EXECUTIVE SUMMARY

§ 354.4. Each Plan shall include the following general information:
(a) An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.

☑ **23 CCR § 354.4(a)**

ES.1. Introduction

On 16 September 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) for the primary purpose of achieving and maintaining sustainability within the State's high and medium priority groundwater basins. Key tenets of SGMA are the preservation of local control, use of best available data and science, and active engagement and consideration of all beneficial uses and users of groundwater. SGMA requires local agencies to form Groundwater Sustainability Agencies (GSAs) that are tasked with managing basins sustainably through the development and implementation of Groundwater Sustainability Plans (GSPs). Under SGMA, GSPs must contain certain elements, the most significant of which include:

- Sustainability Goal;
- Description of the area covered by the GSP (i.e., the "Plan Area");
- Description of the Basin Setting, including the hydrogeologic conceptual model (HCM), historical and current groundwater conditions, and a water budget;
- Locally-defined Sustainable Management Criteria (SMCs);
- Monitoring networks and protocols for monitoring each applicable sustainability indicator; and
- Description of projects and/or management actions (P/MAs) that will be implemented to achieve or maintain sustainability.

SGMA also requires active stakeholder outreach to ensure that all beneficial uses and users of groundwater have the opportunity to provide input into the GSP development and implementation process. The organizational structure of the Delta-Mendota Subbasin (Basin) GSAs and GSA Groups is shown in **Figure ES-1**.

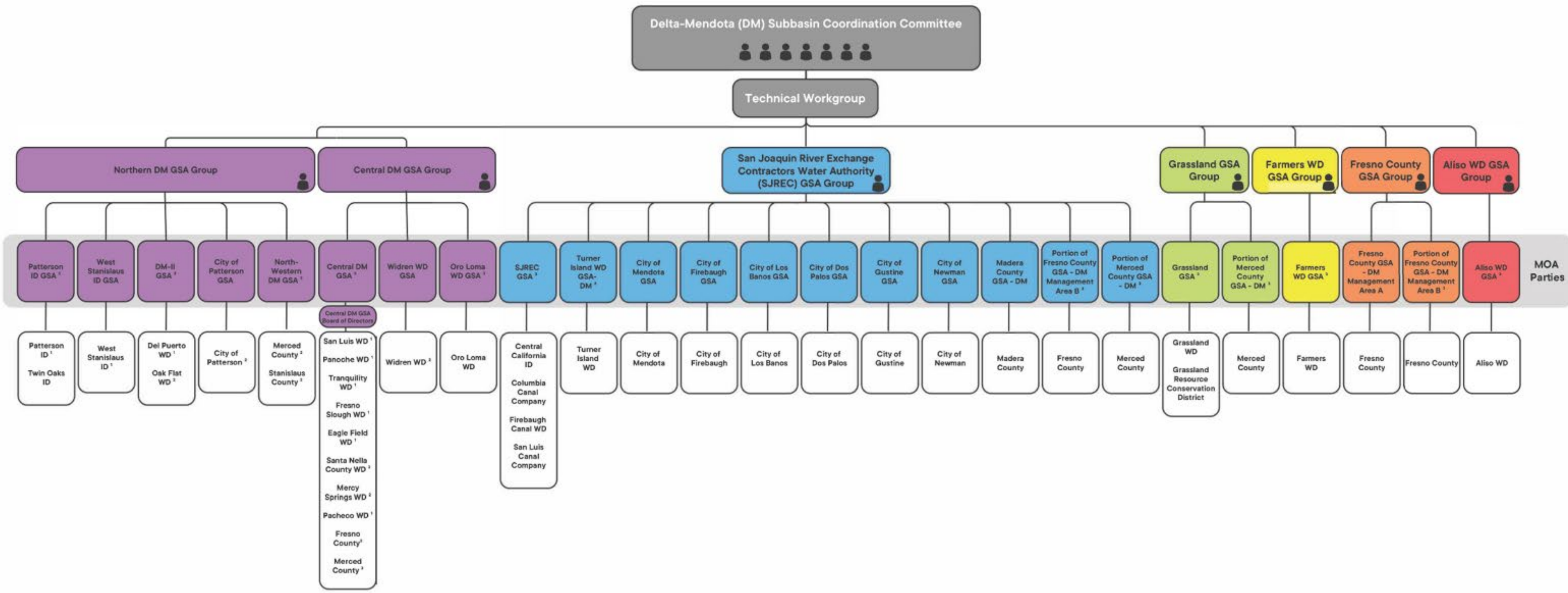

Figure ES-1. Delta-Mendota Subbasin SGMA Governance Structure

The Basin is one of 21 basins and subbasins identified by the California Department of Water Resources (DWR) as in a "critically overdrafted" condition. This designation triggered an accelerated timetable for SGMA compliance, including GSP development by 2020 and achievement of sustainability by 2040.

In compliance with this timeline, the Basin GSAs submitted six GSPs, a Common Chapter, and a Coordination Agreement to DWR in January 2020 (2020 GSPs). DWR designated the 2020 GSPs as "incomplete" in January 2022 and identified four main deficiencies. In June 2022, the GSAs amended and resubmitted the six GSPs to DWR to address the identified deficiencies (2022 GSPs). In March 2023, DWR made a finding of "inadequate" after reviewing the 2022 GSPs and determined that the Basin had sufficiently addressed only one out of the four deficiencies. As a result, the Basin is subject to the state intervention process defined in SGMA regulations and under California Water Code (CWC) §10735 et seq. The first formal step of the state intervention process will be a public hearing convened by the State Water Resources Control Board (SWRCB) to consider designating the Subbasin as probationary based on any specific deficiencies in its GSP that remain unresolved at the time of hearing.

In response to DWR's "inadequate" determination, the 23 Basin GSAs collectively agreed to develop a single GSP for the Basin that synthesizes, updates, and replaces content from the 2022 GSPs and Common Chapter to address the Corrective Actions outlined by DWR. This single GSP has been developed to meet the SGMA regulatory requirements, respond to DWR's deficiencies, respond to comments provided by SWRCB staff during multiple consultation meetings, address public comments, and increase existing coordination among the Basin's 23 GSAs. This GSP provides a path to achieve sustainable groundwater management in the Basin and reflects a comprehensive approach by the Basin GSAs to correct the deficiencies identified by DWR, avoid probation with the SWRCB, and maintain local control of the Basin.

DWR identified three main deficiencies with the 2022 GSPs and identified Corrective Actions. Since submittal of the 2022 GSPs, the GSAs have incorporated substantial revisions into this single GSP in coordination with DWR and SWRCB staff. Revisions made in response to DWR's Corrective Actions are further detailed in **Section 1.2** of this GSP.

- Deficiency #1: The GSPs do not use the Same Data and Methodologies.
- Deficiency #2: The GSPs Have Not Established Common Definitions of Undesirable Results in the [Delta-Mendota] Subbasin.
- Deficiency #3: The GSPs in the [Delta-Mendota] Subbasin Have Not Set Sustainable Management Criteria in Accordance with the GSP Regulations.

In addition to revisions that were made to address DWR Corrective Actions, the GSAs updated this GSP to incorporate current data and information through Water Year (WY) 2023 and made revisions that address comments brought up during more than 10 consultation meetings with SWRCB and DWR staff and GSA-led tours of the Basin with SWRCB members and staff to provide "boots on the ground" demonstrations of GSA efforts towards sustainability.

The Basin GSAs strongly believe that the revised GSP adequately addresses DWR's deficiencies and reflects a high degree of coordination between the Basin GSAs, DWR and SWRCB staff, and Basin stakeholders.

The Basin GSAs may exercise all powers granted to GSAs under SGMA to provide the maximum degree of local control and flexibility consistent with the Basin's Sustainability Goal as set forth in this GSP, including but not limited to all of the authorities provided in Chapter 4 (commencing with CWC § 10723), Chapter

5 (commencing with CWC § 10725), Chapter 6 (commencing with CWC § 10727), Chapter 8 (commencing with CWC § 10730), and Chapter 9 (commencing with CWC § 10732) of SGMA.

ES.2. Sustainability Goal

The Sustainability Goal adopted by all GSAs in the Basin is as follows:

> "The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the Groundwater Sustainability Plan(s) (GSP[s]), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040."

ES.3. Plan Area

The Basin encompasses approximately 765,000 acres at the northwestern end of the San Joaquin Valley Groundwater Basin within portions of San Joaquin, Stanislaus, Merced, Fresno, Madera and San Benito Counties. As shown in **Figure ES-2**, the Basin shares boundaries with nine adjacent groundwater basins. To the north are the medium priority Tracy Subbasin (DWR Basin No. 5-021.15) and the critically overdrafted Eastern San Joaquin Subbasin (DWR Basin No. 5-021.01); to the east are the high priority Modesto and Turlock Subbasins (DWR Basin No. 5-021.02 and No. 5-021.03) and critically overdrafted Merced (DWR Basin No. 5-022.04), Chowchilla (5-022.05), and Madera (5-022.06) Subbasins; and to the south are the critically overdrafted Kings (DWR Basin No. 5-021.08) and Westside (DWR Basin No. 5-021.09) Subbasins. These basins are managed under their own GSPs and SGMA-related activities but coordinate with the Basin GSAs to address issues affecting boundary areas (e.g., accounting for groundwater subsurface inflows and outflows and evaluating consistency of SMCs).

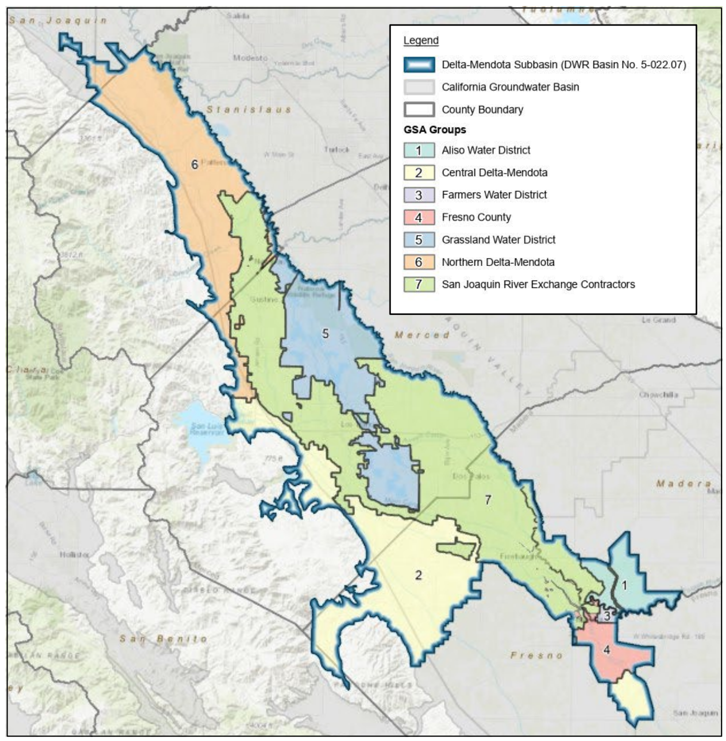

Figure ES-2. Overview of Plan Area, GSA Groups, and Groundwater Basins

The Basin is entirely covered by 23 exclusive GSAs, which are grouped into seven GSA Groups as shown in **Figure ES-2**. Lands within the Basin (the "Plan Area") are predominantly irrigated agriculture, including a diverse array of crop types and portfolios dictated largely by the economics of the farm economy and water supply availability. Actively cropped agricultural lands encompass an estimated 416,000 acres of the Basin, or approximately 54 percent of the total area. Roughly 37 percent of the Plan Area consists of undeveloped lands (284,000 acres), and another two percent of lands are urban, suburban, and rural communities (15,000 acres). Water demands are met using an extensive series of water systems operated by multiple water agencies, cities, and private users. These systems are primarily supplied by imported surface water from the Central Valley Project (CVP) and minimally from the State Water Project (SWP), as well as surface water from the San Joaquin River system. Groundwater is also a key component of water supplies in the Basin and is relied upon for municipal and domestic uses, as well as agricultural and some managed wetland irrigation.

Fifteen census designated places within the Basin include the cities of Patterson, Newman, Dos Palos, Gustine, Los Banos, Firebaugh, and Mendota, and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, South Dos Palos, and Tranquillity.

Disadvantaged communities (DACs) and severely disadvantaged communities (SDACs) in the Basin are identified based on the median household income (MHI) of the area compared to the statewide MHI. Approximately 66 percent of the Basin (507,000 acres) is covered by DWR-designated DACs or SDACs, including approximately 250,000 residents of the cities of Mendota, Firebaugh, Dos Palos, Gustine and the communities of Crows Landing, Dos Palos Y, Grayson, Westley, Volta, South Dos Palos, and Tranquillity. Additionally, approximately 24 percent of the Basin (185,000 acres) is covered by DWR-designated economically distressed areas (EDAs).

ES.4. Stakeholder Outreach Efforts

The Basin GSAs developed a multi-pronged approach for public engagement during the development of this GSP, including the following components:

- **Public Meetings:** The Basin has held numerous meetings open to the public to discuss SGMA and GSP development and implementation. These include meetings of the Basin Coordination Committee, GSA Member Agency Boards and/or City Councils, County Boards of Supervisors, and the Northern and Central Delta-Mendota Region Management Committees.
- **Stakeholder Workshops and Education:** The Basin, in partnership with several non-governmental organizations (NGOs), held several workshops and educational programs to increase public awareness and knowledge of SGMA. These efforts included informational stakeholder workshops, the 2024 Water Leadership Institute (WLI) that focused on groundwater management within the Basin, and the Self-Help Enterprises (SHE) Community Water Needs Assessment. The Basin also hosted bilingual webinars and workshops on 10 May 2024, 7 June 2024, 22 April 2024, and 18 June 2024 to give an overview of the draft GSP and information on how to submit comments. Spanish translation was offered at these meetings. The Basin also hosts its own website dedicated to SGMA information: https://deltamendota.org/
- **Direct Outreach:** GSA staff made direct contact with community representatives to encourage their participation in the GSP development process. Outreach efforts included newsletters, GSA website updates, direct mail, local landowner meetings and workshops, bilingual informational emails to provide updates on GSA activities, and GSA-led tours of the Basin.

- **DWR's Facilitation Support Services:** In late 2023, Basin GSAs took additional steps to improve public outreach during the process of developing a single GSP for the Basin. The first step was to apply for Facilitation Support Services funds (FSS) through DWR. The FSS funds have primarily been used to set up and conduct public outreach meetings in the Subbasin to discuss the proposed single GSP with interested stakeholders.
- **Draft GSP Review Opportunities.** The GSAs published nine draft chapters on 30 April 2024 for public review. The GSAs incorporated comments and published the full draft Public Review Draft GSP on 29 May 2024.

In addition to the engagement opportunities provided above, the public was provided with opportunities to comment on both the 2020 and 2022 GSPs. This GSP has taken those comments into consideration.

ES.5. Basin Setting - Hydrogeologic Conceptual Model

The Basin is a long and narrow groundwater subbasin within the larger San Joaquin Valley Groundwater Basin, approximately 92 miles long and ranging between six and 18 miles wide. The Basin is bounded by geological and/or natural features, such as the Coast Range on the western Basin boundary and the San Joaquin River on the eastern Basin boundary, as well as jurisdictional boundaries such as the water purveyors whose service areas constitute the northern and southern Basin boundaries. The groundwater system in the Basin is comprised of various geologic units, including the Tulare Formation, terrace deposits, alluvium, and flood-basin deposits, and contains two principal aquifers.

The two principal aquifers defined in the HCM are referred to as the "Upper Aquifer" and "Lower Aquifer", between which the Corcoran Clay, a regionally extensive clay layer in the San Joaquin Valley, serves as a principal aquitard, or relatively impermeable layer. The semi-confined Upper Aquifer typically extends from the ground surface to the upper boundary of the Corcoran Clay. It includes both younger and older shallow alluvial deposits as well as the upper portions of the Tulare Formation. The confined Lower Aquifer extends vertically from the part of the Tulare Formation that is confined beneath the Corcoran Clay to the underlying San Joaquin Formation and the boundary where saline water of marine origin is first encountered. The Corcoran Clay pinches out along the western boundary of the Basin, allowing for some measure of interconnection between the Upper and Lower Aquifers in those areas.

The Basin contains several surface water features. The San Joaquin River is the largest river in the Basin and flows northwestward along or near the eastern Basin boundary. Several ephemeral creeks also run west to east throughout the basin, including Del Puerto Creek, Los Banos Creek, and Orestimba Creek. San Luis Reservoir, situated on San Luis Creek along the western boundary of the Basin, is a major reservoir that serves as an off-stream water storage facility for both the CVP and SWP. Also situated in the Basin is significant infrastructure that conveys imported water supplies, including the Delta-Mendota Canal, the California Aqueduct, and local canals.

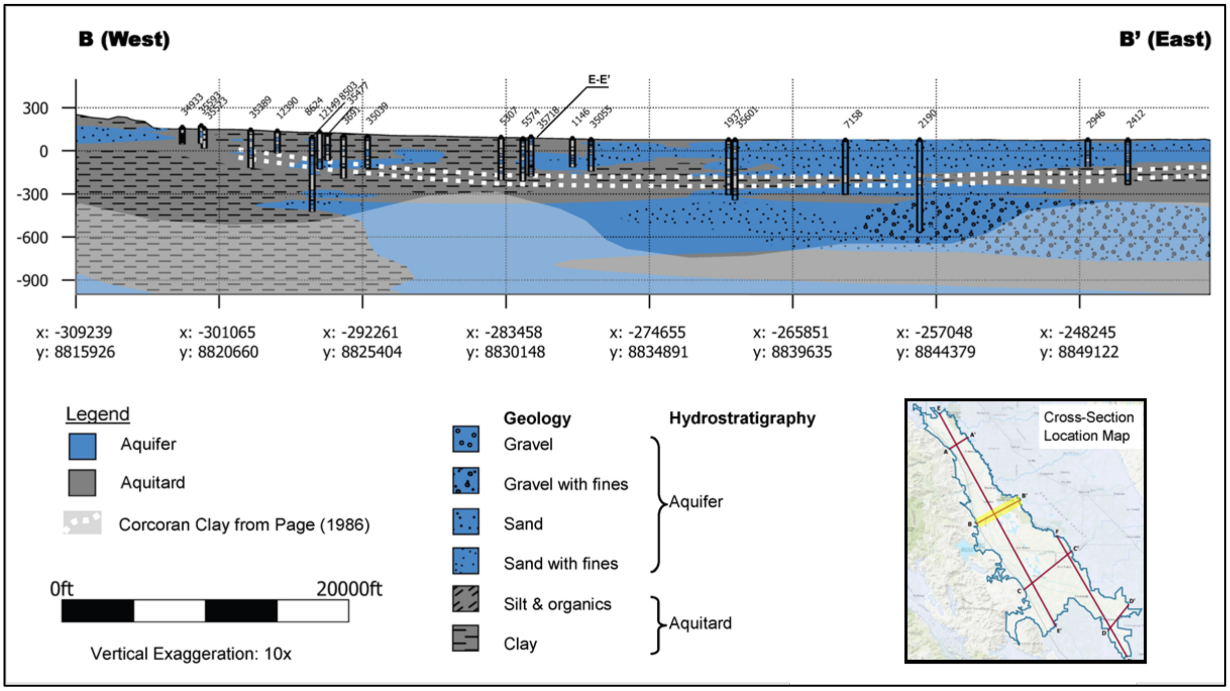

Figure ES-3. Hydrogeologic Cross-Section in the Delta-Mendota Subbasin

Applied irrigation water, direct recharge from ponds, and canal and streambed seepage contribute to the recharge of the Upper Aquifer within the Basin. Recharge to the Lower Aquifer primarily occurs east of the Basin along the western edge of the Sierra foothills. Some recharge within the Basin does occur via downward percolation between the Upper and Lower Aquifers at a very slow rate through the clay and composite wells. In addition, direct recharge and canal and stream seepage along the western edges of the Basin can occur where the Corcoran Clay is thin or non-existent.

Six hydrogeologic cross-sections were developed to illustrate the Basin physical characteristics and the underlying geologic formations, with an example cross-section shown in **Figure ES-3**. The cross-sections were developed by geospatial analysis of geologic information from well logs and Airborne Electromagnetic (AEM) data throughout the Basin. These cross sections help the GSAs better understand Basin subsurface conditions and support the development of the Basin water budgets (inflow-outflow analyses), refinement of the numerical groundwater flow model, and design of the SGMA representative monitoring networks.

ES.6. Basin Setting - Existing Groundwater Conditions

Information on the Basin's current groundwater conditions with respect to the SGMA-defined "Sustainability Indicators" are presented in this GSP and include the following:

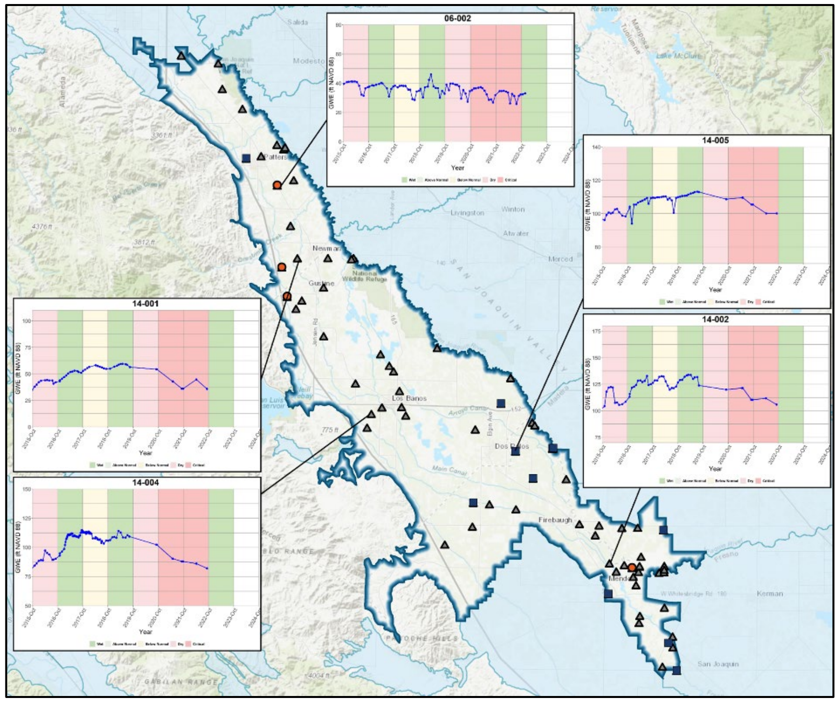

Figure ES-4. Upper Aquifer Groundwater Elevation Hydrographs, 2015-2023

Groundwater Levels: Groundwater levels within the Basin are presented using contour maps depicting the 2015 and current (2023) seasonal high and seasonal low groundwater elevations for each principal aquifer (Upper Aquifer and Lower Aquifer) and hydrographs for various wells across the Basin depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers. The available data indicate that the groundwater generally flows outward from the Basin towards groundwater elevation lows in the neighboring Madera and Chowchilla Subbasins, with the exception of groundwater flow in the southeast direction along the southern boundary towards the Kings Subbasin. Differences in Upper Aquifer groundwater elevations between seasonal high and seasonal low conditions in WY 2023 can likely be attributed to consecutive Dry (WY 2020) and Shasta Critical (WY 2021 and WY 2022) water years prior to and during the seasonal low period of September and October 2022, which caused increased groundwater pumping. Hydrographs show the positive effects of surface water importation, managed aquifer recharge, and water banking activities in raising groundwater levels, tempered by the effects of the recent severe droughts and pumping outside of the Basin (see **Figure ES-4**).

Groundwater Storage: Changes in groundwater storage for the two principal aquifers over selected time periods of interest were calculated using the Central Valley Hydrologic Model Version 2 (CVHM2; Model) and compared to the volumes reported in the Basin's prior Annual Reports which were based on analytical estimates using groundwater elevations. The Model was refined based on local surface water delivery and pumping data for the period of WY 2003-2019, with reliable data primarily available after WY 2010 in most areas of the Basin. During the pre-SGMA period (WY 1970 – WY 2014), the Basin experienced a cumulative Upper Aquifer groundwater storage decline of approximately -2,198,000 acre-feet (AF) and the Lower Aquifer groundwater storage decline of approximately -209,000 AF. During the post-SGMA period (WY 2015 – WY 2023), the Basin experienced a cumulative Upper Aquifer groundwater storage increase of approximately 62,000 AF and the Lower Aquifer groundwater storage decline of approximately -77,000 AF. The change in groundwater storage over the historical period generally corresponds with the variation in water year types. The increase of Upper Aquifer storage in post-SGMA years is primarily due to increased recharge during the period and wetter water year types, considering that the average pumping from the Upper Aquifer during the post-SGMA period (308,000 acre-feet per year [AFY]) was generally similar to the pre-SGMA period. The groundwater storage volumes are calculated as the summation of simulated aquifer storage change and water release caused by subsidence, which represents changes in aquitard storage. Subsidence, and correspondingly water release caused by subsidence, are overestimated in the model. Furthermore, approximately 50% of historical subsidence is shown to be caused by pumping outside the Basin through sensitivity analysis conducted. Therefore, changes in storage values provided here are quite conservative and should be considered in understanding their level of uncertainty.

Water Quality: Drinking water is the most sensitive beneficial use in the Basin. The Basin employed the SWRCB's methodology for identifying constituents of concern (COCs) from State and Regional Water Board datasets and determined that the following are COCs for the Subbasin: arsenic, nitrate (as N), nitrate + nitrite (as N), 1,2,3-trichloropropane (1,2,3-TCP), gross alpha radioactivity, total dissolved solids (TDS), and hexavalent chromium. TDS concentrations above the secondary Maximum Contaminant Level (MCL) of 1,000 milligrams per liter (mg/L) are present in over half of the Upper Aquifer due to the prevalence of marine sediments. TDS concentrations in the southern part of the Upper Aquifer have historically been increasing due to the eastward migration of naturally saline water driven by groundwater elevation gradients spanning multiple subbasins.

Locally, correlation between water levels and groundwater quality has not been observed. The Basin's expanded Representative Monitoring Networks for Water Quality and Groundwater Levels will be used to improve understanding of any trends or correlations between groundwater management (extraction and recharge) and water quality.

Land Subsidence: Land subsidence has been documented within the San Joaquin Valley over both historical and recent timeframes. The majority of the San Joaquin Valley's inelastic subsidence can be attributed to pumping groundwater from below the Corcoran Clay. Recent subsidence measurements indicate that within the Basin, the greatest subsidence has generally been observed along the southeastern boundary and in the Tranquillity Irrigation District (TRID) area. Between 2015 and 2023, total vertical displacement within the Basin ranged from minor uplift on the

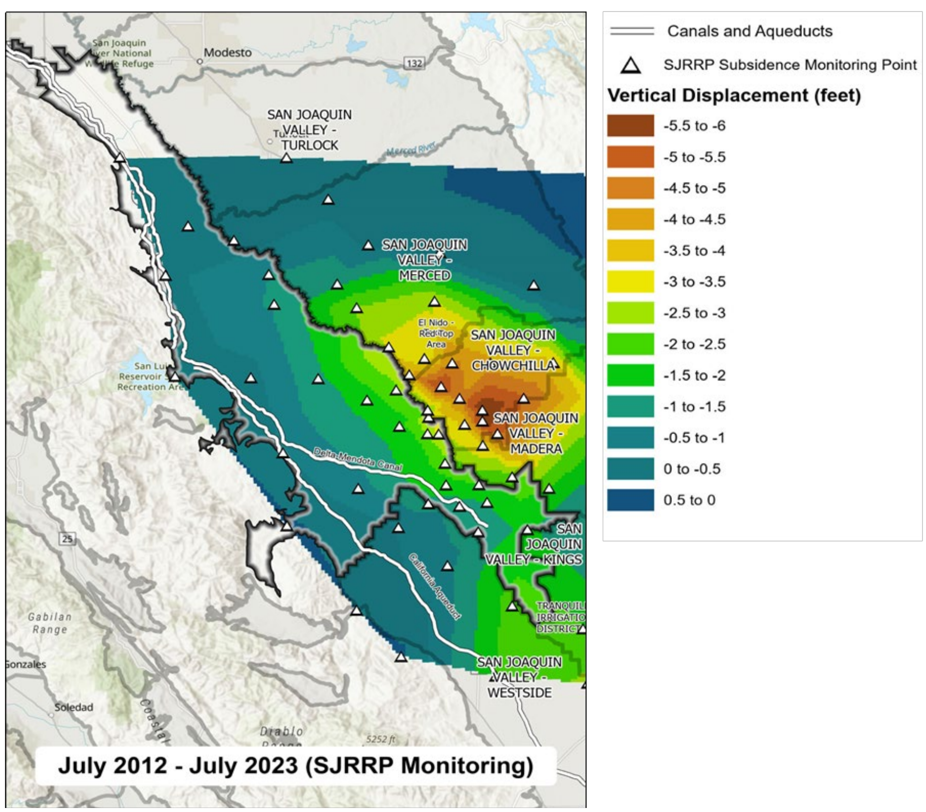

Figure ES-5. Land Subsidence July 2012 – July 2023

western margin of the Basin to approximately 2.2 feet of subsidence in the southeast (see **Figure ES-5**).

Land subsidence caused by factors within the GSA's authority to manage is due to aquitard depressurization following groundwater withdrawal within the Basin, which tends to be greater in the areas dependent on groundwater from the Lower Aquifer and are underlain by a greater proportion of fine-grained deposits, and in periods of drought. In contrast, most of the subsidence occurring on the Basin's eastern boundary is associated with hotspots centered east of the San Joaquin River caused by groundwater pumping outside of the Basin. As the GSAs do not have the authority to regulate this external pumping, the associated subsidence is not within the GSAs' ability to manage. In response to the identified subsidence-related risks, the Basin's Representative Monitoring Network tracks land subsidence and Lower Aquifer water levels throughout the Basin, with emphasis on high-risk areas. Furthermore, the GSAs are enacting P/MAs and coordinating with neighboring subbasins to address subsidence through reductions in Lower Aquifer pumping within and adjacent to the Basin.

Seawater Intrusion: The Basin is located far from coastal areas; therefore, seawater intrusion is not considered to be a relevant Sustainability Indicator.

Interconnected Surface Water: The Interconnected Surface Water (ISW) analysis of the Basin relies on natural surface water bodies delineated in the United States Geological Survey (USGS) National Hydrography Dataset (NHD) and The Nature Conservancy (TNC) ISW in the Central Valley (ICONS) datasets. Perennial and intermittent surface water bodies are most likely to be ISW, while ephemeral surface water bodies are generally not ISW, as their channel bottoms remain significantly above the water table. Using the best available data, science, and tools, miles 16 to 106 of the San Joaquin River were identified as potential ISW (likely connected) and will be subject to the Depletion of ISW SMCs. The WY 2014 (pre-SGMA) depletion rate caused by pumping within the Basin is estimated to be 12,000 AFY within the potential ISW reaches (San Joaquin River) based on the Model, while the long-term historical average annual depletion rate caused by Basin pumping is approximately 7,000 AFY. The Current (WY 2019-2023) average annual depletion within these ISW reaches caused by pumping within the Basin is estimated to be approximately 13,000 AFY, comparable to pre-SGMA conditions.

ES.7. Basin Setting - Water Budget

All GSAs in the Basin coordinated and collaborated on the development and application of the Model to evaluate Basin conditions. The Model is based on the use of a three-dimensional (3-D) groundwater flow model that uses the USGS CVHM2 – San Joaquin Valley (CVHM2-SJV) groundwater modeling platform. This water budget provides an accounting of the total annual volume of water entering and leaving the Basin for Historical (WY 2003 – WY 2018), Current (WY 2019 – WY 2023), and Projected Future (WY 2024 – WY 2073) conditions. The water budgets are presented for the two interconnected water budget systems quantified by the Model the: (1) land-surface water system, and (2) groundwater system within the Basin.

For the land-surface water system, the change in storage is typically negligible and averages to zero in long-term periodical averages. For the groundwater system, modeling results show that the Basin had an average annual net groundwater storage change of -24,000 AFY, -6,000 AFY, and -19,000 AFY during the Historical, Current, and extended Historical through Current (WY 2003 – WY 2023) periods, respectively, indicating a consistent yet decreasing loss in storage since 2003.

In addition, the Basin has experienced a consistent loss of storage due to water release caused by subsidence equaling -105,000 AFY, -173,000 AFY, and -120,000 AFY during the Historical, Current, and WY 2003 – WY 2023 periods, respectively. However, validation of Model results indicate that the subsidence rates and extent are overestimated in the Model, leading to overestimation of water release caused by subsidence. Furthermore, sensitivity analysis conducted as part of the Model application suggests that as much as 50 percent of the subsidence (and subsequent loss of storage) simulated within the Basin is caused by pumping in adjacent basins. Consequently, addressing subsidence and its associated water release cannot be achieved solely through actions within the Basin. Coordination with neighboring basins and regional improvements in groundwater conditions will be required.

Considering the impacts of neighboring areas on Basin overdraft, the Basin Sustainable Yield was conservatively estimated to be approximately between 281,000 to 384,000 AFY over the WY 2003 – WY 2023 period, depending on the period selected (historical, current, or WY 2003-2023). Absent the impacts of neighboring basins on subsidence in the Basin, the sustainable yield over the same period was conservatively estimated to be approximately between 337,000 AFY to 485,000 AFY. The Sustainable Yield is based on results using Model-calculated groundwater pumping and recharge to quantify the volume of water that, if pumped over the water budget period of interest, would have resulted in zero change in storage. The range provided is an estimate based on the historical and current periods, as required by 23 CCR § 354.18.(b)(7). The Sustainable Yield of the Basin will change and likely increase in the future due to the implementation of P/MAs and should be ultimately defined based on the sustainable management criteria outlined in the GSP, as the volume of Basin-wide groundwater extraction that does not lead to Undesirable Results.

Water budget information under Projected future conditions was also developed for the Basin using the Model and a 50-year “analog period” based on hydrologic input from the years 1973 to 2022, with water supply assumptions (i.e., changes to imported water supplies) and DWR-provided inputs for climate variables (i.e., adjusted precipitation and evapotranspiration). The Projected future water budget assesses the magnitude of the net water supply deficit under future conditions that would need to be addressed through P/MAs to prevent Undesirable Results and achieve the Sustainability Goal. Five projected water budget scenarios and one P/MA scenario were developed for this analysis and the results are summarized in **Table ES-1**:

1) Projected Baseline;
2) Projected 2030 Central Tendency Climate Change;
3) Projected 2070 Central Tendency Climate Change;
4) Projected 2070 Extreme Dry Climate Change;
5) Projected 2070 Extreme Wet Climate Change; and,
6) Projected 2030 Central Tendency Climate with Projects and Management Actions (P/MAs) and Adaptive Management Pumping Reduction Plan (PRP)

Table ES-1. Basin Water Budget Summary by Scenario

Scenario	Climate Period	Change in Groundwater Storage (AFY)
Historical	WY 2003-2018	-24,000
Current	WY 2019-2023	-6,000
Overdraft Evaluation Period	WY 2003-2023	-19,000
Projected Baseline	WY 2024-2073 Analog	-24,000
Projected 2030 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	-26,000
Projected 2070 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2070 Climate Change	-28,000
Projected 2070 Extreme Dry Climate Change	WY 2024-2073 Analog with DWR 2070 Climate Change	-34,000
Projected 2070 Extreme Wet Climate Change	WY 2024-2073 Analog with DWR 2070 Climate Change	-8,000
Projected 2030 Central Tendency Climate Change with P/MAs and Adaptive Management Pumping Reduction	WY 2024-2073 Analog with DWR 2030 Climate Change	+5,000

The wide spectrum of changes projected by extreme dry and wet 2070 climate change scenarios showcase the significant uncertainty in projected Basin conditions. The Basin has designed an adaptive P/MA framework with the capacity and flexibility to effectively respond to projected changes and their corresponding inherent uncertainty in the Basin. As discussed in **Section ES-10**, the Basin GSAs have a robust plan to address the estimated overdraft (i.e., 140,000 AFY over the WY 2003-2023 period), avoid Undesirable Results, and reduce groundwater pumping to within the Sustainable Yield by 2040 through implementation of P/MAs, including the PRP.

The simulation of projected conditions under 2030 Central Tendency Climate Change Scenario with planned P/MAs and PRP indicates that the Basin will not experience Undesirable Results from chronic lowering of groundwater levels during its implementation period (by WY 2040) or after (by WY 2073). Furthermore, the projected P/MA scenario indicates that the Basin would achieve an average balanced water budget by 2040, maintaining groundwater storage over WY 2015 conditions for the entire projected period (WY 2024-2073) in the Upper Aquifer and WY 2041-2073 in the Lower Aquifer, reaffirming the sufficiency of P/MAs and the PRP designed under this GSP. It is worth noting that these results include overestimation of the rate and extent of subsidence and, consequently, the total storage loss in the Basin, and therefore, considered quite conservative.

The above notwithstanding, it is important to note that there are inherent limitations in using the Model to predict future conditions given the uncertainties surrounding remaining data gaps, lack of full calibration of the Model for subsidence and water levels, complex hydrogeology and climate change assumptions, and dynamic interconnections with adjacent basins. Despite efforts to address these uncertainties within the GSP's adaptive management framework, existing data limitations and significant sources of uncertainty will require updates and modifications to the Model, the results, and associated policies and P/MA implementation.

ES.8. Sustainable Management Criteria

The SMCs are the metrics by which groundwater sustainability is evaluated under SGMA. Uniform definitions for the following SMC components have been developed in the GSP through a coordinated effort of the GSAs within the Basin.

- **Undesirable Results**: Undesirable Results are the significant and unreasonable occurrence of conditions, for any of the six Sustainability Indicators, that adversely affect beneficial uses and users in the Basin.
- **Minimum Thresholds (MTs)**: MTs are the numeric criteria for each Sustainability Indicator that, if exceeded in a locally defined combination of monitoring sites, may constitute an Undesirable Result for that indicator.
- **Measurable Objectives (MOs)**: MOs are specific, quantifiable goals for the maintenance or improvement of groundwater conditions. MOs use the same units and metrics as the MTs allowing for direct comparison.
- **Interim Milestones (IMs)**: IMs are a set of target values representing measurable groundwater conditions in increments of five (5) years over the 20-year statutory deadline for achieving sustainability.

Table ES-2 summarizes the SMCs for each applicable Sustainability Indicator in the Basin.

Table ES-2. SMC Summary

Sustainability Indicator	Undesirable Results Criteria	Minimum Threshold	Measurable Objective
Chronic Lowering of Groundwater Levels	At least one of the following occurs as a result of groundwater management within the Basin: 1. Groundwater levels decline below the established MTs in 25 percent or more of the RMW-WLs for two consecutive years, or 2. More than 10 drinking water wells are reported as dry in any given year, or 3. More than 170 drinking water wells are cumulatively reported dry by 2040 (10 wells per year over 17 years).	2015 Low Groundwater Elevation (Measured or Approximated Based on Available Data and Allowing for a Minimum of 20 Feet of Operational Flexibility Between the MO and MT)	2015 High Groundwater Elevation (Measured or Approximated)
Reduction in Groundwater Storage	Chronic Lowering of Groundwater Levels Used as a Proxy	Chronic Lowering of Groundwater Levels Used as a Proxy	Chronic Lowering of Groundwater Levels Used as a Proxy
Seawater Intrusion	Not Applicable	Not Applicable	Not Applicable
Degraded Water Quality	MTs for a groundwater quality COC are exceeded in 15 percent of the RMW-WQs in three consecutive semiannual monitoring events and are caused by groundwater management within the Basin.	The greater concentration of either: 1. The applicable health-based screening standard (MCL). 2. The baseline condition at each RMW-WQ, defined as the average measured concentrations in either: (1) the last calendar year with data in the period of 2010-2014; or if no data are available from 2010-2014, (2) the first calendar year with data after 2014 plus the maximum annual fluctuation range.	The MT concentration for each RMW-WQ and COC

Sustainability Indicator	Undesirable Results Criteria	Minimum Threshold	Measurable Objective
Land Subsidence	The extent or rate of subsidence exceeds the applicable MT at any RMS-LS as a result of groundwater management within the Basin, based on a 5-year moving average.	Extent: 2.0 ft of cumulative subsidence between 2020 and 2040 Rate: Maximum five year moving average rate of 0.2 ft/year of subsidence	Extent: 0.0 ft of cumulative subsidence after 2040 Rate: 0.0 ft/yr of subsidence after 2040
Interconnected Surface Water	MT is exceeded for two consecutive years caused by groundwater extraction within the Basin.	Model-estimated Basin-wide depletion rate of 12,000 AFY	Model-estimated Basin-wide depletion rate of 6,700 AFY

Justification of Sustainable Management Criteria:

The primary beneficial uses and users of groundwater in the Subbasin include groundwater pumpers, drinking water users, environmental beneficial users, and surface water rights holders. The SMCs in **Table ES-2** were developed to prevent significant and unreasonable impacts to groundwater uses and users and are justified (i.e., will not result in significant and unreasonable impacts) as follows for all applicable Sustainability Indicators.

Chronic Lowering of Groundwater Levels

- The MTs for Chronic Lowering of Groundwater Levels were established to ensure that they are sufficiently protective of Undesirable Results defined for all other relevant Sustainability Indicators for the Basin, as "setting groundwater level MTs at or above 2015 groundwater elevations will avoid undesirable results for other Sustainability Indicators beyond undesirable results that occurred before, and had not been corrected by, January 1, 2015" (SWRCB, 2024a).
- *Impacts to Beneficial Users*: Basin GSAs plan to implement a Well Mitigation Program to address potential impacts to domestic and small community wells from the Chronic Lowering of Groundwater Levels. A robust Basin-wide well impacts analysis was conducted to quantify potential impacts to beneficial users if groundwater levels reach their MTs, which was compared to the Chronic Lowering of Groundwater Levels Undesirable Results definition. Even in the worst-case scenario where all Representative Monitoring Wells for Chronic Lowering of Groundwater Levels (RMW-WLs) decline to MT groundwater levels, a maximum of 98 drinking water wells are expected to be impacted. Since the criteria for Undesirable Results for Chronic Lowering of Groundwater Levels is based on only 25 percent of RMW-WLs reaching their MTs, the number of impacted wells is projected to be significantly less. Further, since the Well Mitigation Policy (**Appendix N**) is designed be able to address at least 170 dry wells by 2040, even the "worst case" potential impacts are anticipated to be manageable. The Basin calculated the "depletion of supply" for this scenario to quantify the percentage of urban supply volume that may be impacted if groundwater levels decline to their MTs. Under the worst-case scenario, only 4.5 percent of the total estimated urban water supply volume would be impacted by 2040. This depletion of supply

is not considered to be significant and unreasonable, and the MTs were determined to be sufficiently protective of all groundwater pumpers, including drinking water wells users. Furthermore, the GSAs have adopted a policy to address MT exceedances observed in any individual RMW-WL as they occur, with the intent of preventing well dewatering.

- *Consideration of Adjacent Basins*: Since the MTs are set at the actual or interpolated 2015 Low groundwater levels, water levels under the MTs do not differ significantly from actual Fall 2015 water levels for both the Upper and Lower Aquifers. Therefore, it is not expected that the MTs will substantially alter groundwater level gradients beyond those experienced in 2015 or impact any adjacent basins' ability to achieve their respective sustainability goals.

Reduction of Groundwater Storage: If all RMW-WLs were to decline from Fall 2014 water levels to their Chronic Lowering of Groundwater Level MTs, the percent of usable storage would decrease by approximately 10 percent in the Upper Aquifer and remain relatively unchanged in the Lower Aquifer, which is equivalent to the reduction of storage that is not deemed to be significant and unreasonable. Furthermore, since the criteria for Undesirable Results for Chronic Lowering of Groundwater Levels is based on only 25 percent of RMW-WLs reaching their MTs, the percent reduction in usable storage volume that would occur at the point of Undesirable Results for Chronic Lowering of Groundwater Levels would be less than 10 percent. This analysis demonstrates that SMCs for Chronic Lowering of Groundwater Levels are protective against significant and unreasonable effects for Reduction of Groundwater Storage.

Degraded Water Quality

- *Impacts to Beneficial Users*: The MT for Degraded Water Quality is set as the greater concentration of either: (1) the applicable health-based screening standard[1], or (2) the baseline condition at each Representative Monitoring Well for Degraded Groundwater Quality (RMW-WQ), which is either: (1) the last calendar year with data in the period of 2010-2014 plus the maximum annual fluctuation range if observed at each RMW-WQ; or if no data are available from 2010-2014, (2) the first calendar year with data after 2014 plus the maximum annual fluctuation range if observed at each RMW-WQ.[2] Primary MCLs are health-based regulatory drinking water standards set to protect drinking water use, which is generally the most sensitive beneficial use.
- A significant portion of the Basin has historically degraded water quality. Therefore, in some areas of the Basin, it is appropriate to set MTs as a baseline condition, as "the plan may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015" (CWC § 10727.2(b)(4)). Further, while the extent of naturally degraded water quality in the Basin may be significant, it is not unreasonable given that it is largely due to naturally-occurring aquifer conditions and is not related to GSA management of the Basin.
- *Consideration of Adjacent Basins*: The MTs for Degraded Water Quality are not expected to impact adjacent basins' ability to achieve their sustainability goals, as MTs are set based on regulatory thresholds or baseline concentrations. Additionally, the water level MTs are not expected to cause

[1] The Maximum Contaminant Level (MCL) set by the SWRCB Division of Drinking Water (DDW) was used as the applicable health-based screening standard for all COCs.

[2] Maximum annual fluctuation range is determined based on measurements within any one year. Measurements from 1950 to 2015 are prioritized for determining the maximum annual fluctuation range.

significant changes to existing local groundwater gradients and are thus anticipated to be protective in terms of minimizing increased migration of poor-quality water from the Basin.

Land Subsidence

- *Impacts to Beneficial Users*: The criteria for Undesirable Results are justified because the MTs for Land Subsidence are tied back to the design standards for critical infrastructure within the Basin, which accommodate an additional 2.0 feet of inelastic subsidence by 2040. The criteria recognize that small amounts of subsidence could occur in some locations without negatively affecting the critical infrastructure, and that only to the extent that subsidence causes a loss of functional capacity does it qualify as significant and unreasonable.
- *Consideration of Adjacent Basins*: The SMCs for Land Subsidence were set to prevent additional inelastic subsidence from occurring after 2040 as a result of Basin groundwater management. This approach is generally consistent with the approach taken in the adjacent Chowchilla and Merced Subbasins, where the local GSAs also intend to prevent further inelastic subsidence after 2040. In recognition that avoidance of Undesirable Results due to Land Subsidence in the Basin crucially depends on successful management of subsidence hotspots in adjacent basins, the Basin GSAs will continue to coordinate with agencies in adjacent basins during GSP implementation to address subsidence hotspots. Similar to water quality above, while the observed subsidence rates in the Basin may be considered to be significant, they are not unreasonable to the extent that they are caused by factors outside of the Basin and outside of GSA control.

Depletion of Interconnected Surface Water

- *Impacts to Beneficial Users*: The criteria for Undesirable Results are justified because the MTs for the Depletion of ISW are tied back to the surface water depletion rate caused by groundwater extraction (pumping) within the Basin prior to the enactment of SGMA on January 1, 2015. The component of the criteria requiring two consecutive years of MT exceedances provides for confirmation that the depletion of ISW is chronic and not an anomaly.
- *Consideration of Adjacent Basins*: The MTs for the Depletion of ISW are not expected to impact adjacent basins' ability to achieve their sustainability goals, as MTs are set based on pre-SGMA depletion conditions. Additionally, the Chronic Lowering of Groundwater Levels MTs are not expected to cause significant changes to existing local groundwater gradients and are thus anticipated to be protective in terms of preventing additional Depletion of ISW due to groundwater pumping.

Relationships Between Sustainability Indicators

- Chronic Lowering of Groundwater Levels and Reduction in Groundwater Storage are directly, if not linearly, related. As shown in **Table ES-2**, groundwater level MTs are used as a proxy for Reduction of Groundwater Storage. If water levels in all RMW-WLs were to exceed MTs, approximately 10 percent decline in Upper Aquifer would occur relative to the baseline and Lower Aquifer would remain relatively unchanged, which is equivalent to the reduction of storage deemed to not be significant and unreasonable.
- Few contemporaneous and collocated water level and groundwater quality data exist for the Basin's COCs, and where they do exist, no clear correlation between Degraded Water Quality and

Chronic Lowering of Groundwater Levels (and Reduction of Groundwater Storage, by proxy), has been established. The Basin's proposed monitoring will further clarify the potential relationship between water quality and groundwater management during GSP implementation, including through collaboration with the Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS) Prioritization and Optimization study, in which the Basin is serving as an archetype study area (CV-SALTS, 2024).

- Historical inelastic land subsidence has been attributed to Chronic Lowering of Groundwater Levels, particularly due to pumping from the Lower Aquifer outside of and within the Basin. The MTs for Chronic Lowering of Groundwater Levels are set to prevent declines in water levels beyond 2015 conditions, thus they are intended to prevent additional inelastic land subsidence due to pumping within the Basin.
- A potential effect of Undesirable Results due to Land Subsidence is a Reduction of Groundwater Storage due to compaction that can occur in fine-grained layers during groundwater pumping, especially from the Lower Aquifer. The Chronic Lowering of Groundwater Levels MTs are used as a proxy for Reduction of Groundwater Storage and were demonstrated to be protective of Undesirable Results due to Reduction of Groundwater Storage. Chronic Lowering of Groundwater Level SMCs are also protective of Undesirable Results due to Land Subsidence. Through the correlation with Chronic Lowering of Groundwater Level SMCs, it is reasonable to conclude that Land Subsidence MTs will not cause an unreasonable Reduction of Groundwater Storage.
- Studies suggest that consolidation of subsurface layers with high clay content may liberate arsenic and cause Degradation of Groundwater Quality. However, there has been no observed correlation between Land Subsidence and any water quality COCs in the Basin. RMW-WQs have been selected in areas with historical subsidence to continue to monitor the potential relationship between subsidence and arsenic.
- The MTs for Chronic Lowering of Groundwater Levels are set to prevent declines in water levels beyond 2015 conditions, and thus are intended to prevent additional Depletion of ISW.
- The Chronic Lowering of Groundwater Levels MTs are used as a proxy for Reduction of Groundwater Storage and were demonstrated to be protective of Undesirable Results due to Reduction of Groundwater Storage. Chronic Lowering of Groundwater Level SMCs are also protective of Undesirable Results due to Depletion of ISW. Through the correlation with Chronic Lowering of Groundwater Level SMCs, it is reasonable to conclude that Depletion of ISW MTs will not cause an Unreasonable Reduction of Groundwater Storage.
- Changes in surface water-groundwater interaction are likely to impact the Upper Aquifer's water quality in areas primarily impacted by San Joaquin River seepage, due to the different water qualities of the river and the underlying Upper Aquifer. However, due to lack of sufficient data, no direct correlation could be discerned between Depletion of ISW and Degraded Water Quality. As more data are gathered from the Representative Monitoring Sites for Interconnected Surface Water (RMS-ISW) and RMW-WQ, these correlations will be reassessed and considered.

ES.9. Monitoring Network

The objective of the design and management of the SGMA Monitoring Network is to collect sufficient data to support assessment of the Sustainability Indicators relevant to the Basin, and the impacts to the beneficial uses and users of groundwater. The proposed SGMA Monitoring Networks are improved to ensure sufficient spatial distribution and spatial density. In the Basin, the SGMA Monitoring Network consists of 108 RMW-WLs) and (by proxy) groundwater storage (**Figure ES-6**), 90 RMWs for monitoring groundwater quality, 42 representative monitoring sites (RMS) for monitoring land subsidence (including survey points, extensometers, and Global Positioning System [GPS] sites), and 25 RMWs along with nine stream gauges for monitoring depletions of interconnected surface water. The Basin will continue to incorporate Interferometric Synthetic Aperture Radar (InSAR) data to assess land subsidence across the Basin.

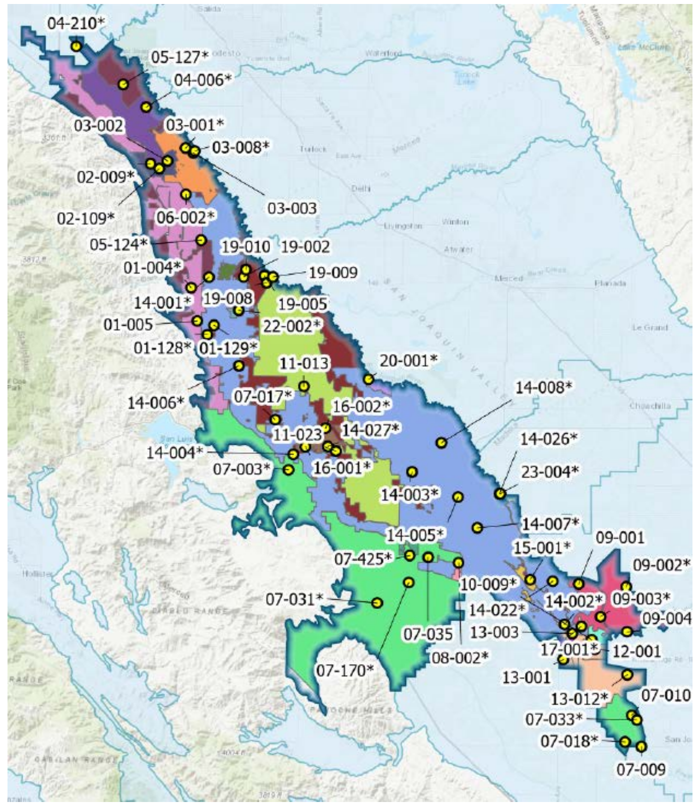

Figure ES-6. Upper Aquifer Representative Monitoring Network for Water Levels

The SGMA Monitoring Networks for the Basin supplement other active monitoring networks and programs in the Basin such as DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) program, Irrigated Lands Regulatory Program (ILRP), CV-SALTS, and San Joaquin River Restoration Program (SJRRR).

Data collected from the SGMA Monitoring Networks for the Basin will be uploaded to the Delta-Mendota Subbasin Data Management System (DMS) that is maintained for the Basin and reported to DWR in accordance with the Monitoring Protocols developed for the Basin. Data collected will undergo quality assurance and quality control reviews at the GSA level prior to being uploaded in the DMS. Additional data collected as part of other regular monitoring programs implemented within the Basin may be used in conjunction with data collected from the SGMA Monitoring Networks to meet compliance with GSP Regulations regarding annual reporting (23 CCR § 356.2) and Periodic Reviews (23 CCR § 356.4), or as otherwise deemed necessary by the GSAs. The DMS will continue to be updated as new data are collected.

ES.10. Projects and Management Actions

Achieving sustainability in the Subbasin will require implementation of P/MAs to address projected water budget deficits that contribute to groundwater level and storage declines and land subsidence, and also to address water quality impacts. As such, the GSAs have developed a portfolio of P/MAs, each with specific expected benefits, implementation triggers, and costs. For purposes of this GSP, the P/MAs have been organized into tiers based on implementation status or anticipated implementation date, where

"Tier 1" P/MAs have been implemented since 2020 and are currently operational, "Tier 2" and "Tier 3" P/MAs have expected implementation dates by 2030 and 2040 respectively, and "Tier 4" P/MAs will be implemented after 2040 or as needed. For example, the Basin GSAs are currently developing and intend to implement a PRP by January 2025 ("Tier 2" P/MA) that will achieve a 42,000 AFY reduction in pumping from the Basin by 2030.

The supply augmentation and demand reduction P/MAs identified by the Basin GSAs comprise a diverse portfolio of options that can be implemented as necessary to achieve sustainability from a total water quantity and water quality perspective. Additionally, if MT exceedances occur, accelerated implementation of P/MAs could be triggered, following steps outlined in the PRP.

A general implementation schedule, or "glide path", has been developed to show how the expected benefits from current and planned P/MAs will address the average annual overdraft of approximately 140,000 AFY by 2040 (see **Figure ES-7**). By 2040, approximately 30 percent of overdraft is projected to be addressed through pumping reduction P/MAs and approximately 70 percent through supply augmentation P/MAs, which in turn will increase or stabilize Basin groundwater levels. Due to uncertainties in the glide path relating to water supplies for supply augmentation projects and hydrologic conditions under climate change scenarios, a sensitivity analysis was conducted to ensure that the planned P/MAs are adaptable in the event of extreme conditions. Under each of these extreme scenarios, the Basin will still be on track to achieve sustainability by 2040.

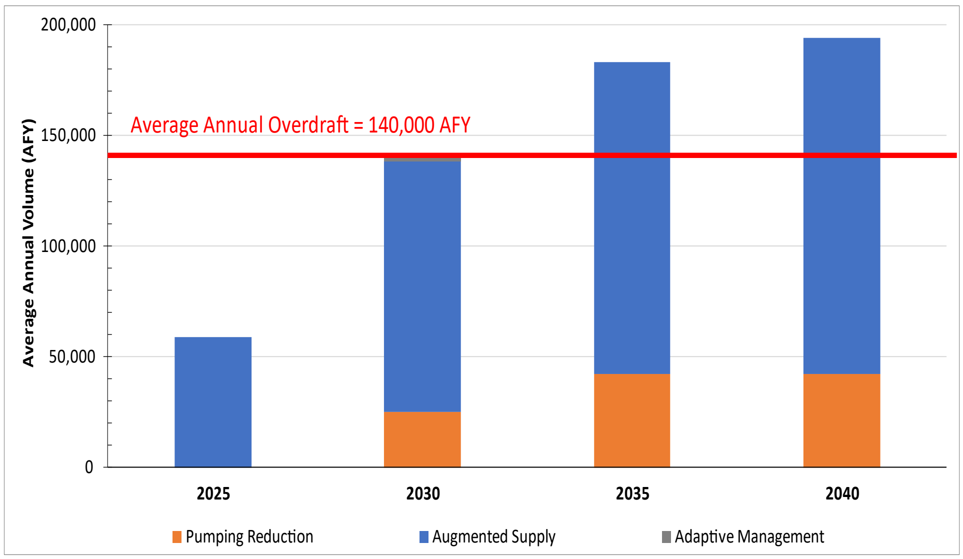

Figure ES-7. Projects and Management Actions Glide Path

The Model was also applied to predict future water level conditions with the implementation of the P/MAs and to assess if Undesirable Results[3] would be expected to occur in the Basin between now and 2040 under 2030 Central Tendency Climate Change Scenario. Specifically, the hydrographs at 71 of the RMW-WLs that are explicitly represented in the Model were evaluated to assess if more than 25 percent of them exceeded their MT between now and 2040.[4] Based on a review of the hydrographs against the SMCs,

[3] For the purposes of this assessment, this portion of the Decline in Groundwater Levels Undesirable Results definition was used: "Groundwater levels decline below the established MTs in 25 percent or more of the RMW-WLs for two consecutive years (i.e., based on measurements from two seasonal high groundwater level periods and two seasonal low groundwater level periods)".

[4] Because some of the RMW-WLs did not have any historical data or have not yet been constructed they were not explicitly represented in the Model. As such this analysis assumed that as long as no more than 25 percent of the 71 RMW-WLs exceed that MT, then by inference no more than 25 percent of the entire RMW-WL network will exceed the MT and create an Undesirable Result.

fewer than 25 percent of the RMW-WLs are projected to exceed their respective MTs in any given year between now and 2040 and no Undesirable Results are projected to occur with successful implementation of the P/MAs and the PRP.

Further, based on the projected Model water budget for the 2030 Central Tendency Climate Change with P/MAs, assuming the successful implementation of P/MAs and focused and adaptive implementation of the PRP, the Basin is projected to maintain aquifer storage above WY 2015 levels for the entire projected period (WY 2024-2073) in the Upper Aquifer and after WY 2040 in the Lower Aquifer (as shown in **Figure ES-8**), consistent with the Basin's Sustainability Goal.

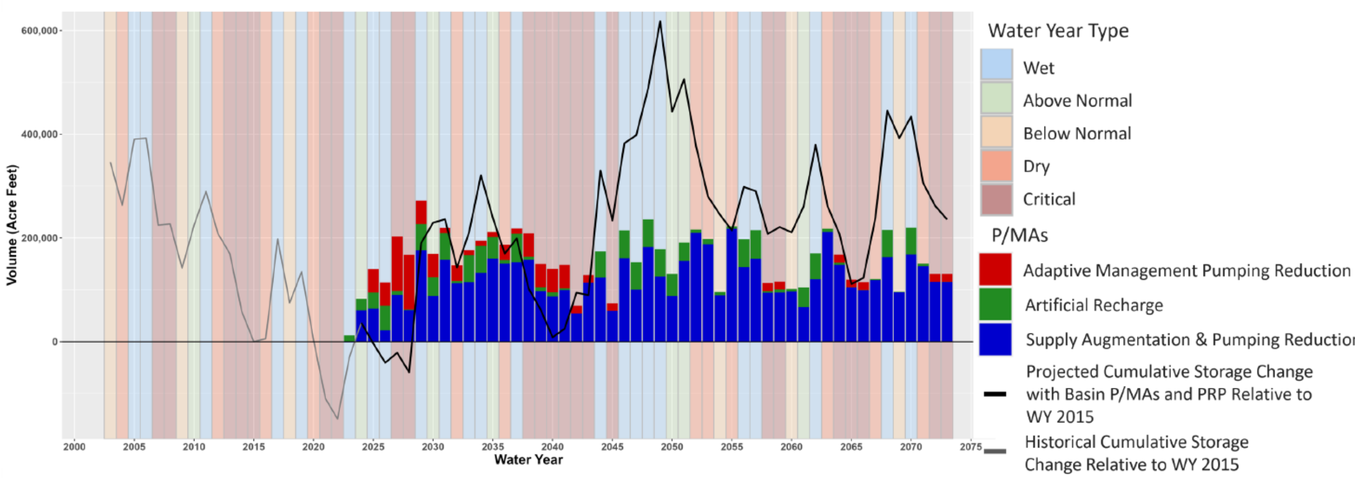

Figure ES-8. Projected Mitigation of Basin Overdraft as a Result of GSP Implementation

ES.11. GSP Implementation

Key Plan and related groundwater management implementation activities to be undertaken by the GSAs over the next five years and through 2040 include:

- Implementation of the Basin's PRP;
    - To address overdraft, the Basin developed a coordinated PRP, which includes a clear implementation plan and schedule to support successful execution beginning January 2025. The implementation plan requires the Basin GSAs to determine specific technical approaches and triggers by October 2024. The Basin GSAs are also required to implement and develop the needed monitoring, administrative, and technical tools, and to conduct the necessary education and outreach by January 2025. The PRP is comprised of six components that, when collectively implemented, should ensure successful compliance with the GSP's SMCs and pumping within the Sustainable Yield: (1) monitoring and data collection, (2) overdraft mitigation plan, (3) groundwater level minimum threshold avoidance plan, (4) water quality minimum threshold exceedance plan, (5) subsidence avoidance plan, and (6) groundwater allocation backstop.
- P/MA implementation, funding, financing, and grant application(s);

- Addressing data gaps, including Model calibration;
- Model refinement and calibration to improve local representation of Basin conditions, including groundwater levels and subsidence;
- Intra-basin and inter-basin coordination;
- Continued outreach and engagement with stakeholders;
- Response to DWR and SWRCB comments on the GSP;
- Continued monitoring, data collection, and annual reporting;
- Enforcement and response actions, including Well Mitigation Policy; and
- Evaluation and updates of the GSP as part of the required Periodic Evaluation.

Collectively, the Plan Implementation Activities described herein demonstrate the Basin GSAs have been actively implementing specific P/MAs, policies, and programs to sustainably manage groundwater resources for all beneficial uses and users of groundwater and continue to meet the Sustainability Goal defined for the Basin.

The costs associated with continued activities by the GSAs fall under two main categories: (1) GSA administration costs, and (2) Costs to implement P/MAs, including capital/one-time costs and ongoing costs. For GSA-specific P/MA implementation, the GSAs intend to meet these cost obligations through a combination of landowner contributions (within their jurisdictions), water rates, partnering agencies, low-cost loan programs, grant funding (DWR, United States Bureau of Reclamation, SWRCB, California Natural Resources Agency, etc.), locally available funds, and other available sources to be determined. Over the first 5-year period (i.e., 2025-2030), Basin-wide costs associated with GSA administration are estimated to range from $2.4M per year in 2025 to $3.9M per year in 2040.

ES.12. Conclusion

The GSAs recognize that groundwater resources management in California fundamentally changed with the passage of SGMA. SGMA has introduced concepts, actions, and deadlines necessary to achieve the stated goals and to avoid Undesirable Results. For the "high priority" and "critically overdrafted" basins, there is a renewed commitment to better monitor, prepare for, and respond to these issues. The GSAs are utilizing authorities granted to them under SGMA to fund, strategically plan, gather additional information, and develop projects and roadmaps for their jurisdictions within the Basin, as coordinated with all GSAs in the Basin and detailed in this GSP. Through the monitoring network, modeling efforts, and P/MAs, the GSAs are confident they can achieve the Sustainability Goal in the Basin by the SGMA-mandated deadlines, and well into the future. The GSAs are committed to this long-term coordinated groundwater management effort, engaging with its communities and stakeholders, and building consensus to ensure groundwater resources within the Basin are adequate and reliable for future generations.