greatest uncertainty.** The calibration and uncertainty analysis identified four areas where additional monitoring and characterization would reduce uncertainty in future versions of the CVM:
    1. *Aquifer properties and sub-surface inflows in the northern Chino Basin.* The northern Chino Basin, including northern Fontana and Upland, has fewer wells relative to the rest of the Basin, which limits the understanding of boundary inflows and aquifer-system properties in these areas. Additional borehole lithology, geophysical data, aquifer-test data, and depth-specific groundwater-level measurements would improve the characterization of aquifer properties and boundary inflows and would improve future CVM re-calibrations.
    2. *San Gabriel Mountain inflows.* Additional monitoring should focus on better quantifying mountain-front recharge and surface-water inflows along the San Gabriel Mountain front. Potential improvements could include stream gaging at key mountain-front drainages, improved monitoring of flows into recharge/flood-control facilities, high-frequency groundwater-level measurements in wells near the mountain front, and targeted water-quality or isotope sampling and analysis studies. These data would improve estimates of boundary inflows (surface and sub-surface inflows), recharge timing, and groundwater-flow gradients in the northern CVM.
    3. *Aquifer properties in western Chino Basin.* The greater variability in simulated groundwater levels at various wells in this area is influenced by complex faulting and the

vertical hydrostratigraphic layering of the aquifer system that is unique to this portion of the Chino Basin and may not be well understood and well represented in the CVM, which limits the ability to achieve better model calibration. Additional borehole lithology, geophysical data, aquifer test data, and depth-specific groundwater-level measurements would improve the characterization of aquifer properties and groundwater flow (horizontal and vertical) in this area of the Chino Basin and would improve future CVM calibrations.

4. *Southern Chino Basin/Santa Ana River interaction.* While the net movement of water between the SAR and the southern Chino Basin remained similar to the 2020 CVM, the total water exchanged (total streambed infiltration plus total rising groundwater) increased by 47 percent in the 2025 CVM. Improving the measurements of the groundwaters/surface water interactions could improve future CVM updates and re-calibrations and better support future planning in the Chino Basin and the SAR watershed. Potential improvements could leverage existing monitoring in the Chino Basin and the SAR to understand rising groundwater and water quality, including paired streamflow measurements upstream and downstream of key reaches, stream-stage monitoring, shallow groundwater-level monitoring near the river, periodic seepage runs, streambed hydraulic-conductivity testing, and continued riparian vegetation/groundwater ET monitoring in Prado Basin.

- **Continue to collect historical data and projections regarding urban outdoor water use.** The difference in historical and projected DIPAW is the largest factor in the difference between the current Safe Yield (131,000 afy) and the reevaluated Safe Yield (121,200 afy). The Projection Ensemble was developed based on the best available information on the current patterns of outdoor water use and the projected impacts of the Conservation Regulation with input from the parties. However, as the Conservation Regulation took effect on January 1, 2025, it will take several years to measurably impact urban outdoor water use and even longer to impact recharge to the Chino Basin. This was a point of discussion during the 2025 SYR process.

  In advance of the 2030 Safe Yield Recalculation, it is recommended that Watermaster continue collaborating with the parties to better understand and quantify urban outdoor water use and the impact of the Conservation Regulation and other drivers on urban outdoor water use. This includes quantifying the nature of the how changes in outdoor water use are occurring, whether it be through less vegetation, improved irrigation efficiency, or other factors. Building upon the prior improvements in data collection will help improve the accuracy of and confidence in estimates of future urban outdoor water use and DIPAW.

7.4.2 Mitigation Measures

The possible mitigation measures to address the potential for MPI associated with the TSY Ensemble are discussed in the above sections and include:

- Subsidence management planning (to address MPI for land subsidence)
- Recharge master planning (to address MPI for land subsidence and pumping sustainability)
- Storage management (to address MPI for land subsidence and pumping sustainability)

- Revised operations of the parties experiencing pumping sustainability challenges

Watermaster should use the MPI results from the TSY Ensemble to identify the areas where these measures should be evaluated and, where appropriate, implemented through existing Basin management programs. These measures should be coordinated with the affected parties and should be targeted to the specific MPI mechanism, location, and operating condition identified in the TSY Ensemble.

7.4.3 Operational Optimization

During the development of the 2025 SYR, the AP expressed interest in using the 2025 CVM and TSY Ensemble results to evaluate operational strategies for pumping, recharge, and storage management. These strategies could be used to enhance Basin management, mitigate MPI, reduce losses from storage, and offset the effects of observed and projected declines in net recharge compared to historical levels.

The 2025 SYR was not designed to optimize Basin operations or identify a preferred combination of pumping, recharge, and storage-management actions. However, the findings of the 2025 SYR and prior studies[12] indicate that certain operational strategies could improve Basin conditions by increasing net recharge, supporting groundwater levels in key areas, strengthening hydraulic control, and/or reducing storage losses. The 2025 CVM and TSY Ensemble results provide a baseline from which Watermaster and the parties can evaluate the effectiveness of these strategies and guide future Basin management. Potential operational optimization activities are summarized in Table 7-4.

Activities identified as maintaining or enhancing Safe Yield have the potential to improve net recharge or reduce losses from storage. Any effect on Safe Yield would need to be quantified through future scenario development and model simulations.

[12] E.g., the 2023 Storage Framework Investigation

Table 7-4. Potential Basin-Management Activities to Avoid MPI and Maintain or Enhance Safe Yield

Activity	Description	Intended Outcome	
		Avoid/ Mitigate MPI	Maintain/ Enhance Safe Yield
Subsidence management	Develop and apply guidance criteria for pumping, recharge, and storage-recovery operations in Areas of Subsidence Concern to reduce the risk of groundwater levels declining below subsidence thresholds.	X	
Recharge master planning	Develop and implement projects and operating strategies to capture more stormwater and enhance recharge in strategic locations where recharge can support groundwater levels, reduce MPI risk, and improve net recharge.	X	X
Storage management planning and strategic management of local storage	Develop criteria for the storage, transfer, and recovery of water in local storage, including the location, timing, and rate of recovery, to avoid localized drawdown, reduce losses from storage, and maintain physical storage.	X	X
Revised local operations of parties	Work with parties experiencing pumping sustainability challenges to adjust wellfield operations, including pumping locations, rates, timing, equipment settings, and coordination among nearby wells, to reduce pumping interference and sustain production.	X	
Increased pumping in the southern Chino Basin to strengthen hydraulic control and minimize storage losses	Evaluate operationally feasible increases or redistribution of pumping in the southern Chino Basin, including the desalter well fields, to maintain hydraulic control, reduce rising-groundwater and evapotranspiration losses, and improve effective use of recharge and storage.	X	X
Strategic Storage and Recovery Programs	Design and implement Storage and Recovery Programs so that recharge and recovery occur at times and locations that increase effective yield, maintain hydraulic control, and avoid groundwater-level declines in areas where MPI could occur.	X	X

DRAFT

CHINO BASIN WATERMASTER

ADVISORY COMMITTEE

June 18, 2026

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 June 2026

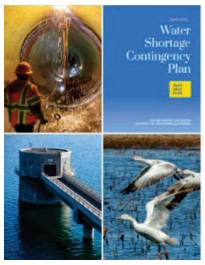
For More Information Contact:

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.

MWD Adopts 2025 Urban Water Management Plan (UWMP) and Water Shortage Contingency Plan (WSCP)

On May 13th, the MWD Board of Directors adopted MWD's 2025 UWMP and WSCP. These plans must be filed with Department of Water Resources every five years. The 2025 UWMP demonstrates MWD's water supply reliability in normal and dry water years, and the 2025 WSCP includes MWD's planned actions to respond to water shortage conditions.



MWD 2025 UWMP– MWD April 13, 2026

CAMP4W Advances Low-Regret Climate Adaptation Investments

On May 26, 2026, MWD's CAMP4W Subcommittee reviewed ongoing evaluations of major water supply investments, including Pure Water Southern California (PWSC), Sites Reservoir, Delta Conveyance, and additional storage projects. Staff highlighted the need to balance long-term reliability, financial considerations, and system flexibility when evaluating future investments. Near-term priorities include maintaining and upgrading existing infrastructure, advancing planning for PWSC, improving regional conveyance flexibility, and continuing to evaluate future storage and supply opportunities. At this stage of CAMP4W, MWD is pursuing low-regret investments to address identified risks, refining the methodology to assess projects and project portfolios, and compiling information so the MWD Board can make decisions at the end of the year.

MWD Continues Water Standby Charge for FY 2026/27

On May 12, 2026, the MWD Board considered continuation of the Water Standby Charge for Fiscal Year (FY) 2026/27. The Standby Charge allows participating member agencies such as IEUA to pay a portion of their Readiness-to-Serve (RTS) obligation through property-based standby charge collections. MWD estimates approximately $43.9 million in Standby Charge revenue in FY 2026/27, which will be applied toward participating agencies' RTS obligations. The IEUA standby charge rate remains $7.59 per acre or parcel, consistent with prior authorized levels.

California Aqueduct Subsidence Program (CASP) Update

On May 26, 2026, MWD's Subcommittee on Imported Water had the Department of Water Resources (DWR) provide an update on the California Aqueduct Subsidence Program. Subsidence caused by long-term groundwater pumping in the San Joaquin Valley continues to impact State Water Project's California Aqueduct operations and capacity. DWR is pursuing a strategy focused on characterizing subsidence impacts, modifying operations where feasible, implementing corrective actions, and identifying cost-effective measures to maintain long-term State Water Project reliability.



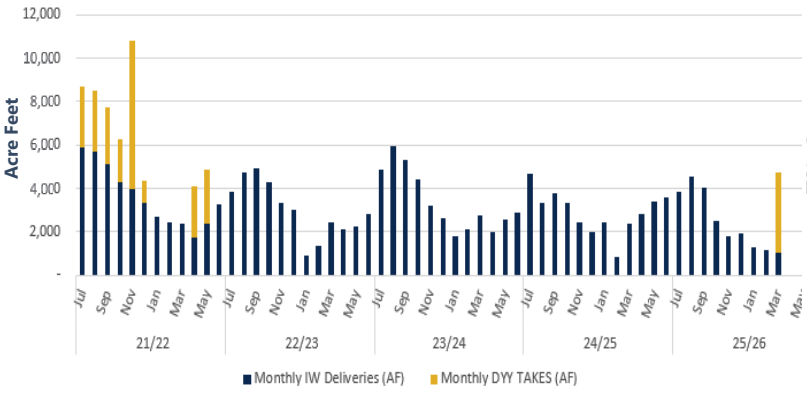
DWR Impact of Subsidence Addendum – May 2025 (Report)

GENERAL MANAGER'S REPORT

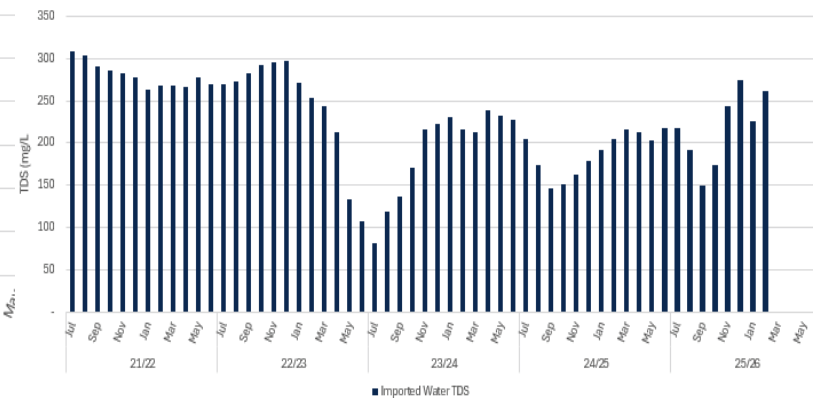
MAY 2026

Imported Water

Full Service Imported Water Deliveries Summary (FY 2020/21 to 2025/26)

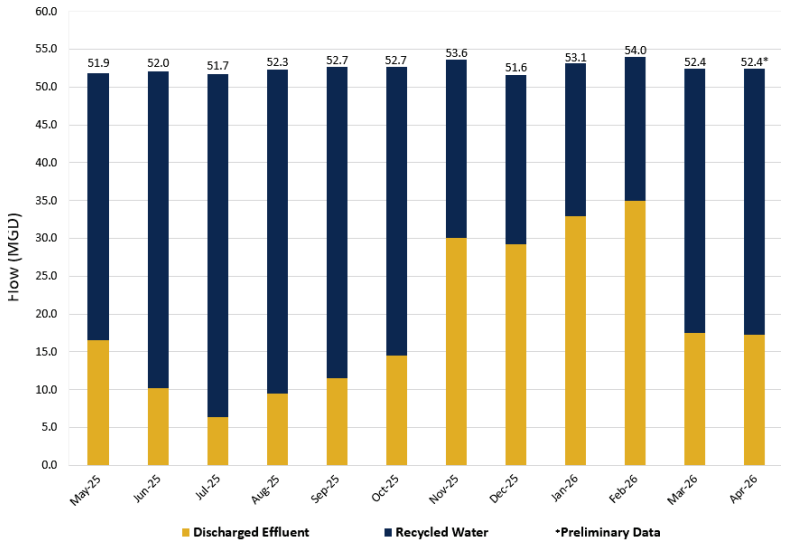


Imported Water TDS Summary (FY 2020/21 to 2025/26)

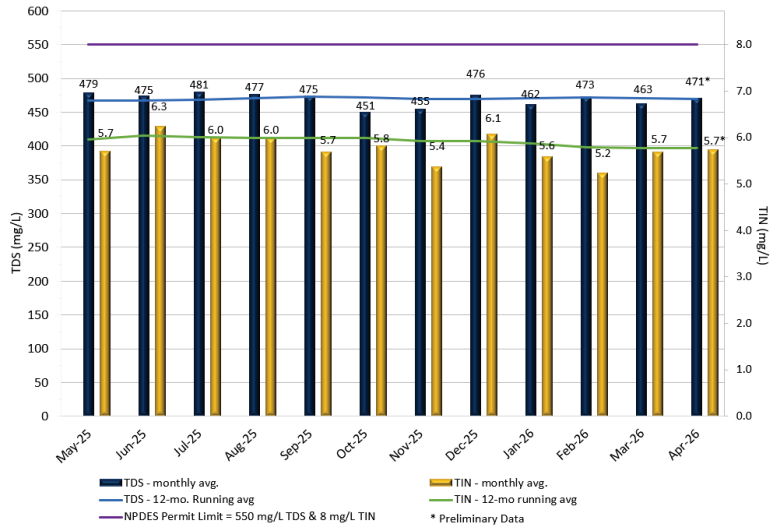


Recycled Water

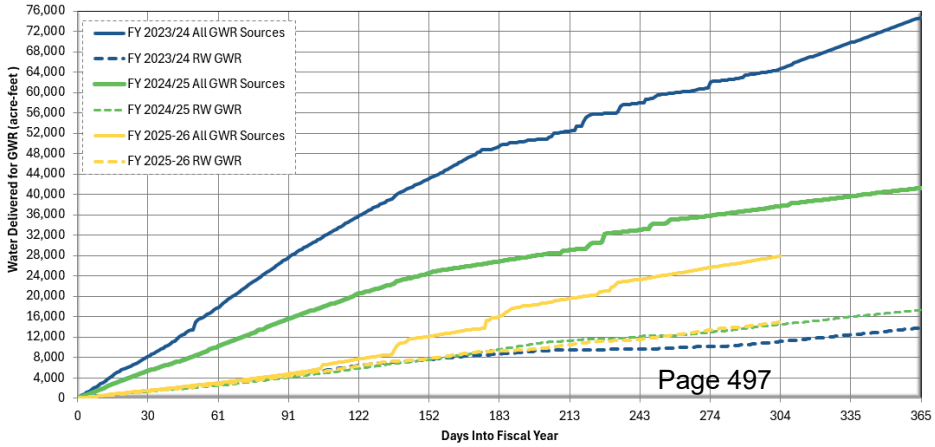
Discharged Effluent & Recycled



Agencywide Effluent TDS & TIN



Groundwater Recharge



APRIL 2026 NOTES:

- Total stormwater and dry weather flow recharged is preliminarily estimated at 278.8 acre-feet.
- Recycled water delivered for recharge totaled 1,531.6 acre-feet.
- There was 397 acre-feet of imported water recharged in the Chino Basin from SAWCo.
- 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 1,996.4 acre-feet.

The Metropolitan Water District of Southern California

Water Supply Conditions Report - https://www.mwdh2o.com/WSCR

Questions? Reach out via the form: https://forms.office.com/g/Gj3aReAuCm

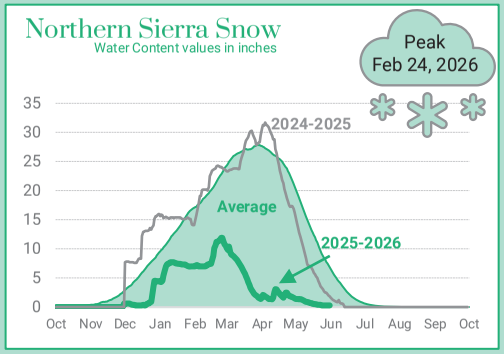
Water Year 2025-2026

As of: 05/31/2026

State Water Project

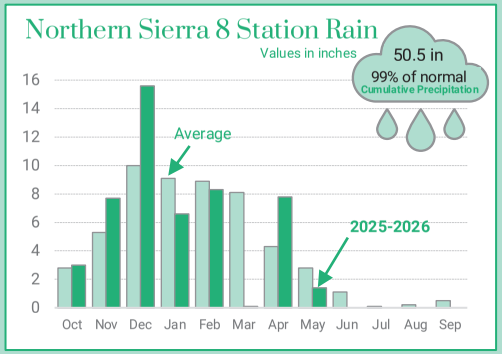
Northern Sierra Snow

Water Content values in inches



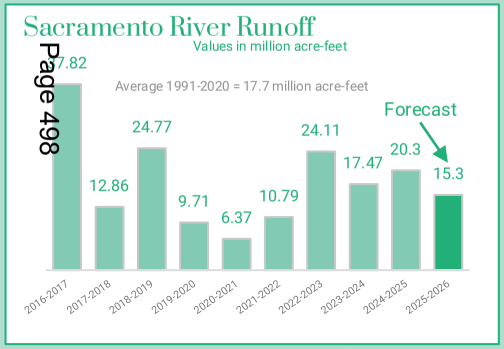
Northern Sierra 8 Station Rain

Values in inches

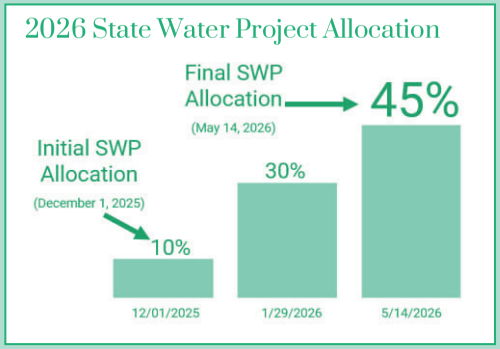


Sacramento River Runoff

Values in million acre-feet

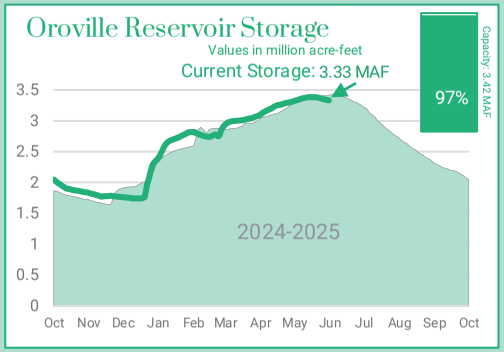


2026 State Water Project Allocation



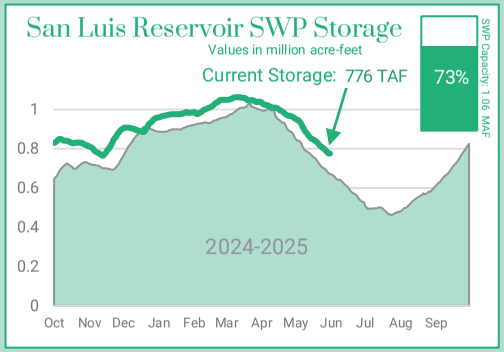
Oroville Reservoir Storage

Values in million acre-feet



San Luis Reservoir SWP Storage

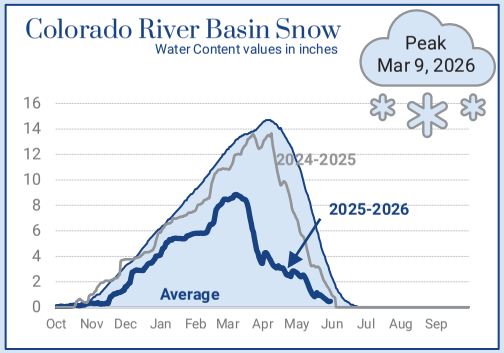
Values in million acre-feet



Colorado River

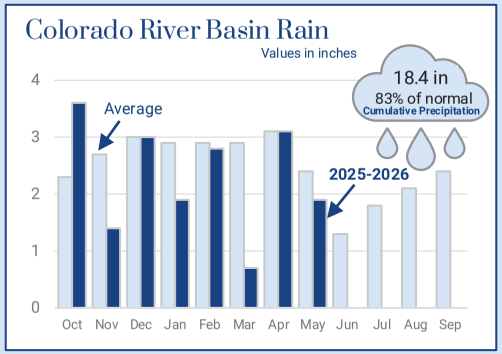
Colorado River Basin Snow

Water Content values in inches

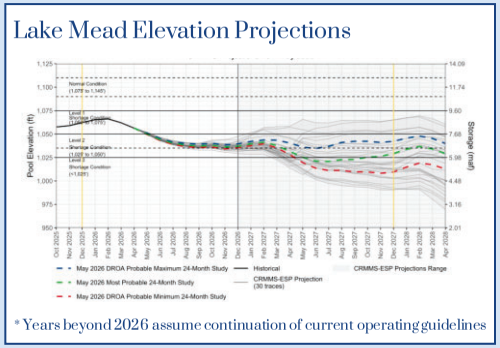


Colorado River Basin Rain

Values in inches



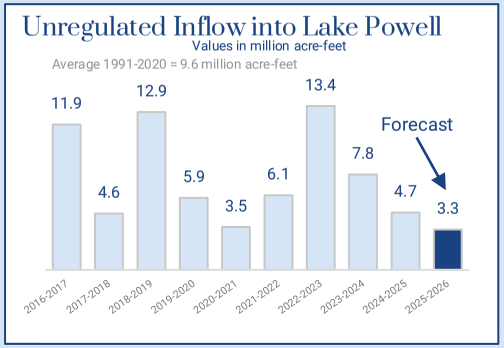
Lake Mead Elevation Projections



* Years beyond 2026 assume continuation of current operating guidelines

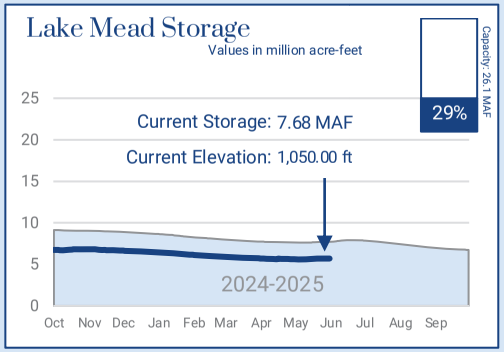
Unregulated Inflow into Lake Powell

Values in million acre-feet



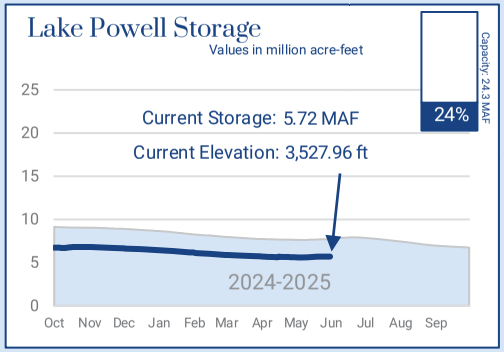
Lake Mead Storage

Values in million acre-feet



Lake Powell Storage

Values in million acre-feet



Water System Infrastructure : https://www.mwdh2o.com/how-we-get-our-water/

Inland Empire Utilities Agency, a Municipal Water District Federal Update

May 29, 2026

Fiscal Year 2027 Appropriations Update

Over the past month, the House Appropriations Committee continued to make progress on advancing the twelve FY27 appropriations bills. To date, the Committee has passed seven of the spending bills. Additionally, the full House passed the first FY27 spending bill, the Military Construction–Veterans Affairs Appropriations bill. Looking ahead to June, the Committee is on track to pass all twelve spending bills before the July 4th Congressional recess. The Senate Appropriations Committee continues to have discussions between Republicans and Democrats to come to a bipartisan agreement on top-line funding levels. The Committee has yet to publish a markup schedule for the FY27 appropriations bills.

FY27 Appropriations Bill	House Subcommittee Allocation (in Billions)	House Subcommittee Markup	House Full Committee Markup	House Floor
Agriculture–Rural Development–FDA	$26.27	Passed on April 23 by a 10–7 vote	Passed on April 29 by a 35–25 vote	
Commerce–Justice–Science	$77.341	Passed on April 30 by an 8–6 vote	Passed on May 13 by a 32–28 vote	
Defense		June 11	June 24	
Energy–Water Development		Passed on May 15 by a voice vote	Passed on May 20 by a 34–25 vote	
Financial Services–General Government	$25.298	Passed on April 17 by a 9–6 vote	Passed on April 22 by a 34–28 vote	
Homeland Security		June 5	June 10	
Interior–Environment		Passed on May 21 by a 7–5 vote	June 3	
Labor–HHS–Education		June 5	June 9	
Legislative Branch	$7.3	Passed on April 30 by a 5–4 vote	Passed on May 13 by a 34–28 vote	

Military Construction–VA	$157	Passed on April 17 by a voice vote	Passed on April 21 by a 58–0 vote	Passed on May 15 by a 400–15 vote
National Security–State	$47.32	Passed on April 23 by an 8–5 vote	Passed on April 28 by a 35–27 vote	
Transportation–HUD		May 21	June 3	

Congressional Republicans Hit Roadblock on Reconciliation 2.0 Bill

In May, Congressional Republicans continue to work towards the goal of passing a second reconciliation package, containing $70 billion for in multi-year funding for Customs and Border Patrol (CBP) and Immigration and Customs Enforcement (ICE), by June 1st. The plan was for both the House and the Senate to vote on the package before the Congressional Memorial Day recess. However, challenges arose related to $1 billion included in the package for the Secret Service (including funding for the ballroom), as well as the Administration's announcement of the $1.8 billion anti-weaponization fund. As a result, neither the House nor the Senate voted on the bill prior to leaving Washington, DC. Congressional Republicans are expected to take up the legislation when Congress reconvenes next week.

OMB Proposes Sweeping Overhaul of Federal Grant Regulations

On May 29, the Office of Management and Budget (OMB) published a **proposed rule** that would represent a significant overhaul of federal grant regulations. It would give federal agencies broad authority to terminate grants on the basis that they no longer serve program goals, agency priorities, or the national interest. Key provisions also include placing senior political appointees in charge of screening grant proposals; instituting new reviews of recipients' foreign connections; barring grant recipients from implementing DEI policies, gender transition services, or voter registration drives; requiring grant materials to be written in English; and requiring recipients to pass E-Verify immigration status screening. The rule has a 45-day public comment period with a target implementation date of October 1, 2026.

FEMA Review Council Releases Final Report

On May 7, the President's Council to Assess the Federal Emergency Management Agency (FEMA) released its **final report**, following months of delays. The Council was established by Executive Order 14180 on January 24, 2025, to conduct a full-scale evaluation of FEMA and recommend structural changes. The report's guiding doctrine is that disaster response should be locally executed, state or tribally managed, and federally supported, and it calls for implementing reforms over a phased two-to-three-year period. The report made the following ten recommendations:

- Equipping states, local governments, tribes, and territories to lead disaster response with the federal government in a supporting role
- Enhancing critical federal programs and resources to support communities
- Realigning the criteria for federal disaster assistance
- Replacing the Hazard Mitigation Grant Program with a two-phase funding structure
- Streamlining the Individual Assistance program into a single direct payment program
- Reforming the Public Assistance program to provide direct funding
- Reforming the National Flood Insurance Program for financial stability and risk resilience
- Reducing administrative costs
- Revitalizing a unified national network for partnership
- Transforming the agency

Several recommendations require congressional action to implement, including the replacement of the Hazard Mitigation Grant Program, streamlining of the Individual Assistance program, reform of the Public Assistance program, reform of the National Flood Insurance Program, and the broader agency transformation.

LEGISLATIVE ACTIVITY

House Passes Farm Bill. On April 30, the House passed the *Farm, Food, and National Security Act of 2026* (**H.R. 7567**) by a 224–200 vote, marking the first time a Farm Bill has passed a congressional chamber since 2018. The bill would reauthorize federal agriculture, nutrition, conservation, rural development, forestry, energy, and crop insurance programs through Fiscal Year 2031. Prior to the bill's passage, the House also voted to strip a provision that would have preempted state and local pesticide warning label rules. The bill now heads to the Senate, where the Senate Committee on Agriculture, Nutrition, and Forestry has not yet introduced their own version of the legislation. The current authorization of the 2018 Farm Bill is slated to expire September 30, 2026.

House Committee Advances Bill to Improve Recycling Infrastructure and Accessibility. On May 21, the House Energy and Commerce Committee passed the *Recycling Infrastructure and Accessibility Act* (**H.R. 2145**) by a 48–0 vote. The bill would establish an Environmental Protection Agency (EPA) pilot grant program to improve recycling accessibility in areas located more than 75 miles from a materials recovery facility, with eligible projects including expanding recycling collection programs, increasing transfer stations, and supporting public-private partnerships to reduce transportation and collection costs. The bill would also direct EPA to coordinate with state, local, and tribal governments to collect recycling and composting data and compile a nationwide inventory of materials recovery facilities every four years. The bill now advances to the full House for consideration.

House Subcommittee Advances Brownfields Reauthorization Bill. On May 14, the House Energy and Commerce Subcommittee on Environment advanced the Brownfields Revitalization for a Better Tomorrow Act (**H.R. 8739**) to the full Committee by a voice vote. The bill would reauthorize EPA's Brownfields Program, which supports the cleanup and productive reuse of contaminated sites.

Bipartisan Bill Introduced to Create Tax Credit for Water Reuse Projects. On May 13, Senators Katie Britt (R-AL) and Ben Ray Luján (D-NM) introduced the Advancing Water Reuse Act (**S. 4506**), which would create a 30 percent investment tax credit for qualifying water reuse projects. Eligible projects include installation or expansion of onsite water recycling systems at manufacturing, food processing, and other industrial facilities including data centers; replacement of freshwater use with recycled water from a municipal provider; and construction or expansion of municipal water recycling systems for industrial purposes. The bill has been referred to the Senate Finance Committee.

Bill Introduced to Require Data Centers to Pay for Own Power and Grid Upgrades. On May 18, Senator Adam Schiff (D-CA) introduced the *Energy Cost Fairness and Reliability Act* (**S. 4559**), which would require large load facilities with peak demand exceeding 50 megawatts, including data centers, to bring their own power and pay 100 percent of the cost of grid network upgrades required for their interconnection. The bill would also direct the Federal Energy Regulatory Commission to update transmission policies to allow data centers to reduce demand during peak energy periods and to allow grid operators to curtail power to data centers during peak demand. It would prohibit data centers from drawing power from existing generating facilities already serving other customers. The bill would also direct the Department of Energy to collect data on data center energy use and establish an AI testbed at a national laboratory.

Problem Solvers Caucus Launches Bipartisan Gerrymandering Working Group. On May 27, the House Problem Solvers Caucus announced the formation of a **bipartisan working group** focused on reforming the congressional redistricting process. The working group, co-chaired by Representatives Jeff Hurd (R-CO) and Ed Case (D-HI), includes ten members evenly divided between Republicans and Democrats. Members have cited the influence of partisan redistricting on political polarization and electoral competitiveness as motivating factors. The group is expected to examine potential redistricting reforms ahead of the 2030 Census.

House Democrats Launch End Corruption Caucus. On May 27, Representatives Jason Crow (D-CO), Alexandria Ocasio-Cortez (D-NY), and Mike Levin (D-CA) launched the **End Corruption Caucus**, which is focused on advancing anti-corruption legislation and restoring public trust in government. As part of the launch, the three Members introduced a resolution calling on the House to denounce corruption in all its forms and oppose policies that benefit special interests at the expense of the American people. The caucus intends to address issues including dark money in elections, stock trading by Members of Congress, and the revolving door between the public and private sectors.

FEDERAL FUNDING OPPORTUNITIES

Reclamation Publishes Title XVI Water Recycling and Reuse Program NOFO. The Bureau of Reclamation has published a **NOFO** for the Title XVI Water Recycling and Reuse Program, which funds the planning, design, and construction of water reclamation, recycling, and reuse projects. The NOFO has two application periods. The first application period closes on August 26, 2026. The second application period closes on August 26, 2027.

Reclamation Publishes Desalination Construction Program NOFO. The Bureau of Reclamation has published a **NOFO** for the Desalination Construction Program, which funds the planning, design, and construction of desalination facilities for seawater or brackish groundwater or surface water. The NOFO has two application periods. The first application period closes on August 26, 2026. The second application period closes on August 26, 2027.

Reclamation Publishes Enhancing Water Resources Program NOFO. The Bureau of Reclamation has published a **NOFO** for the Enhancing Water Resources Program, which funds projects that benefit water resource management for multiple uses, including water conservation and efficiency projects, water infrastructure improvements, and river and watershed restoration. The NOFO has two application periods. The first application period closes on September 9, 2026. The second application period closes on September 8, 2027.

FEDERAL AGENCY ACTIONS AND PERSONNEL CHANGES

OPM Proposes Governmentwide NDA for Federal Employees. On May 27, the Office of Personnel Management **published** a draft nondisclosure agreement (NDA) for public comment that federal agencies could elect to require of both new and existing employees. The proposed NDA would require employees to acknowledge and agree to comply with existing legal obligations to protect non-public, confidential, or proprietary government information, and would remain in effect after an employee leaves federal service. Former employees who signed the NDA would need written permission from an authorized agency official before disclosing information designated as confidential. Violations could result in legal penalties including financial restitution. OPM states the NDA preserves existing whistleblower protections and does not create new restrictions on employee speech beyond those that already exist in law. The NDA would be optional for individual agencies to adopt. Public comments are due June 26.

EPA Launches Interactive Permitting Authority Map. On May 6, the Environmental Protection Agency (EPA) launched the **EPA Permitting Authority Map**, an interactive online tool that allows users to identify which regulatory agency holds permitting authority for EPA environmental permit programs at any given location. The tool is intended to reduce uncertainty in the permitting process by consolidating permitting authority information in a single, publicly accessible resource. EPA also released new informational tools to help communities, local officials, and developers assess the suitability of Brownfield and Superfund sites for industrial reuse, including data center development, through an updated Redevelopment Mapper.

EPA Proposes to Rescind PFAS Drinking Water Standards for Four Substances and Extend PFOA and PFOS Compliance Deadline. On May 20, EPA published two proposed rules related to the 2024 PFAS National Primary Drinking Water Regulation. The **first proposed rule** would rescind drinking water standards for four substances—perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid and its ammonium salt (HFPO-DA, commonly known as GenX chemicals), and hazard index mixtures of these three PFAS plus perfluorobutane sulfonic acid (PFBS)—on the basis that the 2024 rule followed an unlawful procedure under the *Safe Drinking Water Act* by finalizing

regulatory determinations for these substances simultaneously with the drinking water standards rather than sequentially. The **second proposed rule** would retain the existing PFOA and PFOS maximum contaminant levels of 4.0 parts per trillion each while providing eligible public water systems the option to request a two-year extension of the April 2029 compliance deadline to April 2031. Systems granted an extension with PFOA or PFOS levels at or above 12 parts per trillion would be required to implement short-term mitigation measures. EPA will hold a virtual public hearing on July 7. Comments are due July 20.

FEMA Administrator Nominated. On May 11, President Trump **nominated** Cameron Hamilton to serve as Administrator of the Federal Emergency Management Agency (FEMA). The nomination has been referred to the Senate Committee on Homeland Security and Governmental Affairs. Hamilton previously served as FEMA's Acting Administrator at the start of the current administration before being dismissed.

##

West Coast Advisors
Strategic Public Affairs

May 27, 2026

To: Inland Empire Utilities Agency

From: Michael Boccadoro
Beth Olhasso

RE: May Report

Overview:
California entered late spring with a mixed water outlook as reservoirs remained near historic highs despite the Sierra snowpack melting far earlier than normal after a record-hot March. Statewide precipitation through April reached 100% of average, but much of it fell as rain instead of snow, reducing the state's natural summer water storage. Reservoir conditions remain strong, with San Luis Reservoir at 106% of historical average, Lake Oroville at 120% of normal, and Lake Shasta at 105% of average for this time of year. Water managers cautioned that the weak snowpack could still create challenges later in the summer because reduced snowmelt limits steady runoff during the hottest months.

Governor Newsom's May Revise budget proposal preserved most major natural resources and climate programs but signaled a more restrained fiscal approach as California faces long-term budget pressures. The proposal includes $25 million for the Healthy Rivers and Landscapes Program tied to Bay-Delta restoration and science efforts, while shifting some environmental agency costs away from the General Fund. Debate continues over the future of California's cap-and-trade, or "cap-and-invest," program, which supports transit, wildfire prevention and clean water projects. Lawmakers now face negotiations over environmental funding ahead of the June 15 budget deadline.

At the ACWA spring conference, Governor Newsom urged California water leaders to accelerate major infrastructure projects, particularly the Delta Conveyance Project, arguing the state's current water system was built for a climate that no longer exists. Newsom said California must modernize water conveyance, storage and groundwater systems to manage more volatile storms and longer droughts. He highlighted the Delta tunnel as a critical resilience project protecting State Water Project supplies from earthquakes, sea-level rise and declining snowpack. The Governor also emphasized investments in groundwater recharge, recycled water, Sites Reservoir and local water supply development.

California regulators and environmental groups are raising concerns over federal plans to increase water deliveries from Shasta Reservoir to Central Valley agricultural contractors. State officials warn that releasing too much cold water now could leave Sacramento River temperatures dangerously warm later this summer, threatening Chinook salmon spawning and survival.

A coalition of Tribal leaders, environmental organizations and fishing groups released a new "Water Renaissance Plan" calling for California to shift away from imported water projects and invest more heavily in local water supplies. The proposal emphasizes wastewater recycling,

stormwater capture, groundwater cleanup and conservation instead of the Delta tunnel, arguing Southern California could meet up to 85% of its demand locally by 2045.

The Legislature is entering the final push to move bills out of their house of origin before the May 29 deadline. SB 872 (McNerney), would create a long-term Delta Levees and Canal Subsidence Fund providing up to $300 million annually for canal repairs and Delta levee improvements, though funding details are still under negotiation. Other key bills include AB 2215 extending deadlines tied to State Water Project permits and AB 2777 expanding financing flexibility for recycled water and wastewater projects. Lawmakers are also advancing bills related to tribal water rights, utility emergency access and invasive golden mussel prevention.

Inland Empire Utilities Agency
Status Report – May 2026

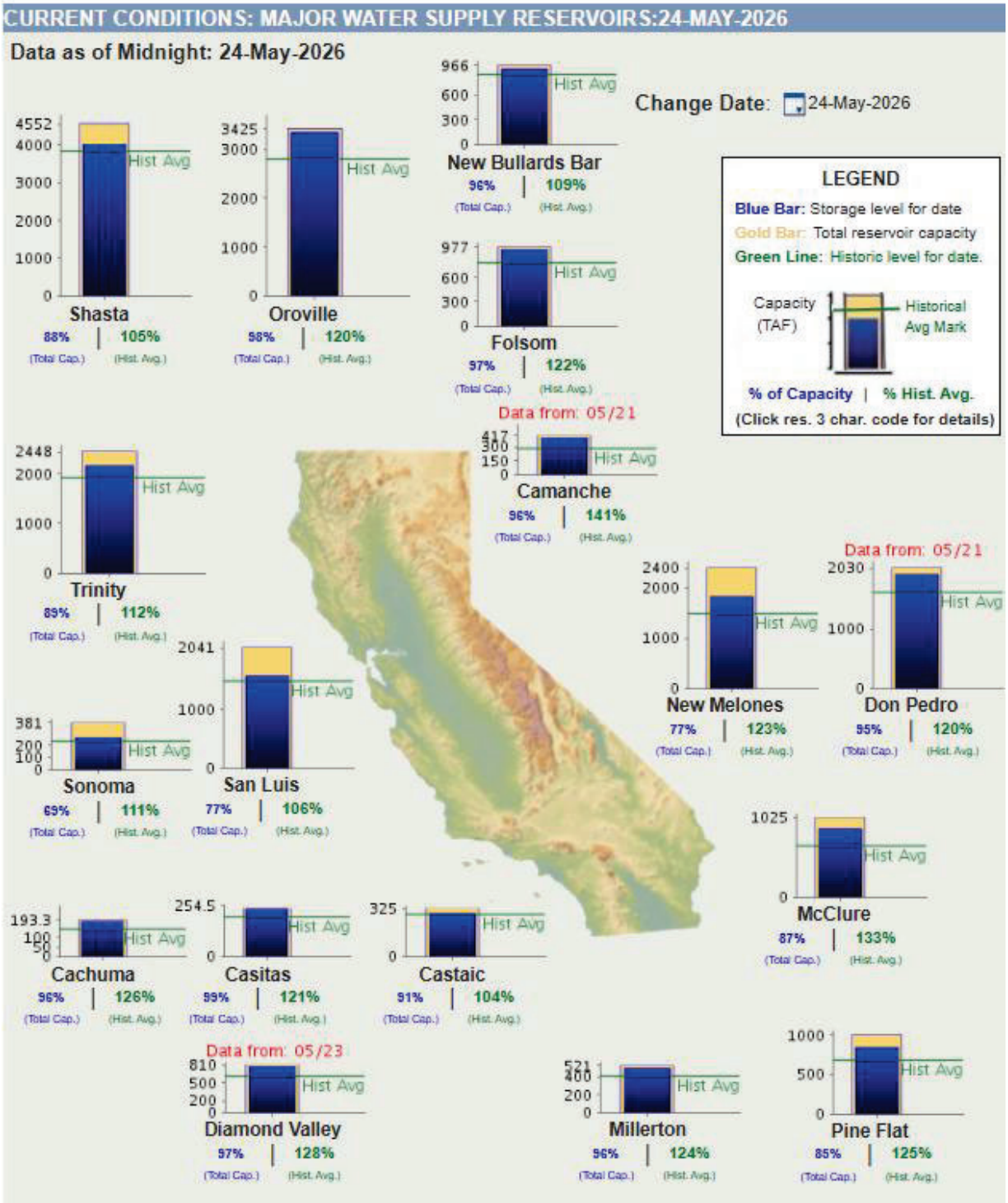
Water Supply Conditions

California entered the late spring with a sharply divided water picture: reservoirs remained near historic highs thanks to strong carryover storage and near-average precipitation, while the Sierra snowpack all but disappeared weeks ahead of schedule after a record-hot March.

According to the Department of Water Resources (DWR), statewide precipitation through the end of April measured 21.4 inches, or 100% of average for the water year. But despite average precipitation totals, California's mountain snowpack — the state's largest natural reservoir — collapsed unusually early.

Even with the poor snowpack, California's reservoirs remained exceptionally healthy because of water stored from prior wet years and continued spring precipitation. Water managers warned, however, that the weak snowpack could still create problems later in the summer because snowmelt typically provides a slow, steady source of runoff during the hottest months.

Reservoirs are still holding strong-- San Luis reservoir is at 106 percent of historical average and 77 percent capacity. Lake Oroville is at 98 percent capacity, 120 percent of normal; Lake Shasta is sitting at 88 percent of capacity, 105 percent of average for this time of the year.


CURRENT CONDITIONS: MAJOR WATER SUPPLY RESERVOIRS:24-MAY-2026
Data as of Midnight: 24-May-2026
Change Date: 24-May-2026
LEGEND
Blue Bar: Storage level for date
Gold Bar: Total reservoir capacity
Green Line: Historic level for date.
Capacity (TAF)
Historical Avg Mark
% of Capacity | % Hist. Avg.
(Click res. 3 char. code for details)
Hist Avg
Shasta
88% | 105%
Oroville
58% | 120%
New Bullards Bar
96% | 109%
Folsom
97% | 122%
Data from: 05/21
Camanche
96% | 141%
Trinity
89% | 112%
New Melones
77% | 123%
Data from: 05/21
Don Pedro
95% | 120%
Sonoma
69% | 111%
San Luis
77% | 106%
McClure
87% | 133%
Cachuma
96% | 126%
Casitas
99% | 121%
Castaic
91% | 104%
Data from: 05/23
Diamond Valley
97% | 128%
Millerton
96% | 124%
Pine Flat
85% | 125%
(Total Cap.)
(Hist. Avg.)

Governor Newsom Reveals May Revise Budget

California's natural resources programs escaped the deepest cuts in Gov. Gavin Newsom's May Revise budget proposal, but the spending plan signals a tighter fiscal era for environmental and conservation programs as lawmakers prepare for difficult negotiations ahead.

The revised 2026-27 budget, unveiled May 14, closes what the administration says was a projected deficit while preserving nearly $30 billion in reserves. The proposal leans heavily on stronger-than-expected tax revenues tied to California's booming artificial intelligence sector and stock market gains.

Even with the improved fiscal outlook, the May Revise reflects a broader shift away from the rapid expansion of climate and natural resources spending seen during the state's recent surplus years. The administration framed the proposal as one focused on "fiscal restraint" while still maintaining core investments in clean energy, wildfire resilience and ecosystem restoration.

Among the headline resource proposals, the budget adds $25 million for the Healthy Rivers and Landscapes Program, aimed at supporting habitat restoration and science tied to the Bay-Delta Water Quality Control Plan update.

The administration also proposes shifting roughly $9.6 million in California Environmental Protection Agency costs away from the General Fund and onto alternative funding sources, including activities at the Department of Toxic Substances Control and the California Air Resources Board. Environmental advocates say the move highlights the growing pressure on agencies to find dedicated revenue streams as General Fund dollars tighten.

At the same time, uncertainty continues to hang over California's long-term climate funding structure. Debate is intensifying around the state's proposed overhaul of its cap-and-trade program — rebranded as "cap-and-invest" — which could significantly reduce revenues that currently support transit, affordable housing, wildfire prevention and clean water projects. Local governments and environmental groups warn the changes could strip billions from programs communities increasingly rely on to address climate resilience.

The Legislative Analyst's Office (LAO) cautioned that while higher tax receipts improved the state's immediate condition, California still faces structural budget deficits in future years. The LAO noted that the May Revise relies on stronger revenues and reserves, but warned the state remains vulnerable to economic downturns because of its dependence on volatile capital gains taxes.

For natural resources agencies, the May Revise may ultimately represent a holding pattern rather than an expansion year. Core climate and conservation priorities largely remain intact, but new large-scale commitments are scarce, and agencies are increasingly being asked to stretch existing dollars further.

The Legislature now has until June 15 to pass a final budget, with environmental funding expected to remain a major point of negotiation between lawmakers, labor groups, local governments and climate advocates.

Governor Newsom Addresses ACWA Conference

Governor Newsom used his appearance at the Association of California Water Agencies (ACWA) conference to deliver an unmistakable message to the state's water leaders: California must move faster on major infrastructure projects — especially the Delta tunnel — if it hopes to adapt to a hotter and more volatile climate future.

Addressing water managers, local agency officials and industry leaders at the ACWA spring conference, Newsom framed the state's water challenges as part of a broader climate transformation that is rapidly outpacing the state's traditional infrastructure and regulatory systems.

"We built a water system for a world that no longer exists," Newsom said, arguing that California must modernize its conveyance, storage and groundwater systems to capture increasingly erratic storm flows and prepare for longer drought cycles.

The Governor repeatedly emphasized the Delta Conveyance Project, describing the proposed tunnel beneath the Sacramento-San Joaquin Delta as one of the state's most important long-term resilience investments. Newsom argued that sea-level rise, earthquake risk and declining snowpack threaten the reliability of the State Water Project, which supplies water to roughly 27 million Californians.

The remarks came just weeks after the project achieved a major permitting milestone when the Delta Stewardship Council rejected most appeals challenging the tunnel's consistency with the Delta Plan. The ruling preserved the California Department of Water Resources' certification and allowed the project to continue advancing through the state approval process.

Newsom told conference attendees that California cannot continue delaying large-scale projects because of what he described as decades-long permitting and litigation cycles. He urged water agencies to support a more streamlined approach to environmental review and infrastructure delivery.

Alongside the Delta tunnel, Newsom highlighted investments in groundwater recharge, recycled water, Sites Reservoir and local storage projects. He also praised urban conservation efforts and acknowledged that water recycling and regional self-sufficiency will play a growing role in California's future water portfolio.

State Regulators Concerned About Federal Actions at Shasta

The latest battle in California's water wars is centering on Shasta Dam, where the Trump administration is moving to send more water to Central Valley farms despite warnings that the plan could threaten already struggling salmon populations.

Federal officials recently increased water allocations from the Central Valley Project to agricultural contractors south of the Delta, citing improved reservoir conditions after spring storms to 25 percent. But environmental groups, fishing organizations and California regulators say releasing too much cold water from Lake Shasta now could leave river temperatures

dangerously warm later this summer and fall — a critical period for Chinook salmon spawning in the Sacramento River.

State water regulators warned in a recent letter that the federal draft temperature management plan could lead to salmon egg mortality if conditions worsen later in the year. The concern stems from lessons learned during the 2021 drought, when warm river temperatures below Shasta Dam caused massive losses of winter-run Chinook eggs and juvenile fish.

The dispute highlights a broader political fight between California and the Trump administration over Delta pumping and water deliveries. Federal officials have pushed to weaken some environmental protections in order to move more water south to farms and communities, while California agencies argue the approach could damage fish populations, destabilize Delta operations and even reduce supplies available for Southern California cities.

Fishing advocates say the stakes are especially high because California's commercial salmon industry is only beginning to recover after multiple years of closures tied to collapsing fish populations. Water agencies serving agriculture, meanwhile, argue additional supplies are necessary after years of drought and ongoing uncertainty over Delta restrictions.

Tribal and Environmental Leaders Release "Water Renaissance Plan"

A new coalition of environmental organizations, fishing groups and Tribal leaders is calling for what it describes as a "Water Renaissance" in California — a sweeping shift away from large imported water projects and toward local, climate-resilient water supplies.

The newly released Water Renaissance Plan for California argues the state should prioritize investments in wastewater recycling, stormwater capture, groundwater cleanup and conservation rather than continue pursuing the controversial Delta Conveyance Project, also known as the Delta tunnel. The coalition says Southern California could eventually meet as much as 85% of its water demand through local supplies by 2045, compared with roughly 50% today.

Supporters of the plan say California's traditional reliance on imported water from the Sacramento-San Joaquin Delta, the Colorado River and the Eastern Sierra is becoming increasingly unreliable because of climate change, shrinking snowpack and overallocation of river systems. The report estimates Southern California could develop between 1.8 million and 2 million acre-feet of drought-proof local water supplies through recycling, conservation and stormwater investments.

The coalition behind the proposal includes the California Sportfishing Protection Alliance, Defenders of Wildlife, Friends of the River, Golden State Salmon Association, LA Waterkeeper, Restore the Delta, San Francisco Baykeeper, Sierra Club California, the Winnemem Wintu Tribe and Yosemite Rivers Alliance. More than a dozen additional organizations have endorsed the plan since its release.

The proposal arrives as Gov. Gavin Newsom intensifies his push for the Delta tunnel, which supporters argue is essential to protecting water deliveries from earthquakes, sea-level rise and climate disruption. But Water Renaissance advocates say the tunnel would lock California into

an expensive and outdated water strategy while further stressing the Delta ecosystem and struggling salmon populations.

Bruce Reznik, executive director of LA Waterkeeper, said the state should focus its investments on water supplies that are available "rain or shine," arguing local projects offer greater long-term reliability than importing water hundreds of miles across the state. Coalition leaders also point to growing uncertainty surrounding future Colorado River supplies and environmental restrictions in the Delta as evidence California must diversify its water portfolio.

Legislative Update

The Spring push to move bills through their first house is in the final stages. Bills have run through the gauntlet of policy committee and appropriations committee and now need to be off the floor of their house of origin by May 29.

The first house Suspense File consideration is generally more friendly than when bills are in the opposite house. Of the 332 measures on the Senate Suspense File, 242 were passed to the floor, with 90 being held (27% hold rate). In the Assembly, 468 of the 637 measures were passed, with 169 being held (26.5% hold rate). This is about standard for both houses.

State Water Contractors Sponsored Legislation:

SB 872 (McNerney) has been amended into a major climate and water infrastructure funding bill.

Under the revised language, SB 872 would create the Delta Levees and Canal Subsidence Fund that would fund toward critical water system upgrades over the next two decades — beginning in the 2026–27 fiscal year through 2046–47.

Key provisions include:

- $150 million annually to the California Department of Water Resources for capital improvements aimed at restoring original conveyance capacity in state water facilities affected by land subsidence — a growing problem as pumping lowers groundwater levels and damages canals.
- $150 million annually to the Sacramento-San Joaquin Delta Conservancy for levee repairs and related projects in the Delta, strengthening flood protection and habitat conditions.

The bill was amended to take out a specific funding source, which will lead to more discussions on the concept during the budget process.

The bill also includes a restriction that these funds cannot be used for the design, construction, operation, mitigation, or maintenance of new Delta conveyance facilities beyond existing infrastructure.

The bill has received bipartisan support throughout the process, passing to the Assembly on a 39-0 vote.

DWR has recently been talking about the bill and subsidence as budget discussions heat up. It seems they aren't backing the entire $300 million a year ask, but are supporting an investment in the budget, likely in the $25 million range for short-term.

AB 2215 (Calderon): moves a portion of the DCP Trailer Bill from 2025 into a policy bill. AB 2215 would require that the time periods for the application of water to beneficial use and for the completion of construction work for specific water right permits held by the Department of Water Resources for the operation of the State Water Project be December 31, 2045. The bill passed out of the Assembly Water, Parks and Wildlife Committee 11-0 and the Appropriations Committee and was approved by the full Assembly 57-1. ACWA recently took a support position on the bill.

State Water Project contractors and MWD member agencies are rallying behind these two bills as essential legislation to keep water flowing.

CASA & WateReuse CA:

CASA and WateReuse CA's co-sponsored legislation, AB 2777, to add more capacity to the Clean Water State Revolving Fund and make it easier for agencies to get larger loans or reduce burdensome requirements in the contract has passed out of the Environmental Safety & Toxic Materials Committee and Appropriations Committee and passed off the Assembly Floor 75-1.

Other significant legislation:

- **AB 1881 (Ramos)** and **AB 2218 (Kalra)** on tribal water rights. Both bills give tribes significant powers over infrastructure projects. Stakeholders have been working with the authors and sponsors to work out mutually agreeable language. Both bills passed out of Appropriations Committee and passed off the Assembly Floor.
- **SB 1001 (Archuleta)** Identification cards for utility workers to allow access during emergencies. This legislation was significantly amended to align with an already existing system at the CA Office of Emergency Services to offer Personal Identity Verification-Interoperable (PIV-I) cards to operators who apply and meet the requirements. This bill was held in Appropriations Committee.
- Golden Mussels Bills
    - **AB 2032 (Ransom)**: specifies specific actions for the state to undertake to research and provide best management practices for eradication. The bill has an urgency clause, but passed off the Assembly Floor well ahead of the 2/3 vote threshold with 78 "aye" votes.
    - **AB 1772 (Papan):** creates a standardized boat inspection program for all reservoir operators.
    - **AB 1894 (Rubio):** Looks to address some agencies forbidding SWP water from entering a system. The bill has made it to the Senate and has been referred to the Natural Resources and Water Committee where it is expected to be amended to address some concerns of other water users, including MWD.

These are just a few bills that will continue to work their way through the legislature in the coming months.

IEUA Bill List- May 2026

Italics denote two-year bills

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 35	Alvarez, D	Safe Drinking Water, Wildfire Prevention, Drought Preparedness, and Clean Air Bond Act of 2024: Administrative Procedure Act: exemption: program guidelines and selection criteria.	01/14/2026	1/27/2026 In Senate. Read first time. To Com. on RLS. for assignment.	Senate Natural Resources & Water Committee		The bill would require a state entity that receives funding from Proposition 4 to administer a competitive grant program established using the Administrative Procedure Act exemption to do certain things, including develop draft project solicitation and evaluation guidelines and to submit those guidelines to the Secretary of the Natural Resources Agency, except as provided. The bill would require the Secretary of the Natural Resources Agency to post an electronic form of the guidelines submitted by a state entity and the subsequent verifications on the Natural Resources Agency's internet website.	CASA, WateReuse, ACWA, CSDA, CMUA all support SUPPORT
AB 1603	Schultz, D	Perfluoroalkyl and polyfluoroalkyl substances (PFAS): Department of Pesticide Regulation	05/20/2026		Senate Rules		Prohibits, commencing January 1, 2035, the use, manufacture, or sale of pesticides that contain intentionally added perfluoroalkyl and polyfluoroalkyl (PFAS) substances; prohibits the Department of Pesticide Regulation (DPR) from registering new pesticides that contain intentionally added PFAS; and places other prohibitions and restrictions on the use, manufacture, and sale of pesticides that contain intentionally added PFAS.	CASA Support SUPPORT
AB 1997	Lee, D	Land use: housing development approvals: timelines and processes	04/27/2026		Senate Rules		Requires a lead agency to approve or disapprove a housing development project where 90% of the units are affordable to very low or extremely low income households within 30 days of certifying an environmental impact report (EIR), and establishes a working group to make recommendations on the most effective ways to expedite the development of housing.	CSDA Oppose IEUA OPPOSE
AB 2215	Calderon, D	Water rights: permits: State Water Project.	3/18/2026		Senate Desk		Would require that the time periods for the application of water to beneficial use and for the completion of construction work for specific water right permits held by the Department of Water Resources for the operation of the State Water Project be December 31, 2085.	IEUA Support SWC sponsored bill

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
AB 2777	**Comm. on ESTM**	State Water Pollution Control Revolving Fund program: loans: outdoor eating areas: water reuse.	03/26/26		Senate Rules		Authorizes the State Water Resources Control Board (State Water Board), when administering loans under the Clean Water State Revolving Fund (CWSRF), to assess a fee instead of interest (also known as fee in lieu of interest) for financial assistance services rendered under the CWSRF. Makes a technical change to recently enacted legislation dealing with recycled water.	CASA & WATEREUSE Sponsored SUPPORT
SB 601	***Allen, D***	*Water: waste discharge.*	*07/10/2025*	*Two-Year Bill*	*Assembly Appropriations*		*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 872	**McNerney, D**	Climate change: funding priorities	3/19/2026	Sen Natural Resources & Water Committee	ASSM. W,P,WL	4/7/2026	This bill would require, of that amount, beginning with the 2026–27 fiscal year and continuing through the 2046–47 fiscal year, the sum of $150,000,000 be appropriated annually, to the Department of Water Resources for the purposes of supporting capital improvements to restore the original design water conveyance capacity for state water conveyance systems impacted operationally by land subsidence, and the sum of $150,000,000 be appropriated annually to the Sacramento-San Joaquin Delta Conservancy for projects in the Sacramento-San Joaquin Delta to improve existing levees	Support Sponsored by SWC and Restore the Delta

Bills With Positions

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
SB 935	**Choi, R**	Local agency design-build projects: authorization	1/29/2026		ASM Local Gov 6/3/26		Current law authorizes a local agency, as defined, with approval of its governing body, to procure design-build contracts for public works projects in excess of $1,000,000, awarding the contract either to the lowest bid or the best value. Current law, among other requirements for the design-build procurement process, requires specified information submitted by a design-build entity to be certified under penalty of perjury. These provisions authorizing local agencies to use the design-build procurement process are repealed on January 1, 2031. This bill would repeal the above-described January 1, 2031, repeal date, thereby extending the operation of these provisions indefinitely.	IEUA Support

Watch Bills

Measure	Author	Topic	Last Amend	Status	Location	Calendar	Brief Summary	Notes
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)*	

Acronym List

AB	Assembly Bill
ACF	Advanced Clean Fleets
ACWA	Association of California Water Agencies
BRIC	Building Resilient Infrastructure and Communities
CARB	California Air Resources Board
CASA	California Association of Sanitation Agencies
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CMUA	California Municipal Utilities Association
CSDA	California Special Districts Association
CVP	Central Valley Project
DOE	Department of Energy
DOJ	Department of Justice
DWR	Department of Water Resources
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FDA	United States Food and Drug Administration
HHS	Health and Human Services
HUD	Housing and Urban Development
IRWD	Irvine Ranch Water District
LAO	Legislative Analyst's Office
LNG	Liquefied Natural Gas
MilCon	Military Construction
MWD	Municipal Water District / Metropolitan Water District of Southern California
NOFO	Notice of Funding Opportunity
OIG	Office of Inspector General
OMB	Office of Management and Budget
POTW	Publicly Owned Treatment Works
PSPS	Public Safety Power Shutoff
SB	Senate Bill
SCE	Southern California Edison

Acronym List

SWC	State Water Contractors
SWRCB	State Water Resources Control Board
VA	Veterans Affairs


Wineville Rubber Dam


New Wineville Pumps


Pump flow into Jurupa


New SW Diversion at Jurupa


New Jurupa Pump


Added Basin at RP3

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/POs Cost: **$28,715,304 (as of June 3, 2026)**
- Remaining Budget: **$130,712 (finalizing cost)**

Completed scope items (all project items completed)

- New added basin at RP3 Basin
- 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.
- All new pumps fully installed and tested
- All system controls and SCADA connections tested and functional.

Updates:

- March 30, 2026, the contract work with SCW for the final phase of the Project—the installation and testing of the new pumps at the Wineville and Jurupa Basins—was substantially completed/closing out the project
- April 2, 2026, IEUA completed a final inspection with the State Water Resources Control Board to verify compliance for the $15 million State Revolving Fund Loan and $9.8 million Storm Water Grant.
- IEUA staff will host the U.S. Bureau of Reclamation for its final inspection of the Wineville and Jurupa Basin Improvements on May 5, 2026, for which USBR provided $740,000 in construction funding.
- IEUA is finalizing project costs.

Updated: June 6, 2026

Chino Basin Day DRAFT Agenda

Regional Board Offices, Riverside, CA - May 19, 2026

8:30 AM to 12:00 PM

Microsoft Teams Access

Join: https://teams.microsoft.com/meet/27445475867725?p=lvLCAhmT4hul48X5to
Meeting ID: 274 454 758 677 25
Passcode: aG7Tu3EW
Dial in by phone
+1 916-562-0861,935528084# United States, Sacramento
Phone conference ID: 935 528 084#

- Introductions
- Discussion Items with Regional Board:
    - Regional Board Priorities
- Priority (IEUA, CBWM, CDA) Updates:
    - Maximum Benefit SNMP – CBWM/IEUA/WY
        - Hydraulic Control
    - CDA Operations – CDA
    - Basin Plan Amendment – CBWM/IEUA/ WY
    - Septic to Sewer Study Update – IEUA
    - Chino Basin Program – IEUA
- Break
- Secondary (IEUA, CBWM, CDA) Updates:
    - State of the Basin – CBWM/WY
    - Reach 3 Special Study – IEUA/CBWM
    - Chino Creek 1B – IEUA/WY
    - Water Quality Scenario Planning- IEUA