

Upper Ventura River Valley Basin

Annual Report Water Year 2025



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Upper Ventura River Valley Basin Annual Report Water Year 2025

Prepared for



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Executive Summary

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(a) General information, including an executive summary and a location map depicting the basin covered by the report.

The Upper Ventura River Groundwater Agency (UVRGA) adopted the Groundwater Sustainability Plan (GSP) for the Upper Ventura River Groundwater Basin (UVRGB, or Basin) on January 6, 2022, and this is the fifth Annual Report in compliance with the California Code of Regulations §356.2 documenting groundwater conditions and GSP implementation for Water Year 2025 (i.e., October 1, 2024, through September 30, 2025).

Total precipitation in the Basin during Water Year 2025 was 9.22 inches, compared to the average of 21.28 inches, making the Water Year type classification for Water Year 2025 dry. Basin-wide measured groundwater levels in Water Year 2025 were generally lower than the values in the prior Water Year. Groundwater extraction in Water Year 2025 was higher than Water Year 2024; however, surface water use decreased in 2025 relative to 2024. Total water use within the Basin meets agricultural, M&I, domestic, and riparian vegetation demands and is sourced from groundwater and local surface water. Estimated total water use in the Basin for Water Year 2025 was 2,771 acre-feet per year (AF/yr), slightly lower than the prior Water Year (3,277 AF/yr). The change in groundwater storage for the Basin for Water Year 2025 was calculated using the updated numerical groundwater model of the Basin. The groundwater storage decreased by 6,175 AF during Water Year 2025, primarily due to decreased percolation of surface water. Groundwater quality remained stable for the Water Year 2025, compared to the historical data.

The numerical groundwater model was unavailable for last year's Annual Report; therefore, Appendix A is included in this year's Annual Report to update Water Year 2024 groundwater conditions text and figures using results from the numerical groundwater model (i.e., groundwater level contours and change in groundwater in storage).

Sustainability is evaluated by comparing monitoring data to the Sustainable Management Criteria (SMC) for each applicable sustainability indicator: chronic lowering of groundwater levels, reduction of groundwater storage, degraded water quality, and depletion of interconnected surface water. The groundwater levels measured in Water Year 2025 were compared to the SMC established for the chronic lowering of groundwater levels and reduction of groundwater storage sustainability indicators (which has groundwater levels as a proxy), and no monitoring wells exceeded the minimum threshold. Undesirable results associated with groundwater level declines are defined as minimum threshold exceedances at all seven representative monitoring sites, which has yet to occur. For the degraded water quality sustainability indicator, measurable objectives were met during Water Year 2025. For the depletion of interconnected surface water sustainability indicator, measurable objectives were met during Water Year 2025. Although the land subsidence sustainability indicator was determined to be inapplicable to UVRGB, the GSP included annual review of InSAR data, subject to continued availability from the California Department of Water Resources (DWR). InSAR measurements of land surface elevation changes during 2025 were well below the accuracy range, indicating there was no measurable land subsidence due to groundwater withdrawal within the UVRGB.

GSP implementation efforts during Water Year 2025 included the following:



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- The Water Year 2024 annual report’s approval by DWR occurred on July 11, 2025;
 - Continued implementation of the GSP management action “Foster Park Protocols to Address Direct Depletion of Interconnected Surface Water;”
 - Continued groundwater level and streamflow monitoring at existing monitoring sites;
 - Continued surface water flow monitoring at existing monitoring sites where and when feasible;
 - Continued visual streamflow terminus monitoring;
 - Continued riparian Groundwater Dependent Ecosystem monitoring;
 - Continued implementation of UVRGA’s well registration, metering, and extraction reporting ordinance;
 - Continued implementation of the GSP management action “Domestic Well Survey” by including a domestic well questionnaire in the well registration forms sent to well owners;
 - Continued implementation of the GSP project “Actions to Address Indirect Depletion of Interconnected Surface Water,” which includes ongoing monitoring pursuant to UVRGA’s monitoring workplan for the Foster Park Aquatic Groundwater Dependent Ecosystem area. In addition, the numerical groundwater model calibration was updated to improve the representation of streamflow at the Foster Park gage in preparation for assessing the indirect depletion;
 - GSP project “Groundwater Level Monitoring Data Gaps Project,” which consisted of outreach to well owners to request access to add wells to the groundwater level and quality monitoring networks was completed during Water Year 2025. Two wells were added to the monitoring network during the 2025 Water Year. With the transducer installations that occurred during the 2024 and 2025 Water Years, all groundwater level data gaps identified in the GSP have now been addressed.; and
 - Continued progress on the GSP project “Confluence Aquatic Habitat Area Biological Monitoring Study” consisting of ongoing monitoring pursuant to UVRGA’s monitoring workplan for the Confluence Aquatic Groundwater Dependent Ecosystem area.



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Acronyms and Abbreviations

AF/yr	acre-feet per year
cfs	cubic feet per second
CMWD	Casitas Municipal Water District
DMS	Data Management System
DWR	Department of Water Resources
eWRIMS	Electronic Water Rights Information Management System
ft	foot/feet
GPS	global positioning system
GSP	Groundwater Sustainability Plan
InSAR	interferometric synthetic aperture radar
ISW	interconnected surface water
M&I	municipal and industrial
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MOWD	Meiners Oaks Water District
RWQCB	Regional Water Quality Control Board
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
TDS	total dissolved solids
USGS	United States Geological Survey
UVRGA	Upper Ventura River Groundwater Agency
UVRGB, Basin	Upper Ventura Groundwater Basin (Upper Ventura River Valley Basin, Department of Water Resources Basin No. 4-003.01)
VRWD	Ventura River Water District
WQO	Water Quality Objective



1.0 Introduction [§356.2(a)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(a) General information, including an executive summary and a location map depicting the basin covered by the report.

This document is the fifth Annual Report for the Upper Ventura River Valley Basin (California Department of Water Resources [DWR] Basin No. 4-003.01; referred to herein as the Upper Ventura Groundwater Basin [UVRGB] or Basin), fulfilling the requirements set forth by the Sustainable Groundwater Management Act (SGMA) Groundwater Sustainability Plan (GSP) Regulation Code §356.2. The Upper Ventura River Groundwater Agency (UVRGA) adopted its GSP on January 6, 2022 (UVRGA, 2022). This annual report presents data and information for Water Year 2025 (i.e., October 1, 2024, through September 30, 2025) for the UVRGB. In addition, Appendix A is included in this year's Annual Report to update Water Year 2024 groundwater conditions text and figures using results from the numerical groundwater model, which was unavailable during preparation of the Water Year 2024 annual report.

To track the progress of the GSP implementation, monitoring network data are compared against the Sustainable Management Criteria (SMC) established in the adopted GSP (UVRGA, 2022). This report also provides updates on the status of GSP implementation, including projects and management actions described in the adopted GSP.

The calibration of the numerical groundwater model developed for the GSP was updated in 2025 to improve the match to observed low streamflow data. This calibration update included a critical review and quantification of streamflow measurement uncertainty (INTERA, 2025). The simulation period for the calibration update model was extended to include Water Years 2024 and 2025 for this Annual Report and was used to estimate groundwater transpiration by riparian vegetation, change in groundwater in storage, and streamflow depletion for the Basin in support of report development.

1.1 Background

The UVRGB is a DWR-designated medium-priority groundwater subbasin in western Ventura County. The Basin is in the central portion of the Ventura River Watershed along the Ventura River near the communities of Casitas Springs, Mira Monte, and Meiners Oaks (Figure 1.1). The Basin is bordered by the Ojai and Lower Ventura River Groundwater basins to the east and south, respectively (DWR Basin Nos. 4-002 and 4-003.02).

The UVRGB is a thin alluvial-fill aquifer that is intimately connected to the Ventura River. The groundwater budget and flow conditions in the alluvial aquifer are dominated by interaction with the Ventura River, which provides most of the recharge (inflows) to the Basin as streamflow percolation in the northern portion of the Basin and receives most of the discharge (outflows) from the Basin as down-valley groundwater flow that feeds springs (i.e., groundwater discharge) in the Ventura River in the southern portion of the Basin. Groundwater extractions are secondary to groundwater discharge to the Ventura River, except during dry periods when the spring flows decrease substantially due to low Ventura River streamflow entering the northern end of the Basin.



Groundwater has historically supplied approximately one-third of the water used in the Basin for municipal, agricultural, domestic, and environmental uses and is sourced from local extractions. Most of the extracted water is used for irrigation and public supply. There are also a number of domestic wells that supply water to homes and limited landscape irrigation. Other sources of water supply for the Basin include private agricultural spring and creek diversions located adjacent to the Basin and local surface water diverted from the Ventura River by an agricultural entity and by Casitas Municipal Water District (CMWD) for storage in Lake Casitas. The non-groundwater supplies provide approximately two-thirds of the water supply in the Basin.

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2.0 Groundwater Conditions [§356.2(b)]

This section describes precipitation and Water Year type for the Basin, updates to the numerical groundwater model, groundwater elevations, groundwater quality, groundwater extraction, surface water supplies, total water use, and the change in groundwater storage for the Basin. Groundwater data for Water Year 2025 were collected from a variety of agencies and incorporated into the UVRGA Data Management System (DMS), which is described further in the GSP (UVRGA, 2022).

2.1 Precipitation and Water Year Types

Precipitation data were provided by the Ventura County Public Works Agency from gages 020B (Ventura River County Water District) and 218 (Meiners Oaks – County Fire Station) and were updated for Water Year 2025 (Figure 2.1). Total precipitation for Water Year 2025 was 9.22 inches, compared to the average of 21.28 inches at gages 020B and 218 for the period 1926-2025 (Figure 2.2).

The Water Year type for 2025 was classified as dry (Figure 2.2) based on total annual precipitation (from Ventura County Watershed Protection District rainfall gage 20B) for a given Water Year compared to long-term historical precipitation trends from precipitation gages within the Basin (see Section 3.1.1.1 in the GSP [UVRGA, 2022]). Sixty percent of the precipitation for Water Year 2025 occurred during the month of February, and most of the months experienced below-average precipitation. The cumulative departure from mean precipitation became negative in Water Year 2025, indicating a return to dry conditions for the Basin (Figure 2.2).

2.2 Numerical Groundwater Model Update

The numerical groundwater model was constructed for the GSP and was used to simulate a historical period from 2006 to 2019 to prepare the historical and current water budgets for the GSP (Appendix H in the GSP; UVRGA, 2022). The model was updated for previous Annual Reports to include data for their respective reported Water Years. For this fifth Annual Report, the numerical model was updated to include data through Water Year 2025. Because the numerical model was out-of-service for calibration updates during the preparation of last year's Water Year 2024 Annual Report, Appendix A is included in this Annual Report to provide updates to Water Year 2024 groundwater conditions, which rely on results from the numerical groundwater model (i.e., groundwater level contours, change in groundwater in storage, and streamflow depletion).

During 2024 and 2025, several changes and insights to the numerical groundwater model and its associated inputs occurred since its last update for the Water Year 2023 Annual Report. The work completed and insights gained are summarized as follows and documented in a Technical Memorandum (INTERA, 2025; Attachment A), which is available on UVRGA's website at https://uvrgroundwater.org/wp-content/uploads/2025/10/UVRGA_Calibration_2025_TM_20251002_FINAL.pdf:

1. **River Channel Change Evaluation:** Evaluated impacts of changes in river channel geomorphology from January 2023 flooding event on model.

New Information and/or Model Improvements: Modeled streamflow results are generally insensitive to changes in streambed elevation and location of channel. Future updates to channel geomorphology following extreme flood events appear not to be critical for model performance.



2. Model Verification: Checked model performance using data post-calibration data (i.e., data after 2018).

New Information and/or Model Improvements: Model found to overpredict low streamflows during post-calibration period (i.e., after 2018). Additional model calibration was determined to be warranted.

3. Critical Review of Streamflow Data: Quantified errors in streamflow datasets used for model inputs and calibration.

New Information and/or Model Improvements: Uncertainty in streamflow data is significant and impacted prior model calibration. Removed unreliable data and accounted for streamflow measurement attributes (i.e., measurement quality ratings, measurement location). Developed upper and lower estimates of surface water inflows to basin to bracket model uncertainty and switched streamflow calibration dataset at United States Geological Survey (USGS) gage to error-barred, location-based measurements instead of rating curve.

4. Update Other Model Inputs Using New Data.

New Information and/or Model Improvements: Updated model with data obtained since model construction: previously unavailable well logs (basin thickness), groundwater levels collected by UVRGA, and pumping rates from UVRGA well registration and groundwater extraction reporting program.

5. Sensitivity Analysis: Assessed sensitivity of model calibration to changes in key model parameters.

New Information and/or Model Improvements: Determined key model parameters in different hydrogeologic zones that could improve model calibration and predictive ability.

6. Model Calibration Update: Updated the model calibration to improve its fit to observed streamflow data.

New Information and/or Model Improvements: The model's ability to represent streamflow (especially low flows) improved significantly.

7. Review of Model Uncertainty: Assessed uncertainty in streamflow inputs for the model.

New Information and/or Model Improvements: A high range in modeled streamflow results were produced from the sensitivity analysis runs, which informed the recommendation for a predictive uncertainty analysis of the model.



2.3 Groundwater Elevations [§356.2(b)(1)(A),(B)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:

(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.

(B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.

Groundwater levels were monitored in Water Year 2025 by the UVRGA, County of Ventura, Meiners Oaks Water District (MOWD), and a private well owner. Groundwater elevations were updated through Water Year 2025 for the monitoring wells in the UVRGB monitoring network (Figure 2.3). Figure 2.3 also shows the hydrogeologic areas for the Basin identified in the GSP, which are used to facilitate explanation of conditions in different areas of the Basin. Generally, groundwater flows from a northern to southern direction, following the surface drainage and the topographic gradient of the Basin. In the Mira Monte/Meiners Oaks hydrogeologic area, groundwater flow is generally to the southwest and west towards the Upper Ventura River.

2.3.1 Groundwater Elevation Contours [§356.2(b)(1)(A)]

Observed groundwater levels for Water Year 2025 were contoured and are discussed below. Modeled groundwater level elevation contours from previous years guided the contours. Observed groundwater levels for the seasonal highs (spring) and lows (fall) for Water Year 2025 are included for each monitoring location on the contour maps for reference.

Groundwater level contours for the Water Year 2025 spring-high season (March of 2025) indicate flow directions and gradient were generally from north to south, which is consistent with previous years (Figure 2.4). Groundwater level contours for the Water Year 2025 fall-low season (September of 2025) indicate flow directions were consistent with the spring-high season for the same Water Year (Figure 2.5). Groundwater level measurements were on average approximately 8.5 foot (ft) lower in fall (September of 2025) compared to spring (March of 2025), with most of the declines occurring in the Robles and Santa Ana hydrogeologic areas of the Basin adjacent to the Upper Ventura River channel.

2.3.2 Groundwater Elevation Hydrographs [§356.2(b)(1)(B)]

Groundwater elevation hydrographs for representative monitoring wells in the Basin are shown with Water Year types in Figure 2.6. The temporal trend during Water Year 2025 is generally downward for all monitoring wells. However, despite dry conditions for Water Year 2025, previous consecutive years of above average streamflow and precipitation have kept groundwater levels relatively high compared to the available historical datasets.



2.4 Groundwater Quality

Groundwater quality data were collected by the County of Ventura and potable water suppliers reporting to the California Division of Drinking Water. Maps of average concentrations of the key indicator constituents for Water Year 2025 in the UVRGB are shown in Figures 2.7 through 2.11. Note that, for the groundwater quality data, well 03N23W08B01S state well number has been updated to 03N23W05P02S as it was previously misidentified by the well owner.

The average nitrate concentrations in Water Year 2024 ranged from 0.6 to 11 milligrams per liter (mg/L) (Figure 2.7) and are consistent with the historical data for the Basin (see GSP section 3.2.4; UVRGA, 2022). Nitrate concentrations are highest in the Mira Monte/Meiners Oaks area to the east of the Ventura River, with one well (04N23W16A01S) having average nitrate concentrations above the Maximum Contaminant Level (MCL) of 10 mg/L, and with an average concentration of 11 mg/L for Water Year 2025. The Mira Monte/Meiners Oaks area is known to be a source of nitrate for the Basin (UVRGA, 2022). All the remaining wells in the Basin have average concentrations below the MCL, which is consistent with the historical record. While nitrate levels of up to 10 mg/L as Nitrogen are acceptable based on drinking water standards, the Water Quality Objective (WQO) for total Nitrogen in the Ventura River within the UVRGB, as defined in the Regional Water Quality Control Board (RWQCB) Basin Plan (RWQCB-LA, 2019), is 5 mg/L (Nitrate-N + Nitrite-N). Nitrate concentrations in areas of rising groundwater (i.e., Casitas Springs Hydrogeologic Area) were lower than the RWQCB Basin Plan WQO of 5 mg/L (Figure 2.7).

The average total dissolved solids (TDS), sulfate, chloride, and boron concentrations for Water Year 2025 are all consistent with the historical data for the Basin (Figures 2.8 through 2.11). Well 05N23W33B04S shows TDS and sulfate concentrations slightly above their respective WQOs (see Figures 2.8 and 2.9), and well 03N23W08B11S shows sulfate concentrations slightly above its respective WQO (see Figure 2.9); however, they were within the range of historical data (see GSP Section 3.1.3.3; UVRGA, 2022) and are, therefore, unattributed to groundwater extraction or GSP implementation actions within the UVRGB. In addition, boron was at or above the WQO in two wells within the basin (05N23W33B04S and 04N23W09B05S; Figure 2.11) but were also within the range of historical data (see GSP Section 3.1.3.3; UVRGA, 2022). Higher boron concentrations are related to geologic sources to surface flows (see GSP Section 3.1.3.3; UVRGA, 2022). Some of the sampled wells were unanalyzed for these constituents during Water Year 2025; however, the spatial distribution of available water quality data was adequate for annual reporting purposes. Please see the GSP section 3.2.4 for additional detail on the groundwater quality for the Basin (UVRGA, 2022).

2.5 Groundwater Extraction [§356.2(b)(2)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(2) *Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.*



Groundwater extractions were metered by Ventura River Water District (VRWD), MOWD, CMWD, the City of Ventura, and private well owners with registered wells that extract more than 2 acre-feet per year (AF/yr). Pursuant to UVRGA’s well registration, metering, and reporting ordinances (Ordinance Nos. 1 through 4), all wells extracting more than 2 AF/yr of groundwater are required to have a calibrated flow meter installed and have their groundwater extractions reported to UVRGA quarterly. Implementation of the ordinances began during Water Year 2023, and metered and estimated extraction data were obtained during Water Year 2025, which was the first full year of metered groundwater extractions for private wells subject to UVRGA metering requirements. Groundwater extractions are now based on metered data or the registration estimate if meter data were unavailable, as compared to the GSP and prior annual reports, which relied upon previous estimates made using less reliable information.

Monthly groundwater extraction data were provided by the City of Ventura, CMWD, VRWD, and MOWD, which report volumes supplying municipal and industrial (M&I) water uses for the Basin. Agricultural groundwater extraction was quantified based on available meter data, evaluation of water use records in the State Water Resources Control Board’s Electronic Water Rights Information Management System (eWRIMS), or qualitative information provided as part of the well registration program.

Groundwater extraction by riparian vegetation¹ (i.e., transpiration of groundwater) was calculated using the updated numerical groundwater model (see Appendix H in GSP; UVRGA, 2022; INTERA, 2025).

The values discussed in this section and presented in Table 2.1 reflect total extracted groundwater from the UVRGB. Significant volumes of extracted groundwater are exported from the Basin, which explains the differences between the values for extracted groundwater and groundwater use within the Basin (i.e., difference in reported values in Tables 2.1 and 2.2). The extracted volumes for Water Year 2025 are summarized by water use sector in Table 2.1. Total extraction via pumping wells (i.e., excluding the riparian vegetation evapotranspiration²) for Water Year 2025 (5,007 AF) was slightly less than the historical average of 5,035 AF/yr (2006-2019). Agricultural groundwater use accounts for 5% of the total extraction via pumping wells for Water Year 2025, compared to 6% for the historical average. Note that the agricultural extractions included estimates for some wells. Domestic extraction rates were lower than estimated for the historical period due to updates to well registration estimates. M&I extraction rates were 93% of the total extraction via pumping for Water Year 2025, compared to 90% for the historical average. The reported/estimated volumes extracted from each well during Water Year 2025 are shown on Figure 2.12.

2.6 Surface Water Supply [§356.2(b)(3)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(3) *Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.*

¹ Includes the invasive species Arundo.



Surface water supply data were provided by MOWD and VRWD. Surface water is supplied to the Basin by CMWD as direct deliveries to CMWD retail M&I and agricultural customers and as wholesale deliveries to the retailers VRWD and MOWD for M&I and agricultural use. Historically, surface water is estimated to be ~26% of the total deliveries (UVRGA, 2022). Monthly purchases from CMWD were provided by VRWD and MOWD. Data for direct retail deliveries by CMWD were unavailable and were estimated using the methods described in the GSP (UVRGA, 2022). The total estimated surface water supply volume for Water Year 2025 was 831 AF (see Table 2.2 and Figure 2.13).

2.7 Total Water Use [§356.2(b)(4)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.

Water demands in the UVRGB consist of M&I, agricultural, and domestic demands, which are met by a mix of groundwater extractions and surface water deliveries. Additional groundwater use for evapotranspiration by riparian vegetation² was calculated using the numerical model results (see Section 2.5). Water Year 2025 data sources are detailed in Table 2.2 and Figure 2.13. The total water use components were measured or estimated using methods described in the GSP (UVRGA, 2022). The total water used within UVRGB during Water Year 2025 was 2,771 AF (see Table 2.2 and Figure 2.13).

2.8 Change in Storage [§356.2(b)(5)(A),(B)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(5) Change in groundwater in storage shall include the following:

(A) Change in groundwater in storage maps for each principal aquifer in the basin.

(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.

The change in groundwater storage for the UVRGB for Water Year 2025 (Figure 2.14) was calculated for this annual report using the numerical groundwater model. The total change in storage between spring-high groundwater levels in Water Years 2024 and 2025 was calculated to decrease by 6,175 AF

² Includes the invasive species Arundo.



(Figure 2.14). This decrease is due primarily to decreases in surface water percolation, which resulted in lower groundwater levels throughout the Basin. The change in storage for the Basin was also calculated for each hydrogeologic area, and the greatest changes in storage are in the Robles and Mira Monte/Meiners Oaks areas (Figure 2.14).

Figure 2.15 shows the annual change in groundwater in storage and the cumulative change in groundwater in storage for the Basin between Water Years 2006 and 2025, along with the Water Year type and groundwater use (pumping) up to Water Year 2025.

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3.0 Plan Implementation [§356.2(c)]

§356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.

The plan implementation for the UVRGA GSP was initiated with the submittal of the GSP to DWR in January of 2022. DWR approved the GSP in April 2023. Progress towards implementing the UVRGA GSP is evaluated in this Annual Report by comparing monitoring data to the SMC for each applicable sustainability indicator for the past Water Year (2025). The monitoring data consist of groundwater levels, groundwater quality, and streamflow. UVRGA published a number of memoranda each Water Year to document its various monitoring networks. These annual monitoring memoranda are incorporated into this annual report by reference and are available on UVRGA's website:

- Groundwater Levels (Rincon, 2025a): https://uvrgroundwater.org/wp-content/uploads/2026/01/2025-Annual-Memorandum_Final.pdf
- Surface Water Flow Monitoring (Rincon, 2026a): https://uvrgroundwater.org/wp-content/uploads/2026/01/Camino-Cielo-Stream-Flow-Monitoring_WY-2025_Final.pdf
- Visual Surface Water Monitoring (Rincon, 2026b): https://uvrgroundwater.org/wp-content/uploads/2026/01/Visual_Stream_Monitoring_WY_2025_Final.pdf
- Riparian Groundwater Dependent Ecosystems Monitoring (Rincon, 2026c): https://uvrgroundwater.org/wp-content/uploads/2026/01/Riparian-GDE-Monitoring_WY-2025_Final.pdf
- Aquatic Groundwater Dependent Ecosystems Monitoring (Rincon, 2025b): https://uvrgroundwater.org/wp-content/uploads/2026/02/Aquatic-GDE-Three-year-Monitoring-Letter-Report_FINAL.pdf

3.1 Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage

The SMC are the same for both the chronic lowering of groundwater levels and reduction of groundwater storage sustainability indicators because groundwater levels are used as a proxy for the reduction of groundwater storage sustainability indicator. Groundwater levels were evaluated for the seven representative monitoring wells within the Basin and were plotted against their respective minimum thresholds, measurable objectives, and interim milestones (Figure 3.1).

No wells exceeded the minimum threshold. All wells had groundwater levels between the 5-year interim milestone and measurable objective except two wells—05N23W33G01S and 03N23W08B07S—that met



their respective measurable objectives in Water Year 2025 (Table 3.1)³. The measured high groundwater levels for Water Year 2025 were relatively high compared to the historical dataset due to the preceding wet Water Years (see Figure 3.1). Undesirable results associated with water level declines are defined as a minimum threshold exceedance at all seven representative monitoring sites, which has not occurred.

3.2 Degraded Water Quality

Water Year 2025 groundwater quality data were available for seven of the eight monitoring wells or closely spaced groups of wells that are assigned sustainable management criteria (Figure 3.2). Well 04N23W15B02S was not analyzed for the primary constituents (Nitrate, TDS, chloride, sulfate, and boron), and Well Group No. 1 and wells 04N23W16B07S and 04N23W16C08S (within Well Group No. 3) were not analyzed for TDS, chloride, sulfate, and boron during Water Year 2025. However, the spatial distribution of available water quality data was adequate for annual reporting purposes.

Nitrate is the only constituent of concern for the degraded water quality sustainability indicator (UVRGA, 2022). The minimum threshold was defined as any nitrate isocontour exceeding 10 mg/L located outside of the Mira Monte/Meiners Oaks Area—encompassing domestic wells that produce groundwater and have no alternative source of drinking water—that UVRGA determines to be caused by pumping or GSP projects and management actions. The Mira Monte/Meiners Oaks Area is recognized as a source area for nitrate in groundwater and, as such, minimum thresholds are inapplicable in this area. The public water supply well operators currently manage nitrate by blending with surface water from Lake Casitas. Nitrate measurable objectives were developed for two distinct areas of the Basin: (1) areas with predominantly percolating groundwater (Kennedy, Robles, and Santa Ana areas), and (2) areas with predominantly rising groundwater (in the Casitas Springs Area) (see Table 3.2 for further explanation). An isocontour value of 7.5 mg/L (as nitrogen) is the measurable objective for the percolating groundwater, and an isocontour value of 3 mg/L (as nitrogen) is used for the measurable objective in the Casitas Springs Area.

Figure 3.3 shows the nitrate (as total nitrogen) isocontours for Water Year 2025, which are based on annual average concentrations observed at the seven monitoring wells and well groups with available data. Based on the interpreted contours, Water Year 2025 results meet the measurable objectives for both areas of predominately percolating groundwater (Kennedy, Robles, and Santa Ana areas) and predominately rising groundwater levels (Casitas Springs Area). Table 3.2 summarizes the SMC and nitrate results for Water Year 2025.

3.3 Depletion of Interconnected Surface Water

The Ventura River is considered an interconnected stream system with complex groundwater-surface water interactions that vary significantly with time and location in the Basin. The GSP concluded that significant and unreasonable effects on the Foster Park Habitat Area (see Figure 2.3) could potentially occur under certain low-flow conditions (UVRGA, 2022). SMC established for this area are shown on Table 3.3. The minimum threshold and measurable objective are the same for this sustainability indicator, and the 5-year interim milestone is equal to the maximum simulated depletion in excess of the

³ Seasonal high groundwater levels are selected for comparison to SMC to represent full groundwater conditions for the Basin. Note, seasonal high groundwater levels may occur at different times for each water year and may occur outside of spring.



measurable objective during the historical period (2006-2019), which is equal to 10.7 cubic feet per second (cfs) (UVRGA, 2022).

Numerical modeling output was analyzed to assess the frequency, duration, and volume of depletions that are simulated to cause undepleted⁴ Ventura River flows at the Foster Park USGS stream gage to deplete to below 2 cfs during Water Year 2025 (Table 3.3 and Figure 3.4⁵). The top chart in Figure 3.4 shows undepleted flows (blue) and depleted flows (red). The difference between the blue and red lines at any point in time is the total depletion, which is shown as the black line on the bottom chart. The bottom chart on Figure 3.4 also shows the direct depletion in light blue. Indirect depletion is represented as the distance between the light blue direct depletion line and the black total depletion line. The minimum threshold is plotted in orange on the bottom chart on Figure 3.4. No undepleted flow was simulated to be below 2 cfs during Water Year 2025. The modeled depletion results for Water Year 2025 remained within the minimum threshold and met the 5-year interim milestone and measurable objective.

3.4 Land Subsidence

The GSP concluded that the land subsidence sustainability indicator is inapplicable to UVRGB because of the Basin's small aquifer, coarse-grained nature, lack of significant clay units, and extremely rapid recovery of groundwater levels during recharge events. Nonetheless, the GSP included annual review of interferometric synthetic aperture radar (InSAR) data (subject to continued availability from DWR) to confirm the absence of land subsidence related to groundwater conditions.

DWR provides land surface displacement data for the UVRGB on their SGMA Data Viewer Web-based geographic information system viewer (DWR, 2025), which includes InSAR measurements for Water Year 2025 (TRE Altamira, Inc., 2021). This land surface displacement dataset was downloaded and reviewed. DWR has stated that, on a statewide level for the total vertical displacement measurements between June 2015 and June 2018, the errors due to measurement are as follows (Paso Robles GSA, 2020):

- The error between InSAR data and continuous global positioning system (GPS) data is 16 millimeters (0.052 ft) with a 95% confidence level, and
- The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 ft with 95% confidence level.

Therefore, a land surface change of less than 0.1 ft (the cumulative error) is within the noise of the data collection and processing and is considered equivalent to no measurable subsidence in this GSP.

The reported cumulative vertical displacement from the InSAR measurements during the 2024 to 2025 study period was consistently well below the accuracy range, and areas falling below the accuracy range are shown in gray on Figure 3.5. This indicates that there is no measurable land subsidence due to groundwater withdrawal within the UVRGB.

⁴ Streamflow that would exist if no groundwater pumping had occurred.

⁵ Note, the updated numerical groundwater model (see Section 2.2) resulted in changes to the historical model output; therefore, some differences are apparent when comparing this figure to earlier reports. The primary differences include (1) refined observed streamflow data (i.e., only manual measurements depicted on graph), (2) generally lower simulated streamflow due to an improved calibration, and (3) constant daily modeled output as opposed to an alternating daily and monthly modeled output from the previous model.



3.5 Seawater Intrusion

The GSP concluded that the seawater intrusion sustainability indicator is inapplicable to UVRGB because it is an inland basin with no connection to the ocean. UVRGB is located 6 miles inland from the Pacific Ocean, and the base of the Basin (bedrock elevation) along the southern boundary (also the lowest point in the Basin) is ~160 ft above mean sea level.

3.6 Projects and Management Actions

The status of all projects and management actions included in the GSP is discussed in the following subsections. All projects and management actions are on track with the schedules presented in the GSP.

3.6.1 Domestic Well Survey

The UVRGA Board of Directors adopted the Ordinance Establishing Well Registration, Metering, and Reporting Requirements in July 2022. The ordinance requires well owners to register existing and new wells with UVRGA, flowmeters on all *non-de minimis* wells, period flowmeter calibration verification, and quarterly reporting of groundwater extractions. The well registration form developed for ordinance implementation serves as the primary tool for performing the domestic well survey. The registration form collects information about domestic wells, including whether the well is used for drinking water supply and whether a backup potable water supply is available. The form also offers nitrate testing (to be paid for by UVRGA) for interested domestic well owners. Implementation of this management action was initiated during Water Year 2023 by reaching out to well owners to register their wells. As mentioned above, the well registration form includes a domestic well questionnaire. During Water Year 2025, UVRGA staff continued follow-up with well owners to register their wells. As of September 30, 2024, 186 of the 188 wells in the Basin have either been registered or confirmed abandoned/destroyed. Nitrate testing Water Year was scheduled during Water Year 2025 and completed in November 2025.

3.6.2 Foster Park Protocols to Address Direct Depletion of Interconnected Surface Water

The Foster Park Protocols management action consists of operational protocols for the City of Ventura extraction facilities in the Foster Park Aquatic Habitat Area, which addresses direct depletion of interconnected surface water (ISW). The Foster Park Protocols involve monitoring the Foster Park streamflow gages (VR-1 and USGS gage 11118500) and shutting down the City's extraction facilities when certain surface water flow thresholds are reached.

The trigger for implementing the Foster Park Protocols was the settlement agreement between the City of Ventura and Santa Barbara Channelkeeper regarding the action titled *Santa Barbara Channelkeeper v State Water Resources Control Board and the City of San Buenaventura* (Los Angeles County Superior Court, Case No. 19STCP01176) (Appendix D of the GSP). The settlement agreement was executed in September 2019, amended in August 2020 (Appendix D of the GSP) and January 2025 (Attachment B). The Foster Park Protocols have been operative since September 2019 and as of January 2025 have now been replaced with an updated framework which includes multiple streamflow conditions (i.e., wet, moderate, and dry) under which extractions are to cease (See Exhibit A in Attachment B).



3.6.3 Actions to Address Indirect Depletion of Interconnected Surface Water

The Actions to Address Indirect Depletion of Interconnected Surface Water management action consists of a series of planning activities to develop and implement a project and/or management action to address indirect depletions of ISW, which is detailed in Table 6.1-01 of the GSP (UVRGA, 2022).

In general, the path includes (1) addressing the groundwater level data gaps that impact quantification of indirect depletions of ISW, (2) updating the numerical flow model better to quantify indirect depletion, and (3) developing appropriately sized projects or management actions to address indirect depletions. It is noted that the timeline shown in GSP Table 6.1-01 purposefully spans much of the 20-year GSP implementation period because of the uncertainty associated with potential outcomes of the Ventura River Watershed Adjudication and the SWRCB Instream Flow Enhancement process. Outcomes from these legal and regulatory processes could materially change the approach to addressing indirect depletion, including the potential for indirect ISW depletion to be addressed through projects or management actions developed by and funded through those processes. Significantly more clarity is expected from the potential outcomes of the legal and regulatory processes during the first 5-year GSP evaluation period. UVRGA will track those processes carefully and update the approach to addressing indirect depletion of ISW as more information becomes available.

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Progress on this management action during Water Year 2025 included:

1. Two groundwater level monitoring wells were added to the groundwater level monitoring network, which addressed the remaining groundwater level monitoring data gap identified in the GSP.
2. The numerical model calibration update to improve the modeled quantification of indirect depletion was completed. The model calibration was updated to improve the representation of streamflow at the Foster Park gage. In addition, observed streamflow measurements were reviewed critically to assess error ranges and uncertainty in the model inputs. Several model enhancements were included in the model update and are summarized in Section 2.2. The quantification of indirect depletion is currently being evaluated with the updated model.

3.6.4 Groundwater Level Monitoring Well Data Gaps Project

Work on this project was initiated during Water Year 2023 and consisted of initial outreach to well owners to request access to add wells to the groundwater level and quality monitoring networks. Two wells were added to the monitoring network during Water Year 2025, which addressed the remaining data gap identified in the GSP.

3.6.5 Stream Gage Data Gaps Project

The Stream Gage Data Gaps Project includes the installation of three new surface water gages to address surface water flow monitoring data gaps (Figure 3.6):

1. Camino Cielo Road at Ventura River: The purpose of this gage is to provide more precise quantification of baseflows entering the Basin via the Ventura River. UVRGA has gauged when flows are low enough for safe river access during spring through fall since Water Year 2023. DWR has relocated the Santa Ana Boulevard gage (now named “OLA”) to the Camino Cielo Road location (Figure 3.6). DWR is currently establishing a rating curve for this gage. UVRGA plans to cease monitoring streamflow at this location once the OLA gage is fully operational.
2. Santa Ana Boulevard at Ventura River: The purpose of this gage was to monitor surface water flow upstream of groundwater dependent ecosystem areas and was included in the GSP because DWR agreed to install a gage in this area under the Technical Support Services program. The gage was constructed during Water Year 2021. However, flooding in January 2023 moved the active channel away from the gage location. DWR determined that this site is not favorable for maintenance of a stream gage and agreed to relocate the gage to a more stable location (i.e., gage “OLA” located at Camino Cielo Road location (Figure 3.6). UVRGA does not plan to install a gage at the Santa Ana Boulevard location for the same reasons that DWR decided not to reinstall a gage.
3. The GSP called for gaging in the Casitas Springs Area, south of San Antonio Creek confluence. : The purpose of this gage is to monitor streamflow in the Confluence Aquatic Habitat Area. Gauging has been performed in this area by the City of Ventura (i.e., gage “VR-1”) and by UVRGA (i.e., “Lower Confluence Gage”) when flows are low enough for safe river access during spring through fall since Water Year 2023. Note, gage VR-1 was relocated north of the location identified in the GSP following the January 2023 flood, which washed out the original gage location.



Gage “VR-2” operated by the City of Ventura, was included in the GSP, but was lost during the flooding of January 2023 and will not be replaced. This gage has been replaced by gaging by UVRGA at location “Upper Foster Park” as part of the Aquatic GDE monitoring program.

3.6.6 Confluence Aquatic Habitat Area Biological Monitoring Study

The Confluence Aquatic Habitat Area Aquatic Groundwater Dependent Ecosystem Monitoring Program was initiated during Water Year 2023 and continued during Water Year 2025.

3.6.7 Additional Projects and Management Actions for the GSP

No new projects or management actions beyond those included in the GSP are being considered at this time.

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Figures

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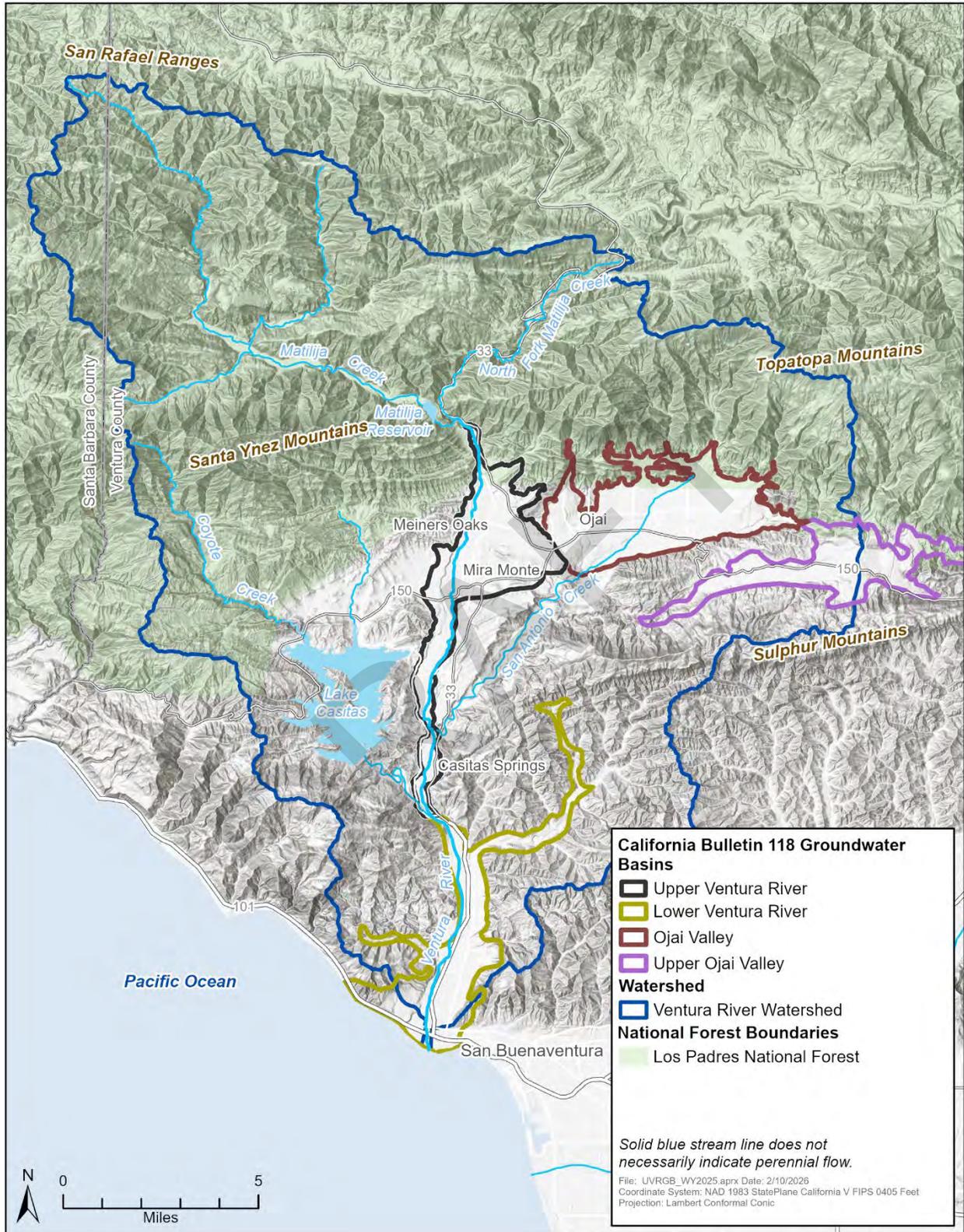


Figure 1.1 Upper Ventura River Groundwater Agency Basin Boundary Map

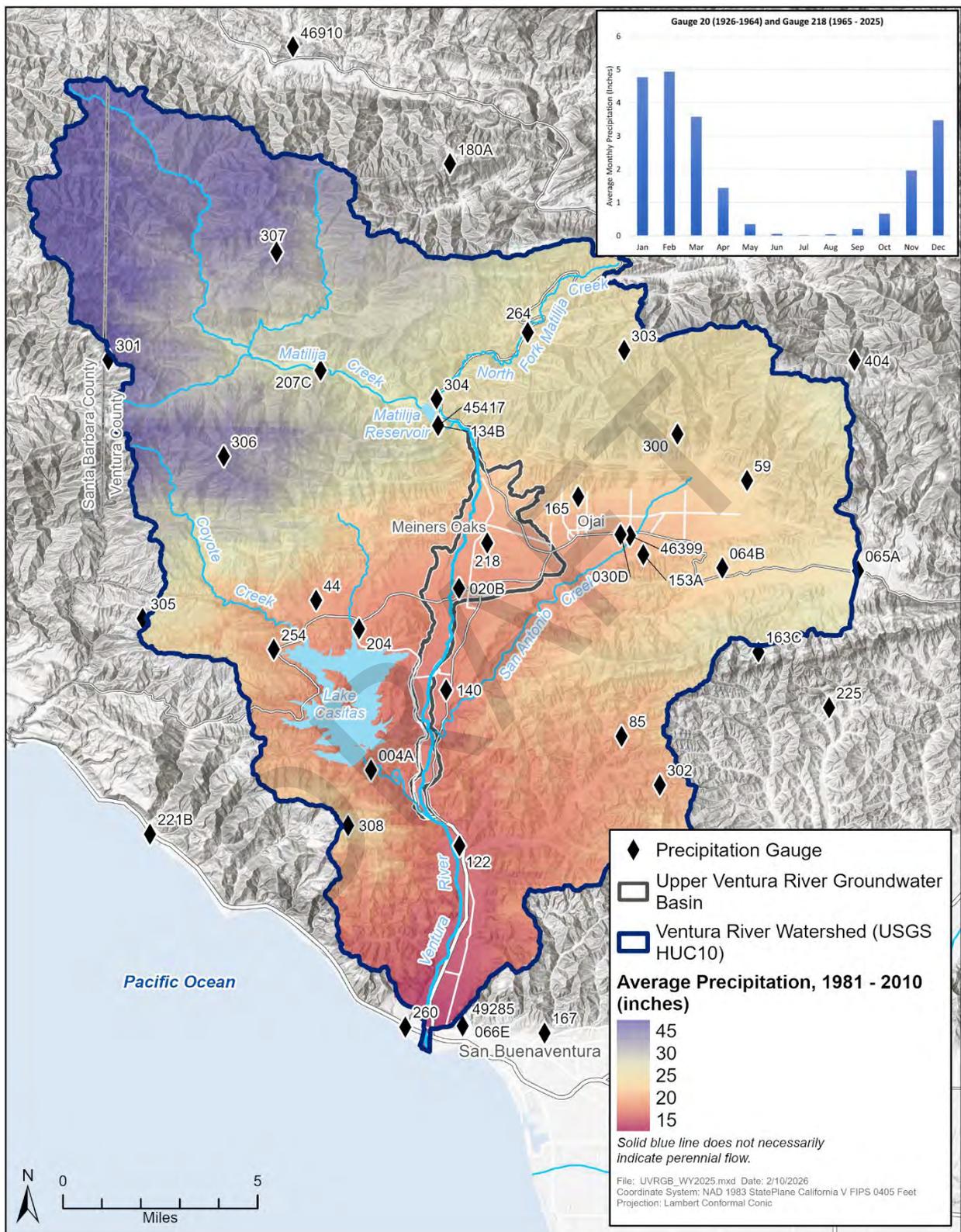


Figure 2.1 Precipitation Map in the Ventura River Watershed

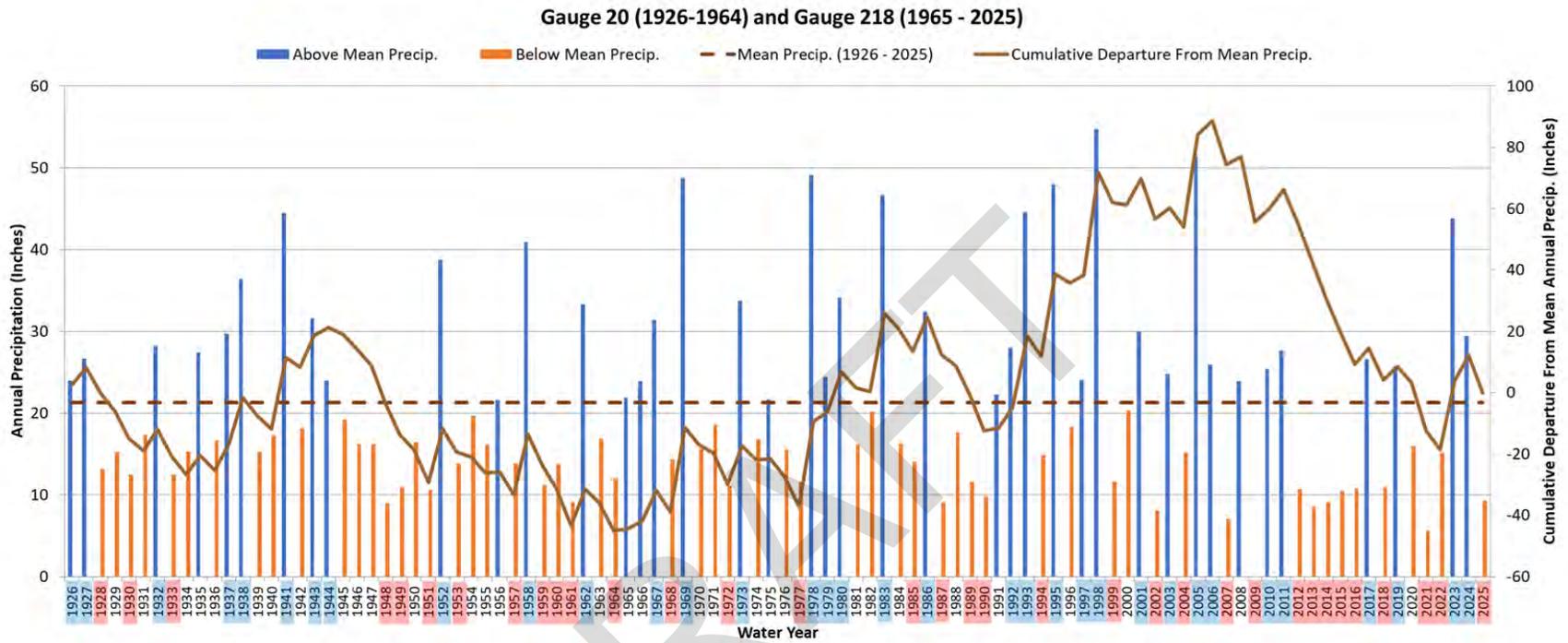
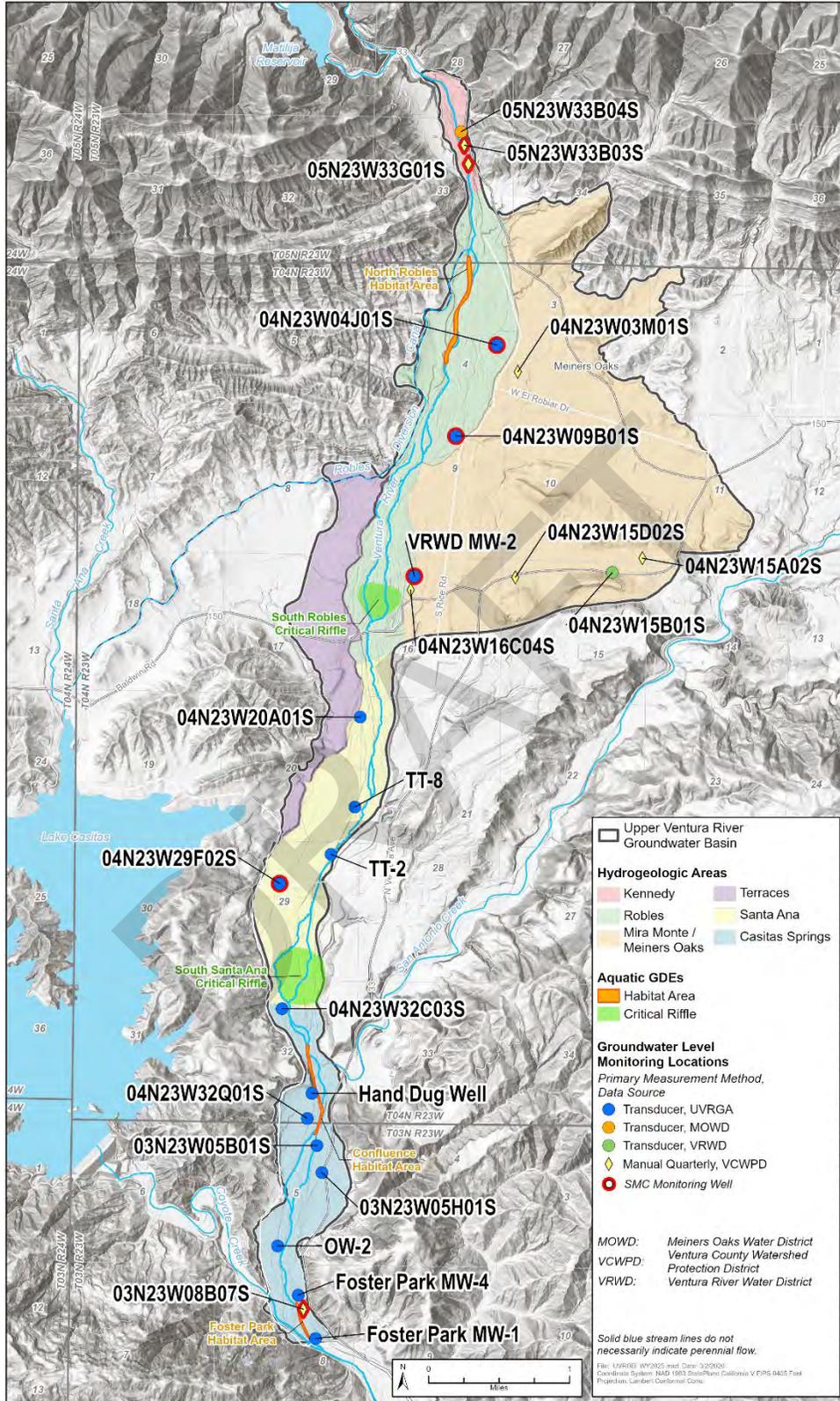


Figure 2.2 Annual and Cumulative Departure from Mean Precipitation



GDE = groundwater-dependent ecosystem

Figure 2.3 Existing and Planned Groundwater Level Monitoring Wells

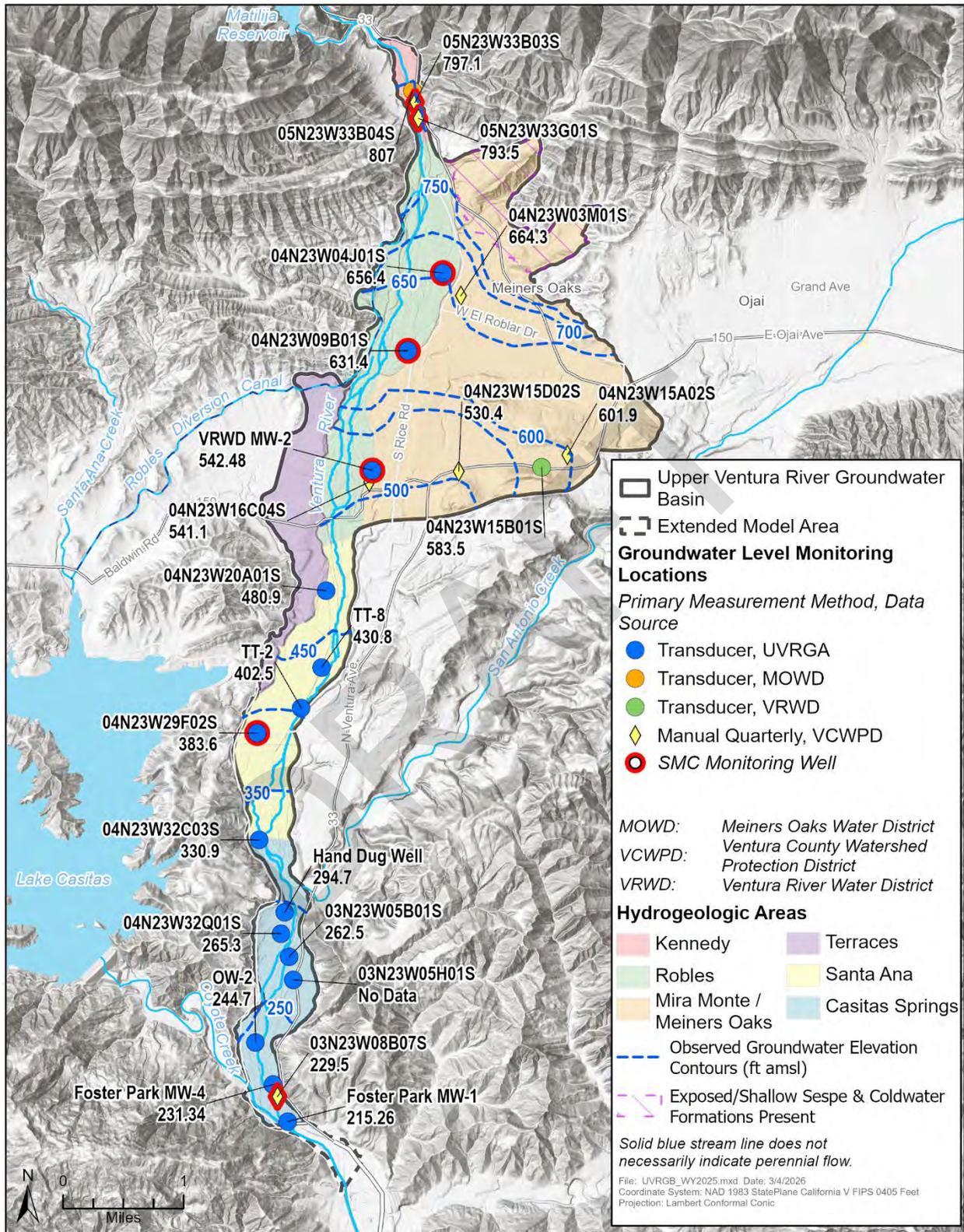


Figure 2.4 Contour Map for High Observed Groundwater Levels (Wet Season) – March 2025

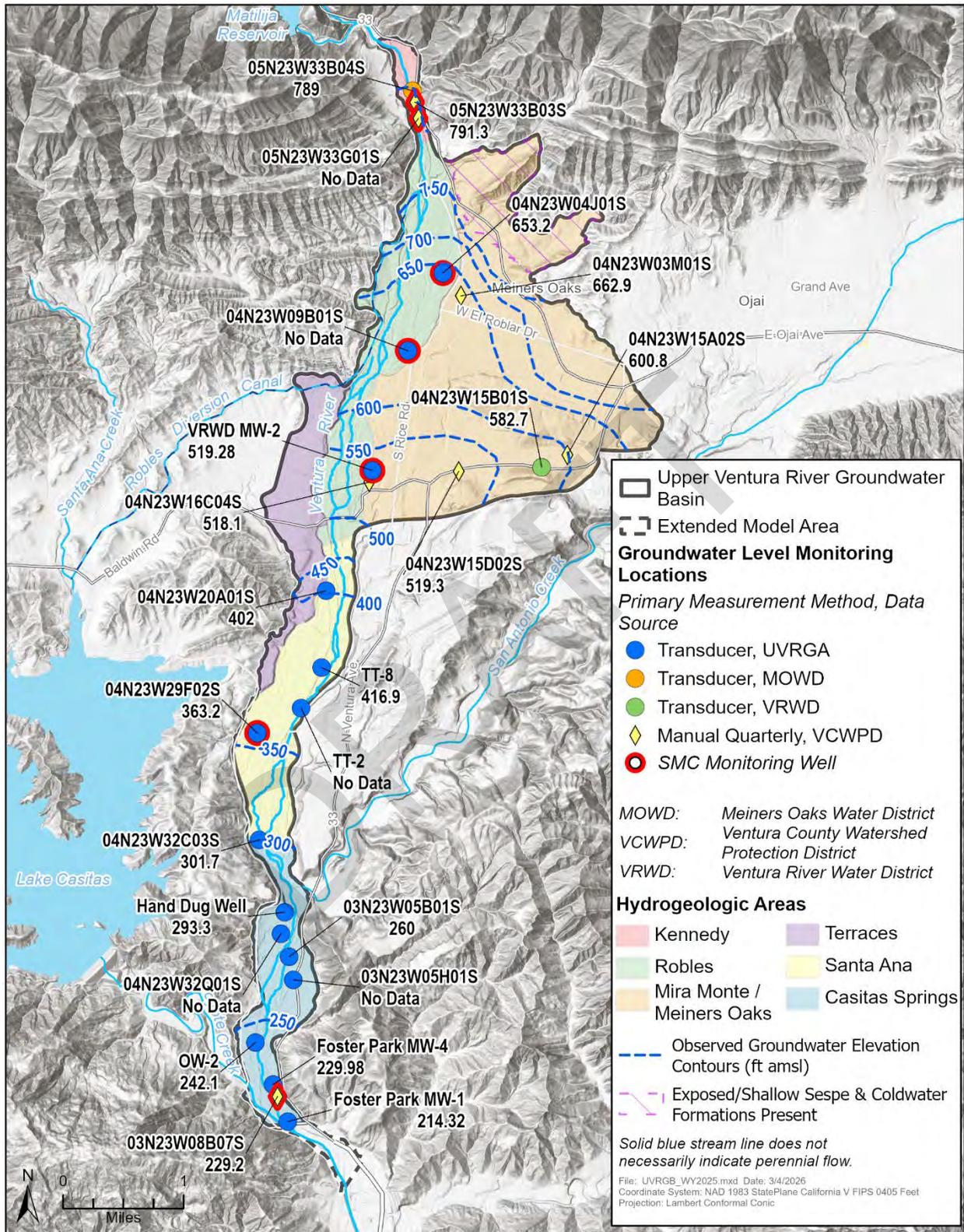


Figure 2.5 Contour Map for Low Observed Groundwater Levels (Dry Season) – September 2025

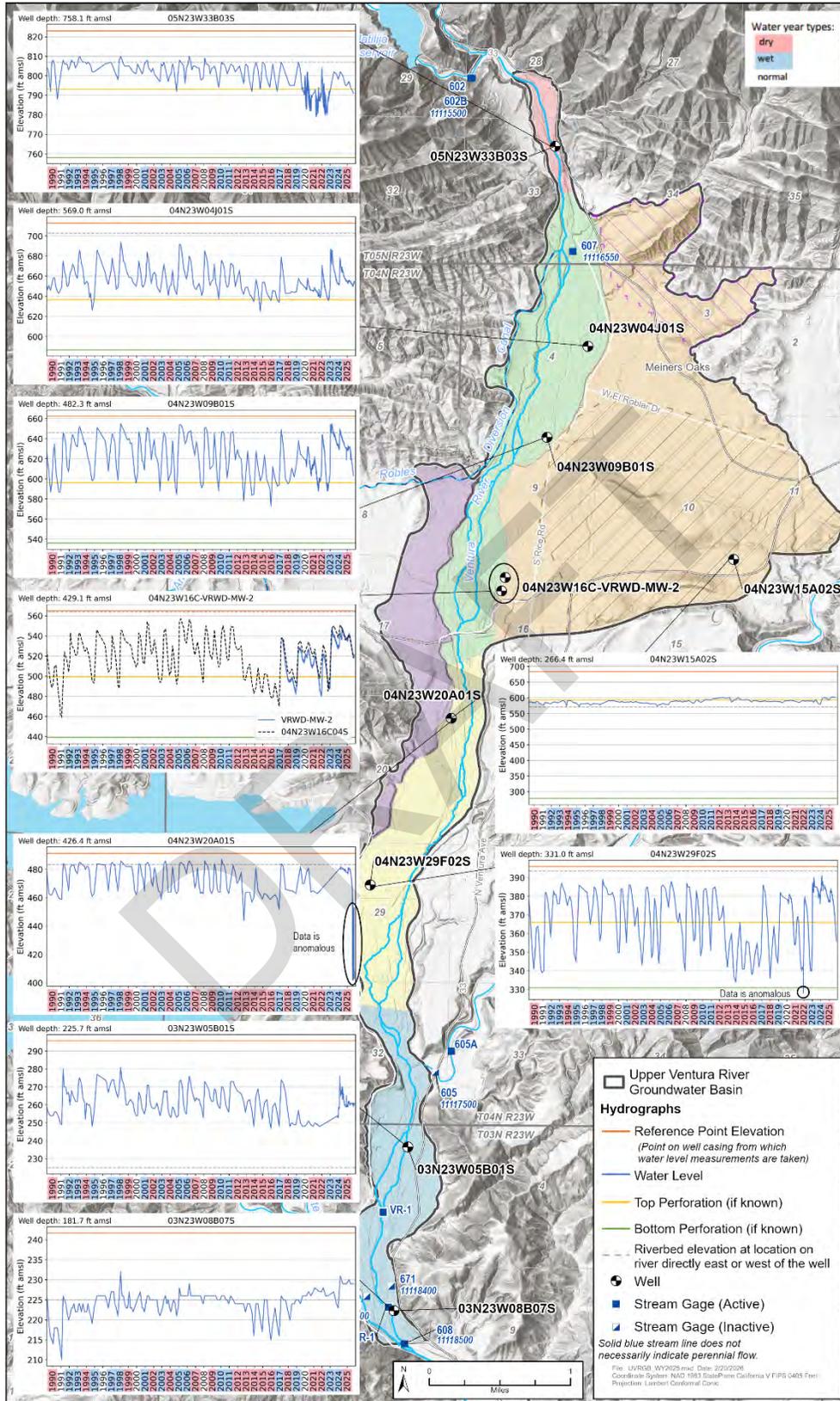


Figure 2.6 Groundwater Level Hydrographs for Key Wells in the UVRGB

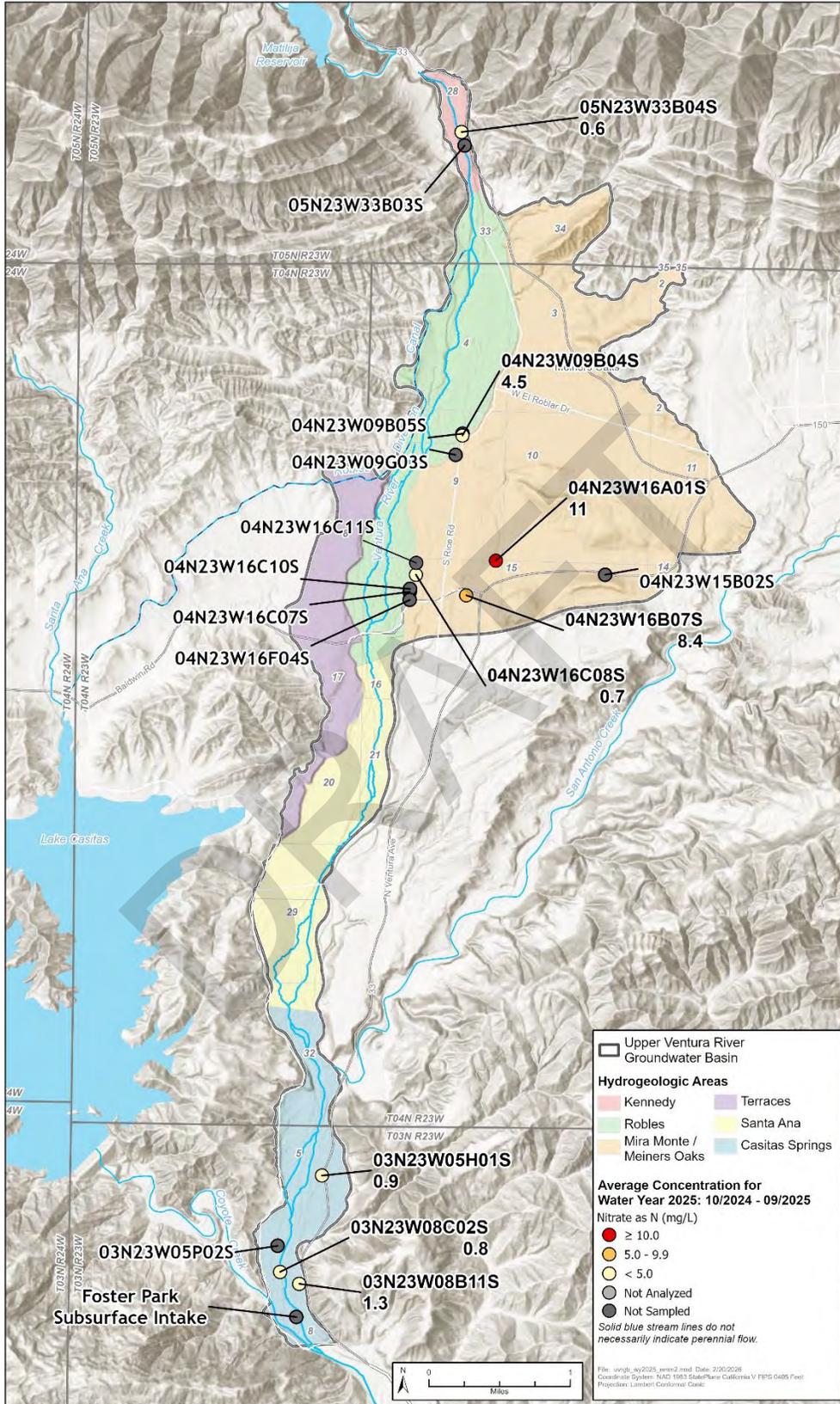


Figure 2.7 Average Nitrate as Nitrogen (N) Concentration in UVRGB, Water Year 2025

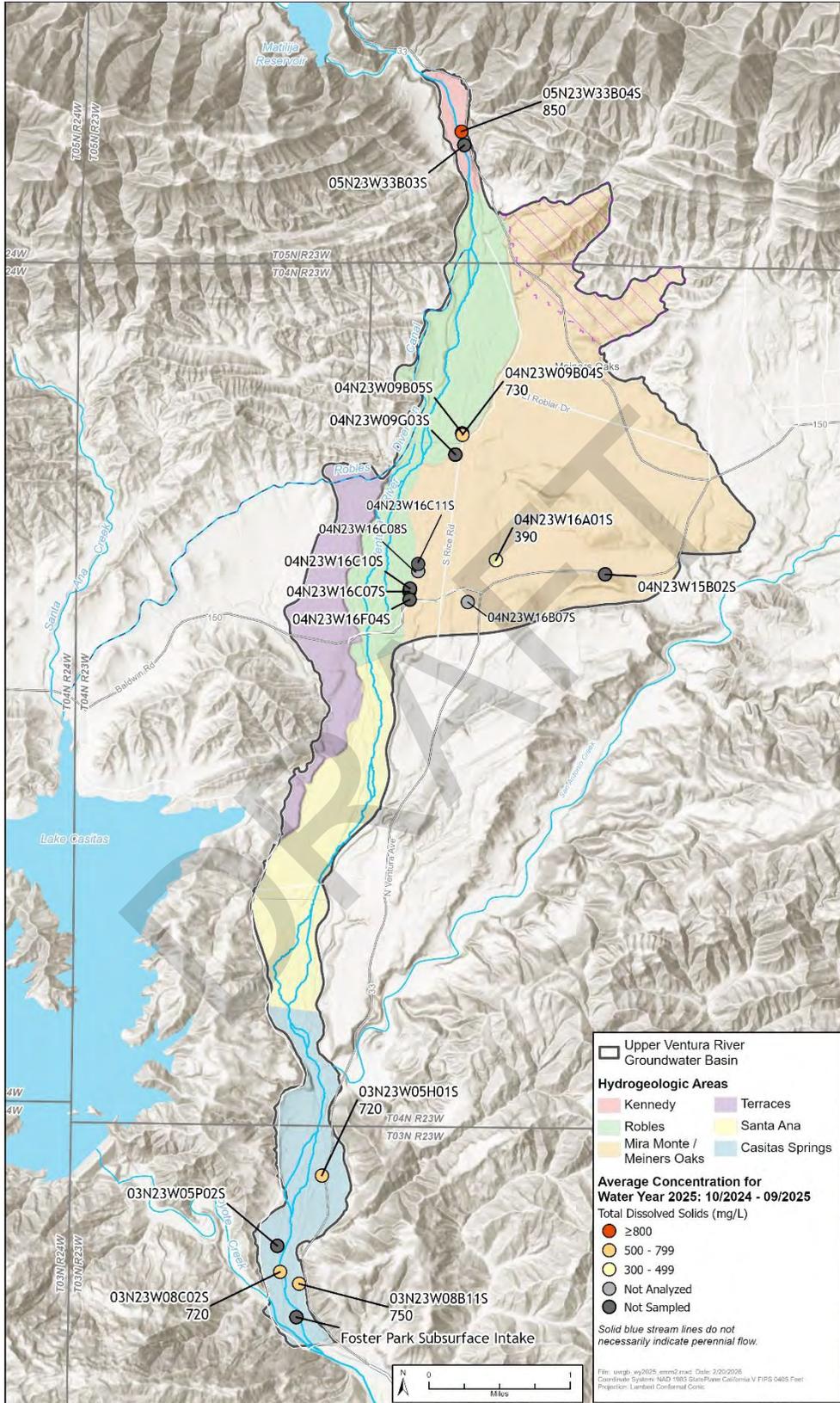


Figure 2.8 Average Total Dissolved Solids Concentration in UVRGB, Water Year 2025

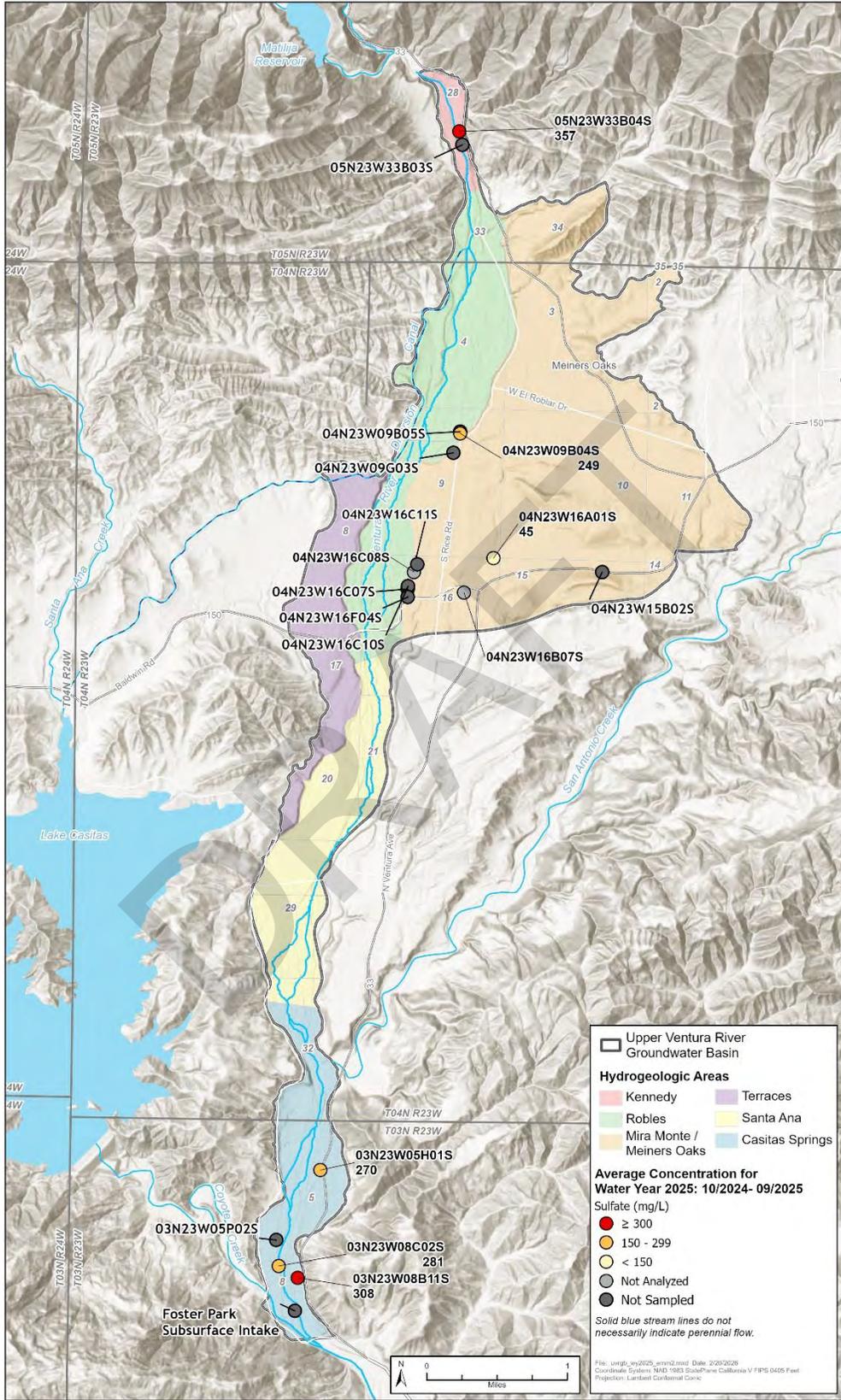


Figure 2.9 Average Sulfate Concentration in UVRGB, Water Year 2025

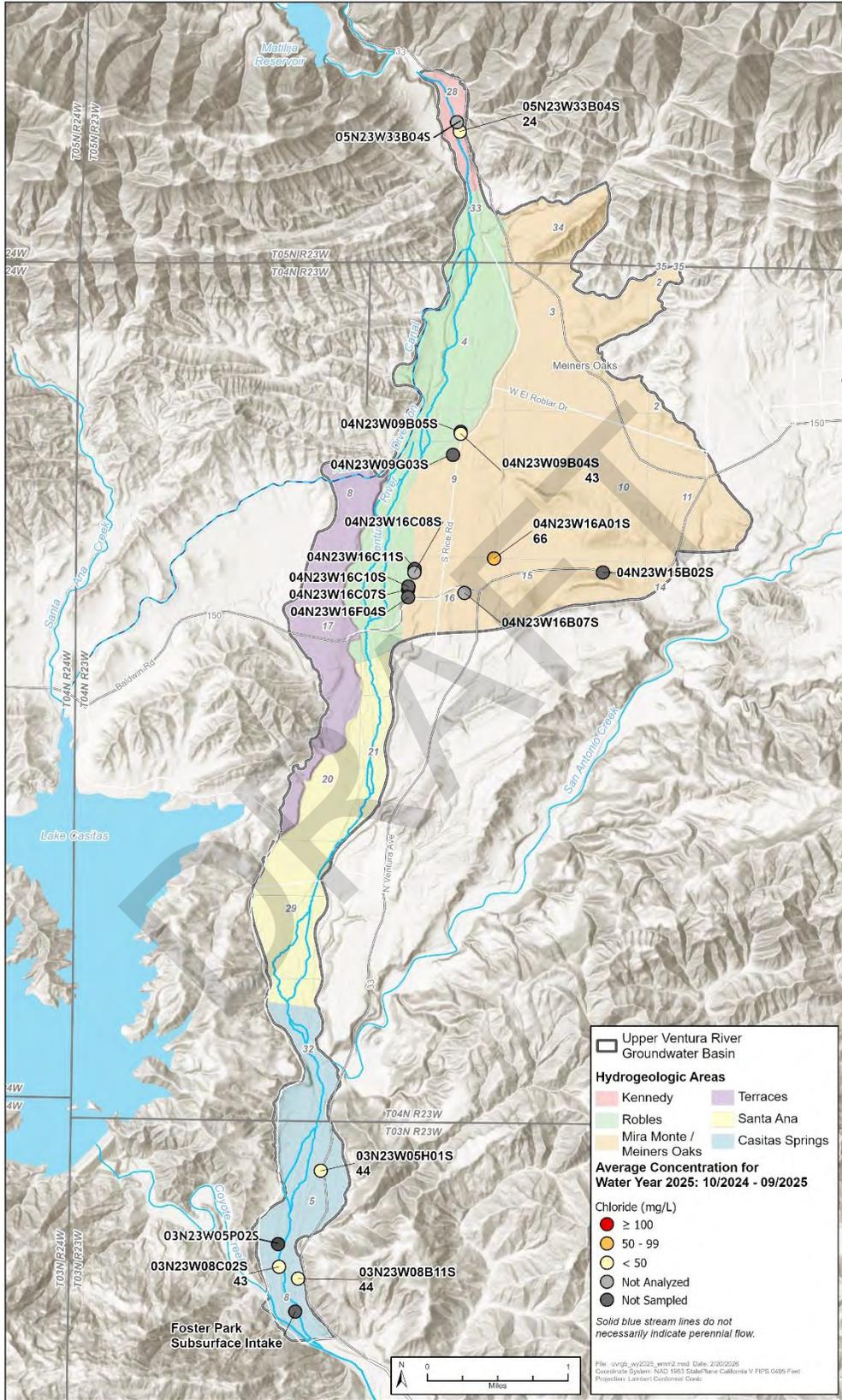


Figure 2.10 Average Chloride Concentration in UVRGB, Water Year 2025

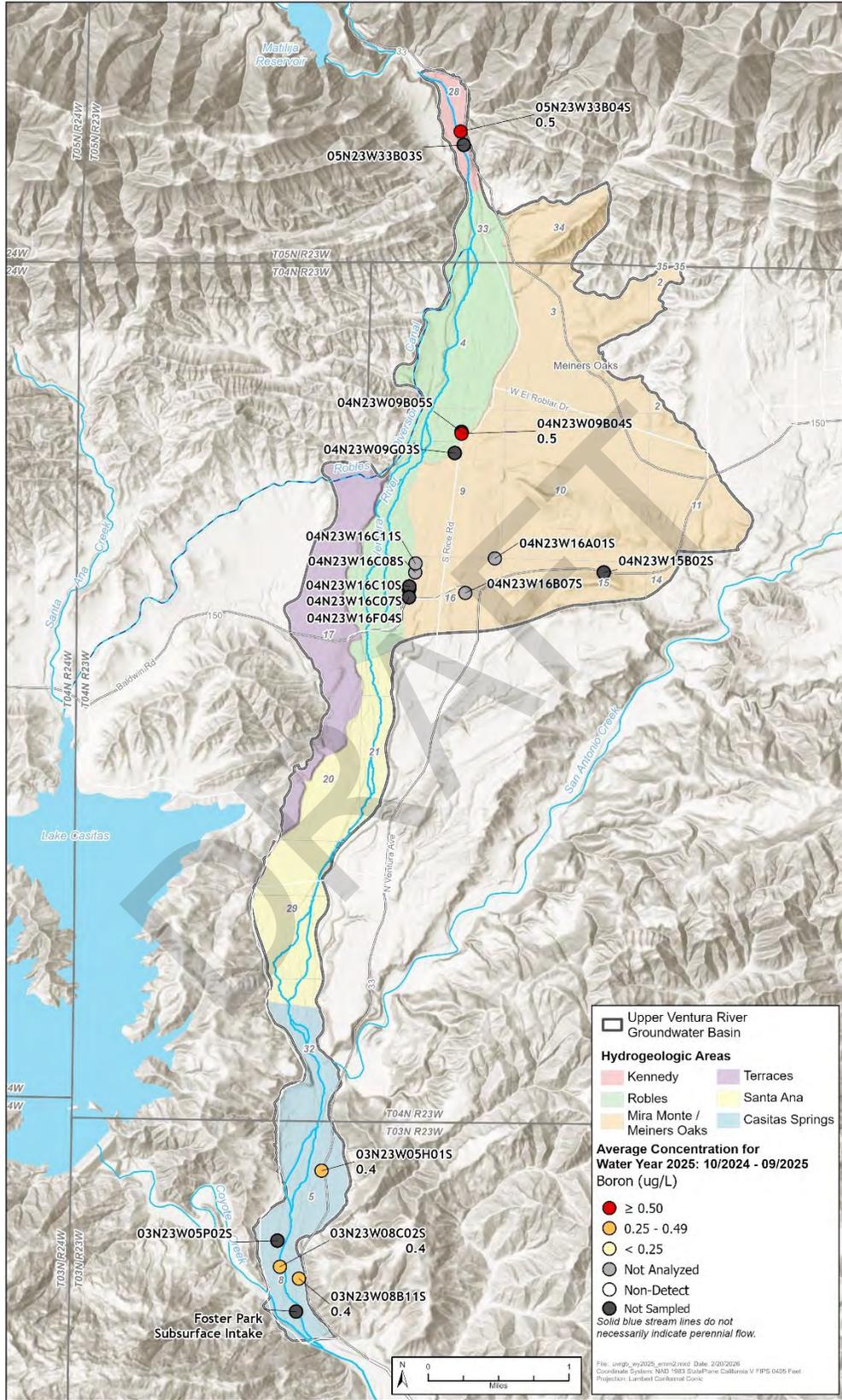


Figure 2.11 Average Boron Concentration in UVRGB, Water Year 2025

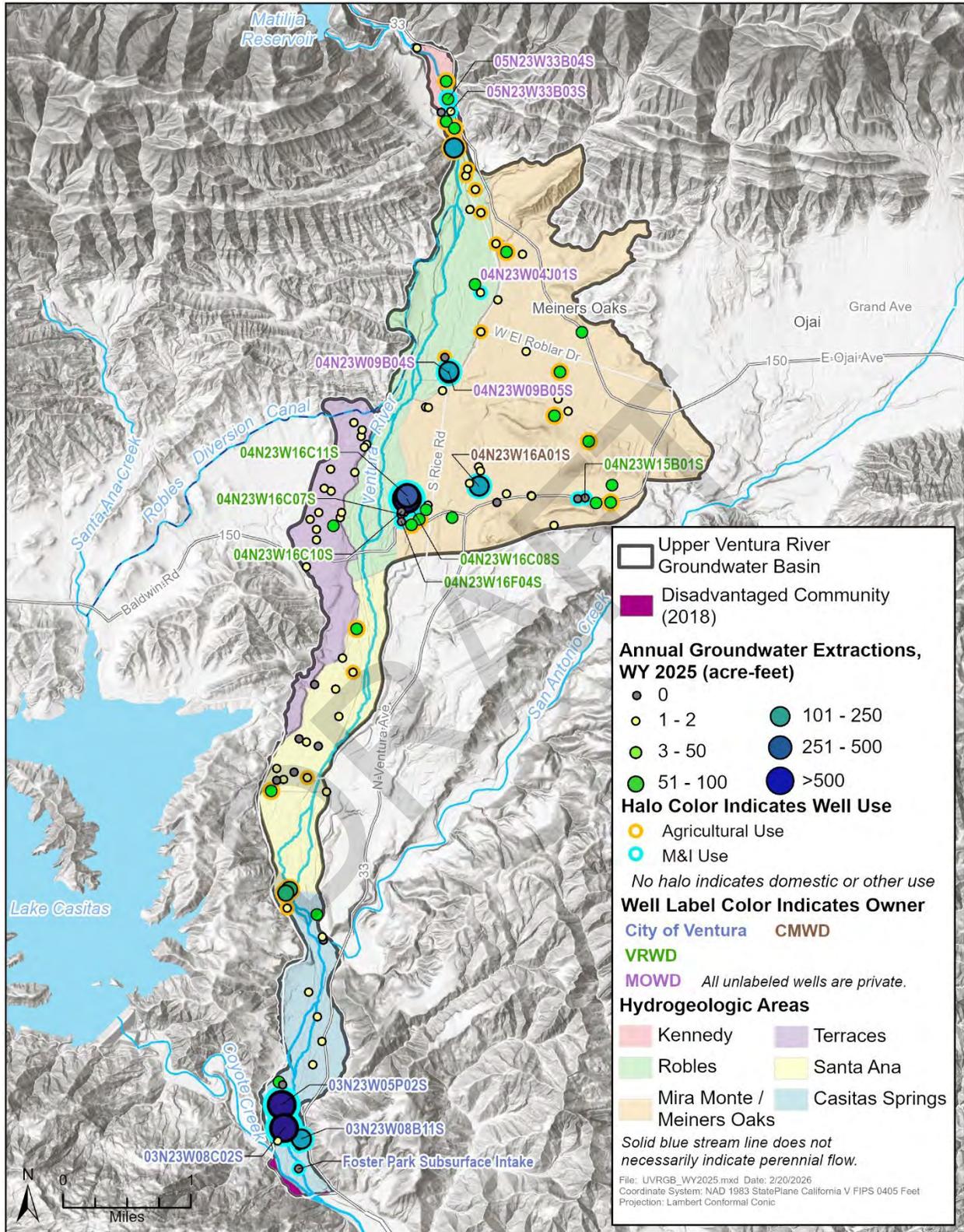


Figure 2.12 Extraction Well Rates, Water Year 2025

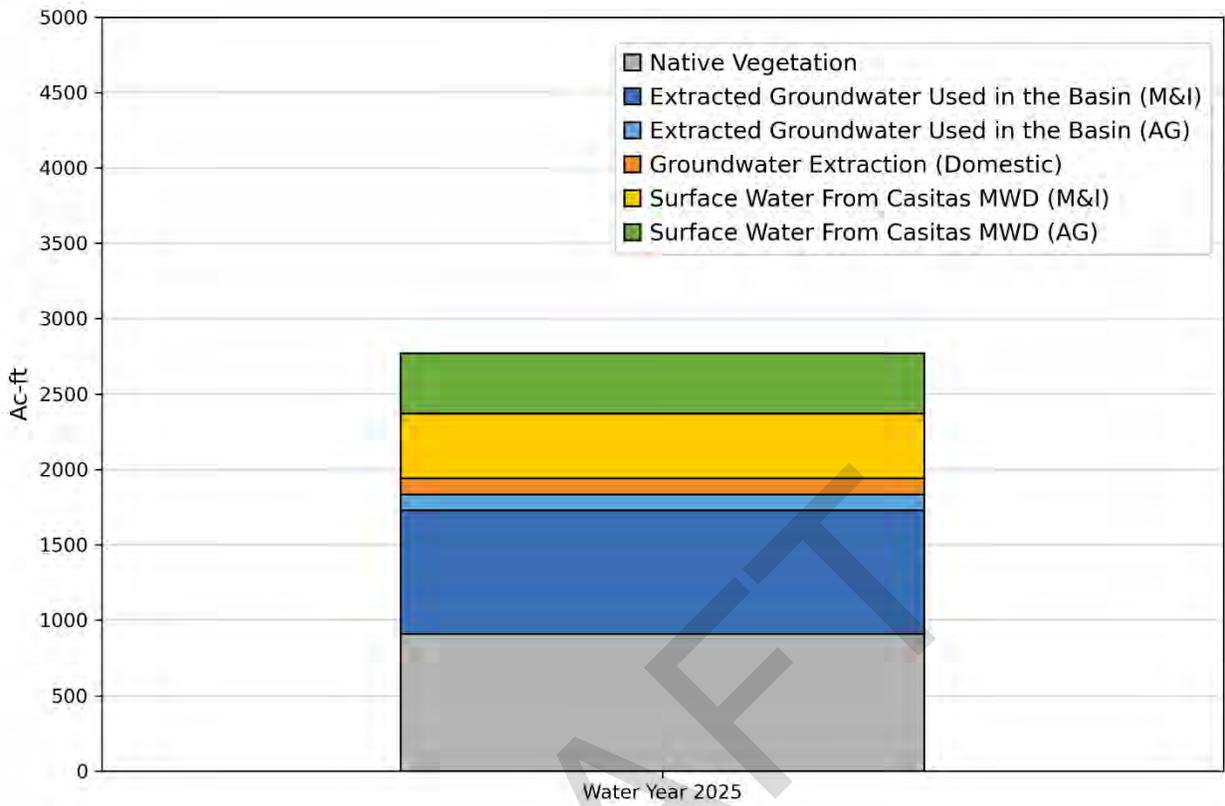


Figure 2.13 Total Water Use Within UVRGB During Water Year 2025

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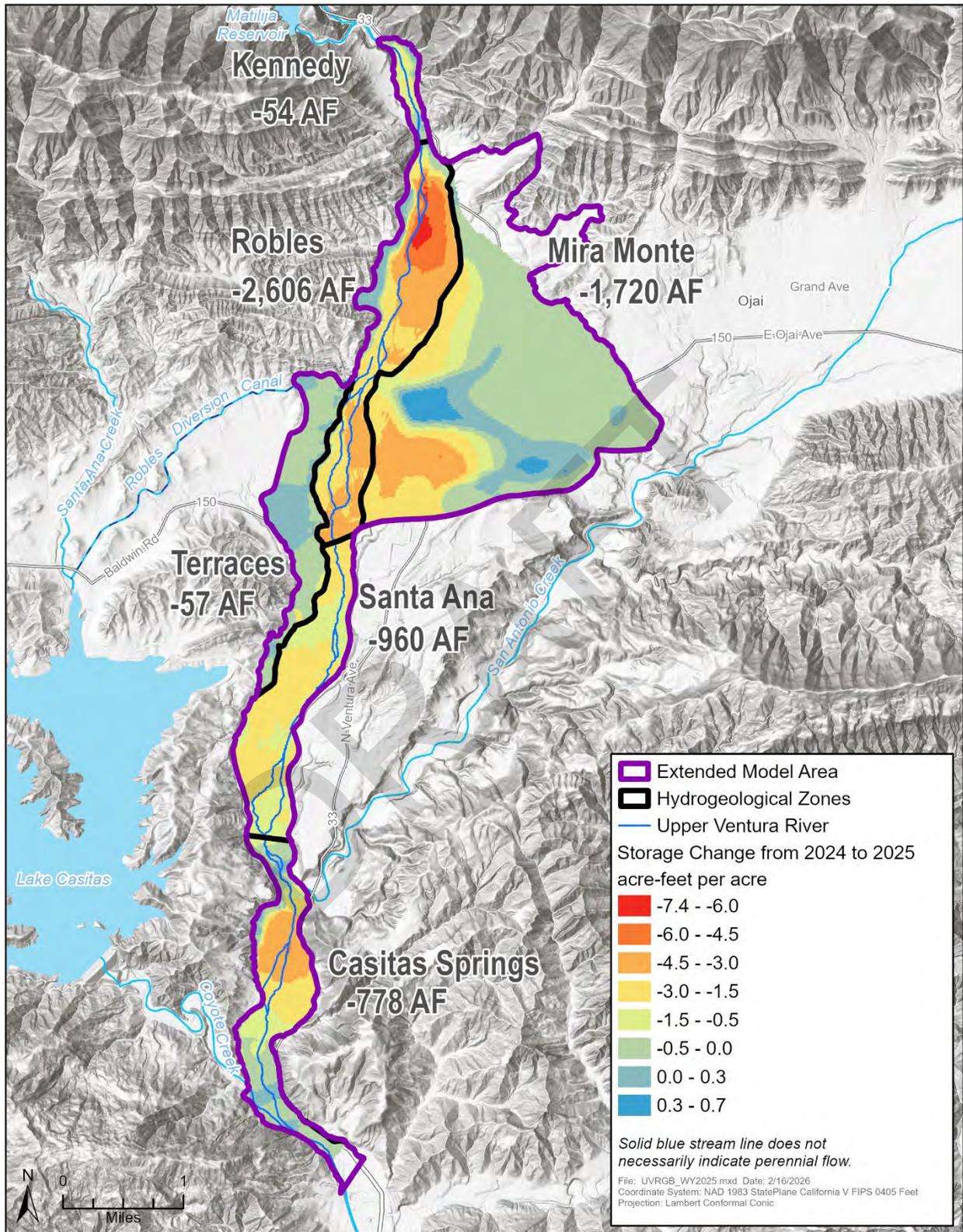


Figure 2.14 Change in Groundwater in Storage Map from Water Years 2024 to 2025

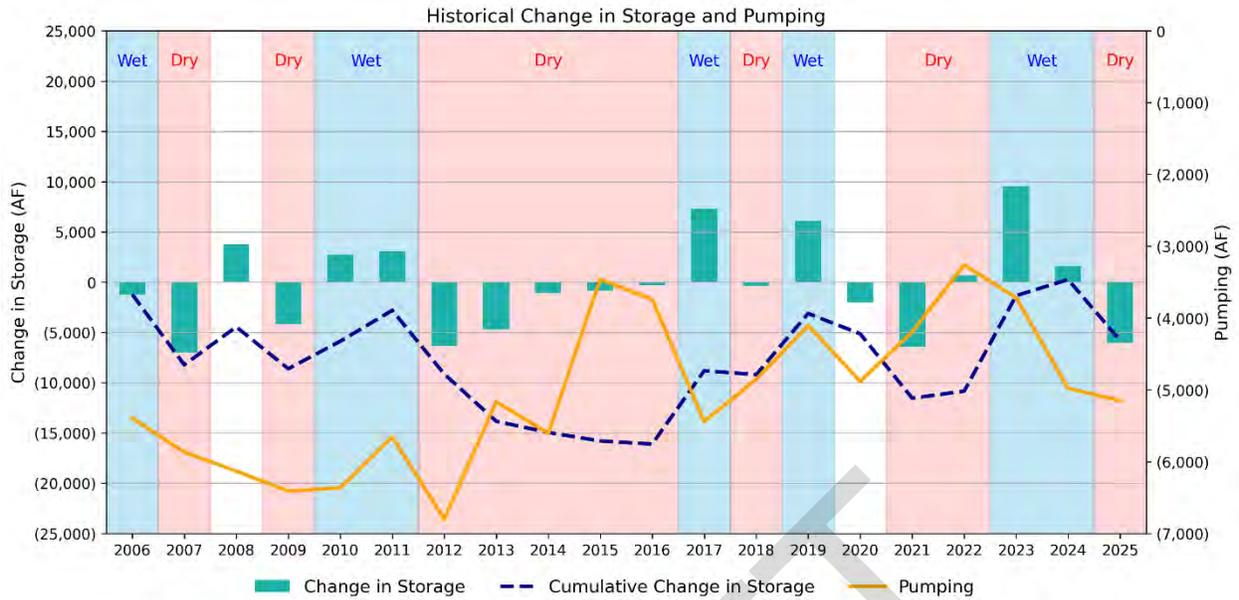


Figure 2.15 Change in Groundwater Storage with Annual Groundwater Extraction and Water Year Type

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Figure 3.1 Groundwater Level Hydrographs with Minimum Thresholds, Measurable Objectives, and Interim Milestones, Water Year 2025

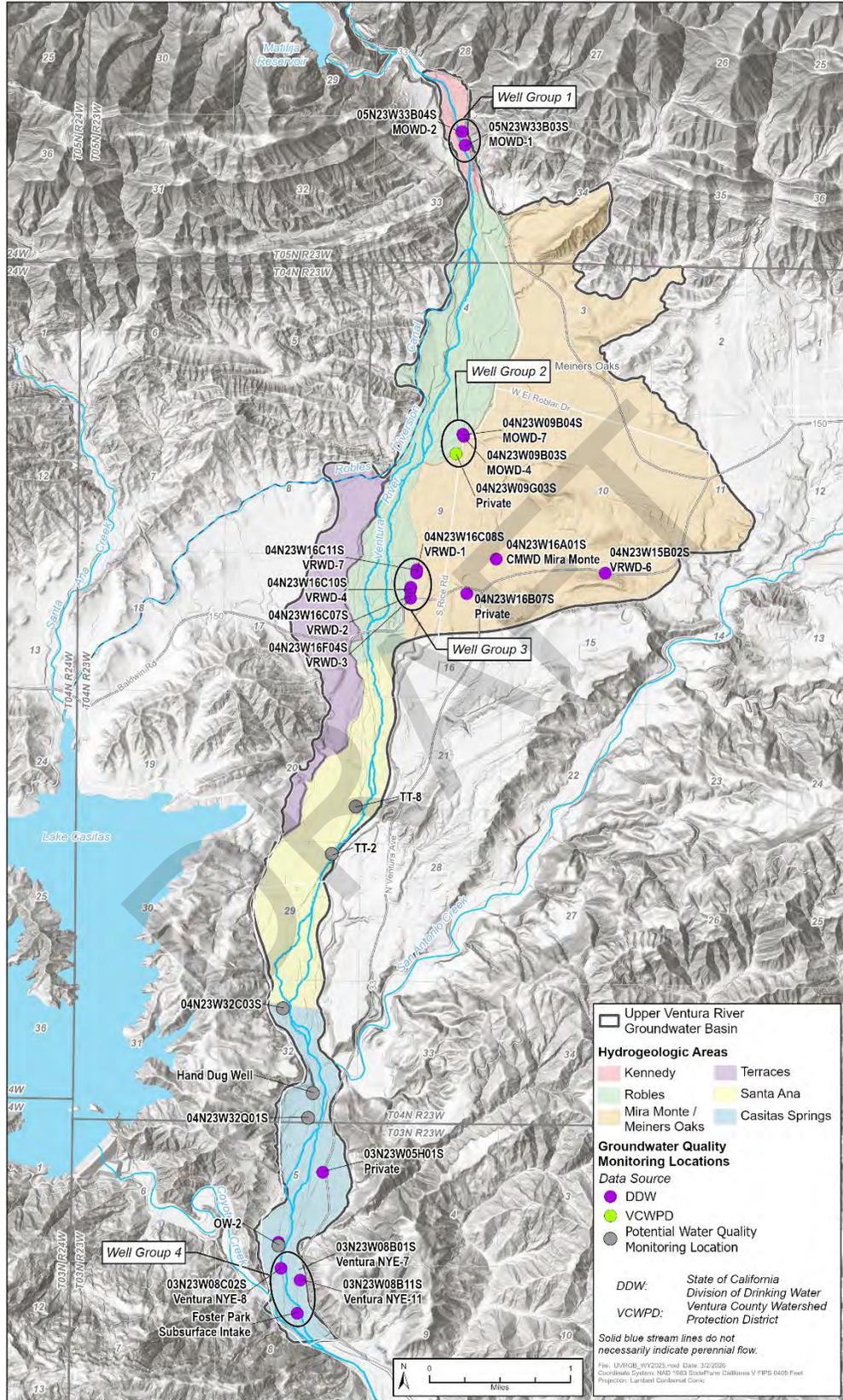


Figure 3.2 Existing and Planned Water Quality Monitoring Network

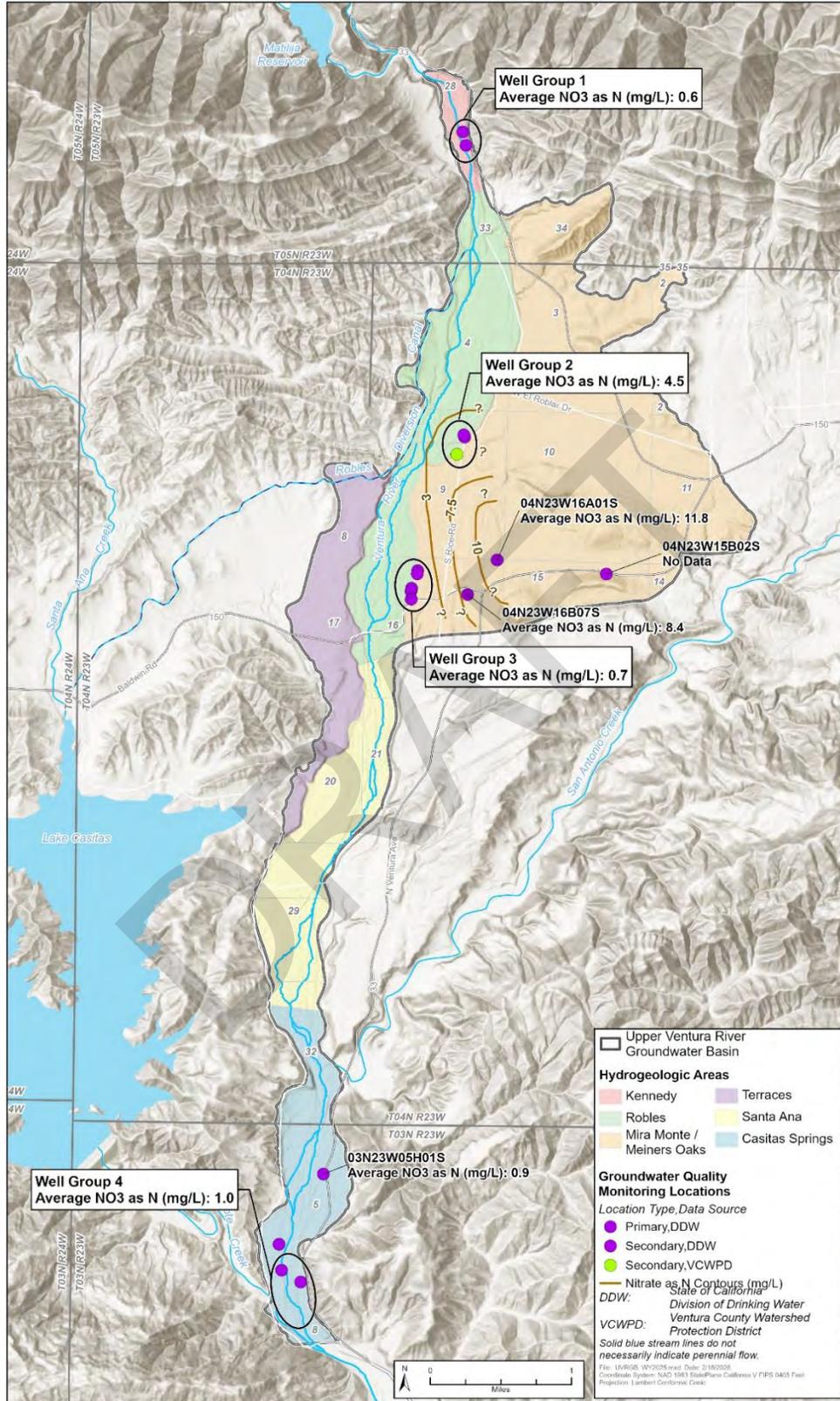


Figure 3.3 Nitrate Concentration Contours for the Degraded Water Quality Sustainability Indicator, Water Year 2025

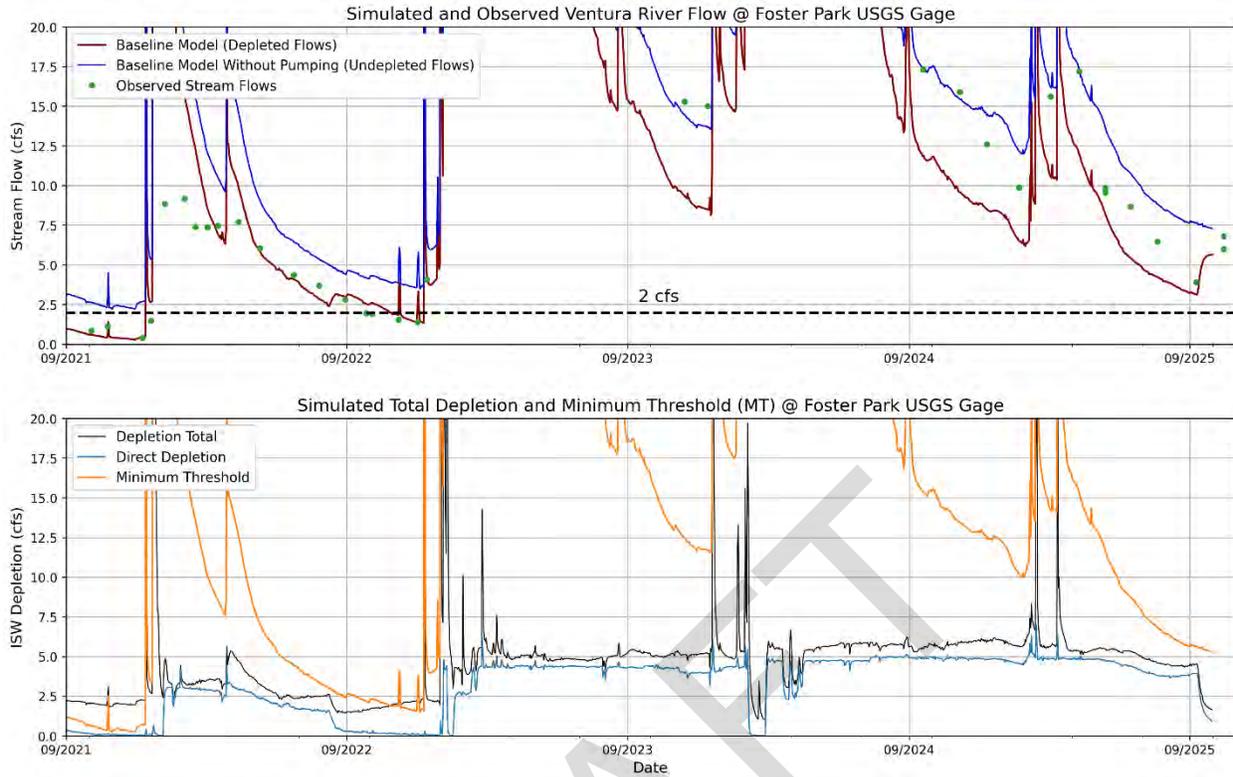


Figure 3.4 Foster Park Aquatic Habitat Area Simulated Streamflow and Depletion

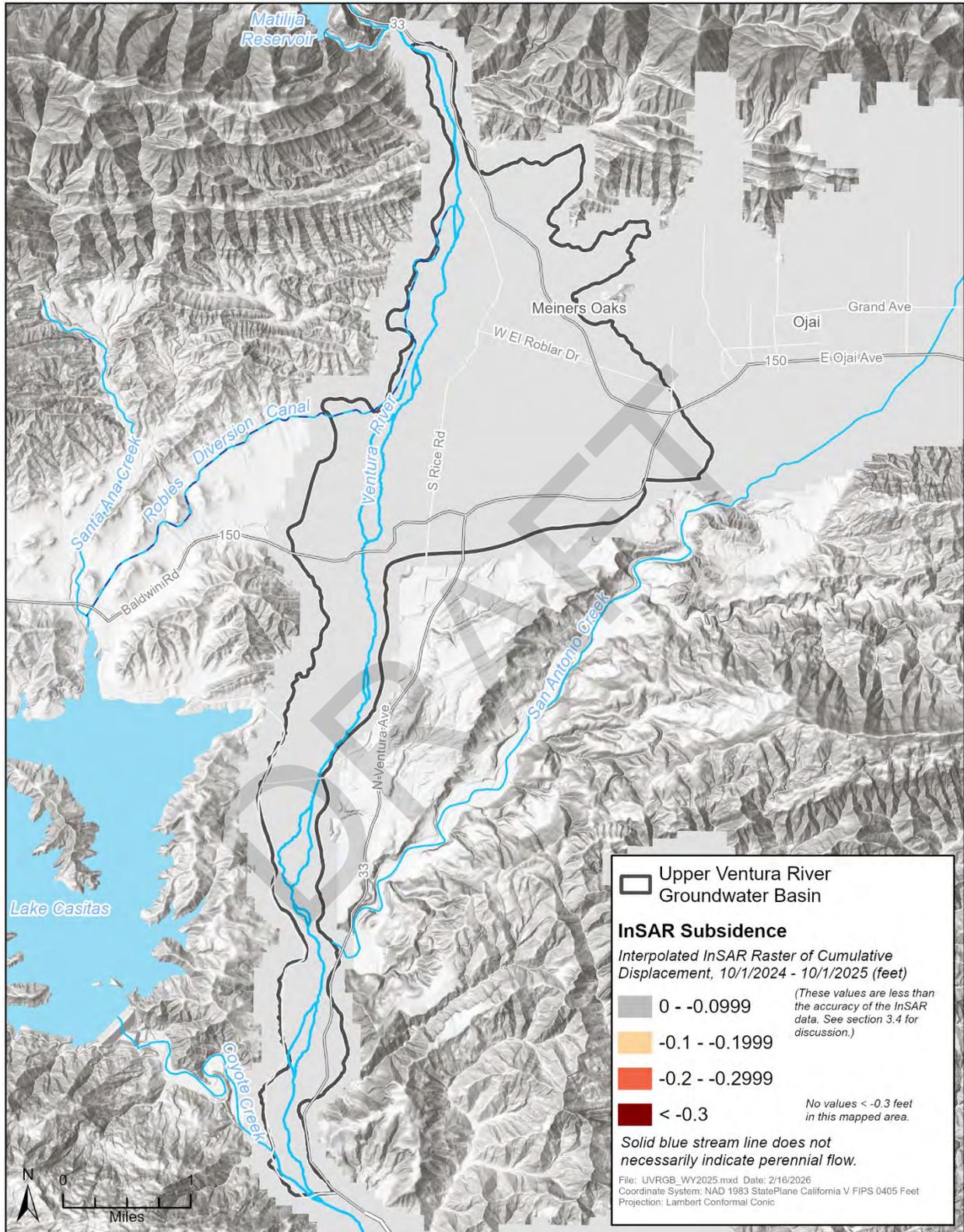
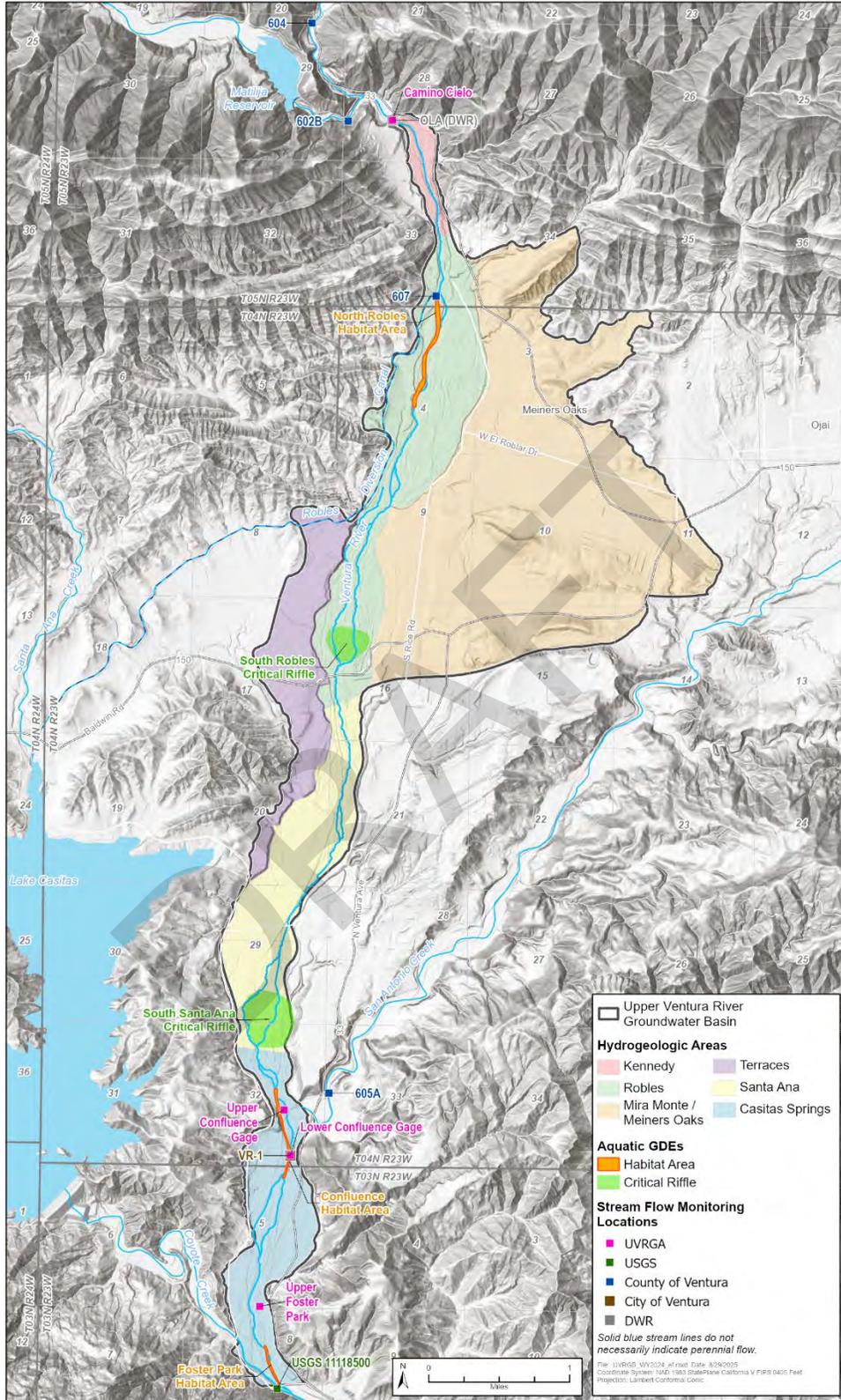


Figure 3.5 Subsidence for Upper Ventura River Groundwater Basin Between Water Years 2024 and 2025



GDE = groundwater-dependent ecosystem

Figure 3.6 Existing and Planned Surface Water Gages



Tables

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Table 2.1 Groundwater Extraction From UVRGB by Water Use Sector During Water Year 2025.^a

Water Use Sector		Water Year 2025	Method of Measurement	Accuracy of Measurement
		AF/yr		
Agricultural		246	Direct ^b	High
Municipal and Industrial ^b	VRWD	829	Direct ^c	High
	MOWD	323		
	CMWD	161		
	City of Ventura	3,342		
Domestic		106	Estimated ^d	Medium
Subtotal (extraction via pumping wells)		5,007		
Native Vegetation		910	Estimated ^e	Medium
TOTAL		5,917		

Notes:

- Totals may not match sum of values due to rounding.

^a Significant volumes of agricultural and municipal and industrial extracted groundwater are exported from the Basin. Values in this table reflect total extracted groundwater from the UVRGB.

^b Based on reported values from the UVRGA well registration program. See text Section 2.5 for details.

^c Based on reported values from each district and the City of Ventura.

^d See Table 2.2 for volumes of extracted groundwater used within UVRGB. See text Section 2.5 for details on estimation methods.

^e Calculated using the numerical groundwater model – see GSP Appendix H (UVRGA, 2022) for details on estimation methods.



Table 2.2 Total Water Use Within UVRGB During Water Year 2025.

Water Year 2025					
Water Use Sector	Water Source Type		Total (AF)	Method of Measurement	Accuracy of Measurement
	Groundwater Extraction (AF)	Surface Water (direct and retail deliveries from CMWD) (AF)			
Agricultural ^a	105	400	505	Direct and estimated ^{b,c}	Medium
Municipal and Industrial	819 ^d	431	1,250	Direct and Estimated ^{b,e}	High
Domestic ^a	106	0	106	Estimated ^c	Medium
Native Vegetation ^f	910	Unknown ^g	910	Estimated	Medium
TOTALS (AF)	1,940	831	2,771		

Notes:

- Totals may not match sum of values due to rounding.

^a Estimated based on metered data or registration estimates if meter data were unavailable. See Section 2.5 for additional details.

^b CMWD wholesale purchased surface water is metered, direct surface water purchases are estimated; see GSP Section 3.3.1.1 (UVRGA, 2022) for more information.

^c See Section 2.5 for estimation methods.

^d Significant volumes of agricultural and municipal and industrial extracted groundwater are exported from the Basin. Values in this table reflect extracted groundwater that is used within the UVRGB; see GSP Appendix H (UVRGA, 2022) for more information and Table 2.1 for total extraction volumes.

^e Groundwater is based on reported values from each district and the City of Ventura; see Table 2.1 for total extraction volumes.

^f Estimated from numerical model inputs, procedures detailed in the GSP (see Appendix H; UVRGA, 2022).

^g The modeled streamflow excludes surface water evapotranspiration losses; see GSP Appendix H (UVRGA, 2022) for more information.



Table 3.1 Sustainable Management Criteria^a for the Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage Sustainability Indicators.

State Well Identification Number	Well Name	Chronic Lowering of GW Levels and Reduction of GW Storage MT (ft amsl)	Chronic Lowering of GW Levels and Reduction of GW Storage MO (ft amsl)	IM 5-year (ft amsl)	IM 10-year (ft amsl)	IM 15-year (ft amsl)	IM 20-year (ft amsl)	2025 High GW Level (ft amsl) ^b
05N23W33B03S	Kennedy 05N23W33B03S	792	806	792	806	806	806	797.1
05N23W33G01S	Kennedy 05N23W33G01S	787	797	787	797	797	797	793.5
04N23W04J01S	North Robles 04N23W04J01S	625	679	625	679	679	679	656.4
04N23W09B01S	North Robles 04N23W09B01S	573	648	573	648	648	648	631.4
04N23W16C-VRWD MW-2 ^c	South Robles VRWD-MW-2	467	546	467	546	546	546	542.5
04N23W29F02S	Santa Ana 04N23W29F02S	334	385	334	385	385	385	383.6
03N23W08B07S	Casitas Springs 03N23W08B07S	215	225	215	225	225	225	229.5

Notes:

ft amsl = feet above mean sea level; GW = groundwater; IM = interim milestone; MO = measurable objective; MT = minimum threshold

^a The combination of minimum threshold exceedances that is deemed to cause significant and unreasonable effects in the basin for chronic lowering of groundwater levels is minimum threshold exceedances in the seven representative monitoring sites.

^b Seasonal high groundwater levels are selected for comparison to SMC to represent full groundwater conditions for the Basin. Note, seasonal high groundwater levels may occur in different times each water year and may occur outside of spring.

^c This representative monitoring site combines data for wells 04N23W16C04S and VRWD-MW-2 – see Figures 2.6 and 3.1 for additional details. The data for well 04N23W16C04S was used to develop the SMC (see GSP Section 4.4 and Appendix Q; UVRGA, 2022).

Color Key:

MO met
5-year IM met
MT exceeded



Table 3.2 Water Quality Minimum Thresholds and Measurable Objectives.

Constituent	MCL (mg/L)	RWQCB WQO (mg/L)	Range of Average Historical Concentrations for Wells or Well Groups (mg/L)	MT isocontour (mg/L) ¹	MO isocontour (mg/L) ²	Status of Sustainable Management Criteria for Water Year 2025
Percolating Groundwater Areas (Kennedy, Robles, Mira Monte/Meiners Oaks, and Santa Ana Hydrogeologic Areas)						
Nitrate (as N)	10	10	1.1 – 12.6	10	7.5	MO met
Areas with Rising Groundwater (Casitas Springs Hydrogeologic Areas)						
Nitrate (as N)	10	5 (Surface Water WQO)	1.1 – 1.4	10	3	MO met

Notes:

MCL = maximum contaminant level; mg/L = milligrams per liter; MO = measurable objective; MT = minimum threshold; WQO = water quality objective

Color Key:

MO met
MT exceeded

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¹ SGMA undesirable results are considered to occur when any isocontour exceeds 10 mg/L outside of the Mira Monte / Meiners Oaks Area and encompasses an area with active domestic wells producing groundwater from the alluvial aquifer that lack an alternative drinking water source. If the minimum threshold is exceeded, UVRGA will investigate to determine if caused by pumping by a GSP project or management action.

² The measurable objectives are unintended to apply in the Meiners Oaks / Mira Monte Area because this area is known to be a source area for nitrate and is an existing area of nitrate impacts. If the measurable objective is unmet, UVRGA will investigate to determine if caused by pumping by a GSP project or management action.



Table 3.3 Summary of ISW Depletion and SMC in the Foster Park Habitat Area for Water Year 2025.

Undepleted Flow (without groundwater pumping – derived from groundwater model)	Depletion Minimum Threshold and Measurable Objective	Goal	5-year Interim Milestone: Depletion in Excess of Measurable Objective	Water Year 2025 Simulated Depletion
> 2 cfs	Undepleted flow minus 2 cfs	The minimum threshold and measurable objective seek to prevent depletions of surface water flow caused by groundwater pumping that would cause surface water flow to be less than 2 cfs when surface water flow would not be less than 2 cfs without pumping.	Maximum modeled depletion rate of 10.7 cfs	Measurable Objective met
≤ 2 cfs	0 cfs	The minimum threshold and measurable objective seek to prevent depletions of surface water flow caused by groundwater pumping when surface water would already be 2 cfs or less without groundwater pumping.		Inapplicable (undepleted flows are not ≤ 2 cfs)

Notes:

cfs = cubic feet per second

Color Key:

MO met
5-year IM met
MT exceeded

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Appendix A

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Appendix A

Updated Numerical Groundwater Model Results for Water Year 2024 Annual Report

The numerical groundwater model was unavailable for the water year 2024 Annual Report; therefore, this Appendix provides updates to water year 2024 groundwater conditions relying on results from the numerical groundwater model (i.e., change in groundwater in storage). Streamflow depletion is not provided as an update to the water year 2024 report since modeling was not required due to observed streamflow not falling below 13 cfs, which indicated the measurable objective was met.

Updates to Simulated Change in Storage

The modeled results for change in groundwater in storage shown on the map and chart presented in Section 2.8 were unavailable in the water year 2024 Annual Report (Figures 2.14 and 2.15). The figure and chart were updated with the results from the numerical groundwater model (Figures A-1 and A-2). The total change in storage between spring-high groundwater levels in water years 2023 and 2024 was calculated to have increased by 1,617 acre-feet (AF) (Figure A-1). This increase is due primarily to sustained wet conditions for the Basin following the wet year for water year 2023. The change in storage for the Basin was also calculated for each hydrogeologic area, and the greatest change in storage was in the Mira Monte/Meiners Oaks areas (Figure A-1).

Figure A-2 shows the annual change in groundwater in storage and the cumulative change in groundwater in storage for the Basin between water years 2006 and 2024, along with the water year type and groundwater use (pumping) up to water year 2024.

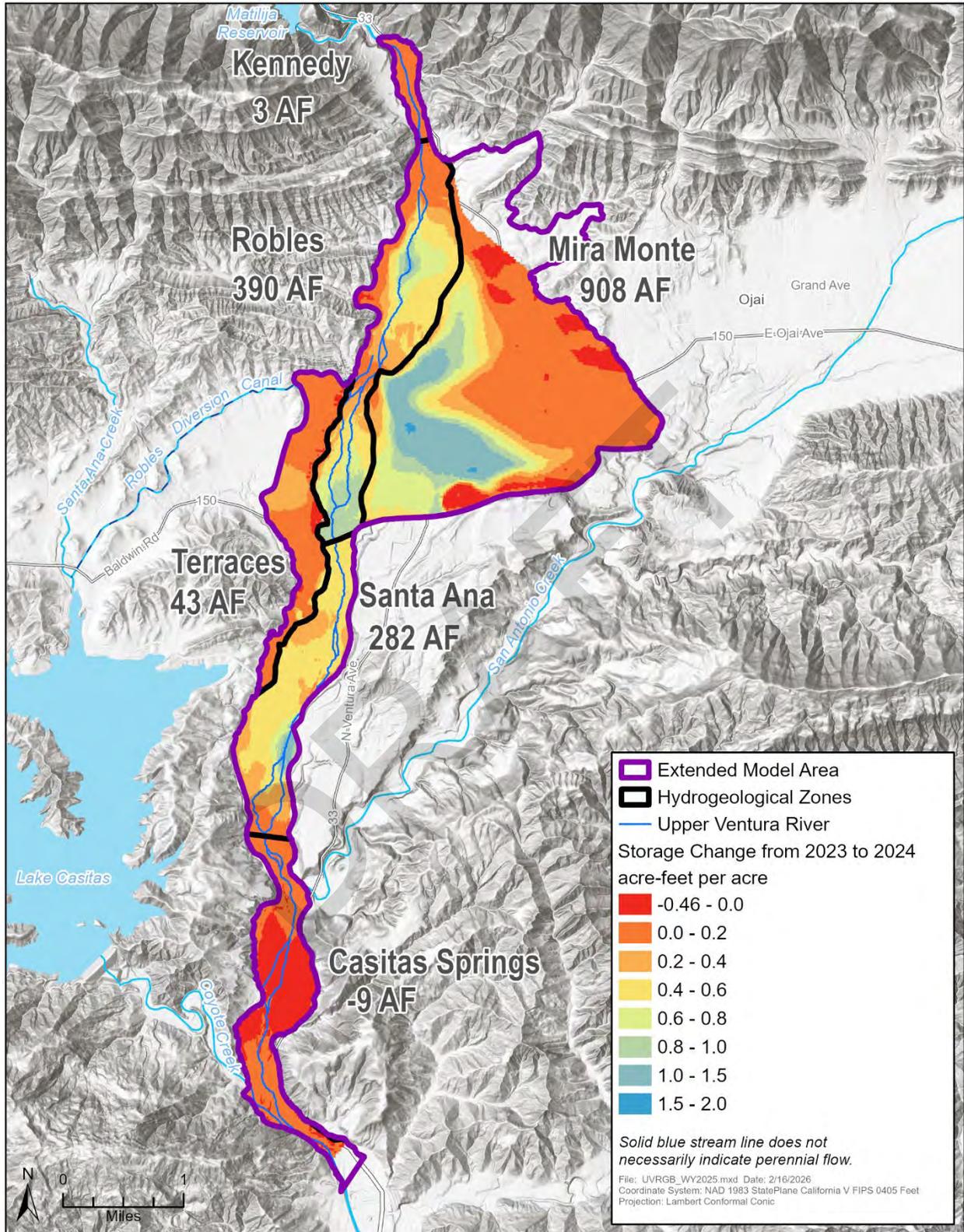


Figure A-1. Updated Figure 2.14 from the water year 2024 Annual Report. Change in Groundwater in Storage Map from Water Years 2023 to 2024.

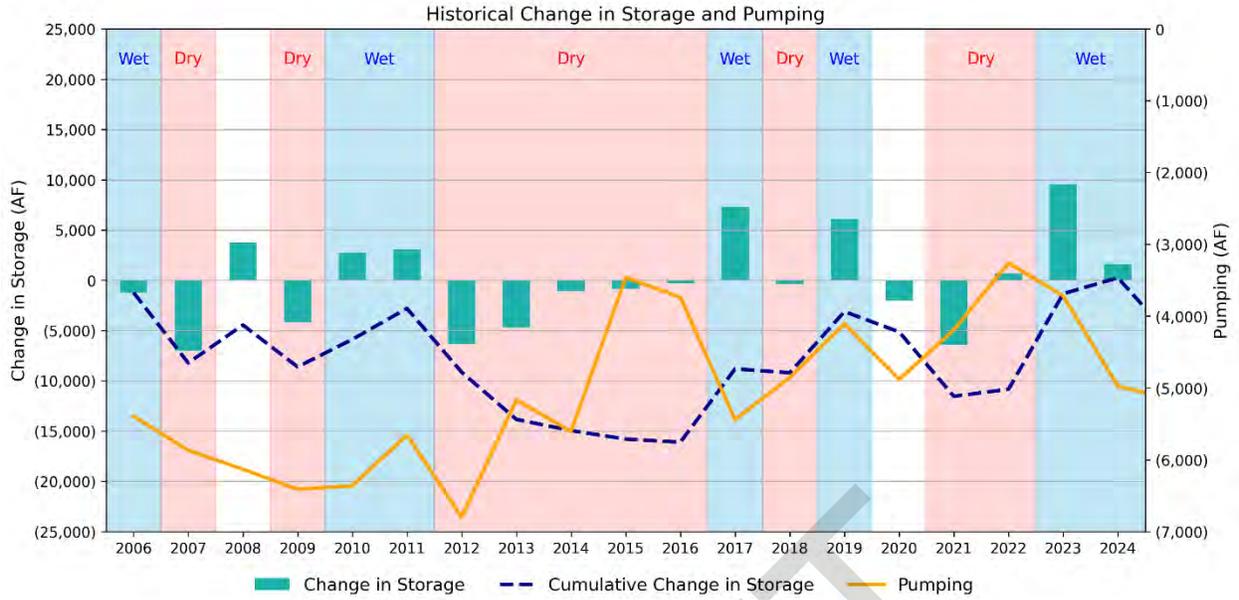


Figure A-2. Updated Figure 2.15 from the water year 2024 Annual Report. Change in Groundwater Storage with Annual Groundwater Extraction and Water Year Type.



Attachment A

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Technical Memorandum

UVRGA Groundwater Model Sensitivity Analysis and Calibration Update

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OCTOBER 2, 2025

Executive Summary

The depletion of interconnected surface water (ISW) sustainability indicator is a key component of the Upper Ventura River Groundwater Agency (UVRGA) Groundwater Sustainability Plan (GSP). The GSP identifies the potential for significant and unreasonable effects on steelhead when surface water flows decline below 2 cubic feet per second (cfs), as measured at the Foster Park United States Geological Survey (USGS) gage 11118500 located at the Camino Cielo bridge. Therefore, the GSP includes sustainable management criteria (SMC) intended to prevent streamflow from declining below 2 cfs at Foster Park as a direct result of groundwater extraction and to avoid further depletion of streamflow from groundwater extraction when streamflow is below 2 cfs. As GSP implementation is guided by numerical modeling, it is important to ensure UVRGA’s numerical model can accurately simulate the lower range of Ventura River flows approaching the 2 cfs threshold. This memorandum describes work INTERA undertook to improve the UVRGA numerical model’s ability to simulate low flows in the Ventura River relevant to GSP implementation and to improve delineation of the model’s limitations in this regard.

The UVRGA numerical groundwater model simulates groundwater/surface water interactions and is used to estimate the depletion of ISW due to groundwater pumping near the Upper Ventura River. The Upper Ventura River is a dynamic, high-energy system that changes both spatially and temporally. Perennially wet and dry reaches of the river are highly dependent on groundwater/surface water interactions driven primarily by available groundwater in storage and alluvial thickness. In addition, storm events can change the river channel geomorphology and riparian vegetation. The model relies on gaged streamflow data to represent the surface water conditions of the Ventura River accurately; therefore, understanding what components of the modeled streamflow are most sensitive to changes to inputs is a key process to maintaining and calibrating a well-built model. INTERA, with input and review by UVRGA’s Executive Director Bryan Bondy, has completed the tasks summarized in **Table ES-1** to improve the model’s ability to represent streamflow conditions and evaluate model use limitations.

Table ES-1. Summary of work completed and insights gained.

Work Completed	Insights Gained	Section Discussed
<u>River Channel Change Evaluation</u> : Evaluated impacts of changes in river channel geomorphology from January 2023 flooding event on model	Modeled streamflow results are generally insensitive to changes in streambed elevation and location of channel. Future updates to channel geomorphology following extreme flood events appear not to be critical for model performance.	2.1
<u>Model Verification</u> : Checked model performance using data post-calibration data (i.e., data after 2018)	Model found to overpredict low streamflows during post-calibration period (i.e., after 2018). Additional model calibration determined to be warranted.	2.1
<u>Critical Review of Streamflow Data</u> : Quantified errors in	Uncertainty in streamflow data is significant and impacted prior model	2.2

Work Completed	Insights Gained	Section Discussed
streamflow datasets used for model inputs and calibration	calibration. Removed unreliable data and accounted for streamflow measurement attributes (i.e., measurement quality ratings, measurement location). Developed upper and lower estimates of surface water inflows to basin to bracket model uncertainty and switched streamflow calibration dataset at USGS gage to error-barred, location-based measurements instead of rating curve.	
<u>Update Other Model Inputs Using New Data</u>	Updated model with data obtained since model construction: previously unavailable well logs (basin thickness), groundwater levels collected by UVRGA, and pumping rates from UVRGA well registration and groundwater extraction reporting program.	2.3
<u>Sensitivity Analysis:</u> Assessed sensitivity of model calibration to changes in key model parameters.	Determined key model parameters in different hydrogeologic zones that could improve model calibration and predictive ability.	3.2
<u>Model Calibration Update:</u> Updated the model calibration to improve its fit to observed streamflow data.	The model's ability to represent streamflow (especially low flows) improved significantly.	4.1
<u>Review of Model Uncertainty:</u> Assessed uncertainty in streamflow inputs for the model.	A high range in modeled streamflows was produced, which informed the recommendation for a predictive uncertainty analysis of the model.	4.1.2

The investigation of the streamflow measurement data refined the model representation of streamflow and provided direction for a focused calibration update of the model. The updated model is significantly improved in comparison with the original model developed for the GSP. The model can now more accurately represent Ventura River streamflow under low-flow conditions, which is critical for the GSP implementation. However, the predictive uncertainty of simulated streamflow requires further investigation to quantify depleted streamflow optimally and assess undesirable results for the Basin. This technical memorandum provides additional detail for each of the completed tasks and associated lessons learned shown in the table above.

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Acronyms and Abbreviations

cfs	cubic feet per second
GSP	Groundwater Sustainability Plan
HK	horizontal hydraulic conductivity
INTERA	INTERA Incorporated
ISW	interconnected surface water
KGE	Kling-Gupta Efficiency
LiDAR	Light Detection and Ranging
MAE	Mean Absolute Error
NSE	Nash-Sutcliffe Efficiency
RMSE	Root Mean Square Error
RSS	Residual Sum of Squares
SFR-K	streambed hydraulic conductance
Ss	specific storage (model layer 2 only)
Sy	specific yield
TM	technical memorandum
USGS	United States Geological Survey
UVRGA	Upper Ventura River Groundwater Agency
UVRGB	Upper Ventura River Groundwater Basin
VK	vertical hydraulic conductivity

1.0 Introduction

INTERA Incorporated (INTERA), with input and review by the UVRGA Executive Director, Bryan Bondy, developed a numerical groundwater model (model) of the Upper Ventura River Groundwater Basin (UVRGB, or Basin) in support of the Groundwater Sustainability Plan (GSP) (UVRGA, 2022a) for the Upper Ventura River Groundwater Agency (UVRGA). The model is an important tool for GSP implementation, with a primary purpose to estimate depletion of interconnected surface water (ISW) within the Basin.

The details behind the original model build, calibration methodology, and predictive results used for the GSP are documented in Appendix H of the GSP (INTERA and Bondy, 2022). The original model was calibrated to streamflow and groundwater level data for the 2005-2018 period, and the model has been extended incrementally for each GSP Annual Report through water year 2023 without additional calibration (UVRGA, 2022b; 2023; 2024). The model was not extended for the water year 2024 annual report (UVRGA, 2025) because the model was “out-of-service” for this calibration update project.

This technical memorandum (TM) summarizes the work performed to update the model calibration and is organized into five sections:

1. **Introduction**
2. **Background** – a summary of all the relevant information related to the model calibration update.
3. **Sensitivity Analysis and Setup for Calibration Update** – statement of calibration goals, sensitivity analyses, updates to calibration datasets, and calibration setup.
4. **Calibration Results** – description of calibration results and uncertainty analysis.
5. **Conclusions and Limitations** – key findings of the model calibration described in this TM and a discussion of the model limitations.

2.0 Background

A general timeline of the UVRGA model development, along with key steps leading to the updated and recalibrated model, are shown on **Figure 2-1** and described in this section.

The original model calibration dataset covered the 2005-2018 period, and the latest version of the model—prior to the work completed for this TM—extended during annual report preparation up to and including water year 2023 (UVRGA, 2024).

2.1 Review of Work Completed Following the January 2023 Flood

A major flood event on January 10, 2023, changed the Upper Ventura River channel geomorphology. Following this, the model was updated to reflect the post-flood channel morphology, and the updated model output was reviewed to assess the impact of channel morphology changes on model results (INTERA and Bondy, 2024). A Light Detection and Ranging (LiDAR) survey was completed by UVRGA in 2023 to provide updated channel elevation data, which was then input into the model. This work showed

that model results are generally insensitive to changes in streambed elevation and location of channel and that future updates to channel geomorphology following extreme flood events do not appear to be critical for model performance.

This work also provided an opportunity to review the post-calibration period (i.e., post-2018 model performance). This is referred to a “model verification” in the modeling community. The model verification revealed that the calibration of model-simulated streamflow during the post-calibration period (i.e., post-2018) was significantly poorer than during the calibration period (i.e., error between simulated and observed streamflow of <10 cubic feet per second [cfs] averaged 4.4 cfs, as compared to an error 1.2 cfs of for the pre-2018 dataset). The model error during the verification period exceeded the 2 cfs minimum threshold included in the GSP, indicating the need for an investigation into potential sources of error related to streamflow data, model sensitivity analysis, and model calibration update (INTERA and Bondy, 2024).

2.2 Critical Review of Streamflow Data

Ventura County maintains streamflow gages on both Matilija Creek forks (604 and 602B) and San Antonio Creek (605A), and the United States Geological Survey (USGS) maintains a streamflow gage on the Ventura River at Foster Park (Station ID 11118500) (**Figure 2-2**). Streamflow data are incorporated into the model in two ways: (1) gaged tributary inflows from the Matilija and San Antonio Creeks serve as a model input for the simulated Ventura River streamflow, and (2) gaged streamflow at the USGS Foster Park gage on the Ventura River (11118500) is used to calibrate the model simulated Ventura River streamflow (Figure 2-2). Note the “streamflow calibration dataset” referenced throughout this TM represents the Foster Park USGS 11118500 gage data.

In general, stream gage operation consists of continuous stage monitoring using a river level sensor combined with periodic manual flow measurements. The continuous stage values are converted to streamflow using rating curves, which are developed using a stage-discharge relationship and adjustments (a.k.a. “rating curve shifts”) to account for changes in the stage-discharge relationship over time. Available continuous and manual streamflow data were compiled and checked for any visible anomalies, shifts, or drifts.

Initial findings were shared with USGS and Ventura County staff responsible for field measurements and data processing, and multiple discussions took place to improve understanding of gaging methodology. Guidance and feedback from the County and USGS provided detailed information to interpret streamflow measurement data and calculate the ranges of measurement error and uncertainty in rating curve estimation (INTERA, 2024). The key findings of the streamflow data evaluation included (1) identification of errors in streamflow inputs to the model, (2) ranges of error for manual measurements, (3) uncertainty assessment of streamflow rating curves, (4) refinement of streamflow calibration datasets, and (5) insight to guide sensitivity analysis and calibration updates to improve the model’s ability to match streamflow data. **Figure 2-3** shows an example hydrograph for the Foster Park gage and the range in measurement error. These findings were documented in a TM submitted to UVRGA in 2024 (INTERA, 2024).

The model’s streamflow calibration dataset was updated based on the findings of the critical review of streamflow data. The updates included ranges of errors on streamflow measurements, an emphasis on

baseflow (i.e., sustained low flows following storm events) manual measurement data, and removal of the rating curve estimated data from the quantification of calibration statistics. The rating curve for the Foster Park gage is updated frequently following manual streamflow measurements, and the reporting on these updates was unavailable for review; therefore, the uncertainty associated with streamflow estimated from the rating curve was considered unreliable for use as a calibration dataset. The rating curve estimates of streamflow data can still be used for a visual and qualitative assessment of the match between simulated and observed streamflow; however, these estimates were not used in this calibration. The model is not expected to match the rating curve estimated data because it is mostly based on data collected at locations other than the Foster Park gage location. Further refinement of the streamflow calibration dataset took place during the model calibration update, which is described in Section 3.3.

2.3 Other Model Updates

The model was also updated using new data and further review of existing data. These model updates included:

1. Converting model stress periods from a mix of daily and monthly fully to daily periods to reduce estimation error associated with averaging flows over month-long periods;
2. Incorporating data from the UVRGA well registration and groundwater extraction reporting program;
3. Updating the Ventura River-Coyote Creek confluence location and associated Ventura River channel characteristics;
4. Updating the modeled bedrock surface in selected areas based on previously unavailable boring logs; and
5. Adjusting model run-time efficiency.

These updates were completed prior to the calibration update work. Additional details on the above listed model updates are provided in the following subsections.

2.3.1 Model Stress Periods

A stress period for the model is a time interval where model inputs, such as pumping, streamflow, or recharge, are held constant. The model stress periods were originally designed to be monthly; however, they were subdivided into daily for the wet season (November-March) and monthly for the dry season (April-October) to reduce model computational time and output file sizes. Conversion to global daily stress periods was implemented to improve the accuracy of modeled low streamflow and represent effects of groundwater extraction on streamflow during the dry season.

2.3.2 Updates to Modeled Pumping Rates

The estimated pumping rates for individual wells within the Basin were refined based on data from UVRGA's well registration and groundwater extraction reporting program. This program has collected information from the well owners about well status (active, backup, abandoned, destroyed) and groundwater extraction quantities. Wells with estimated extractions exceeding 2 acre-feet per year are

required to install a flowmeter and report groundwater extractions on a quarterly basis. The well registration responses and groundwater extraction reporting data were used to update the simulated pumping rates within the model to represent groundwater extractions more accurately.

2.3.3 Coyote Creek Confluence Model Setup

Information provided by USGS on the location of the Foster Park gaging station and subsequent inspection of the Upper Ventura active channel braids in the Foster Park area indicated the original model setup inaccurately represented the Coyote Creek confluence with the Ventura River. Two channels for the Ventura River are regularly noted at the Foster Park gage in the USGS manual measurement notes. The original model had one channel for the Ventura River and one channel for the Coyote Creek at the Foster Park gage location, with the Coyote Creek confluence occurring downstream of the Foster Park gage. However, based on communication with USGS staff and additional inspection of aerial photography, the Coyote Creek confluence was determined to be upstream of the Foster Park gage, and two channels represented the Ventura River at the Foster Park gage (**Figure 2-4**). This updated the calculation of modeled streamflow at the Foster Park gage to be the sum of the streamflow at both channels.

2.3.4 Updates to the Modeled Bedrock Surface

Previously unavailable boring logs provided new data to update the depth to bedrock for the model. Twelve locations were added to the bedrock interpolation, and the bedrock surface was either raised or deepened (**Figure 2-5**). In general, the bedrock surface was raised in the vicinity of the data near Santa Ana Boulevard and deepened in the south near Casitas Springs.

2.3.5 Model Run Time Improvements

Longer model run times were encountered after converting all stress periods to daily (Section 2.3.1) and incorporating the other model updates discussed in the previous subsections. Adjustments to the model solver maximum iterations were tested to optimize the run time while preserving the model simulation accuracy. Model run times were generally shortened by 50%, which improved the efficiency of running several model realizations for the sensitivity analysis and calibration update.

2.4 Summary of Model Background

The model development timeline (Figure 2-1) shows tasks completed for the model prior to calibration update and highlights the key steps which led to the updated model. In summary, the following key findings are noted:

1. Changes to the Ventura River channel geomorphology had no significant impact on the model performance.
2. Verification of the post-calibration streamflow data (i.e., post-2018) indicated the model required evaluation of potential sources of error in the streamflow data and calibration update.

3. Updates to the model streamflow calibration update dataset were made based on critical review of the streamflow data and consultation with USGS. A scope for sensitivity analysis and calibration update was prepared at this point.
4. Model updates were made based on updated data and increased the temporal resolution of the model prior to sensitivity analysis and calibration update.

The setup for sensitivity analysis and calibration update is described in Section 3.

3.0 Sensitivity Analysis and Setup for Calibration Update

This section presents the sensitivity analysis and calibration update of the original model. A sensitivity analysis (Section 3.2) was performed (1) to determine which model parameter inputs have the most effect on simulated streamflow at the Foster Park gage and (2) to help streamline the calibration of the model by eliminating insensitive parameters and constraining the range of parameter values for calibration. The calibration update of the model was then performed to identify the best combination of parameter changes needed to achieve the calibration goals (Sections 3.3 and 3.4).

3.1 Calibration Goal and Overall Approach

The overarching goal of the calibration update was to improve the model's ability to match observed streamflow at the USGS Foster Park gage while maintaining a similar level of calibration to observed groundwater levels to the original model. Important factors for the streamflow calibration dataset include:

- A primary focus on matching streamflow during baseflow recession and low-flow conditions (i.e., <10 cfs) at the Foster Park gage location.
- An emphasis on post-2018 streamflow data, due to the (1) results of the model verification, which indicated the calibration during this period was significantly poorer than during the original calibration period (Section 2.1), and (2) Foster Park manual streamflow measurements were more reliable after 2018 (i.e., measurement locations were either unknown or downstream of the basin where the model lacks available data).
- Removing the rating curve estimated streamflow and using only manual measurement data for the observed dataset used in calibration (see Section 2.2).
- Accounting for the manual measurement distance from the gage (see Sections 3.3.1 and 3.3.2).
 - Due to manual measurement location issues (see Section 3.3.1), pre-2017 streamflow data were largely unreliable because the streamflow measurement locations were either unknown or made downstream of the basin where the model lacks data. These data were not used when quantifying the closeness of fit between simulated and observed streamflow.
- Updated groundwater level observations were also included in the calibration process to ensure the model maintained an accurate representation of observed groundwater conditions.

These factors are important because the model is used to estimate streamflow depletion, and minimum thresholds for the depletion of ISW can be exceeded during low flows when depleted streamflow is <2 cfs. The accuracy of streamflow measurement data used for calibration is critical for assessing the model's performance.

3.1.1 Calibration Approach Using PEST++IES

The model computation time varies from approximately four to eight hours depending on the processor. Calibrating the model through manual trial-and-error was computationally infeasible, given the run times and the number of runs required to explore the parameter space. To address this, the calibration update utilized the automated calibration software suite Parameter Estimation Iterative Ensemble Smoother (PEST++IES; White, 2018), which provides an efficient, objective framework for numerical model calibration.

PEST++IES offers several advantages over manual calibration. It automates the adjustment of parameter ensembles (combinations of multiple parameter values and spatial distribution) within prescribed zonal (geographic) ranges and iteratively minimizes differences between simulated and observed data at specified targets using a quantitative objective function representing the fit between model simulated results and field measurements. In addition, the use of pilot points, rather than zones of constant parameter values, allows a flexible spatial variability in parameters. Pilot points are discrete locations where parameter values are perturbed and provide a smooth interpolation of parameters over the model grid between pilot points. The ensemble-based approach improves efficiency in exploring parameter space, requiring fewer model runs versus testing each parameter individually.

3.2 Sensitivity Analysis

Following the incorporation of updates described in Section 2.3, INTERA conducted a series of sensitivity runs to identify which parameters most influenced simulated streamflow at Foster Park and to guide selection and setup of parameters to include in the calibration. The model parameters tested for sensitivity included horizontal and vertical hydraulic conductivity (HK and VK, respectively), specific yield (Sy), specific storage (Ss; model layer 2 only), and streambed hydraulic conductance (SFR-K). Parameter adjustments focused on the Casitas Springs, Santa Ana, and Robles hydrogeologic zones (**Figure 3-1**). INTERA completed and analyzed a total of 60 model runs for sensitivity based on the combinations of parameter adjustments for each hydrogeologic zone.

Reducing Sy in the Casitas and Santa Ana zones—and therefore unconfined groundwater storage upstream of Foster Park—lowered baseflows and steepened the recession portion of the streamflow curve. **Figures 3-2** and **3-3** show the simulated streamflow response at Foster Park due to changes to Sy in the Santa Ana and Casitas Springs zones, respectively. Sustaining baseflow at the Foster Park gage is generally controlled by the amount of groundwater storage directly upstream; therefore, changes to Sy in the Robles and Mira Monte had little effect because of their greater distance from the gage. Similar effects were observed for adjustments to the Ss in layer 2.

Simulated streamflow at the Foster Park gage was also sensitive to adjustments to HK in the Casitas Springs and Santa Ana zones. Increasing HK in the Casitas Springs zone reduced baseflows and steepened recessions, and decreasing HK led to generally higher baseflows (**Figure 3-4**). Increasing HK in

the Casitas Springs zone increased the rate of groundwater flow during wet periods, leaving less water to support streamflow later in the season, and vice versa. Reducing HK in the Santa Ana zone decreased simulated streamflow at Foster Park, while raising HK increased it, which had the opposite effect as adjustments to HK in the Casitas zone (**Figure 3-5**). Because the Santa Ana zone is upgradient of the Casitas zone, lowering HK reduced the rate of groundwater flow, which restricted the groundwater discharge to streamflow farther downstream in the Foster Park gage area. Conversely, increasing HK in the Santa Ana zone facilitated faster transmission of groundwater toward the Foster Park gage, which sustained higher flows during the dry season.

Additional sensitivity runs were performed with the Casitas Springs zone subdivided into upstream and local areas near Foster Park (**Figure 3-6**). Approximately half of the basin groundwater extraction occurs near the Foster Park gage, and this additional zone isolated the model parameters in the vicinity of the pumping wells to explore the effect of changes to HK upstream of the pumping center. These runs showed that simulated streamflow was most sensitive to HK changes immediately around Foster Park, while similar changes farther upstream had smaller effects. **Figure 3-7** shows the HK increased by a factor of 1.5 for both the upper and lower Casitas Spring zones.

Streamflow at Foster Park was largely insensitive to changes to VK in all zones and to changes in SFR-K in the Casitas and Santa Ana zones. Changes to SFR-K in the Robles zone produced a stronger response to simulated streamflow at Foster Park. However, increasing SFR-K in the Robles zone led to the simulated channel going dry in many of the streambed reaches in the Robles zone, which was inconsistent with independent wet/dry surveys conducted by UVRGA (2022a); therefore, these adjustments were excluded from the calibration setup.

In summary, the manual sensitivity analysis identified S_y and HK in the Santa Ana and Casitas zones as the parameters exerting the most influence on simulated streamflows at Foster Park. With the Casitas zone subdivided, HK adjustments in the lowermost zone near the gage affected streamflow the most. Reduction in storage parameters in the upstream portions of the Casitas zone and the Santa Ana zone led to noticeable decreases in simulated baseflow. These findings guided the selection and prioritization of parameter groups, definition of parameter bounds, and setup of the PEST++ IES framework.

3.3 Updates to Calibration Datasets

This subsection describes the updates to the streamflow and groundwater level calibration datasets for the model calibration update. For the original model calibration, the rating curve estimated streamflow was qualitatively used to evaluate the closeness of fit between simulated and observed data. Through the critical review of available streamflow data and additional analysis of modeled streamflow output during sensitivity analysis, the streamflow dataset was updated to focus on a quantifiable comparison of simulated and observed values. This focused on manual streamflow measurements with consideration of measurement error and location. In addition to modifications to the streamflow calibration dataset, the groundwater level calibration dataset was expanded to include post-2018 measurements.

3.3.1 Streamflow Measurement Distance Analysis

The Foster Park gage (11118500; see Section 2.2) manual streamflow measurements were collected by USGS field staff measuring flow across a cross-sectional area of the Ventura River channel. Accessibility

to the channel near the gage can be limited due to riparian vegetation; therefore, field staff frequently take manual flow measurements at a distance from the actual location of the Foster Park gage. The recorded distance from the Foster Park gage where streamflow measurements have been taken ranged from more than 800 feet downstream to about 620 feet upstream. The variability in streamflow measurement location introduces uncertainty that went unrecognized and unaddressed during calibration of the original model, which compared simulated streamflows to the rating curve-estimated streamflows reported for the Foster Park gage. Due to the inconsistency in manual streamflow measurement location used to develop the rating curve, the rating curve stage-discharge relationship is not representative of the actual gage location (i.e., 11118500), and streamflow estimated using the rating curve is therefore unreliable and not used for the calibration update.

The Foster Park gage is located in a highly dynamic reach of the Ventura River, with a subsurface dam approximately 1,000 feet upstream of the gage and a prominent bedrock uplift (reduced aquifer thickness) immediately downstream of the gage. **Figure 3-8** presents a cross section of the model grid in the vicinity of the Foster Park gage and shows the variable depth to bedrock and relative location of the gage and subsurface dam. Together, these features create steep hydraulic gradients and large changes in stream-aquifer exchange over short distances. Therefore, streamflow measurements taken at distances from the Foster Park gage do not represent conditions at the Foster Park gage itself. This has the effect of adding uncertainty to both the manual measurements and the rating curve estimated streamflows, because the manual measurements are used to generate the rating curve's stage-discharge relationship, and rating curve-estimated flows are based on stage measurements at the Foster Park gage. Due to the highly variable streamflow conditions in the vicinity of the Foster Park gage, it is especially important that streamflow measurement locations used for calibration are accurately represented in the model calibration process.

Upon inspection of model output, INTERA discovered that simulated streamflow differs by more than 2 cfs within only 200 feet upstream or downstream of the gage, and by as much as 5 cfs at 500 feet downstream (see **Figures 3-9** and **3-10**). Wet/dry survey results generally agree with these streamflow dynamics, with a consistent re-wetting of the channel immediately downstream of the Foster Park gage (UVRGA, 2022a). Note, from 2009 through 2016, nearly all manual streamflow measurements for low flows were taken downstream at an average of approximately 400 feet from the Foster Park gage or were reported without a specified measurement location. Figure 3-9 shows a chart of the streamflow measurement distance versus time (left) and a map view of the model grid and measurement distances (right). Because most streamflow measurements were taken downstream during the pre-2017 period, the stage-discharge relationship used to develop the rating curve for this period was not representative of streamflow at the Foster Park gage. Therefore, the rating curve-estimated streamflow used to calibrate the original model produced a bias that generally over-simulated streamflows at Foster Park because streamflow is generally higher downgradient. Around 2017, manual streamflow measurements were closer to or directly at the Foster Park gage, and, since then, the average measurement distance has been approximately 100 feet upstream (Figure 3-9). Therefore, the apparent over-simulation of baseflow at Foster Park during this post-2018 period found in the model verification (Section 2.1) was not due to a decline in the model performance; rather, it was because the measured dataset shifted to reflect actual gage and upstream conditions and thus lower flows. This finding helped refine the streamflow calibration process to ensure consistency between the simulated streamflow and the manual measurements by accounting for the distance from the Foster Park gage.

3.3.2 Summary of Streamflow Calibration Dataset Updates

The analysis of streamflow measurement distance effects on the model results led to refinement of the streamflow measurement calibration dataset to weight manual measurements taken either at the Foster Park gage or upstream. Weighting was applied to the calibration metrics of the model to favor more reliable observation datasets. Weighting is a statistical process applied in calibration where factors are assigned to residuals for specific observation datasets based on their relative precision and reliability. A weight equal to 1 is neutral, while weights greater than 1 are applied to more reliable datasets and weights less than 1 are applied to less reliable datasets (a weight of zero removes the dataset from the calibration). In addition, modeled streamflow outputs were extracted from the model cell located at the reported measurement distance to calculate streamflow residuals (difference between model simulated value and observed value) accurately. Downstream measurements were excluded from the calibration dataset due to (1) the uncertainty in model stratigraphy and lack of data to assess groundwater levels in this area and (2) groundwater management decisions being based on streamflow at the Foster Park gage.

Streamflow observations below 10 cfs were given higher weights to focus on the baseflow range in observations most relevant to the 2 cfs minimum threshold for the depletion of ISW sustainability indicator. The refined streamflow calibration dataset removed nearly all pre-2017 manual streamflow measurements, as they were either collected downstream of the Foster Park gage, had an unspecified measurement distance, or were >10 cfs. The only pre-2017 data included in the calibration dataset were several observations of zero flow during dry periods between 2013 and 2017.

An additional analysis of the streamflow dataset noted an unusual baseflow recession pattern for 2018 that the model could not simulate. The recession is unusually steep, and baseflow rapidly flattens out (for example, see USGS measured streamflow in Figures 3-2 through 3-5). Previous and subsequent years do not exhibit this same pattern. Additional inspection of the observation dataset indicated all gaged tributary inflows for the model input (gages 602B, 604, and 605) were flagged as either “estimated” or “poor” and appeared to be overestimating the typical shape of the recession curve (see Section 4.1.2 for additional detail). This portion of the streamflow data was deemed unreliable for calibration and was given a low weight in the calibration dataset (see Section 3.4).

3.3.3 Groundwater Level Calibration Dataset

All groundwater level observations used in the original model calibration were retained for the calibration update dataset, and additional data collected since then were included. Importantly, monitoring wells FP-MW-1 and FP-MW-4, located near the Foster Park gage, were instrumented after 2018 and provided new groundwater level observations adjacent to the Ventura River channel. Groundwater level data were assigned lower weights relative to the streamflow measurement data to focus the calibration update on improving the match to post-2018 low streamflow conditions at the Foster Park gage.

3.4 Setup of PEST++ IES Analysis

The results of the sensitivity analysis and dataset updates previously described provided the framework for setting up the PEST++ IES calibration. Parameter groups were defined primarily for Sy and HK in the

Casitas Springs and Santa Ana zones (Figures 3-2 through 3-5), with parameter ranges prescribed to favor the calibration goal of improving the overall match to post-2018 observed baseflow. Weights were applied to the calibration datasets (see Section 3.3.2) to favor more reliable observation datasets.

Groundwater level observations were included in the calibration dataset but were assigned lower weights than streamflow observations. For each of the groundwater wells used in the calibration dataset, weighting was normalized by the number of observations per well so that each well contributed equally to the total residual associated with groundwater levels. The streamflow calibration dataset was updated due to multiple factors summarized in Section 3.1. Streamflow data were weighed to consider only manual measurements collected at or upstream of the Foster Park gage and <10 cfs. Within the streamflow calibration dataset, the weighting was scaled to the magnitude of measured streamflow to emphasize focus on baseflow conditions (**Table 3-1**). Note, rating-curve based continuous streamflow estimates were not used to assess the calibration fit.

Table 3-1. Foster Park streamflow observation weighting used for PEST++IES.

Measurement Direction from Gage Specified by USGS	Observed Streamflow Magnitude	Observation Weight Applied	Weighting Explanation
<i>Downstream</i>	All Flows	0	Located outside of basin - lack of bedrock elevation data and groundwater levels downstream of Foster Park
<i>Unspecified (unknown location)</i>	All Flows	0	Unknown measurement location
<i>Upstream</i>	$0 < q \leq 2$ cfs	2.5	Emphasis on low flows. Not including observations greater than 10 cfs
	$2 < q \leq 5$ cfs	1.5	
	$5 < q \leq 10$ cfs	1.0	
	$q > 10$ cfs	0	
<i>At Gage</i>	$0 < q \leq 2$ cfs	2.5	Emphasis on low flows. Not including observations greater than 10 cfs
	$2 < q \leq 5$ cfs	1.5	
	$5 < q \leq 10$ cfs	1.0	
	$q > 10$ cfs	0	
<i>Observations made after 10-01-2019</i>	All Flows	3	Post WY-2019 weights raised to steer IES towards matching key targets in later years
<i>All observations between 04-01-2018 and 08-01-2018 (heavily estimated tributary inflows)</i>	All Flows	0.1	De-weighted to account for estimated and poor rating tributary inflows during this period

PEST++IES iteratively runs several realizations of the model (perturbing parameters within a prescribed range) and identifies parameter combinations, which minimize the overall residual between simulated and observed data. The range of error associated with observation data was accounted for in the calibration process by assigning a zero residual when the modeled streamflow was within the reported

measurement error range. The PEST++IES calibration was then configured so that, after computing the residual, the total error was rescaled such that 20% of the objective function was attributed to groundwater error and 80% to streamflow error. This approach balanced the relative influence of the two datasets, providing a calibration focus on streamflow conditions at Foster Park while maintaining a similar level of calibration to groundwater levels as the original model.

4.0 Calibration Results

Using the updated calibration datasets and weighting functions described in Section 3, PEST++IES was executed through a series of calibration runs to improve the match to observed data, with each model iteration building on the insights gained from previous iterations. Wider ranges of parameters were used in earlier iterations to explore the model parameter space more thoroughly, while later runs progressively narrowed parameter bounds based on results from both the sensitivity analysis and information gained from the early calibration runs. In addition, after each PEST++IES iteration, the best fit model realizations were qualitatively (visually) assessed relative to key groundwater well hydrographs and the measured streamflow at Foster Park. The spatial distribution of hydraulic conductivity and storage parameter fields were also visually assessed to ensure consistency with the hydrogeologic conceptual model. In total, roughly 20 iterations of the calibration were performed, each running the model hundreds of times. Once satisfactory fits to streamflow and groundwater targets were achieved, a final calibration run was setup in Monte Carlo¹ mode, using the best-calibrated model run from previous PEST iterations as the starting iteration and further refining the Casitas Springs zone. This allowed further exploration of the parameter spaces for a well-calibrated model run. The final calibrated model, referred to as the “updated model” in this TM, was selected from the Monte Carlo runs using calibration metrics described in the following subsections.

4.1 Modeled Streamflow Improvements

This section discusses the results of the updated model regarding streamflow measurements. The uncertainty in modeled streamflow due to the error in tributary inflows is also analyzed to provide recommendations for the future use of the model.

4.1.1 Updated Model Streamflow Results

The updated model shows an overall improved ability to match streamflow measurements at Foster Park in comparison with the original model. The improvement to simulating streamflow reflects the effectiveness of (1) the parameter adjustments made by PEST++IES during the calibration process, (2) the refinement of the streamflow calibration dataset described in Section 3, and (3) the other model updates described in Section 2.3.

Model performance in simulating streamflows at Foster Park was evaluated by comparing simulated and observed data. The residual is used as a calibration metric and is calculated by subtracting the simulated streamflow from the observed streamflow. Objective functions of Root Mean Square Error (RMSE),

¹ Monte Carlo refers to a method which randomly samples parameter values from a prescribed range.

Mean Absolute Error (MAE), Residual Sum of Squares (RSS), and two efficiency metrics commonly used in surface water modeling—the Nash-Sutcliffe Efficiency (NSE; Nash and Sutcliffe, 1970) and the Kling-Gupta Efficiency (KGE; Gupta and Kling, 2011)—use the residual to quantify the closeness of fit between simulated and observed streamflow. In general, a lower value for the objective function represents a closer fit between simulated and observed data; however, both NSE and KGE range from negative infinity to 1.0, with values closer to 1.0 indicating better performance. Across all metrics, the closeness of fit between simulated and observed streamflow for the updated model was improved in comparison with the original model (Table 4-1).

Table 4-1. Streamflow residual objective function metrics for the original and updated models. Metrics were calculated using observations (i.e., manual streamflow measurements at or upstream of Foster Park) for flows less than or equal to 10 cfs.

Objective Function	Equation	Original Model	Updated Model
RMSE ¹	$\sqrt{\frac{\sum_{i=1}^n (obs_i - sim_i)^2}{n}}$	3.1	1.5
MAE ¹	$\frac{1}{n} \sum_{i=1}^n obs_i - sim_i $	0.82	0.85
RSS ¹	$\sum_{i=1}^n (obs_i - sim_i)^2$	1,261	288
NSE ^{1,2}	$1 - \frac{\sum_{i=1}^n (obs_i - sim_i)^2}{\sum_{i=1}^n (obs_i - \overline{obs})^2}$	-0.53	0.63
KGE ^{2,3}	$1 - \sqrt{(r - 1)^2 + (\alpha - 1)^2 + (\beta - 1)^2}$	-0.06	0.82

¹ obs_i is the i^{th} observed value and sim_i is the i^{th} simulated value produced by the model, n is the number of observations, See Sections 3.1 and 3.3.2 for details on the observed values used in the model calibration.

² The best possible value of NSE and KGE is 1.0 (Nash and Sutcliffe, 1970; Gupta and Kling, 2011).

³ r is the Pearson correlation coefficient, α is a term representing the variability of prediction errors, and β is a bias term (Gupta and Kling, 2011).

Figure 4-1 compares simulated and observed streamflow at manual measurement locations for the original and updated models. The continuous output of streamflow at the Foster Park gage is included as solid lines for reference, and the color-coded points are simulated streamflow at the measurement location distance from the gage, which are used for the residual calibration metrics (see Table 4-1 above). The observed streamflow dataset includes the measurement error range as vertical lines. These results visually show a clear improvement between the original and updated model results and are verified with the quantification of the residuals included in Table 4-1 above. Note, there are limited observed data available prior to 2018 due to most of the manual measurements being located downstream or location is unknown. For the purpose of qualitative analysis, Figure 4-2 compares simulated and observed streamflow including the downstream and unknown manual measurements. In this comparison, it is noted that the original model generally overestimated pre-2018 flows due to being calibrated to rating curve estimated streamflow data rather than manual streamflow measurements

including their distance from the gage (see Section 3.3.1). The influence of measurement distance is particularly evident in 2010, 2011, and 2012, when most measurements were taken approximately 500 feet downstream from the Foster Park gage (Figure 4-2). This plot also visually shows a clear improvement between the original and updated model results, with the updated model points closer to the observed points than the original model points.

The updated calibration demonstrated a clear improvement in predicting streamflow at Foster Park in comparison with the original model. By shifting the calibration dataset from rating-curve estimates to manual streamflow measurements and explicitly accounting for the measurement location, the model is now calibrated to a dataset that more closely represents actual streamflow conditions in the vicinity of the Foster Park gage. This improved the statistical performance of the model and resolved the apparent post-2018 discrepancy identified during the model verification task (see Section 2.1).

4.1.2 Analysis of Tributary Inflow Error on Model Results

Following the calibration update of the original model, INTERA assessed the impact of error in tributary inflow measurement and estimation used for streamflow input to the model (i.e., Ventura County gages and ungaged tributaries, respectively; see Figure 2-2) using the results of the critical review of streamflow data (see Section 2.2; INTERA and Bondy, 2024). Model scenarios representing the upper and lower error bounds for the inflows were developed to evaluate how the range in error of inflows affects model results. These model runs provide a spread of possible streamflow at Foster Park given the range of error for the tributary inflows.

The range of error for the three gaged tributary inflows was based on measurement ratings described in the INTERA critical review of streamflow data (2024): 5% for “good,” 10% for “fair,” and 25% for “poor” (see example Figure 2-3). These ratings were attributed to measurements at the three gaged tributaries (602B, 604, and 605A, managed by Ventura County). For all ungaged tributaries, the highest error rating (25%) was applied uniformly; however, this likely had insignificant impact on the model results during baseflow because the ungaged tributaries typically do not flow during the dry season.

In addition to the measurement error, there are periods of “estimated” streamflow when gages are offline (INTERA, 2024). Typically, the largest residual between simulated and measured streamflow can be traced to these periods of “estimated” records in the tributary inflows. For example, water year 2018 had extended periods of estimated streamflow for multiple gages during baseflow recession, which may overestimate the inflows for the model. **Figure 4-3** shows streamflow curves for the tributary gages 602B, 604, and 605A for water year 2018. Here, the estimated streamflow is problematic because it was generated by linearly interpolating between manual measurements, which does not follow the form of a typical baseflow recession. The result is an input to the model that misrepresents actual streamflow and understates the steepness of recession curves, making inflows significantly overestimated in this example.

The impact of the estimated inflow on simulated streamflow is evident in the hydrographs presented in **Figure 4-4**, which shows (1) the simulated streamflow with tributary error range (green line with gray band) and (2) simulated streamflow with tributary error range (orange dots with error bars) and observed streamflow (black dots with error bars) at manual measurement locations. Note, extended periods of estimated streamflow are identified for at least one gaged tributary (i.e., 602B, 604, or 605A) during most years (see Figure 4-4 and Attachment A in INTERA, 2024). Across the model period (2005

through 2024), 12% of the streamflow data from gage 602B is estimated, 38% of gage 604 is estimated, and 14% of 605A is estimated. As discussed above, during the 2018 recession, flows at gages 602B and 604 were both estimated May through August, and gage 605A had poor measurements and was intermittently estimated (see Figure 4-3). Consequently, the model oversimulated streamflow compared with the manual measurement observed dataset, and the calibration was unable to match the shape of the baseflow recession for 2018. The range of error for estimated gaged tributary data is likely to be much higher than the 25% prescribed for this analysis; however, this was unquantifiable due to the lack of documentation available from the streamflow data records.

Figure 4-4 shows that the range of errors in tributary inflows is particularly influential on model results during certain years such as 2016, the latter half of 2018, and 2021, when simulated flows exhibit a wider spread of results; these correspond to periods when tributary inflows were largely rated as “poor” or “estimated.” This analysis provides additional context for evaluating the potential uncertainty associated with model inputs and its impacts on simulated streamflow for the Foster Park gage.

To summarize, the updated model results are constrained not only by the calibration process but also by the quality of the data used as inputs and observation targets (i.e., manual measurements). Two primary sources of uncertainty based on estimated ranges of error were identified in this data: (1) uncertainty in the manual streamflow measurements used for calibration (i.e., Foster Park gage) and (2) uncertainty in the tributary inflows for the Ventura River (i.e., Ventura County gages and ungaged tributaries). No additional uncertainty associated with model parameters was explored in this calibration update; therefore, INTERA recommends a comprehensive predictive uncertainty analysis for the model to provide a probabilistic likelihood of minimum threshold exceedance when using the model to assess streamflow depletion. The model inherently has a nonunique solution, meaning there are multiple combinations of parameters that will produce the same closeness of fit to the observed data. Exploring the potential range of model results for equally calibrated models will provide a clearer understanding of how model results impact management decisions for the Basin.

4.1.3 Model Fit to Groundwater Level Measurements

The primary objective of the calibration update was to improve the model’s ability to represent measured streamflow at Foster Park during low-flow conditions while maintaining an acceptable fit to groundwater levels across the Basin. Overall, the calibration update achieved this goal. When model results are evaluated against all groundwater level targets, the updated model preserves the quality of the groundwater level calibration, with both RMSE and MAE objective functions slightly decreasing relative to the original model (**Figure 4-5**). Two areas where visible changes in simulated groundwater levels were noted are the Robles/Mira Monte and Santa Ana zones. The scaled RMSE and MAE (ratio of the model error metric to the range of observed water levels) values for the updated model were 1.9% and 1.4%, respectively—well below the industry standard of 10% (Spitz and Moreno, 1996; Rumbaugh and Rumbaugh, 2017) and show a slight improvement compared with the original model, which was 2.1% and 1.6%, respectively.

Simulated and observed groundwater level hydrographs for key wells within the Basin are shown on **Figure 4-6**. Overall, the model results show acceptable fits to the observed data at the key wells. One exception is at well 04N23W29F02S, which diverged slightly from observed values in comparison with the original model. This response is attributed to the adjustments made during the calibration update,

where groundwater levels were raised upstream to reduce simulated streamflow at Foster Park via the decrease of HK. Although this represents a slight local deterioration in model fit to observed groundwater levels, the degradation in fit at a single groundwater level monitoring location was outweighed by the improvements in representing streamflow dynamics at Foster Park, as well as the improvement in groundwater level fit when all observations are considered. In addition, as can be seen in the hydrograph for 05N23W33B03S, groundwater level data for the post-original model calibration period (i.e., verification period, post-2018) shows a discrepancy between simulated and observed data. Verification of other non-key hydrograph wells with continuous groundwater level data measured during this period also shows some discrepancies, which indicates the model may require additional calibration to improve the match this data. Additional investigation and review of recently measured groundwater levels to determine whether recorded values are pumping or static is also recommended.

4.2 Calibrated Model Parameters

The primary changes to the original model parameters during the calibration update were to the HK and S_y in the Santa Ana and Casitas Springs zones. Parameter bounds were set within reasonable values that aligned with the known measured hydraulic data and the hydrogeologic conceptual understanding for the Basin. The distribution of parameters is shown in **Figures 4-7** and **4-8** and summarized below:

- S_y was overall decreased in the Santa Ana zone and increased in the Casitas Springs zone (Figure 4-7).
- HK was overall slightly decreased in the Santa Ana zone (Figure 4-8).
- HK was overall decreased in the upper Casitas Springs zone and increased in the lower Casitas Springs zone (Figure 4-8).

The zonal relative changes in parameters for the updated model are consistent with the sensitivity analysis findings (Section 3.2). At a finer scale, HK was increased or decreased at pilot point locations in focused areas to improve the match to groundwater levels, potentially accounting for bedrock thickness. In addition, localized areas of S_y changes may reflect storage response from bedrock, which was not explicitly simulated in the model. Nonetheless, the final distribution of parameters was still consistent with the hydrogeologic conceptual model for the Basin and was considered acceptable.

5.0 Conclusions and Limitations

The original model for the Basin was originally calibrated to groundwater level and streamflow data through 2018. Following model verification to post-2018 data, the model required a critical review of streamflow data and calibration update. Model updates were incorporated, and a sensitivity analysis was performed to guide the setup of the calibration update. The calibration data for streamflow and groundwater levels were updated and refined, and the PEST++ IES software was utilized to automate the calibration. Both quantitative (simulated versus observed residuals) and qualitative (visual comparison of data) assessments of groundwater levels, streamflows, and calibrated model parameters guided the selection of the best model fit to observed data. The effort for the calibration update improved the model's ability to represent low-flow conditions at the Foster Park gage while maintaining

an acceptable fit to groundwater levels across the Basin. The following conclusions can be drawn from this TM:

- The Ventura River channel geometry is highly dynamic. The modeling code used to represent streamflow (MODFLOW Streamflow Routing [SFR] package) can only simulate fixed conditions and channel geometry. As was observed following the January 2023 flood, the location and conditions of the river channel can change dramatically following stormflows, and the current model cannot represent transient channel conditions. However, the analysis conducted for the model concluded that results are not significantly impacted by changes in channel geometry.
- Model updates addressed several factors hindering the model's performance: The conversion of the model to daily stress periods, updating modeled pumping rates, adjusting streamflow inputs, modifying the bedrock surface, and addressing solver issues provided an improved model to be used for sensitivity analysis and calibration update.
- Sensitivity analysis provided a focused approach for calibration update: a high-level sensitivity analysis showed which parameter adjustments and areas of the model impacted modeled streamflow and groundwater levels and set the foundation for focused calibration setup.
- The calibration dataset was updated to be the most representative and accurate measured data: Critical review of the USGS streamflow measurements identified that most manual measurements were collected at a distance from the Foster Park gage, and model results change depending on this distance from the gage. In addition, rating curve estimated streamflow is highly uncertain and inconsistently updated. By excluding rating curve measurements, accounting for distance in manual measurements, and assigning a measurement-specific range of errors, a more accurate and representative calibration dataset was developed for the calibration update. The groundwater level calibration dataset was also expanded to include the most recent available data for the Basin.
- The calibration update improved the model's ability to match streamflow measurements: Using the original model with incorporated updates, an updated calibration dataset, and an automated calibration program (PEST++ IES), the model calibration was updated and overall reduced the error in modeled streamflow at Foster Park. Calibration objective functions (i.e., RMSE, MAE, KGE, NSE) all improved relative to the original model, and the updated model better represented both low-flow conditions and seasonal baseflow recessions for the Foster Park streamflow data.
- The calibration update preserved a good match to an expanded dataset of measured groundwater levels: Groundwater targets from the original model were updated, and small improvements were made to Basin-wide RMSE and MAE objective functions.
- Uncertainty in modeled streamflow inputs was assessed: The calibration update incorporated an updated tributary inflow dataset, and insight into the quality of the measured streamflow data provided a range of error, which was applied to the inputs for the updated model. This produced a potential range for model results based on the upper and lower bounds of error for inflows, which informed the recommendation for a comprehensive predictive uncertainty analysis of the model.

The simulated streamflow for the final updated model and the associated uncertainty based on the range of error estimated for the tributary inflows is presented in Figure 4-4 and discussed in Section

4.1.2. The range of simulated streamflow associated with the error in the tributary inflows indicates that the model requires additional predictive uncertainty analysis to quantify the probability of minimum threshold exceedance when it is used to estimate depletion of ISW. Because UVRGA is responsible for addressing depletion due to groundwater pumping causing streamflow to fall below 2 cfs and any depletion when undepleted flows are <2 cfs, the predictive uncertainty of simulated streamflow needs to be accounted for when depleted streamflow approaches the minimum threshold. Incorporating a quantification of predictive uncertainty of the model will provide an optimal assessment of undesirable results. Nonetheless, this study recognizes the importance of additional data collection points to verify sources of error in streamflow measurements, and the installation of the UVRGA gage at Camilo Cielo is a key data point to enhance the understanding streamflow dynamics in the Basin.

5.1 Model Limitations

Several limitations were recognized or emphasized based on the work, as follows:

- Tributary inflows present a large source of uncertainty for the model. While gaged tributaries were assigned measurement-based uncertainty ratings, periods of “estimated” flows may introduce far greater error than can be represented by the maximum of 25% applied to the range of error. Currently, the model inputs for inflows from ungaged tributaries do not impact streamflow during dry seasons; however, they are estimated inputs that may be an inaccurate representation of the Basin hydrology. Model results may be impacted if ungaged tributaries have the potential for inflows during dry conditions.
- Manual streamflow measurements collected at a distance from the Foster Park gage present multiple challenges. A reported location “500 feet downstream” may be imprecise, and, based on the modeled streamflow, small deviations in location can shift the corresponding model cell and introduce variability in streamflow. Consistent and well documented flow measurements will ensure the model is representative of actual flow conditions and that the model is used appropriately for decision making and calibration. Downstream streamflow measurements were removed from the calibration dataset due to the lack of available data concerning the aquifer and groundwater levels in this area, which is located outside of the Basin. Information on depth to bedrock, groundwater levels, and streamflow in this area would help remove this limitation and expand the calibration dataset.
- Limited data are available for bedrock information within the model area. As identified in the original calibration of the model, surface water and groundwater flows are strongly influenced by bedrock elevations and geology. The model is representative of the scale of data available; however, the available logs are insufficient to characterize the bedrock surface accurately in several areas. The calibration of HK and Sy is currently compensating for the lack of detailed bedrock information for the model. Fracture flow within the bedrock is likely not a limitation for the model, but a water quality analysis could help characterize whether bedrock groundwater contributes to the alluvial aquifer.

These limitations highlight that, while the calibration update represents an improvement to the original model, opportunities remain to refine both the model and the supporting datasets. More frequent and

precisely located streamflow measurements at Foster Park, additional lithologic and groundwater level data to constrain conditions downstream better, and improved characterization of tributary inflows would all strengthen future calibration efforts.

5.2 Recommendations

The final work product described in this TM is an updated calibration for the UVRGA model. This updated model significantly improves the ability to simulate groundwater/surface water interaction and manage groundwater use with respect to the ISW sustainability indicator. Additional insight was gained into the uncertainty and limitations of the model, which led to some recommendations, which are discussed as follows:

1. Ongoing collection of streamflow measurements should be consistent and well documented to ensure the model is representative of actual flow conditions and is used appropriately for decision making and subsequent updates. The current documentation of manual streamflow measurements available via the USGS website is very important for assessing the model's ability to match streamflow at the Foster Park gage; however, additional documentation on the rating curve methodology specific to the Upper Ventura gage 11118500 is recommended. Additional documentation of the methods used to measure the distance of manual measurement locations from the Foster Park gage would help the accuracy of comparing simulated streamflow to measurements. Streamflow data collection at other active gages in the Basin (i.e., Ventura County, UVRGA, and DWR) should also maintain documentation consistent with USGS procedures. INTERA recommends ongoing engagement with gage owners and operators to clarify and enhance current documentation and ensure sufficient information is collected for streamflow measurements and estimation methodology.
 - a. The new gage at Camilo Cielo owned and operated by UVRGA is a key data point to enhance the understanding of streamflow dynamics in the Basin. Operation of this gage will reduce many of the uncertainties associated with relying on two gages upstream of the basin. INTERA recommends the data collection and documentation are consistent with USGS methodology.
2. Due to the high variability in manual measurement location at the Foster Park gage, INTERA recommends that USGS or another entity complete a synoptic streamflow study consisting of periodic concurrent streamflow measurements made at various locations upstream and downstream of the USGS Foster Park stage sensor. This study would improve the understanding of localized streamflow variability and quantify the impact of streamflow measurements taken at different locations on the rating curve estimated and reported gauge flows.
3. Based on the results presented in Section 4, INTERA recommends that a more detailed uncertainty analysis be conducted to quantify the overall predictive uncertainty of the modeled streamflow and assessment of depletion. The analysis would provide a probabilistic likelihood of streamflow depletion exceedance. The updated model is a nonunique solution, meaning there are multiple combinations of parameters which produce the same closeness of fit. The recommended uncertainty analysis would utilize the calibration update results presented in this TM to address the potential outcomes under calibration-constrained ensembles of model realizations.

4. INTERA recommends additional characterization of the bedrock to increase the accuracy of groundwater/surface water interaction. Boring logs provide the most accurate information to characterize the bedrock surface; however, geophysical methods may provide a more continuous dataset to help interpret areas without boring logs. In addition, water quality analysis comparing deep and shallow groundwater samples can provide insight into the source of groundwater and the exchange between bedrock and alluvial groundwater.
5. This study achieved the overall goal of improving the model's ability to match streamflow observations while preserving the match to groundwater level observations. However, the assessment of the new groundwater level data acquired since the original model calibration indicates the potential for additional improvement to match groundwater levels. Section 4.1.3 identifies well 05N23W33B03S, which has continuous measurements indicating a discrepancy between simulated and observed groundwater levels. Continuous groundwater level measurements that were not available during the original calibration require additional review and verification to determine whether the model requires additional calibration.

6.0 References

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White, J.T., 2018, A model-independent iterative ensemble smoother for efficient history-matching and uncertainty quantification in very high dimensions: Environmental Modelling & Software, v. 109, p. 191–201.

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FIGURES

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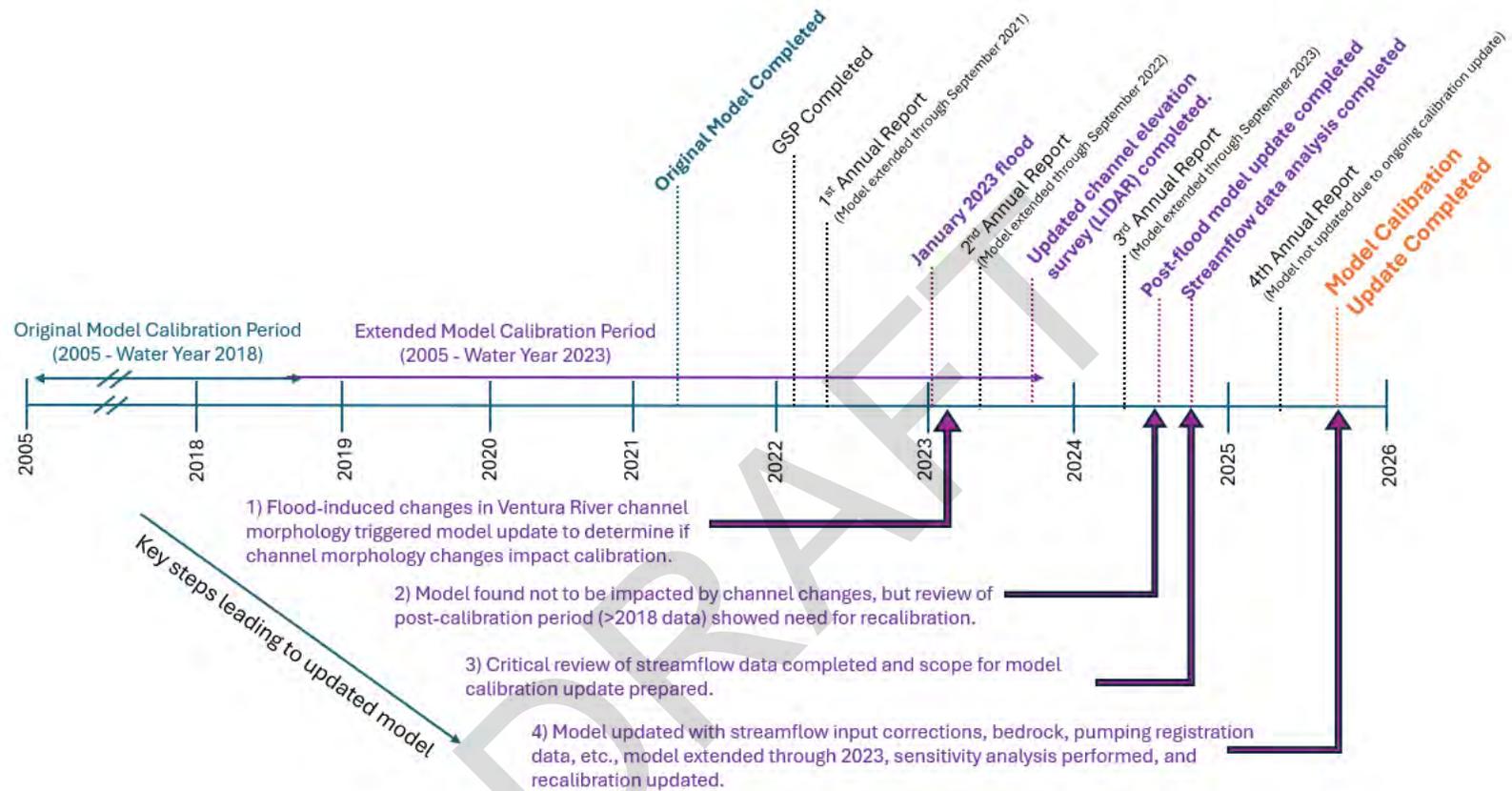


Figure 2-1. UVRGA model development timeline.

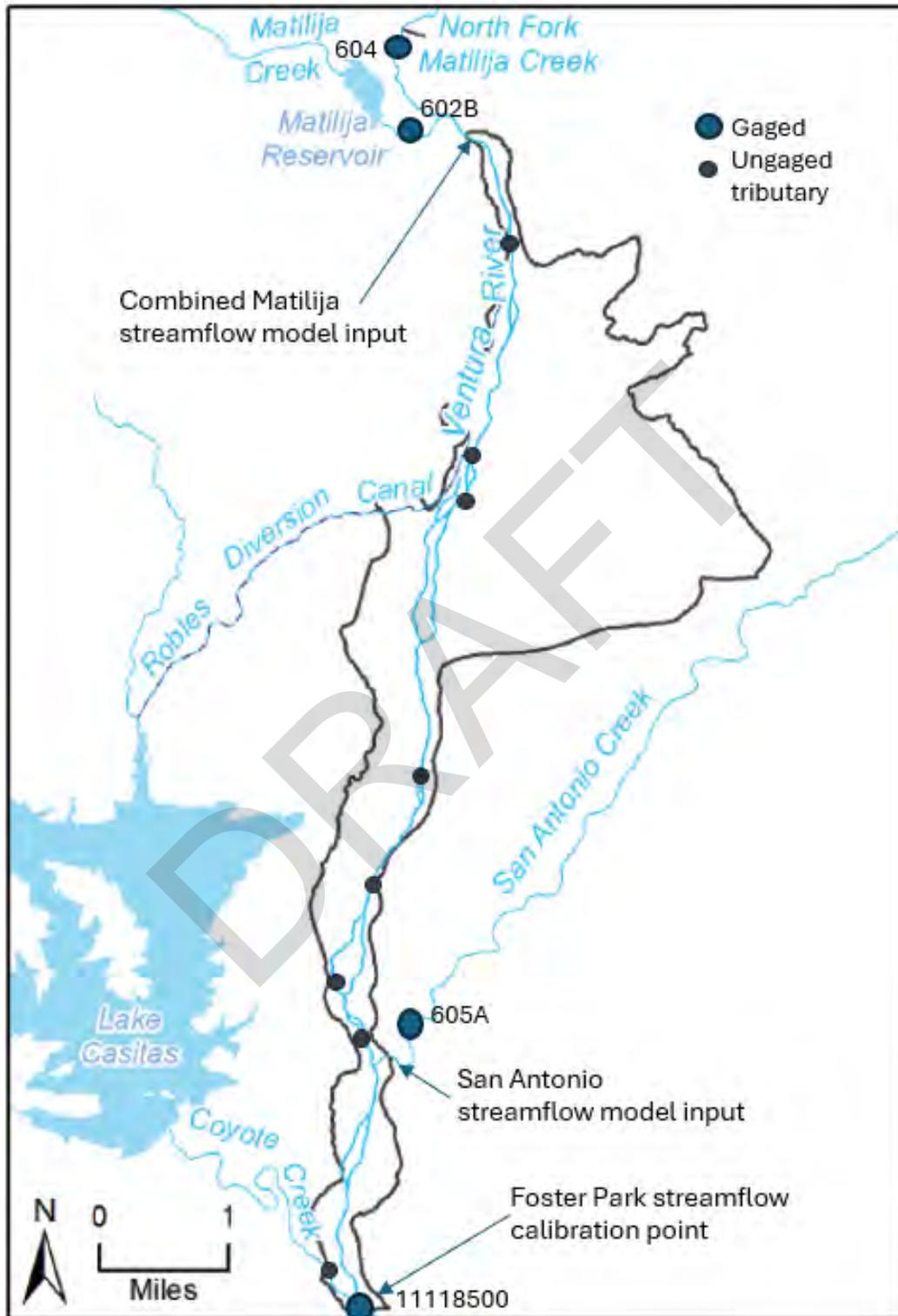


Figure 2-2. Stream gages and ungauged tributary locations in the Basin for the model input and calibration.

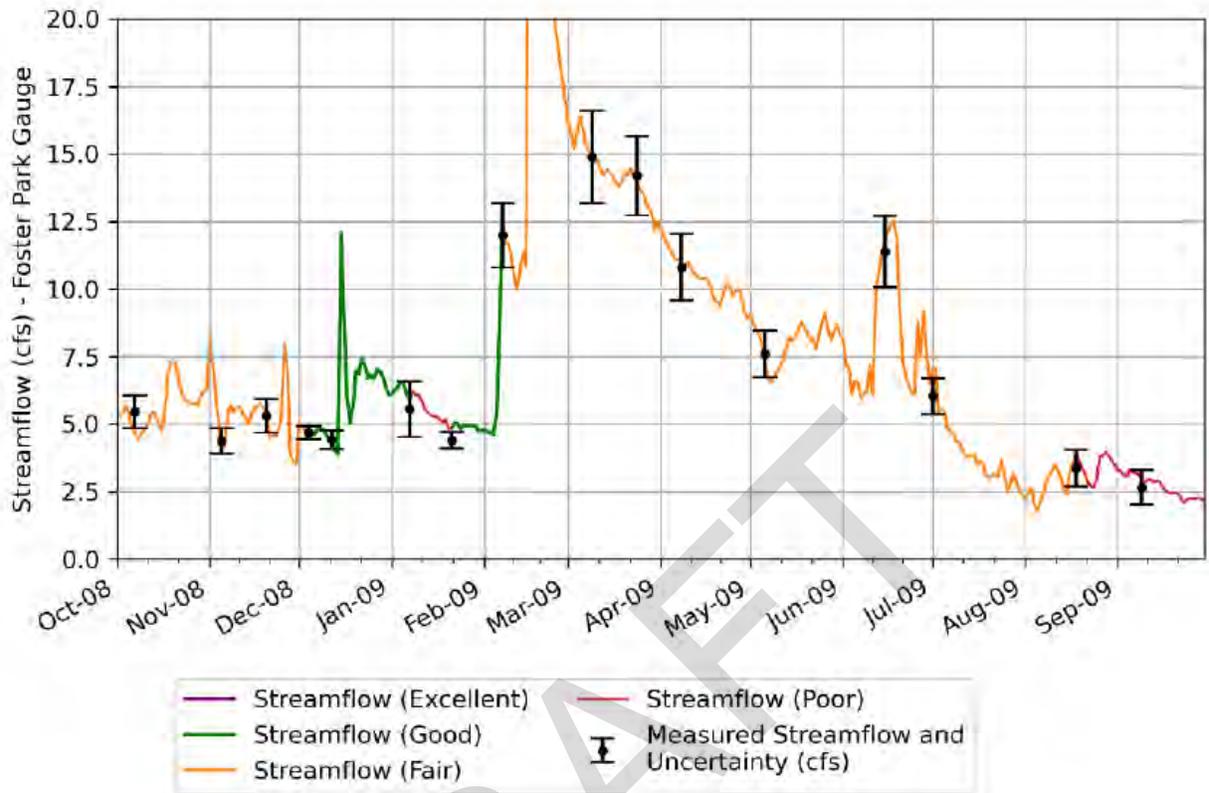


Figure 2-3 Example hydrograph for Foster Park gage 11118500 showing measured and estimated streamflow with quality ratings and range in measurement error.

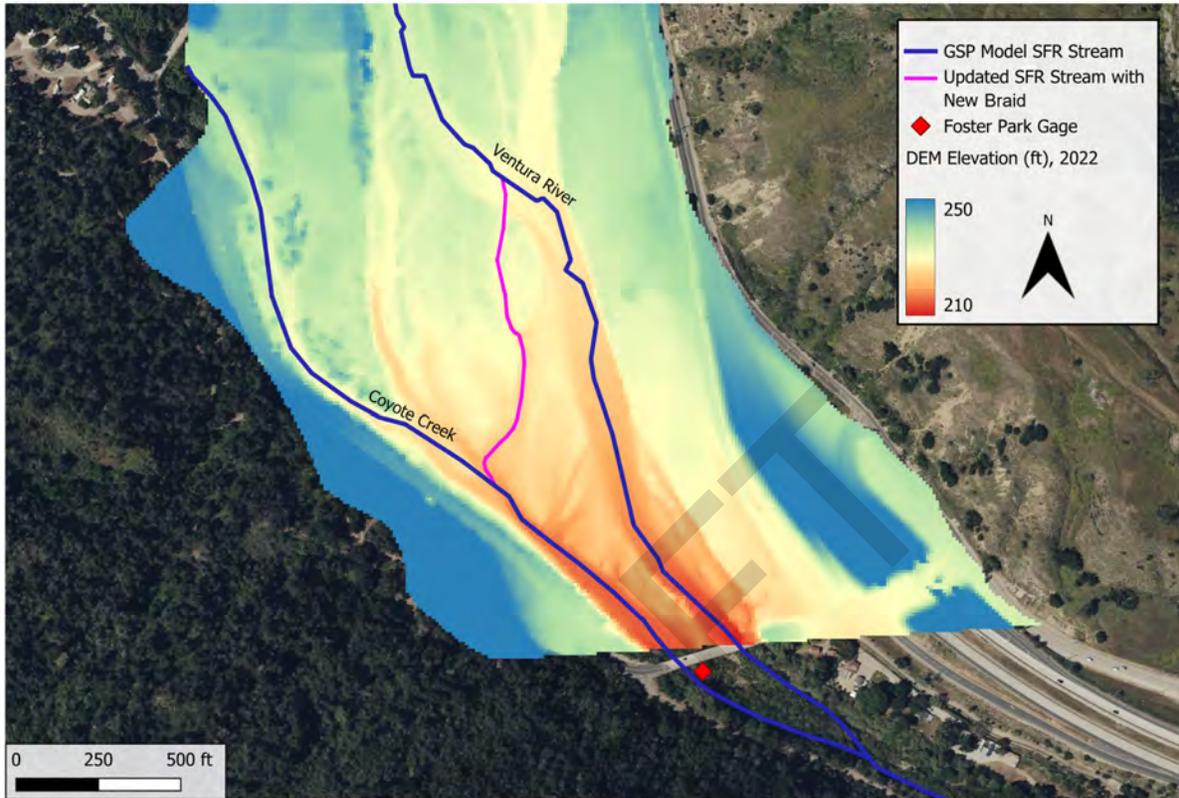


Figure 2-4. Updates to the modeled Ventura River channel braids and Coyote Creek confluence location.

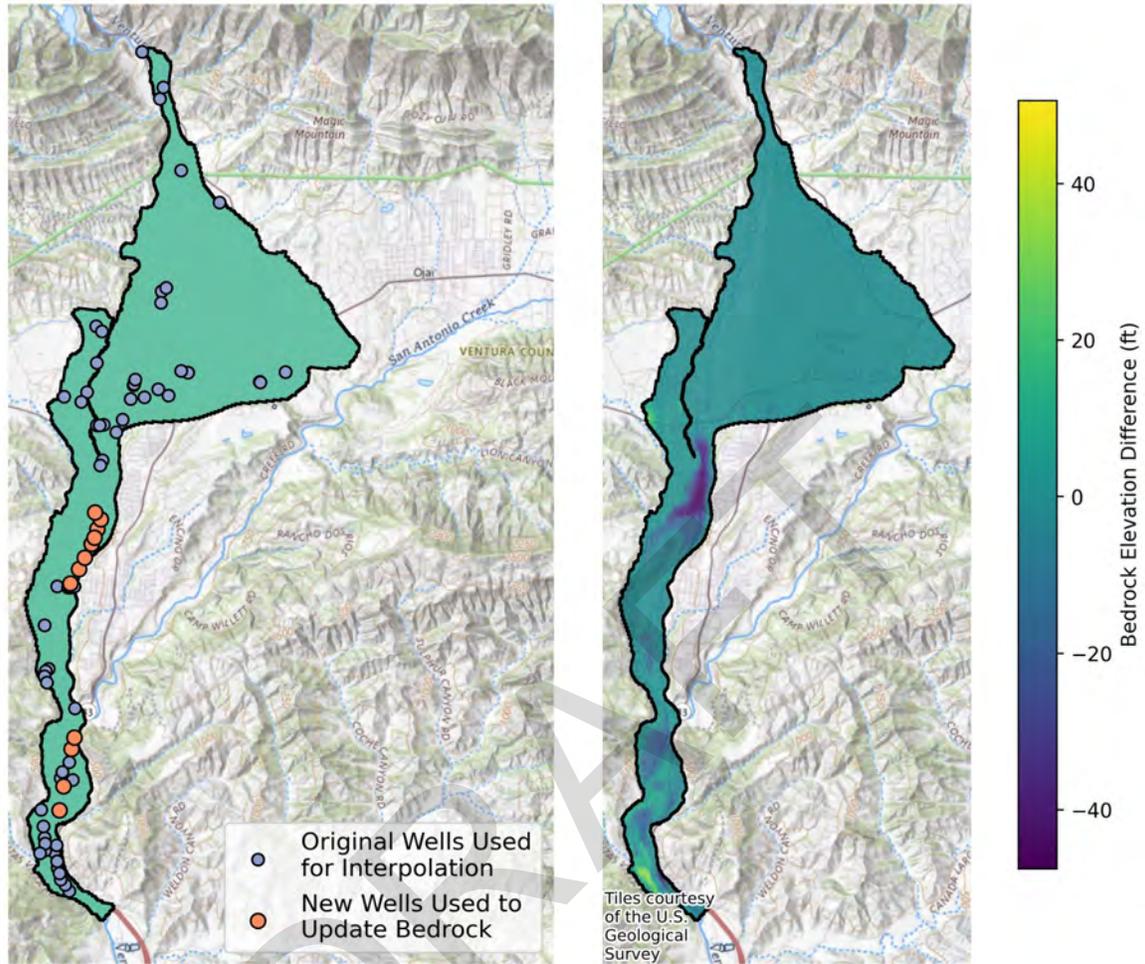


Figure 2-5. New well data and adjustments to modeled bedrock surface.

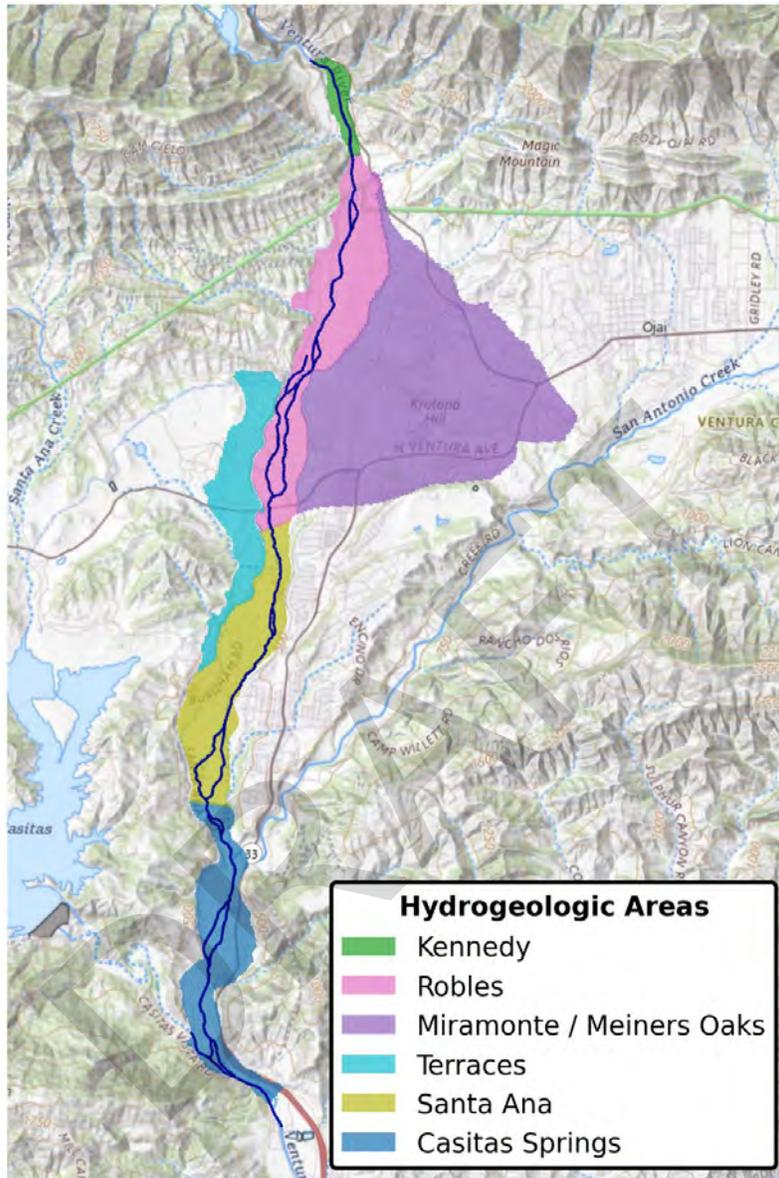


Figure 3-1. Hydrogeologic zones of the Basin.

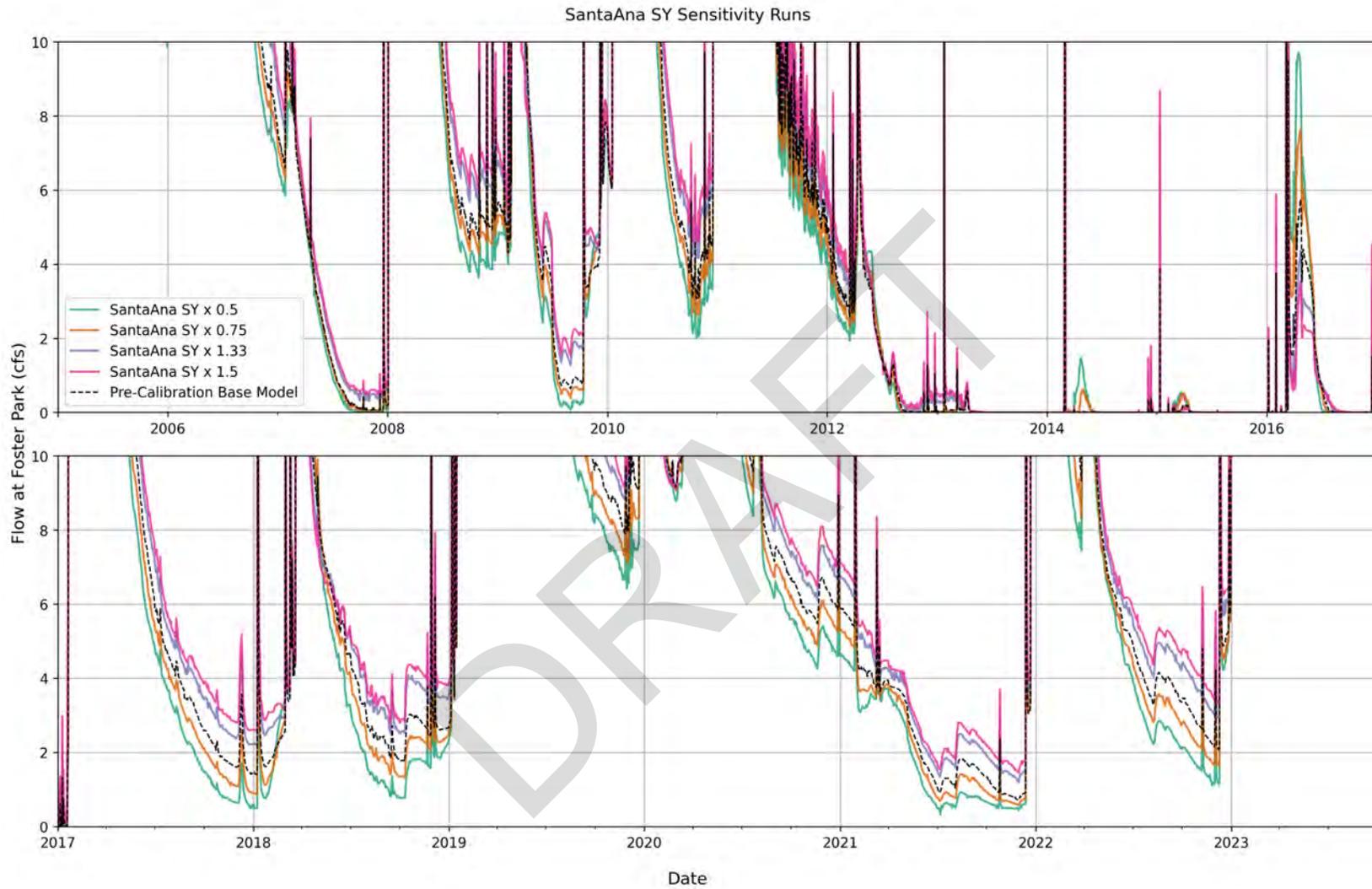


Figure 3-2. Simulated streamflow (at Foster Park gage) sensitivity to changes in specific yield for the Santa Ana zone.

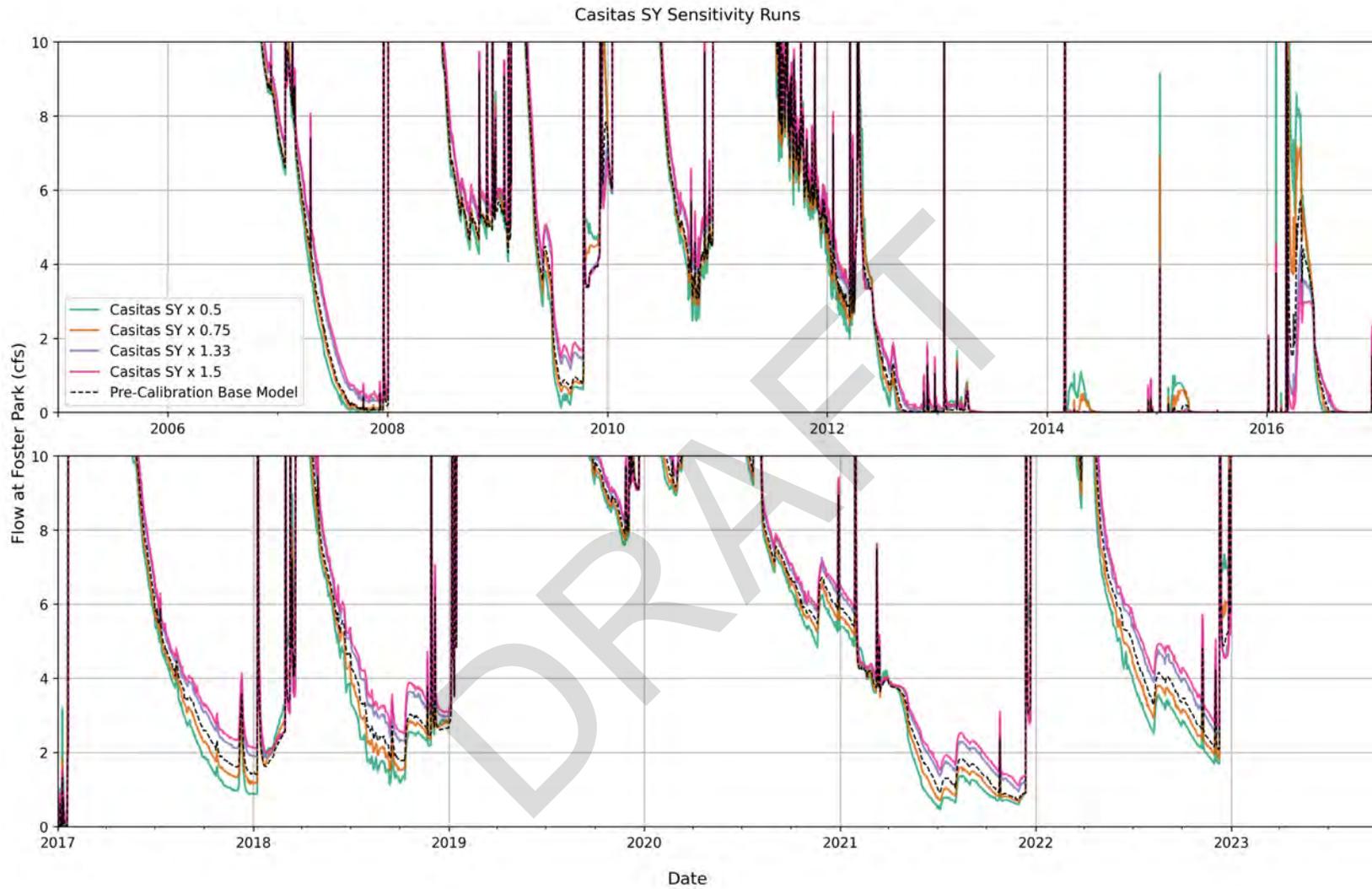


Figure 3-3. Simulated streamflow (at Foster Park gage) sensitivity to changes in specific yield for the Casitas Springs zone.

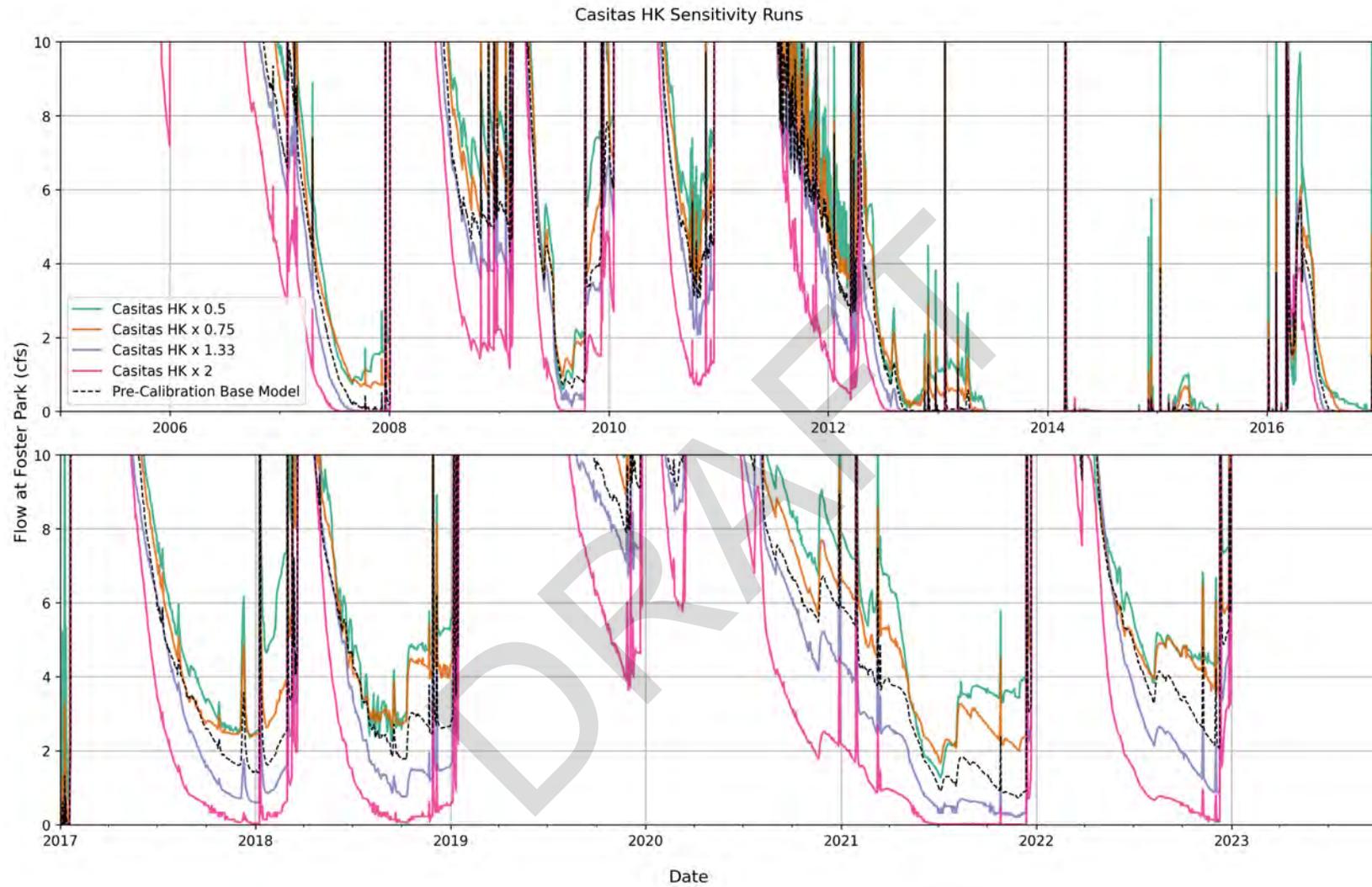


Figure 3-4. Simulated streamflow (at Foster Park gage) sensitivity to changes in HK in the Casitas Springs zone.

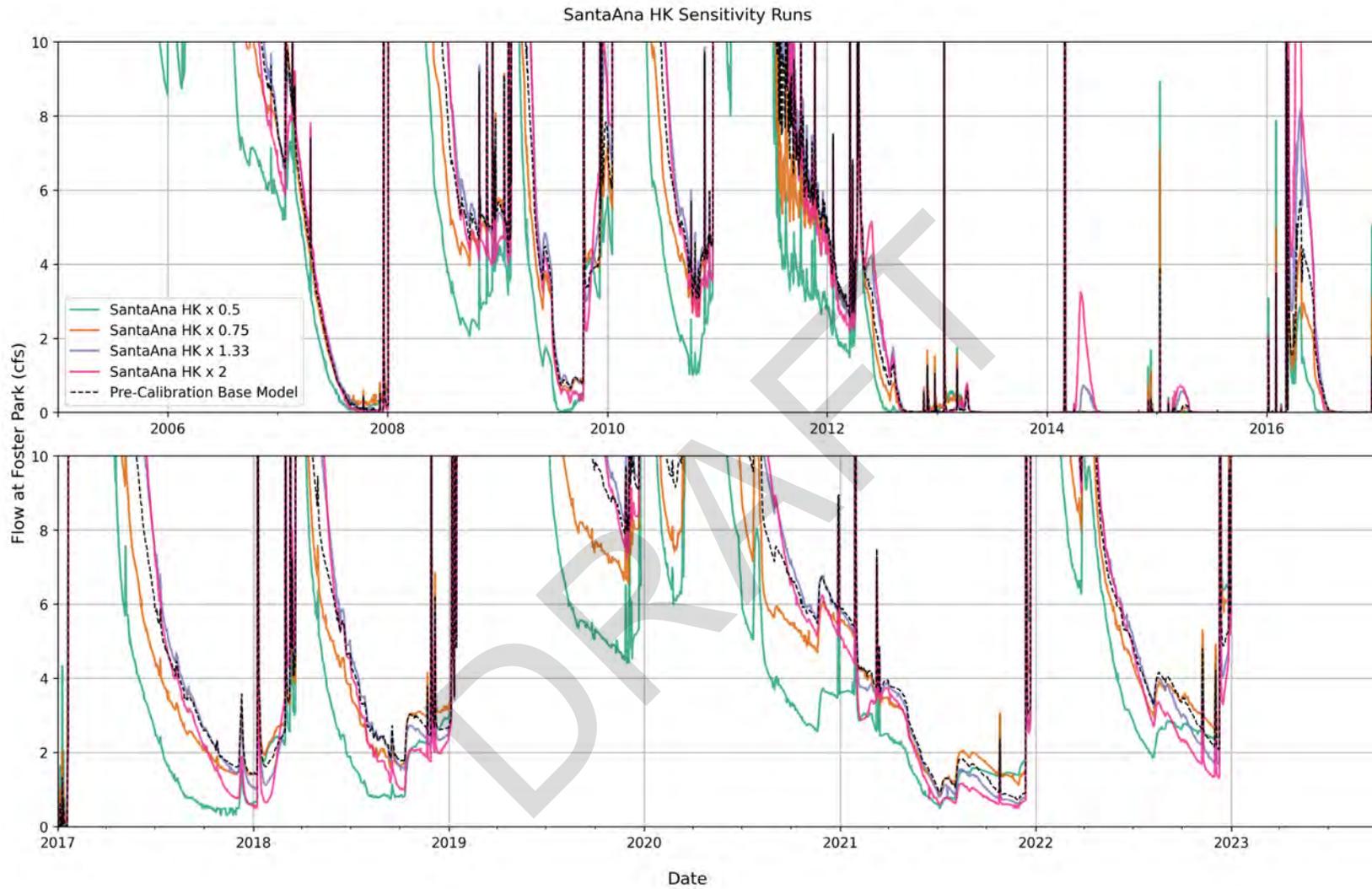


Figure 3-5. Simulated streamflow (at Foster Park gage) sensitivity to changes in HK in the Santa Ana zone.

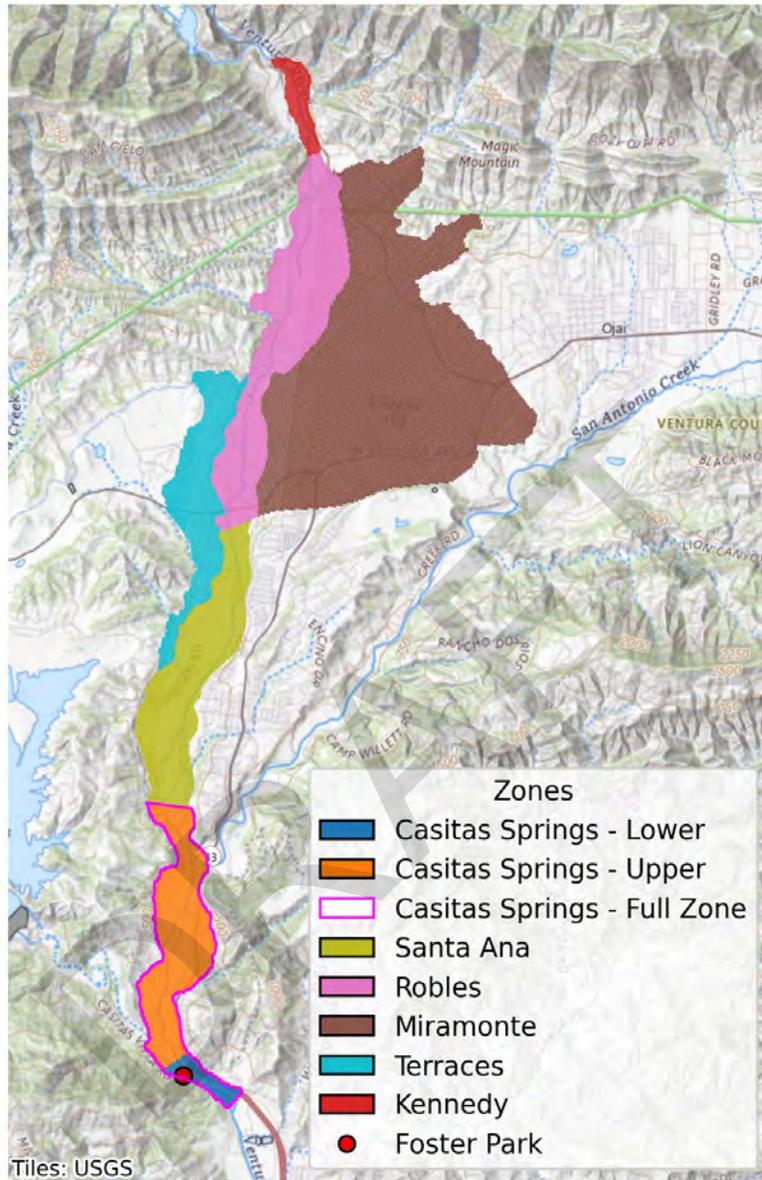


Figure 3-6. Casitas Springs zone with upper and lower split.

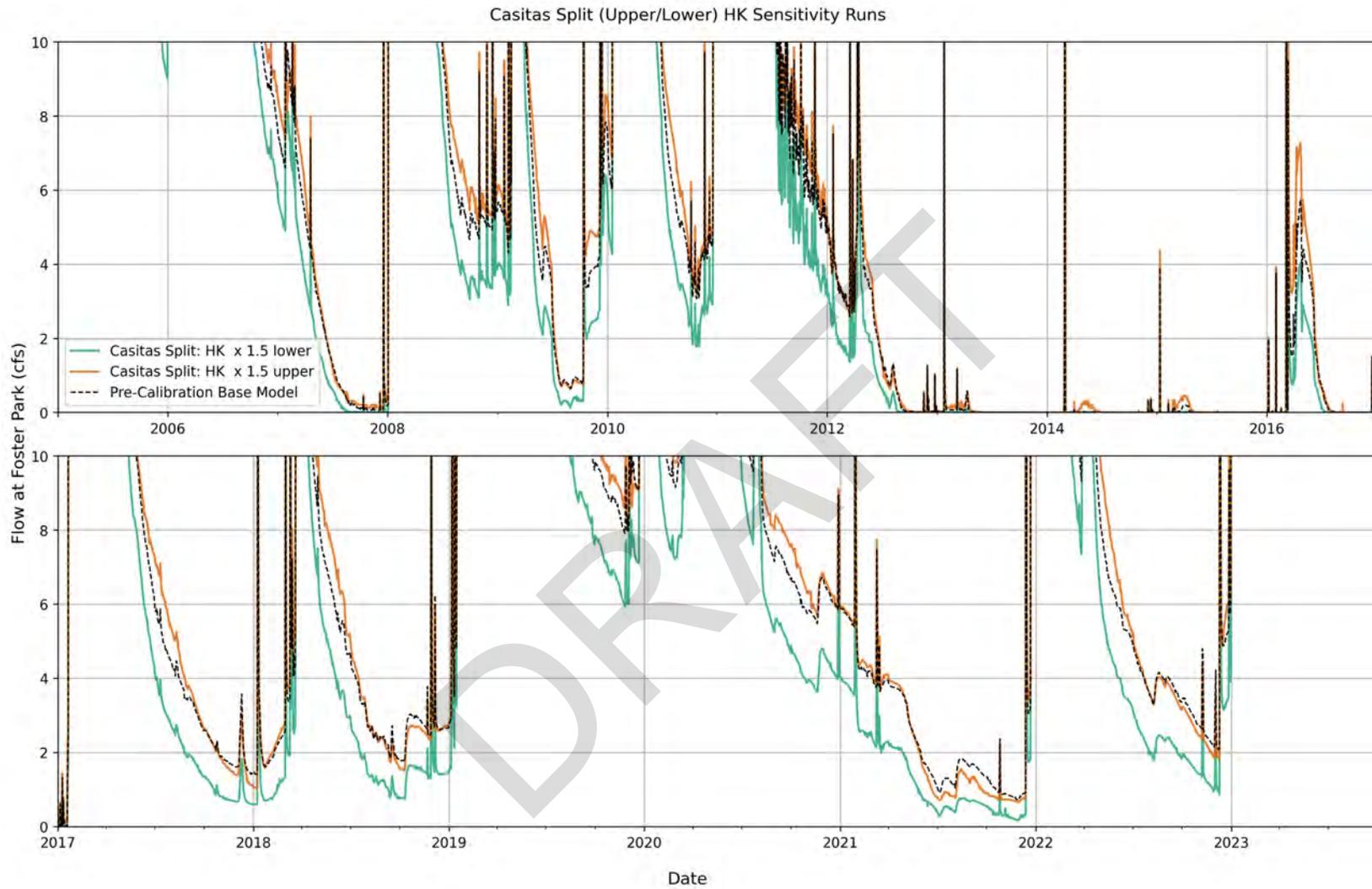


Figure 3-7. Results of upper and lower split of Casitas Springs zone sensitivity runs for HK.

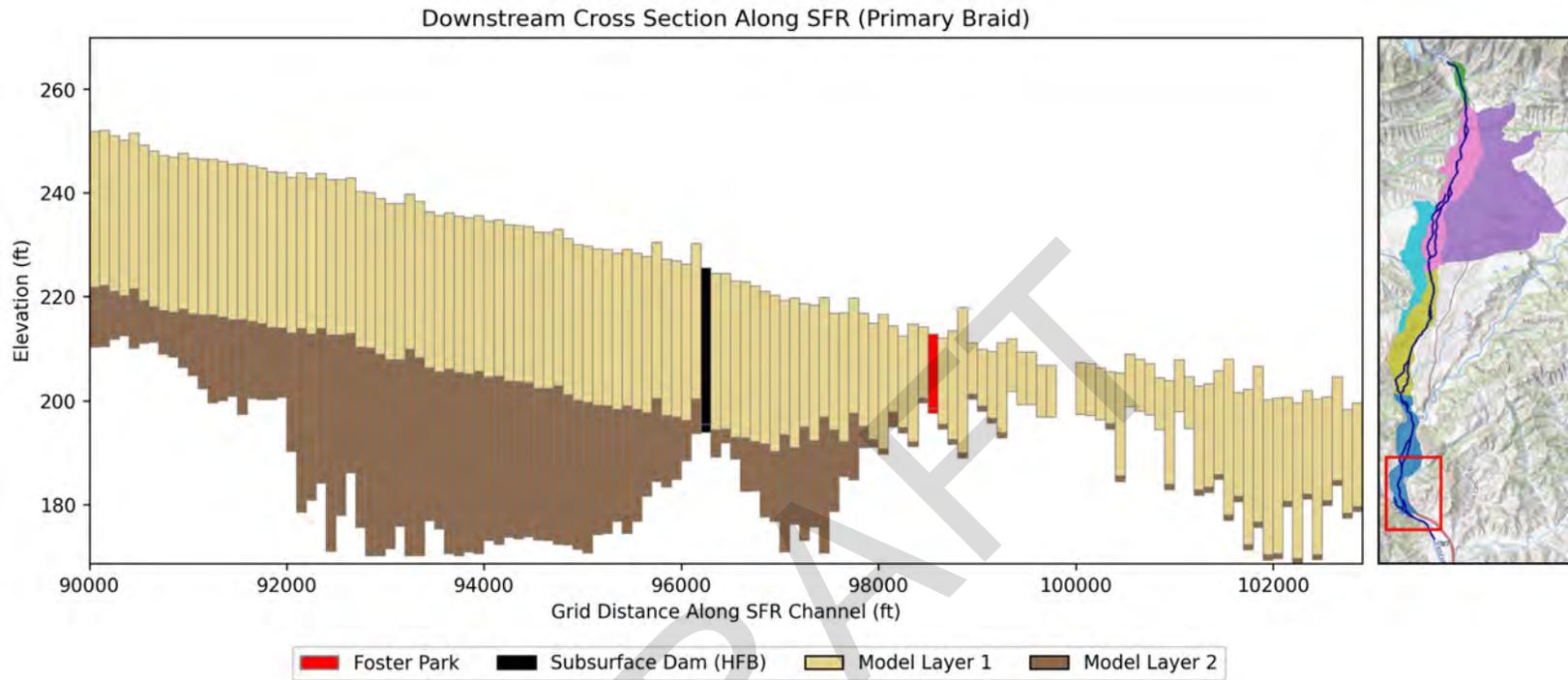


Figure 3-8. Cross-sectional view of the model grid along the Ventura River channel near the Foster Park gage.

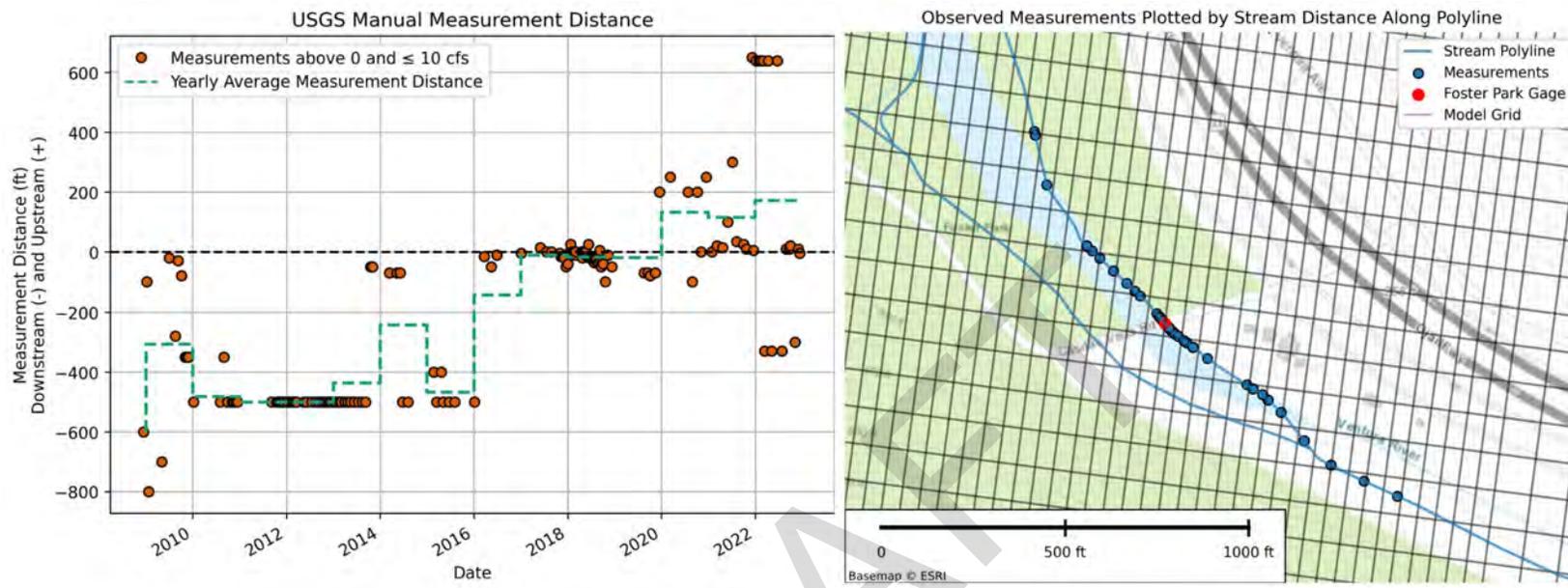


Figure 3-9. Chart of the streamflow measurement distance versus time (left) and a map view of the model grid and measurement locations (right).

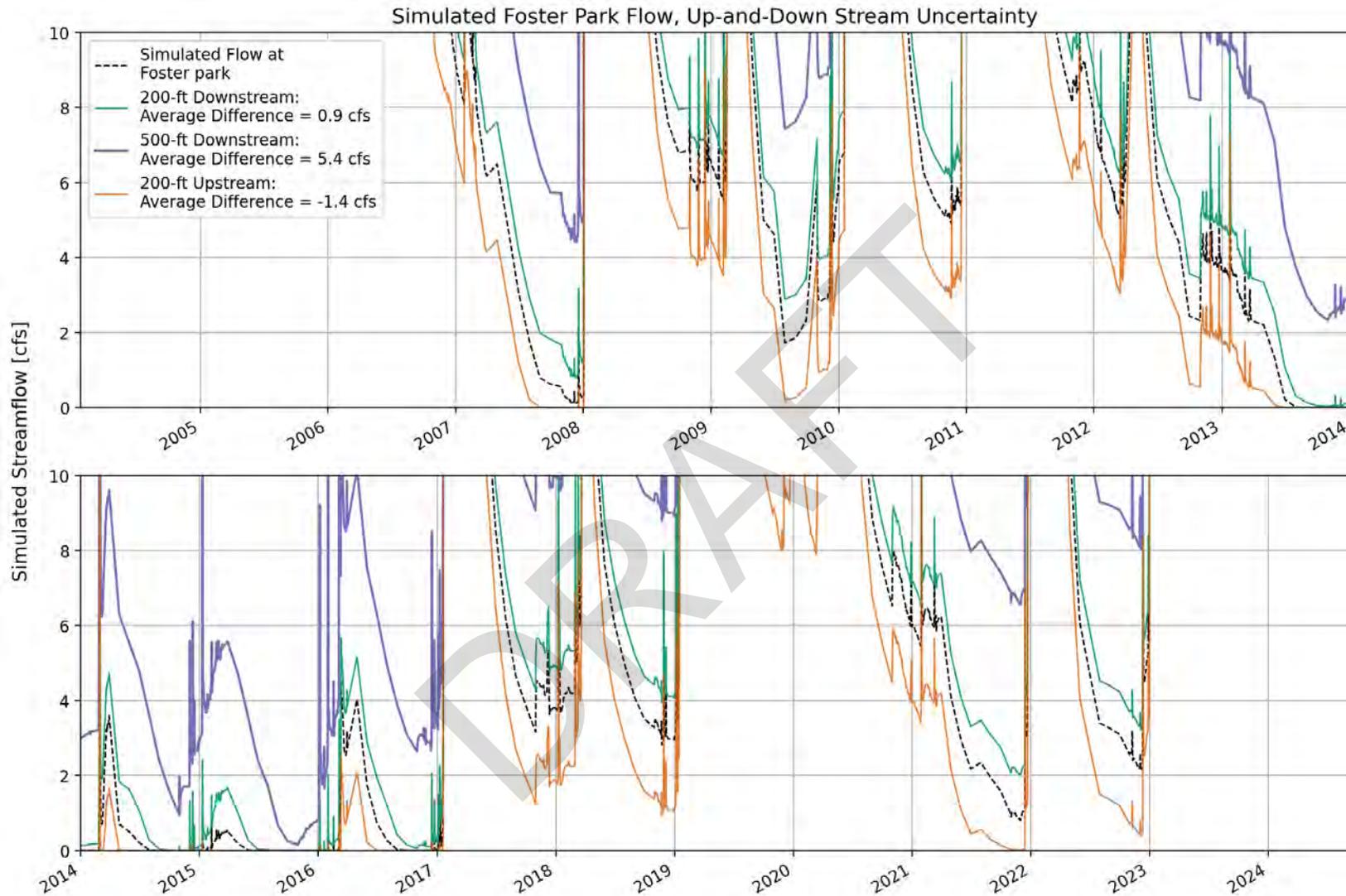


Figure 3-10. Sensitivity analysis results for simulated flow 200 feet upstream and downstream of the Foster Park gage and 500 feet downstream of the gage. Average difference values were calculated for flows less than or equal to 10 cfs.

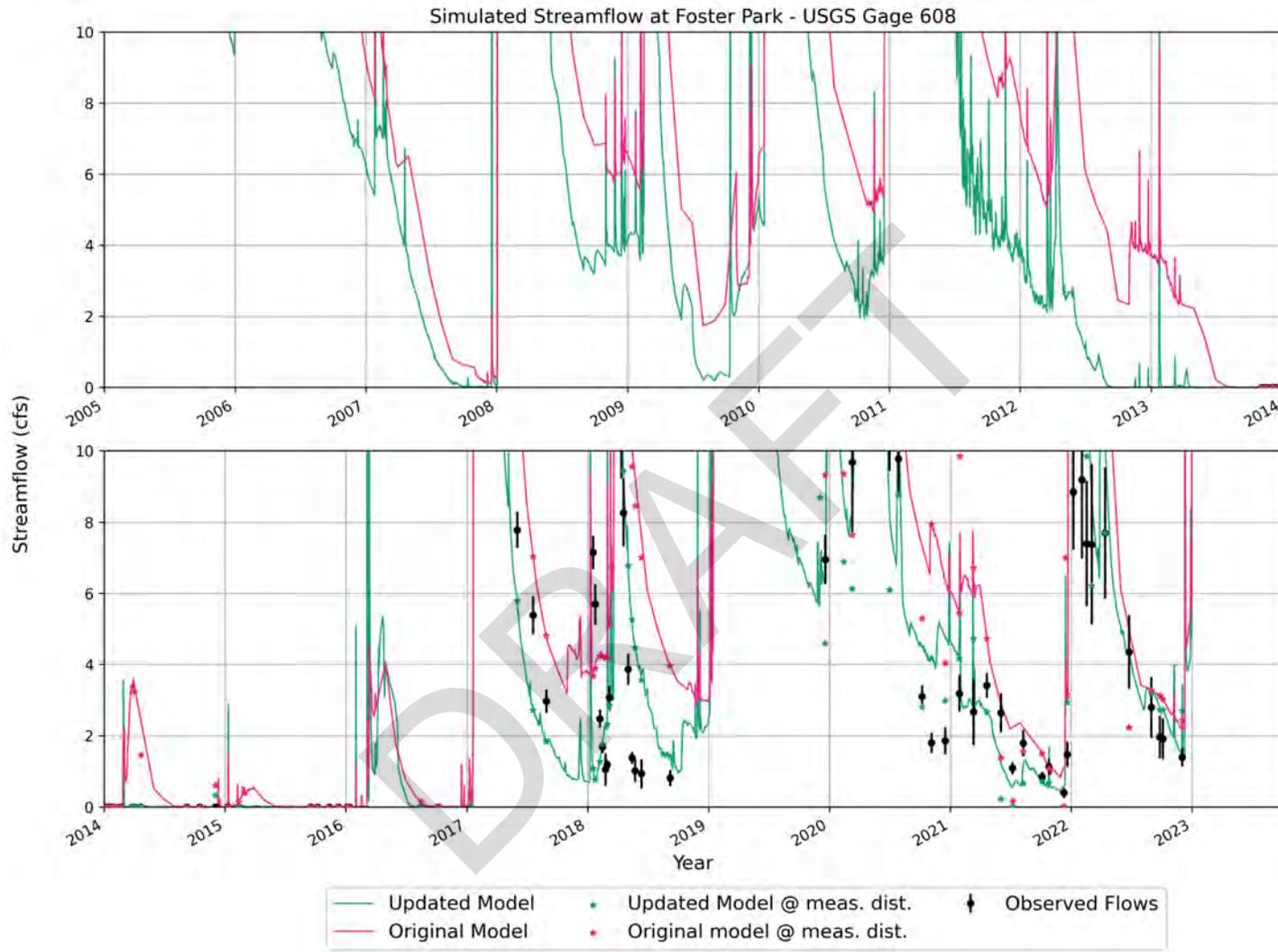


Figure 4-1. Original and updated model simulated streamflow at Foster Park gage (colored lines) and at measurement location (colored dots), compared with observed streamflow at measurement location with range in error (black dots with bars).

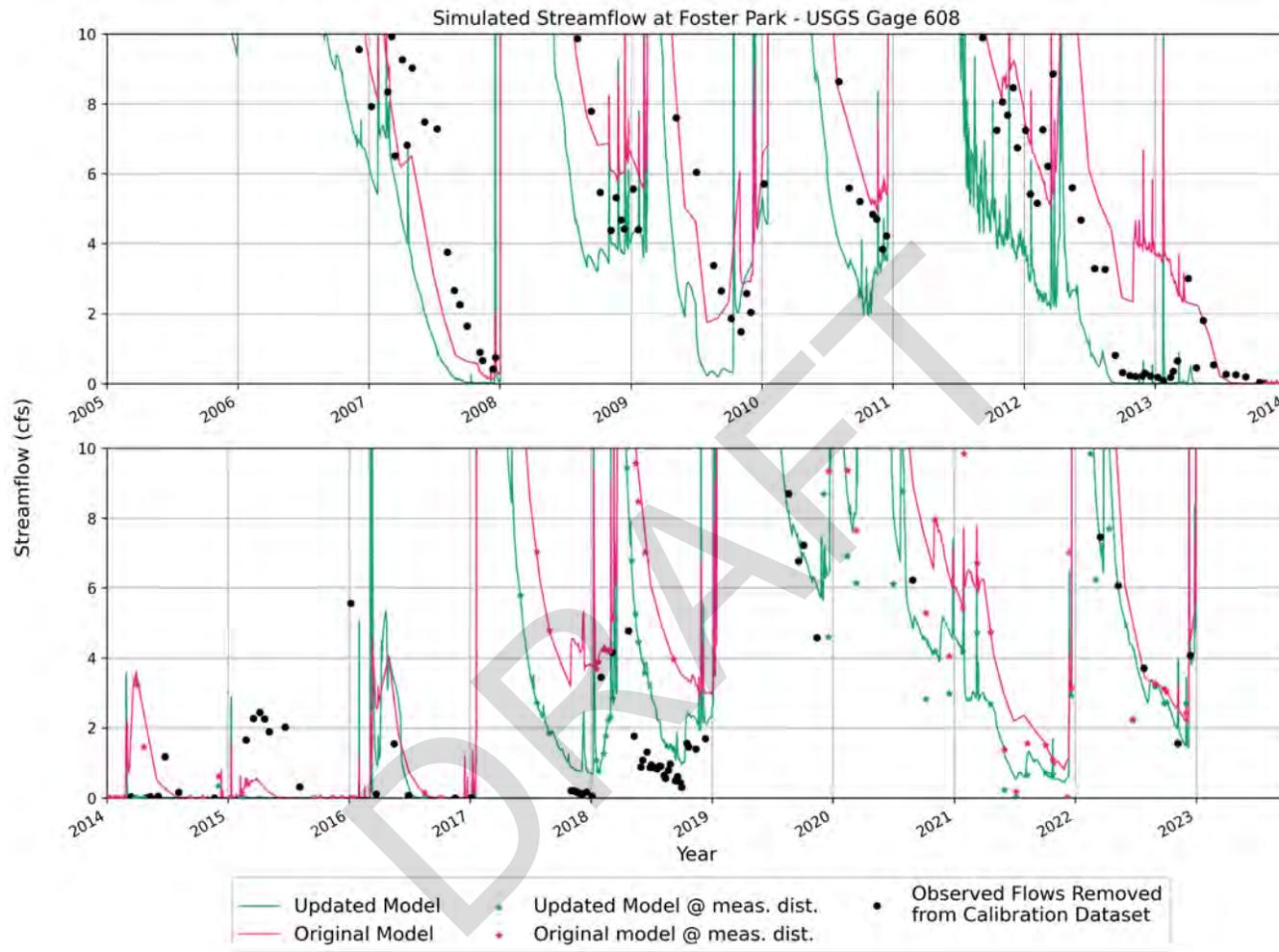


Figure 4-2. Original and updated model simulated streamflow at Foster Park gage and at measurement location compared to observed streamflow measurements that were removed from the calibration dataset. Observations without corresponding simulated data (i.e., colored dots) have an unknown distance; therefore, the simulated flow is set at the Foster Park gage.

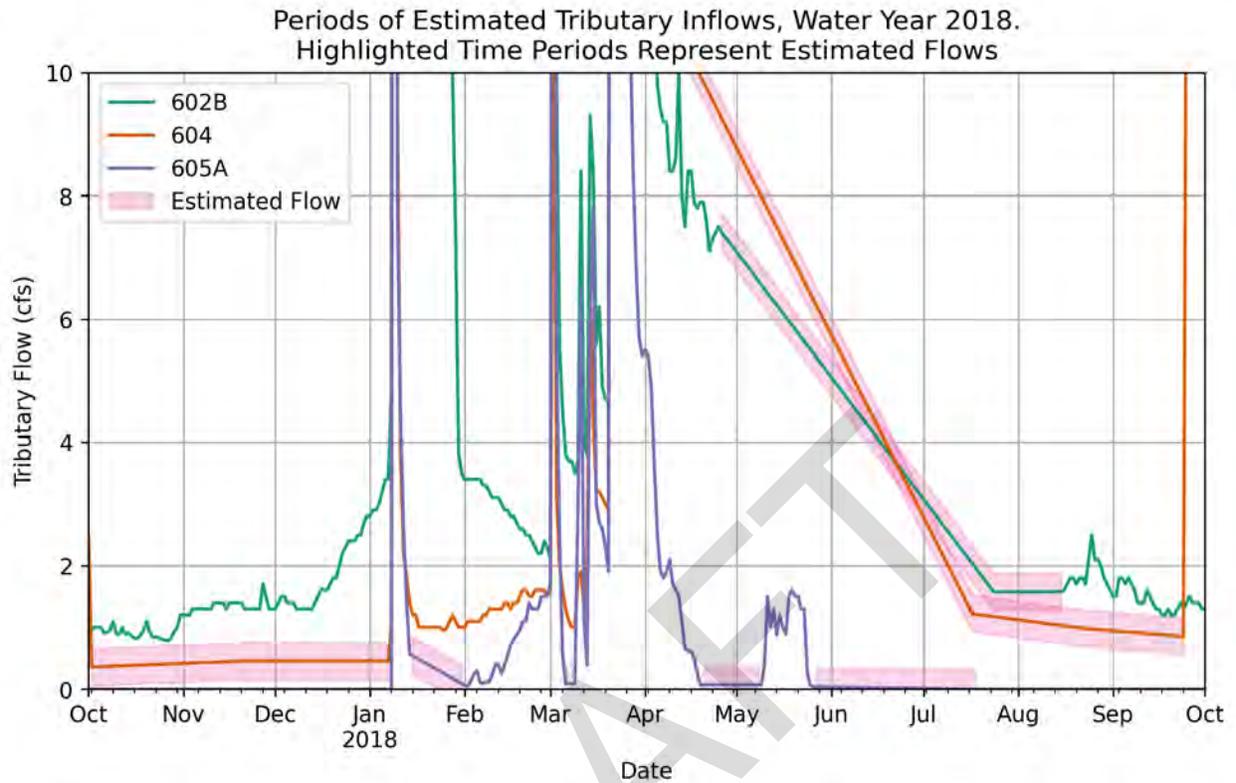


Figure 4-3. Streamflow curves for tributary gages 602B, 604, and 605A during water year 2018. Pink highlight indicates period of data qualified with "estimated" streamflow.

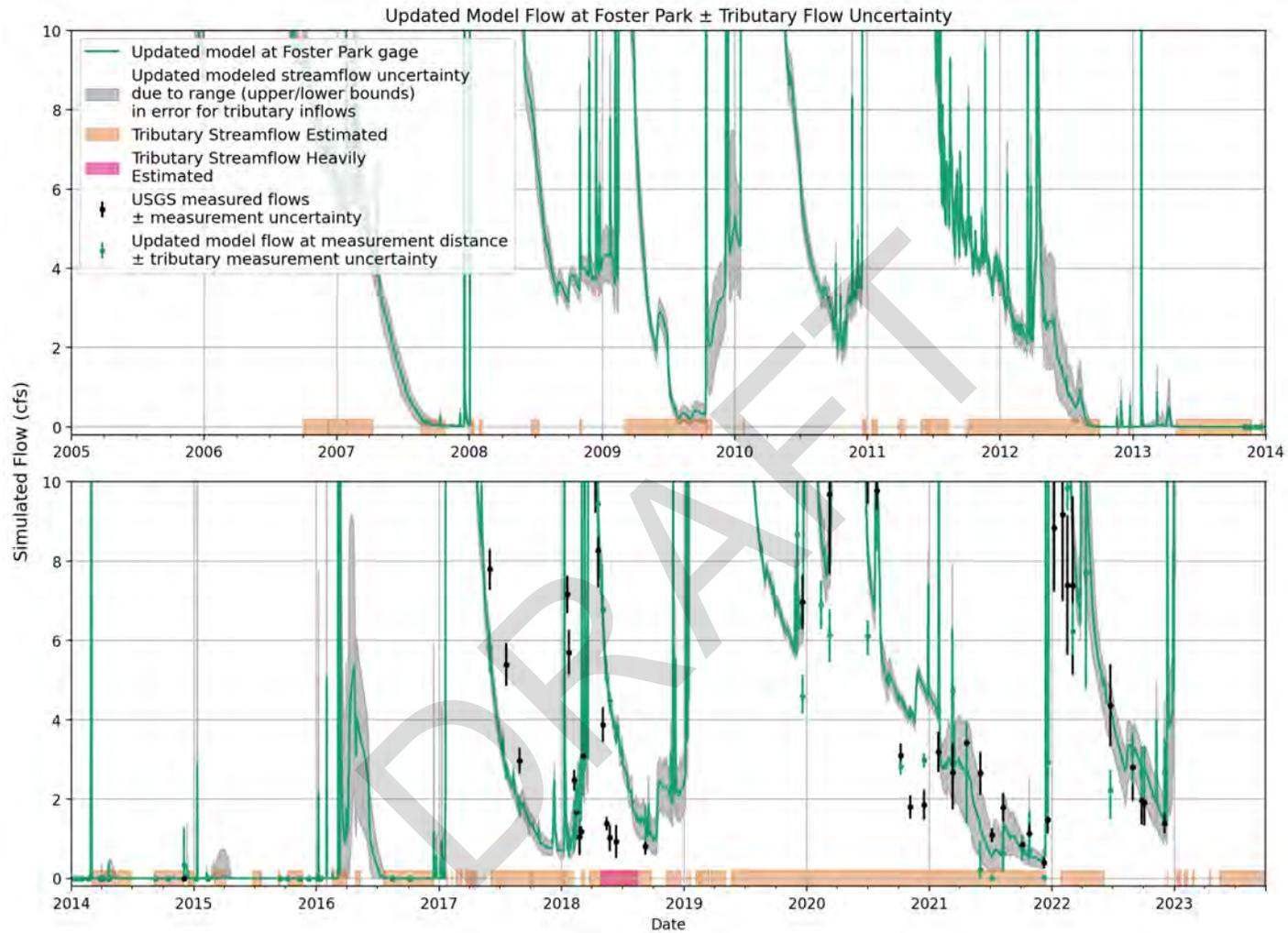


Figure 4-4. Updated model streamflow with applied range in error for tributary inflows (green line with transparent gray band [at Foster Park] and green dots with error bars [at measurement location]) versus observed streamflow (black dots with error bars [at measurement location]). Transparent orange bands along the x-axis show where at least one tributary is estimated, and red band (i.e., 2018) indicate extended (greater than 2 months) periods where more than one tributary gage is estimated.

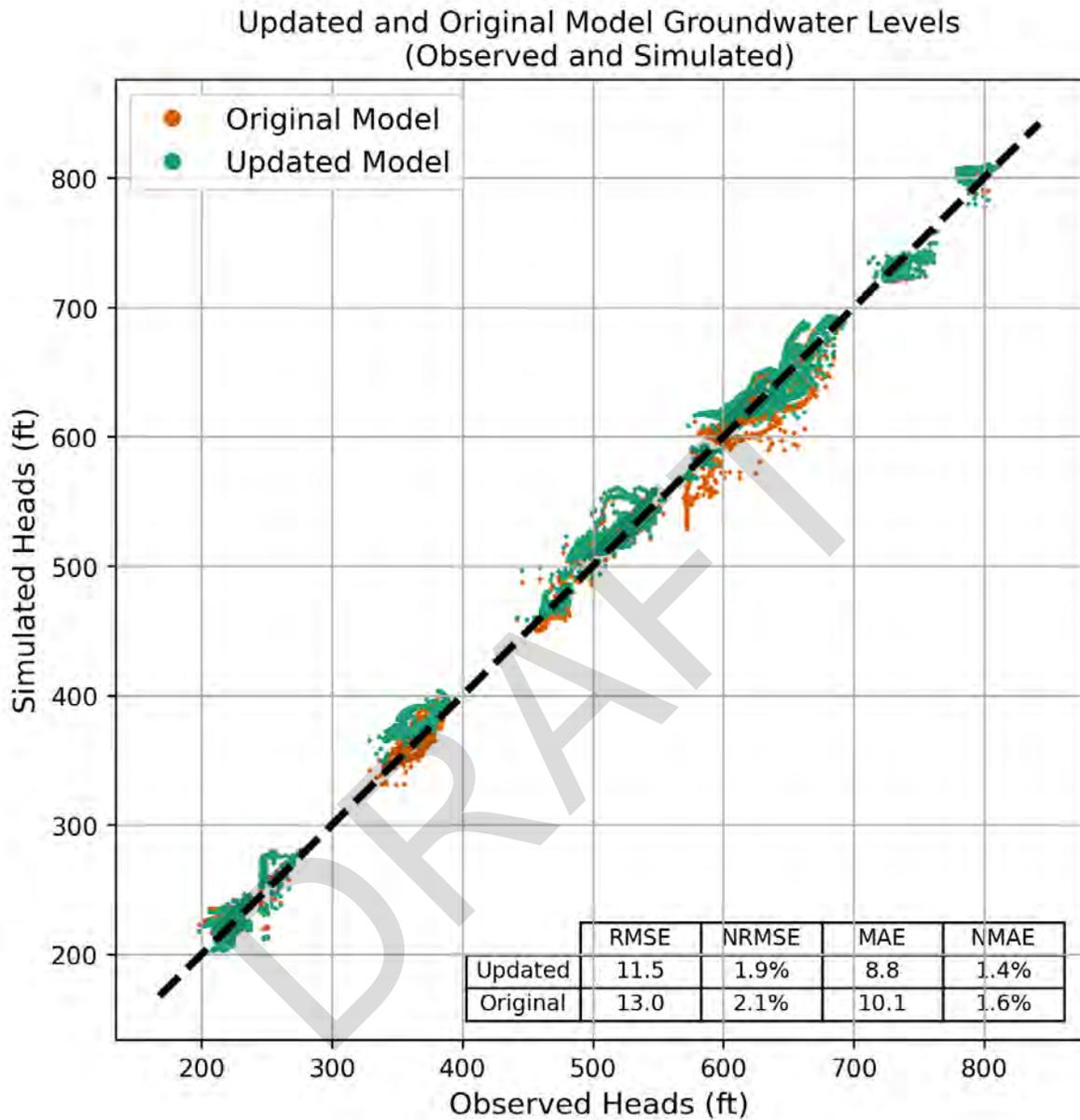


Figure 4-5. Updated model simulated versus observed groundwater level data and objective function metrics. NRMSE and NMAE are the scaled RMSE and MAE, respectively (see Section 3.3.3).

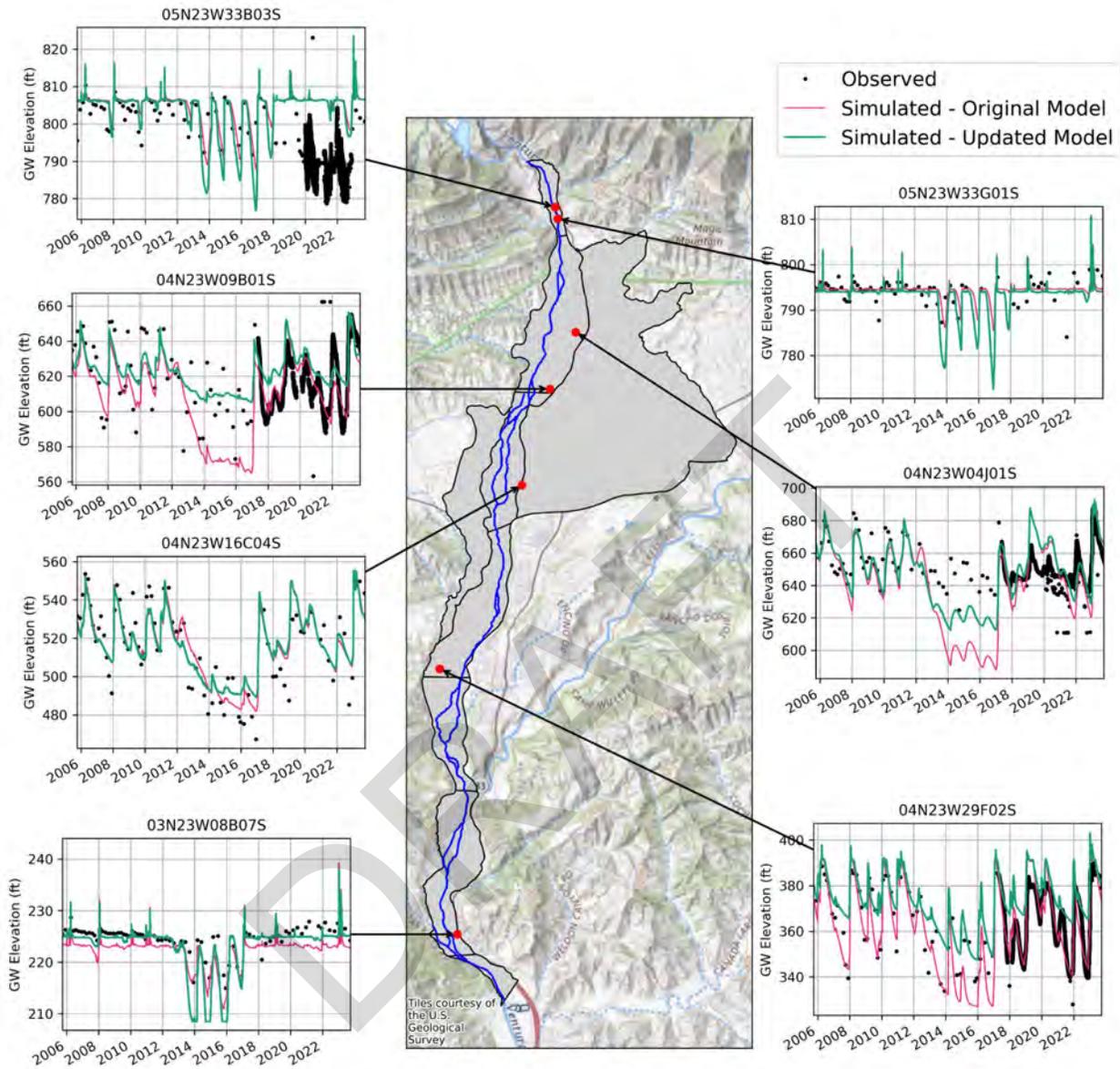


Figure 4-6. Key hydrographs for the original and updated model simulated and observed groundwater level data.

Property: SY Layer 1

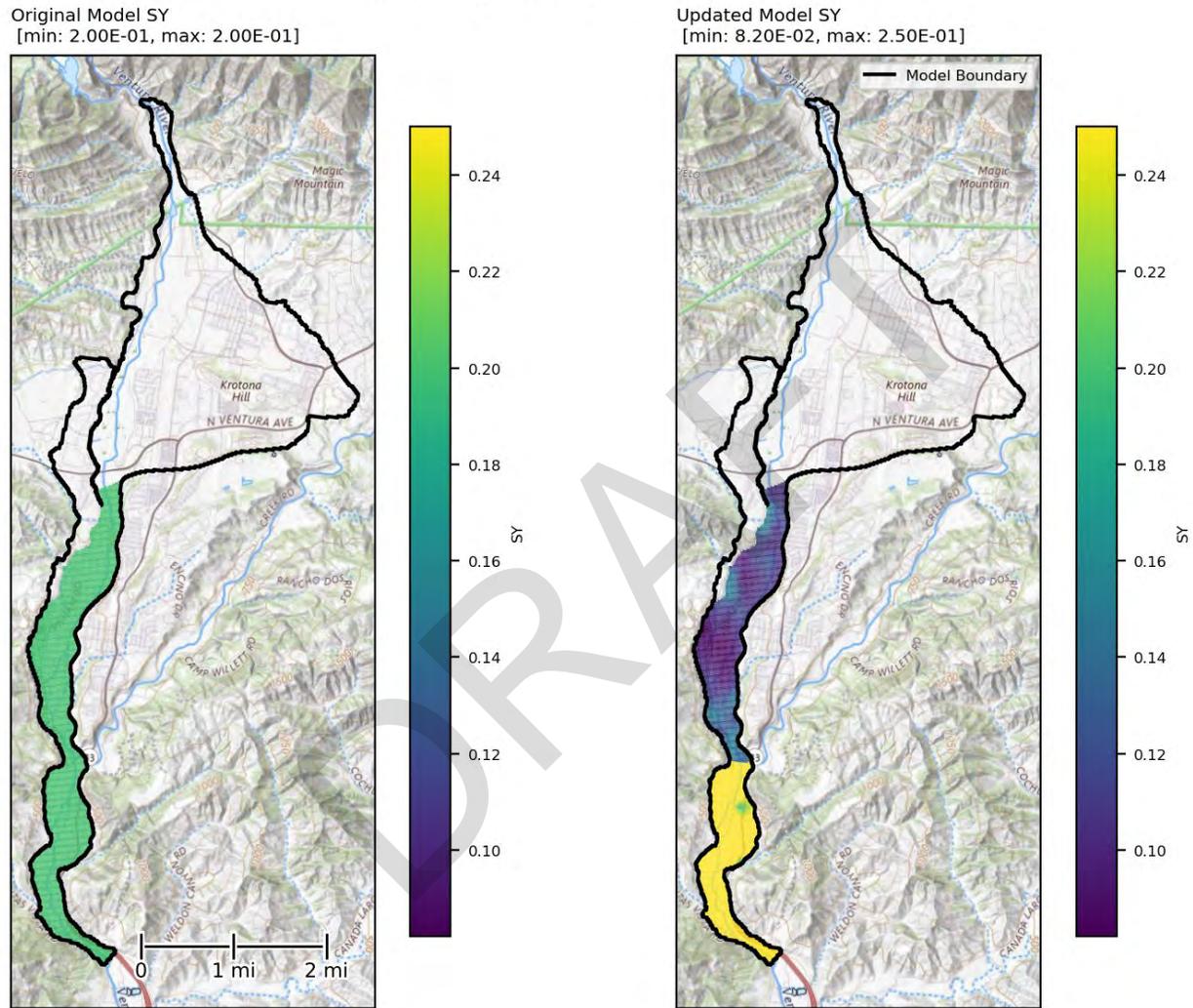


Figure 4-7. Mapped distribution for specific yield (Sy) in Layer 1 for the original model (left) and final updated model (right).

Property: HK Layer 1

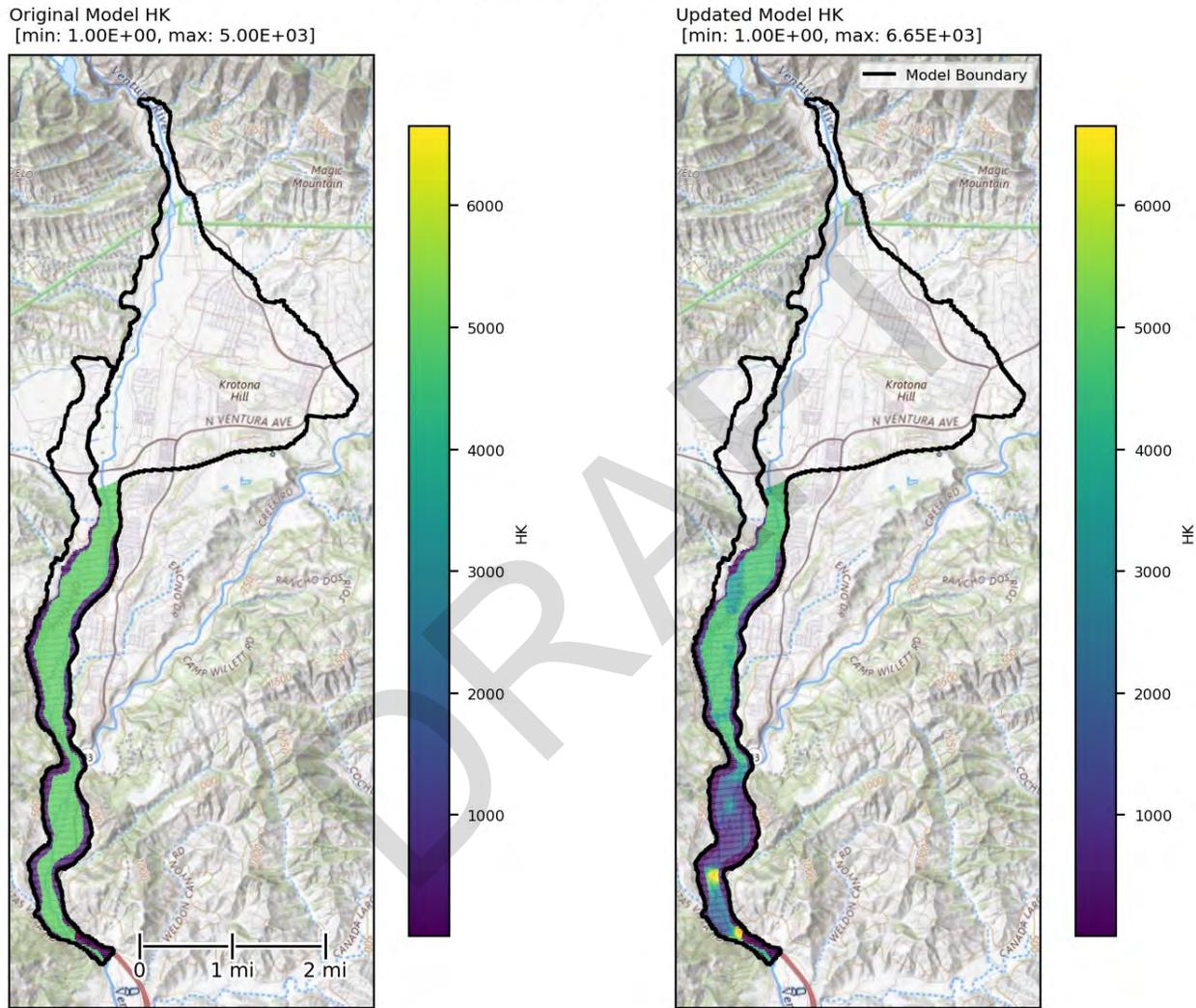


Figure 4-8. Mapped distribution for hydraulic conductivity (HK) in Layer 1 for the original model (left) and final updated model (right).



Attachment B

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1/17/2025 10:14 AM
David W. Slayton,
Executive Officer/Clerk of Court,
By K. Valenzuela, Deputy Clerk

EXEMPT FROM FILING FEES PURSUANT
TO GOVERNMENT CODE SECTION 6103

12 SUPERIOR COURT OF THE STATE OF CALIFORNIA
13 COUNTY OF LOS ANGELES

14
15 SANTA BARBARA CHANNELKEEPER, a
California non-profit corporation,

16 Petitioner,

17 v.

18 STATE WATER RESOURCES CONTROL
19 BOARD, et al,

20 Respondents.

21 CITY OF SAN BUENAVENTURA, et al.,

22 Cross-Complainant,

23 v.

24 DUNCAN ABBOTT, an individual, et al.,

25 Cross-Defendants.
26
27
28

Case No. 19STCP01176

Judge: Hon. William F. Highberger

NOTICE OF RULING

Action Filed: Sept. 19, 2014

Trial Date: Not Set

NOTICE OF RULING

1
2 On January 14, 2025, the parties appeared at a hearing to consider the proposed Interim
3 Order Pending a Physical Solution, the Honorable William F. Highberger, presiding. At the
4 hearing, the parties stated their appearances on the record and/or they are reflected on LA Court
5 Connect records.

6 The Court issued the following Order and rulings:

7 1. On January 14, 2025, the Court entered a Stipulated Interim Order Pending a
8 Physical Solution, attached hereto as **Exhibit A**.

9 2. The Court will hold Status Conferences on May 22, 2025 at 11:00 a.m., August
10 22, 2025 at 10:00 a.m., November 21, 2025 at 10:00 a.m. and January 16, 2026 at 10:00 a.m.
11 City of San Buenaventura (Ventura) and Santa Barbara Channelkeeper (SBCK) will coordinate
12 the filing of a Joint Report seven (7) days before each of these Status Conferences (i.e., Joint
13 Reports to be filed on May 15, 2025, August 15, 2025, November 14, 2025 and January 9, 2026).

14 3. Ventura will hold a monthly meeting with SBCK and will invite all other
15 mediating parties to the meetings.

16 4. The current stay of this case is extended for all purposes to April 1, 2026, subject
17 to extension by the Court for good cause shown.

18 5. Any party (including but not limited to SBCK) may, with twenty (20) days' notice,
19 file a motion asking the Court to lift the stay.

20 6. The Court entered a Minute Order, dated January 14, 2025, attached hereto as
21 **Exhibit B**.

22
23 Dated: January 17, 2025

BEST BEST & KRIEGER LLP

24
25 By: 

26 SHAWN D. HAGERTY
27 CHRISTOPHER M. PISANO
28 Attorneys for Defendant and Cross-
Complainant
CITY OF SAN BUENAVENTURA

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EXHIBIT A

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EXEMPT FROM FILING FEES PURSUANT
TO GOVERNMENT CODE SECTION 6103

11
12 SUPERIOR COURT OF THE STATE OF CALIFORNIA
13 COUNTY OF LOS ANGELES

14 SANTA BARBARA CHANNELKEEPER, a
15 California non-profit corporation,

16 Petitioner,

17 v.

18 STATE WATER RESOURCES CONTROL
19 BOARD, et al,

20 Respondents.

21 CITY OF SAN BUENAVENTURA, et al.,

22 Cross-Complainant,

23 v.

24 DUNCAN ABBOTT, an individual, et al.,

25 Cross-Defendants.

Case No. 19STCP01176
Judge: Hon. William F. Highberger

**~~[PROPOSED]~~ STIPULATED INTERIM
ORDER PENDING A PHYSICAL
SOLUTION**

Date: January 14, 2025
Time: 9:00 a.m.
Dept: 10

Action Filed: Sept. 19, 2014
Trial Date: Not Set

~~PROPOSED~~ **STIPULATED INTERIM ORDER PENDING A PHYSICAL SOLUTION**

On January 14, 2025 at 9:00 a.m., the parties appeared in Department 10 of the above-captioned Court on the Motion for Approval of a Stipulated Interim Order Pending a Physical Solution (Motion). The appearances of the parties are as noted in the record. Having read and considered the Motion, all of the supporting papers and declarations, evidence admitted, and having heard argument of counsel, and good cause appearing therefore, the Court GRANTS the Motion and APPROVES the Stipulated Interim Order Pending a Physical Solution (Stipulated Interim Order) as follows:

BACKGROUND

1. This case is a comprehensive adjudication involving the Ventura River Watershed (Watershed) that is proceeding in accordance with Code of Civil Procedure sections 830 and following, commonly known as the Comprehensive Adjudication Statute. The case has been designated as complex pursuant to California Rules of Court, 3.400(a).

2. This case was originally filed by Plaintiff and Petitioner Santa Barbara Channelkeeper (Channelkeeper) against the State Water Resources Control Board (State Board) and the City of San Buenaventura (Ventura). Ventura subsequently filed and served a Cross-Complaint against certain named surface or groundwater users in the Watershed, as well as all property owners in the four groundwater basins that are located, at least in part, within the Watershed, in accordance with the notice procedures in Code of Civil Procedure section 836. The State Board and the California Department of Fish & Wildlife (CDFW) have intervened in Ventura's Cross-Complaint. Channelkeeper has not intervened in Ventura's Cross-Complaint.

3. In accordance with the Comprehensive Adjudication Statute, the Court has previously entered the following Orders that govern the continued processing of this case:

a. On June 21, 2021, the Court entered an Order based on the Stipulation for Dismissal between Ventura and Channelkeeper. That Order dismissed with prejudice Channelkeeper's First Amended Complaint as against the City, but confirmed certain rights retained by Channelkeeper, including, but not limited to, the "ability to comment on, support, or

1 challenge the physical solution proposed by any party in the Action pursuant to Section 1.5 of the
2 Amendment to Settlement Agreement.”

3 b. On January 13, 2022, the Court entered the Order Establishing Watershed
4 and Basin Boundaries. That Order defines the boundaries of the Watershed as well as the
5 boundaries of the following four groundwater basins that are located, at least in part within the
6 Watershed: Upper Ojai Valley Groundwater Basin, the Ojai Valley Groundwater Basin, the
7 Ventura River Valley—Upper Ventura River Subbasin and the Ventura River Valley—Lower
8 Ventura River Subbasin.

9 c. On October 7, 2022, the Court entered the Interim Order Confirming an
10 Exempt Cross-Defendant Class. That Order confirmed the existence of an Exempt Cross-
11 Defendant class consisting of Cross-Defendants who currently self-identify as diverting or
12 extracting less than five (5) acre-feet per year (AFY) of water from the Watershed.

13 4. The case has been stayed in accordance with Code of Civil Procedure section
14 848(a) since April 12, 2022 to allow a structured mediation to occur. The stated purpose of the
15 structured mediation is to develop and propose to the Court a Physical Solution to govern the
16 Watershed. As reflected in Code of Civil Procedure section 849, this Court has the authority and
17 the duty to consider and impose a Physical Solution where necessary and consistent with Article
18 X, Section 2 of the California Constitution.

19 5. The following parties are currently directly engaged in the structured mediation,
20 and have stipulated to the Court’s approval of this Stipulated Interim Order: Ventura, Cross-
21 Defendants Casitas Municipal Water District (Casitas), the City of Ojai (Ojai), Ventura River
22 Water District (VRWD), Meiners Oaks Water District¹ (MOWD), the Wood-Claeyssens
23 Foundation (Foundation), Rancho Matilija Mutual Water Company (Rancho Matilija), and the
24 Ventura County Watershed Protection District (Watershed Protection), and Interveners the State
25 Board and CDFW. These parties are collectively referred to in this Stipulated Interim Order for
26 convenience as the “Moving Parties”. Ventura and the Cross-Defendant parties listed in this
27 paragraph are collectively referred to in this Stipulated Interim Order for convenience as the
28

¹ A Cross-Defendant listed on the Court’s docket as “Meiners Oaks County Water District.”

1 “Watershed Parties”. Notwithstanding the use, for convenience, of the defined terms “Moving
2 Parties” or “Watershed Parties”, the obligations of the individual members of the Moving Parties
3 or the Watershed Parties in this Stipulated Interim Order are not joint and several, unless
4 expressly provided in this Stipulated Interim Order (by, for example, the use of the phrase “Each
5 Watershed Party shall . . .” to demonstrate that each member has an obligation). As more fully
6 explained in paragraph 20 of this Stipulated Interim Order, each Watershed Party or Moving
7 Party shall only be responsible for the specific obligations assigned to it in this Stipulated Interim
8 Order.

9 6. On December 20, 2024, Ventura filed a Motion, with the stipulated support of the
10 Moving Parties, requesting the Court to enter the Stipulated Interim Order, and thereby impose
11 certain specific requirements on specific members of the Moving Parties, establish a specific
12 timeline and schedule to complete the structured mediation, and continue the stay. The Court
13 finds good cause for approving the Stipulated Interim Order, and hereby GRANTS the Motion
14 and ADOPTS the Stipulated Interim Order.

15 **Interim Flow Protocols and Conservation Requirements**

16 7. Foster Park Protocols: Ventura will implement the following operational protocols
17 at Foster Park (Foster Park Protocols) during the term of this Stipulated Interim Order (as the
18 term is defined in paragraph 15 below). Ventura will cease water extraction at Foster Park when
19 flow measured at Foster Park in a “wet” month is less than 9 cfs, when flow measured at Foster
20 Park in a “moderate” month is less than 7 cfs and when flow measured at Foster Park in a “dry”
21 month is less than 5 cfs. The manner in which it will be determined whether a month is a “wet”,
22 “moderate” and “dry” month is described in Exhibit “A” to this Stipulated Interim Order.
23 Ventura shall measure the flow for purposes of the Foster Park Protocols at its Ventura River 1
24 (VR1) gage. If VR1 is not operational, Ventura shall measure the flow for purposes of the Foster
25 Park Protocols using the United States Geological Survey gage 11118500 located at Casitas
26 Bridge. Ventura’s implementation of the Foster Park Protocols is subject to the specific
27 emergency exceptions and noticing provisions set forth in Exhibit “B” to this Stipulated Interim
28 Order.

1 8. San Antonio Creek Flow Protocols: Casitas will assure a minimum flow of 0.5 cfs
2 to exist in San Antonio Creek as measured within Camp Comfort in the vicinity of the potential
3 habitat project referenced herein in paragraph 11.c below. This minimum flow requirement may
4 be suspended by Casitas when Casitas has declared the existence of a Stage 5 condition as
5 described in its current Water Efficiency and Allocation Program (WEAP) at a noticed public
6 meeting and has provided notice of the proposal to adopt, and of the adoption of, such a
7 declaration by the Casitas Board to the Court. Casitas will assure this minimum flow by whatever
8 means it elects, including, but not limited to, flow augmentation from groundwater or other
9 sources. Initiation of flow augmentation measures will be subject to applicable regulatory
10 approvals. Casitas will provide the State Board and CDFW with an initial identification of flow
11 augmentation options, applicable permitting requirements, and a proposal as to the timing of
12 implementation by on or before February 17, 2025. Casitas will also consider, and meet and
13 confer with the State Board and CDFW about, setting minimum flows for “moderate” and/or
14 “wet” periods as a result of the technical work that will be completed through this Stipulated
15 Interim Order. Casitas will measure flow at the location within Camp Comfort once per week
16 during the pendency of this Stipulated Interim Order. Results and details about these
17 measurements (including a detailed description of the method for measurement and the quality
18 assurance and quality control efforts related to the measurement) will be provided in the quarterly
19 reports.

20 9. Robles Diversion Flow Protocols: Casitas will continue to maintain the flow
21 protocols, summarized in Exhibit “C” hereto, in the existing 2003 National Marine Fisheries
22 Service Biological Opinion issued to the United States Bureau of Reclamation for the operation
23 of the Robles Diversion and Fish Passage Facility.

24 10. Conservation Requirements: Each of the individual Watershed Parties shall
25 implement all legally required water conservation measures. For public agency parties, the
26 conservation measures shall be no less than those required by existing laws, ordinances and
27 agreements applicable to them. For agricultural parties, industry standard agricultural
28 conservation measures shall be implemented. This provision does not address nor impair in any

1 manner the water rights claims of the Watershed Parties and does not specify a specific water
2 consumption amount for agricultural parties. The Watershed Parties will provide detailed
3 information about the water conservation measures they are implementing, and any actions taken,
4 in the quarterly reports.

5 **Interim Watershed Projects**

6 11. The Watershed Parties with jurisdictional authority to act and as identified in the
7 following paragraphs shall implement the projects listed below:

8 a. Removal of Pipeline Passage Barrier at Foster Park: Ventura shall
9 implement the pipeline passage barrier removal project at Foster Park. Ventura will use good
10 faith efforts to complete a passage barrier removal feasibility study and identify preferred
11 alternatives by July 31, 2025. Following selection of the preferred alternative, Ventura will
12 develop a design, permitting and construction schedule for the project, in coordination with the
13 permitting agencies, and shall report that schedule to the Court by December 31, 2025 and also
14 provide updates through the quarterly reporting process in this Stipulated Interim Order. This
15 Stipulated Interim Order may be amended to include the design, permitting and construction
16 schedule through the process described in this Stipulated Interim Order.

17 b. Fraser Street Road Passage Barrier Improvement: The Watershed Parties,
18 as expressly provided for in this Stipulated Interim Order, shall support project-specific efforts
19 toward improvements to the Fraser Street Road Crossing. This support may include future
20 monetary contributions to fund feasibility studies, engineering design, and project permitting and
21 potential project-specific implementation. The Watershed Parties shall commence the
22 preliminary planning process on or before June 1, 2025, and will include in that preliminary
23 planning process an assessment of the permitting requirements, the anticipated cost for
24 implementation of the project, and identification of funding sources (including grants) or local
25 funding options. Updates on this preliminary planning process will be reported to the Court
26 through the quarterly reporting process contained in this Stipulated Interim Order. Any
27 improvements selected will be subject to a final feasibility study, appropriate funding, permitting
28 and all required approvals.

1 c. Steelhead Habitat Enhancement Pilot Project: This project involves
2 planning for the creation of habitat complexity components to improve *O. mykiss* rearing and
3 holding opportunities in San Antonio Creek. The planning process shall include the physical,
4 hydrological and biological assessment of a range of projects such as installation of a pool or
5 pools downstream of Camp Comfort, large woody debris, or other enhancements. The planning
6 process will also include an assessment of the permitting requirements, the anticipated cost for
7 implementation of the projects, and identification of funding sources (including grants) or local
8 funding options (including potential future funding commitments of specific Watershed Parties or
9 other funding options through a final Physical Solution). Casitas shall commence this planning
10 process on or before June 1, 2025, and will report progress to the Court through the quarterly
11 reporting process contained in this Stipulated Interim Order.

12 d. Arundo Removal: The Watershed Parties, the State Board and CDFW, as
13 provided in this Stipulated Interim Order, will support and expedite Arundo removal and related
14 maintenance work through the efforts of Cross-Defendant Ojai Valley Land Conservancy
15 (OVLC) and/or other subsequently identified and agreed upon parties. The Watershed Parties
16 have met and will continue to meet with OVLC to develop a feasibility plan to support OVLC's
17 efforts, including eradication prioritization efforts in upstream locations. Ventura and any other
18 Watershed Party who elects to participate will also develop a funding plan to support OVLC's
19 efforts. The Watershed Parties will update the Court on this feasibility plan through the quarterly
20 reporting process. Ventura will similarly update the Court on the funding plan through the
21 quarterly reporting process. Each Watershed Party shall only be responsible for its specific
22 commitments, if any, made in the feasibility plan, and/or, as applicable, any financial or "in kind"
23 commitments as made in the funding plan, which commitments are all subject to public agency
24 approval, as applicable, for any public agency that has chosen to participate. The Watershed
25 Parties understand that OVLC will be responsible for its procurement, permitting and other
26 aspects of implementation of the Arundo removal work. The Moving Parties will also cooperate
27 in and, as appropriate, support OVLC's efforts to expeditiously obtain all required state and
28 federal authorizations for conducting Arundo removal efforts.

1 e. Human Encampments. Interested members of the Watershed Parties with
2 jurisdictional authority, control of specific private property or who otherwise wish to participate,
3 the State Board and CDFW shall meet to discuss ways in which they may be able to work in good
4 faith to support the removal of human encampments in the Watershed that have a negative impact
5 on Watershed conditions. It is understood that not all Moving Parties have jurisdictional
6 authority over addressing conditions in human encampments and that the only requirement under
7 this provision is to meet to discuss the issue in good faith.

8 f. Matilija Dam Removal Efforts: The Watershed Parties will reasonably
9 support the Matilija Dam removal efforts.

10 g. Permitting Requirements: All of the projects and activities identified in
11 this paragraph are subject to compliance with all applicable laws and the obtaining of all
12 applicable permits, including, but not limited to, approvals as necessary from Watershed
13 Protection in implementing Ordinance No. WP-2.

14 **Initial Governance Efforts**

15 12. The Watershed Parties will work with the Ojai Basin Groundwater Management
16 Agency (OBGMA) and the Upper Ventura River Groundwater Agency (UVRA) to seek to cause
17 those agencies to commence any required processes necessary for those agencies to serve as
18 potential Management Entities in a permanent Physical Solution. The requirements of this
19 paragraph and the actions required under it will not prejudice what is to be included in any
20 permanent Physical Solution, which may include different or additional Management Entities,
21 including, but not limited to, the Foundation and Cross-Defendants in the Upper Ojai Basin, who
22 may also play a management role as part of a permanent Physical Solution. The purpose of this
23 paragraph is solely for the Watershed Parties to work with OBGMA and UVRA to commence
24 any processes that are required such that those entities would be available for timely designation
25 by the Court as Management Entities in the event that they are proposed as such in the permanent
26 Physical Solution and agree to such a role.

1 **Quarterly Reporting and Court Oversight**

2 13. The Moving Parties shall file quarterly reports with this Court regarding the status
3 of conditions in the Watershed, status of implementation of the Stipulated Interim Order, and the
4 status of the structured mediation. Ventura will be responsible for coordinating the preparation
5 and filing of these quarterly reports. Conditions in the Watershed to be included in these
6 quarterly reports shall include, at a minimum, publicly available measured flow data at Foster
7 Park and Camp Comfort and general information about precipitation in the Watershed, the
8 measured level of Lake Casitas and other publicly reported information relevant to this Court’s
9 understanding of Watershed conditions. The quarterly report shall also include material updates
10 on actions, if any, taken to implement the specific terms of this Stipulated Interim Order.

11 14. The Court, upon request of one or more of the Moving Parties, may consider
12 amendments to this Stipulated Interim Order based on the information contained in the quarterly
13 reports. To the extent that the Moving Parties wish to propose such amendments, they shall do so
14 in the quarterly reports, and the Court may provide instructions to the Moving Parties regarding
15 such proposed amendments.

16 **Term of Stipulated Interim Order, Extension of the Stay and Negotiating Schedule**

17 15. This Stipulated Interim Order and its terms shall end on April 1, 2026, subject to
18 extension by the Court for good cause shown.

19 16. The current stay of this case shall be extended for all purposes to April 1, 2026,
20 subject to extension by the Court for good cause shown.

21 17. The Moving Parties shall continue the structured mediation in accordance with the
22 specific negotiating schedule, including monthly, in-person meetings of the mediating parties,
23 attached to this Stipulated Interim Order as Exhibit “D”.

24 18. The Watershed Parties shall provide a complete response (Counter-Offer) to the
25 State Board and CDFW’s proposal (Offer) regarding the elements of a permanent Physical
26 Solution to the State Board and CDFW on or before May 1, 2025. The Counter-Offer shall
27 include proposed implementation measures, including measures designed to increase flow, as
28 feasible. To facilitate development of this Counter-Offer, the Watershed Parties have provided a

1 Counter-Offer development roadmap to the State Board and CDFW. In addition, Casitas and
2 Ventura will, in consultation with the Watershed Parties, the State Board and CDFW, develop a
3 proposed means for defining water-year and/or water-month types by January 31, 2025, for
4 discussion in the structured mediation. The Offer, the Counter-Offer, the Counter-Offer
5 development roadmap, the proposed water-year and/or water-month types shall be considered
6 confidential settlement proposals and are covered by the applicable mediation privilege, unless
7 otherwise agreed to by all the Moving Parties. If the State Board, CDFW, and/or one or more of
8 the Watershed Parties contend that one or more of the Watershed Parties have not timely fulfilled
9 the obligations of this paragraph in good faith, the State Board, CDFW, and/or one or more of the
10 Watershed Parties may, after good faith meet and confer efforts, file a request with this Court to
11 terminate this Stipulated Interim Order and the stay, or to otherwise seek appropriate relief from
12 the Court.

13 **Reservation of Rights and Responsibilities to Implement this Stipulated Interim Order**

14 19. The Moving Parties expressly reserve all of their rights, claims and defenses,
15 including all water rights claims, claims of respective priority and their ability, as needed, to
16 adjudicate such rights and claims in the future in accordance with the Comprehensive
17 Adjudication Statute. In addition, this Stipulated Interim Order has no impact on any of the
18 rights, claims and defenses, including all water rights claims, claims of respective priority and
19 ability, as needed, to adjudicate such rights and claims in the future, of any other Party to this
20 case. All such rights, claims and defenses are reserved.

21 20. This Stipulated Interim Order only obligates the Moving Parties as expressly
22 provided herein. The obligations of the Watershed Parties set forth in this Interim Order are not
23 joint and several, unless expressly provided. Obligations in this Interim Order that are expressly
24 assigned to a specific party or to specific parties shall be the sole responsibility of that specific
25 party or those specific parties.

26 **IT IS HEREBY ORDERED:**

27 Dated: 01/14/2025

28 
JUDGE WILLIAM E. HIGHBERGER

STIPULATION FOR [PROPOSED] INTERIM ORDER — EXHIBIT A

Interim Water Period Typing Definition for Foster Park Protocols

Introduction

The City of San Buenaventura (City of Ventura, City) has developed a definition of interim water period typing for implementation of the temporary Foster Park Protocols that are included in the proposed Ventura River Adjudication Interim Order, to satisfy the requirement in Item 3 of the Term Sheet for the Interim Order.

On October 11, 2024, the Term Sheet for the Interim Order was agreed upon during a Joint meeting of State and Watershed Parties Principals, including a deadline for submittal of the Foster Park interim water period typing method to the State by December 1st 2024, and agreement by the State and City on the method by January 1, 2025. Over the subsequent month, the City worked on development of potential interim water period typing methods.

City staff conferred with staff from the State Water Resources Control Board and the California Department of Fish and Wildlife (State) on two occasions during the development of the definition. The City incorporated feedback from the State and on December 12, 2024, City and State staff agreed on the interim water period typing definition. The water period typing definition was presented to Principals for the City and State on December 18, 2024 and was approved by all parties.

Proposed Water Period Typing for the Foster Park Protocols in the Proposed Interim Order

Water Month Type Definition

Water month types were defined by precipitation, using thresholds (i.e., “bins”) developed from evaluation of historical precipitation and streamflow data. This method accounts for antecedent watershed conditions by including the previous water year’s (WY) precipitation total as well as the current WY’s cumulative precipitation to date in the water month type calculation.

The water month type for implementation of the Foster Park Protocols in the Proposed Interim Order is defined as inches of precipitation output from a weighted precipitation formula, using daily total precipitation data from the Ventura County Watershed Protection District’s (VCWPD) rainfall gage 030D (Ojai-County Fire Station):

Table 1. Water Month Type and Flow Criteria

Water Month Type	Interim Order Foster Park Protocol Flow Criteria
Wet	9 cfs*
Moderate	7 cfs
Dry	5 cfs

* cfs = cubic feet per second

Table 2. Water Month Type Definitions Using a Weighted Precipitation Formula to Incorporate Antecedent Conditions

As of Date ¹	Formula ²	Water Month Type Based on the Results of the Formula Calculation
Oct 1 st	If Sep total precipitation $\leq 0.9"$, then same month type as June. If Sep. total precipitation $> 0.9"$, then month type is wet.	
Nov 1 st	If Oct. total precipitation $\leq 3.3"$, then same month type as June. If Oct total precipitation $> 3.3"$, then water month type is wet.	
Dec 1 st	$= (0.7 * \text{Precip}_{\text{pre}}) + (0.3 * (\text{Oct} + \text{Nov Precip}))$	Wet: ≥ 21.4 Moderate: 11.9 – 21.3 Dry: ≤ 11.8
Jan 1 st	$= (0.4 * \text{Precip}_{\text{pre}}) + (0.6 * (\text{Oct} + \text{Nov} + \text{Dec Precip}))$	Wet: ≥ 18.1 Moderate: 9.5 – 18.0 Dry: ≤ 9.4
Feb 1 st	$= (0.3 * \text{Precip}_{\text{pre}}) + (0.7 * (\text{Oct} + \text{Nov} + \text{Dec} + \text{Jan Precip}))$	Wet: ≥ 16.0 Moderate: 11.2 – 15.9 Dry: ≤ 11.1
Mar 1 st	$= (0.2 * \text{Precip}_{\text{pre}}) + (0.8 * (\text{Oct} + \text{Nov} + \text{Dec} + \text{Jan} + \text{Feb Precip}))$	Wet: ≥ 23.3 Moderate: 13.8 – 23.2 Dry: ≤ 13.7
Apr 1 st	$= (0.2 * \text{Precip}_{\text{pre}}) + (0.8 * (\text{Oct} + \text{Nov} + \text{Dec} + \text{Jan} + \text{Feb} + \text{Mar Precip}))$	Wet: ≥ 27.2 Moderate: 15.7 – 27.1 Dry: ≤ 15.6
May 1 st	$= (0.1 * \text{Precip}_{\text{pre}}) + (0.9 * (\text{Oct} + \text{Nov} + \text{Dec} + \text{Jan} + \text{Feb} + \text{Mar} + \text{Apr Precip}))$	Wet: ≥ 27.3 Moderate: 16.2 – 27.2 Dry: ≤ 16.1
Jun 1 st	$= (0.1 * \text{Precip}_{\text{pre}}) + (0.9 * (\text{Oct} + \text{Nov} + \text{Dec} + \text{Jan} + \text{Feb} + \text{Mar} + \text{Apr} + \text{May Precip}))$	Wet: ≥ 26.0 Moderate: 15.7 – 25.9 Dry: ≤ 15.6
Jul 1 st	Same water month type as June.	
Aug 1 st	Same water month type as June.	
Sep 1 st	Same water month type as June.	
<p>Notes:</p> <p>¹ The water month type of the previous month is determined as of the first day of the month, and implementation of flow criteria starting on the second day of each month. The water month type will be re-evaluated on the fifteenth of the month using the next month's formula. See <i>Implementation</i> for details.</p> <p>² Precipitation data to be used in formula:</p> <ul style="list-style-type: none"> - Precip = current water year's cumulative precipitation total (inches) - Precip_{pre} = previous water year's annual precipitation total (inches) 		

Implementation

From an operational perspective, the City must determine a water month type to inform forward-looking management of pumping. For implementation of the interim Foster Park flow protocols, the City proposes evaluating on the first day of each month what month type has just finished and the fifteenth (15th) day of each month what month type is upcoming. The determined month type will govern operations from the second day of the month through the fifteenth day of the same month when the water month type is re-evaluated. For example, operations in January will be governed by precipitation

through the end of December input into the formula, with the determination of water month type made on January 1st, and the corresponding flow criteria in place from January 2nd through January 15th. On January 15th, the water month type will be evaluated using the February formula and this water month type and corresponding flow criteria will be in place until February 1st. Evaluation of water month type and implementation of a change in flow criteria will occur on workdays only (i.e., Monday – Friday, excluding holidays). If the 1st, 2nd, 15th, or 16th days of the month fall on weekends or holidays, the evaluation and/or implementation will occur on the following weekday.

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STIPULATION FOR [PROPOSED] INTERIM ORDER — EXHIBIT B

1.1 The flow regime at Foster Park may be temporarily modified or suspended under emergency conditions. Emergency conditions include Act of God, unforeseen pipe failure, and the inability of the City to obtain sufficient usable replacement water from Casitas Municipal Water District or other sources to serve its customers. The City shall promptly notify the State Board, CDFW and the Court in writing whenever such an emergency condition exists. The notification shall include the justification for the modification, and supporting documentation. If necessary, the City, the State Board and CDFW shall meet and confer about the modification or suspension to limit its impact on Southern California steelhead and other impacted species.

1.2 If the City seeks to modify the flow regime pursuant to Section 1.1 above because it is unable to obtain replacement water from Casitas Municipal Water District, the City shall provide the State Board, CDFW and the Court with 30 days written notice, if such notice is feasible in light of water management plans or testing trends, or as much advance notice as is feasible when the inability results from an unexpected event. If the modification is based on the inability to obtain replacement water from Casitas, the City shall implement the following specific water conservation measures in the impacted service area during the emergency period of modification or suspension:

1.2.1 City Actions.

- a. Encourage maximum conservation by all customers and users in the impacted area.
- b. No outdoor irrigation using potable water will be allowed.
- c. All water use not required for health and safety is prohibited.
- d. Suspend the issuance of any new development approvals and new water connections in the impacted area other than those required to be processed by state law. Building permits which do not create new demand for water or which are for emergencies, public safety and water conservation may be exempted by the City Manager.

1.2.2 Water Customer Actions.

- a. Comply with mandatory water conservation regulations.
- b. Prohibition of all outside water use unless necessary for the preservation of health and safety and the public welfare.
- c. Watering with hand-held five gallon maximum bucket, filled at exterior hose bib or interior faucet (not by hose) shall be allowed at any time. This will assist in preserving vegetable gardens or fruit trees.
- d. The filling of swimming and wading pools is prohibited.

STIPULATION FOR [PROPOSED] INTERIM ORDER — EXHIBIT C

Existing Flow Protocols at the Robles Diversion and Fish Passage Facility

Casitas, as well as the United States Bureau of Reclamation (“USBR”), have been active participants in the recovery of SC steelhead in the Ventura River since the federal listing of Southern California steelhead (*Oncorhynchus mykiss* or “*O. Mykiss*”) in 1997, through the design, construction, and operation of a fish passage facility at the Robles Diversion and Fish Passage Facility (“Robles Facility”). The Robles Facility, owned by USBR and operated by Casitas, diverts water from the Ventura River to Lake Casitas only when there are sufficient flows in the Ventura River to meet the in-stream flow requirements previously imposed by the 2003 National Marine Fisheries Service (“NMFS”) Biological Opinion for the Robles Diversion and Fish Passage Facility (the “Biological Opinion”).

The Robles Facility is located on the “Dry Reach” of the Ventura River and there is little to no flow in the Dry Reach for most of the year.¹ Prior to diverting at the Robles Facility, a minimum flow of 20 cubic feet per second (CFS) must be confirmed in the Ventura River at the Robles Facility. Diversions rarely occur during summer and fall months due to dry conditions, and there have been some years in the recent past where Casitas has been unable to divert from the Ventura River to Lake Casitas at all.

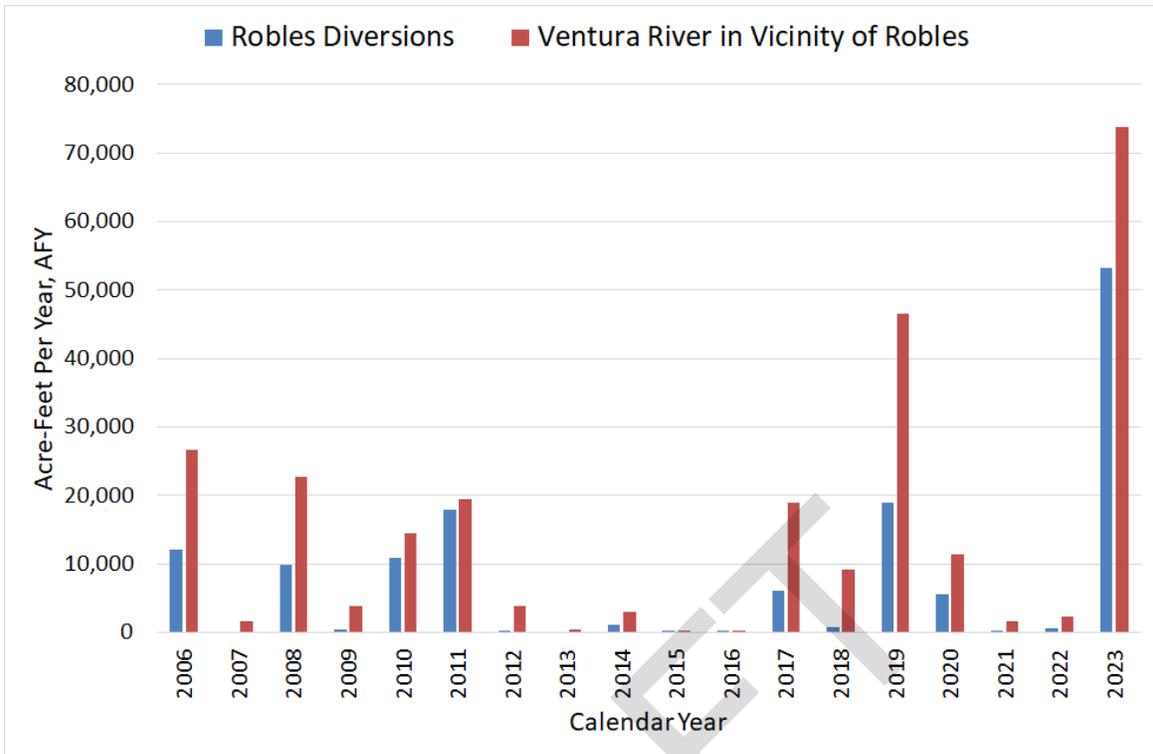
In accordance with the Biological Opinion, during the fish passage augmentation season (January 1 – June 30²), the instream flow requirements imposed on Casitas at the Robles Facility increase before and after storm events. For example, once a defined storm event first occurs, the Biological Opinion imposes a minimum flow in the Ventura River at the location of the Robles Facility of 30 CFS before Casitas can divert from the Ventura River to Lake Casitas. The minimum instream flow bypass requirement increases to 50-171 CFS for 10-12 days after subsequent migratory storm events. Therefore, Casitas, at all times, already bypasses between 20 and 171 CFS at the Robles Diversion per the existing Biological Opinion in order to protect Steelhead.

About 80% of the time there is no significant surface flow in the Ventura River at the Robles Facility (Cardno-Entrix 2012³), and the chart below shows that diversions do not occur during dry periods (e.g. 2012-2016).

¹ In the Dry Reach of the Ventura River water percolates rapidly through the highly permeable riverbed to the groundwater alluvium flowing from north to south, following the surface drainage of the Ventura River. Except during very wet rainfall years, surface water in the Dry Reach generally disappears underground once storm flows have passed—even when surface flow is still present in other reaches of the Ventura River upstream and downstream of the Dry Reach.

² The greatest potential for flow in the vicinity of the Robles Facility falls between January and June each year.

³ Cardno-Entrix. 2012. Ventura River Watershed Protection Plan Report. Prepared for Ventura County Watershed Protection District. February 2012.



The table below shows the estimated amount of Casitas' water that remained in the Ventura River as instream flows since implementation of the NMFS Biological Opinion. After the Biological Opinion was implemented, the Ventura River Watershed experienced extremely dry conditions from 2012-2022 which allowed for little to no diversions at the Robles Facility.. Prolonged drought conditions are common in this flashy Southern California watershed where drought can be immediately followed by extreme precipitation and flooding, sometimes during the same water year.

Casitas Water Remaining in the Ventura River as Instream Flows under NMFS Biological Opinion Operations for Southern CA Steelhead (Estimated based on Calendar Year 2006-2023 Operations)	
Minimum, Acre-Feet per Year	0
Maximum, Acre-Feet per Year	19,724
Average, Acre-Feet per Year	4,256

STIPULATION FOR [PROPOSED] INTERIM ORDER — EXHIBIT D

Monthly meetings between the Watershed Parties and the State shall occur on one day during the third week of each month during the term of the Stipulated Interim Order. The meeting schedule would therefore be as follows:

<u>Mediation Session No.</u>	<u>Month & Year</u>	<u>Mediation Dates</u>
1	January 2025	1/22/25
2	February 2025	2/18/25 – 2/20/25
3	March 2025	3/17/25 – 3/20/25
4	April 2025	4/21/25 – 4/24/25
5	May 2025	5/19/25 – 5/22/25
6	June 2025	6/23/25 – 6/26/25
7	July 2025	7/28/25 – 7/31/25
8	August 2025	8/19/25 – 8/21/25
9	September 2025	9/16/25 – 9/18/25
10	October 2025	10/21/25 – 10/23/25
11	November 2025	11/18/25 – 11/20/25
12	December 2025	12/16/25 – 12/18/25
13	January 2026	1/20/26 – 1/22/26
14	February 2026	2/17/26 – 2/19/26
15	March 2026	3/17/26 – 3/19/26

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EXHIBIT B

SUPERIOR COURT OF CALIFORNIA, COUNTY OF LOS ANGELES

Civil Division

Central District, Spring Street Courthouse, Department 10

19STCP01176

January 14, 2025

**SANTA BARBARA CHANNELKEEPER vs STATE WATER
RESOURCES CONTROL BOARD, et al.**

9:00 AM

Judge: Honorable William F. Highberger
Judicial Assistant: E. Munoz
Courtroom Assistant: R. Sanchez

CSR: Wil S. Wilcox, CSR# 9178
ERM: None
Deputy Sheriff: None

APPEARANCES:

For Plaintiff(s): No Appearances

For Defendant(s): No Appearances

NATURE OF PROCEEDINGS: Order to Show Cause Re: Why the Stay Should Be Further Extended; Hearing on Motion - Other for Approval of Stipulated Interim Order Pending a Physical Solution

Pursuant to Government Code sections 68086, 70044, California Rules of Court, rule 2.956, and the stipulation of appearing parties, Wil S. Wilcox, CSR # 9178, certified shorthand reporter is appointed as an official Court reporter pro tempore in these proceedings, and is ordered to comply with the terms of the Court Reporter Agreement. The Order is signed and filed this date.

APPEARANCES:

For Plaintiff(s): (via LACourtConnect) Daniel Cooper;

For Defendant(s): Shawn Hagerty, Jeremy Jungreis, Noah Golden Krasner, Gregory J. Patterson, and Marc N. Melnick;

For Defendant(s): (via LACourConnect): Adam Kear, Brian E. Moskal, Holly Jacobson, Loa E. Bliss, Ryan Blatz, Jeanne Zolezzi, Neal Magurie, Claude R. Baggerly, Bradley Herrema, Bruce Kuebler, Craig Parton, Peter Raymond Duchesneau, Julie Gantenbein, Kelley Dyer, Laura Rearwin, Matthew George Bullock, Michael Flood, Miles Hogan, Robert Daddi, Roger Marzulla, Vivon Sedgwick, and Nathan Metcalf;

Mediator: (via LACourtConnect) Dave Ceppos;

The matters are called for hearing.

The Court's oral tentative is given to counsel in open court.

The above-captioned motion is heard and argued.

Having heard from counsel, the Court adopts its oral tentative as the final order of the court as

SUPERIOR COURT OF CALIFORNIA, COUNTY OF LOS ANGELES

Civil Division

Central District, Spring Street Courthouse, Department 10

19STCP01176

**SANTA BARBARA CHANNELKEEPER vs STATE WATER
RESOURCES CONTROL BOARD, et al.**

January 14, 2025

9:00 AM

Judge: Honorable William F. Highberger
Judicial Assistant: E. Munoz
Courtroom Assistant: R. Sanchez

CSR: Wil S. Wilcox, CSR# 9178
ERM: None
Deputy Sheriff: None

follows:

The City of San Buenaventura's Motion for Approval of Stipulated Interim Order Pending a Physical Solution filed by City of Buenaventura on 12/23/2024 is Granted.

The motion is granted with the conditions stated on the record.

Request to lift the stay to proceed by way of motion practice with 20 days notice.

Further Status Conference is scheduled for 05/22/2025 at 11:00 AM in Department 10 at Spring Street Courthouse.

Joint status report is due 05/15/2025.

Further Status Conference is scheduled for 08/22/2025 at 10:00 AM in Department 10 at Spring Street Courthouse.

Joint status report is due 08/15/2025.

Further Status Conference is scheduled for 11/21/2025 at 10:00 AM in Department 10 at Spring Street Courthouse.

Joint status report is due 11/14/2025.

Further Status Conference is scheduled for 01/16/2026 at 10:00 AM in Department 10 at Spring Street Courthouse.

Joint status report is due 01/09/2026.

Counsel for City of Buenaventura is to give notice.

Further details of this proceeding are fully reflected in the notes of the court reporter and incorporated herein by reference.