9 WATER BUDGET INFORMATION

§ 354.18. Water Budget
(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.
(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.

☑ **23 CCR § 354.18(a)**
☑ **23 CCR § 354.18(f)**

This section presents information on the water budget for the Delta-Mendota Subbasin (Basin). All Groundwater Sustainability Agencies (GSAs) in the Basin coordinated and collaborated on the development and application of an integrated hydrological model (Model) to evaluate Basin conditions. Consistent with the Groundwater Sustainability Plan (GSP) Regulations (California Code of Regulations Title 23 [23 CCR] Division 2 Chapter 1.5 Subchapter 2) and California Department of Water Resources' (DWR's) Best Management Practices (BMP) #4 Water Budget (DWR, 2016c), this water budget provides an accounting of the total annual volume of water entering and leaving the Basin for historical, current, and projected future conditions.

As discussed in **Section 9.1** below, the water budgets are presented for the two interconnected water budget systems quantified by the Model: (1) land-surface water system, and (2) groundwater system within the Basin. These water budgets are developed and presented following the terminology and methodology proposed by the *Handbook for Water Budget Development With or Without Models* (DWR, 2020a).

The land-surface water system inflows include precipitation, stream inflow, stream-groundwater interaction inflow, and applied water, including groundwater extraction and surface water delivery and diversion. Land-surface water system outflows include evapotranspiration, infiltration, stream outflow, and stream-groundwater interaction outflow.

Inflows to the groundwater system include groundwater recharge, including recharge of precipitation, applied water, and artificial recharge, subsurface inflows from Basin boundaries or adjacent principal aquifers and aquitards, inflows from stream-groundwater interaction, and water released from storage caused by subsidence. Groundwater system outflows include groundwater extraction, subsurface outflows across Basin boundaries and to adjacent principal aquifers/aquitards, stream-groundwater interaction outflows to the stream network, and losses from the unsaturated zone caused by evapotranspiration and drains. The difference between groundwater inflows and outflows represents the "net change in groundwater storage".

9.1 Water Budget Methods and Data Sources

§ 354.18. Water Budget
(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:
(6) The water year type associated with the annual supply, demand, and change in groundwater stored.
(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.

☑ **23 CCR § 354.18(b)(6)**
☑ **23 CCR § 354.18(e)**

9.1.1 Overview of Methodology

☑ **23 CCR § 354.18(e)**
☑ **23 CCR § 354.18(f)**

The water budget information presented herein is based on the use of a three-dimensional (3-D) groundwater flow model (Model) that uses the United States Geological Survey's (USGS) Central Valley Hydrologic Model Version 2 – San Joaquin Valley (CVHM2-SJV) groundwater modeling platform (see **Appendix H**). As recommended by the *Conceptual Master Plan for Subsidence Monitoring and Management* (GSI Environmental Inc., 2022), the Model has been refined based on site-specific information for the Basin. Like all finite-element numerical groundwater flow models, the Model divides the spatial model domain into a network of finite-element cells (3-D mesh), applies estimates of aquifer hydraulic properties to each cell, and calculates water fluxes between element nodes by solving a system of equations based on groundwater flow principles. The spatial grid and orientation in the Model domain are shown in **Figure WB-1**.

The Model simulates the interrelated processes associated with the land-surface water system and the groundwater system. As shown in **Figure WB-2**, the land-surface water system interacts with the groundwater system via stream leakage and/or seepage to and from groundwater, and via the fraction of precipitation and applied water that ultimately becomes deep percolation to groundwater. As described in DWR's BMP #4 Water Budget (DWR, 2016c), it is useful in some basins to develop water budgets with additional detail beyond what is explicitly required by the GSP Regulations. These additional details are necessary because of the complex interrelationships between water use practices, groundwater conditions, subsurface groundwater flows across Basin boundaries, and groundwater/surface-water interactions and their net influence on the Basin water budget. The Model represents the Basin using the characteristics, processes, and data summarized below.

- The Model covers the entire Basin with a uniform horizontal discretization of 1x1 square mile oriented parallel to the Central Valley axis, 34 degrees west of north (Traum et al., 2024).
- The Model is divided into 13 layers in the vertical direction representing the Principal Aquifers and

Aquitard as described in the Basin Hydrogeological Conceptual Model (HCM). Layers 1 to 5 represent the Upper Aquifer, layers 6 to 8 represent the Corcoran Clay, and layers 9 to 13 represent the Lower Aquifer.

- The Model incorporates updated information on surface water deliveries (Central Valley Project [CVP] and State Water Project [SWP] water) provided by GSAs contributing to groundwater and surface-water interactions for Water Year (WY) 2010-2023.
- The Model is extended to WY 2023 using public data, historical data from similar WY type, and data received from GSAs.
- Groundwater pumping is estimated by the Model, including agricultural, municipal, and domestic pumping.

As discussed in **Appendix H,** while not fully calibrated, the Model adequately represents the conditions of the Basin and adjacent basins to support development of this GSP.

9.1.2 Water Budget Periods

☑ **23 CCR § 354.18(a)**

Per 23 CCR § 354.18(a), water budgets are quantified for Historical, Current, and Projected periods. The historical period is defined herein as the sixteen-year period between WY 2003 and 2018, which includes historical surface water delivery and land use conditions in the Basin, represents average hydroclimatic conditions, and satisfies the required minimum extent of ten (10) years. As shown in **Table WB-1**, the 16-year average precipitation for the Basin represented in the Model for the historical period was 10.5 inches per year (in/yr).

The Historical period, provides a balanced mix of water year types similar to long-term average hydrology (25 percent wet years, 6 percent above-normal years, 19 percent below-normal years, 19 percent dry years, and 31 percent critical years), and includes a representative, although likely overestimated, number of Shasta Critical Years, which impacts and reduces the San Joaquin River Exchange Contractors (SJREC) and Grassland Water District (and other wildlife refuges) surface water deliveries. The SJREC and Grasslands import over 66 percent of the surface water used in the Basin due to their senior water rights, and their allocations are influenced by inflows to Shasta Reservoir. The 16-year period from WY 2003-2018 was considered to adequately represent average hydrologic conditions for purposes of quantifying the historical water budget for the Basin.

The Current period is selected as the five years between WY 2019 and 2023, representing the most recent hydrology, water supply, water demand, and land use conditions in the Basin. The five-year averaging period is believed to be more representative of Basin's current conditions than any single recent year due to the highly variable hydroclimatic conditions (multiple wet and critical years) experienced in the past five years.

The Projected period is synthesized according to the 23 CCR § 354.18(c) using the 50-year historical period of WY 1973-2022 for climatic conditions, which follows the current period ending in WY 2023 and extends from WY 2024 through WY 2073. The projected period uses the most recent land use provided by DWR at the time of GSP development (2021 Land Use). It assumes operations of the Basin's water supply system, such as artificial recharge, surface water diversions and deliveries, and groundwater extractions, correspond to the WY 2003-2022 period based on water year types and the San Joaquin Valley Water Year Index (SJV Index). As discussed in **Section 9.4**, the Projected period is also used to simulate climate change impacts on the Basin, using the DWR proposed methodology and 2030 and 2070 climate change scenarios (DWR, 2018c).

Table WB-1. Summary of Precipitation Represented in the Numerical Model, WY 2003-2023

Water Year	Annual Precipitation (inches)	Water Year Type(1)	Water Year Index(1)
2003	10.9	BN	2.81
2004	9.0	D	2.21
2005	17.1	W	4.75
2006	13.4	W	5.9
2007	5.7	C	1.97
2008	8.6	C	2.06
2009	7.9	BN	2.72
2010	14.0	AN	3.55
2011	16.0	W	5.58
2012	7.2	D	2.18
2013	7.3	C	1.71
2014	5.3	C (SC)	1.16
2015	7.8	C (SC)	0.81
2016	14.8	D	2.35
2017	16.1	W	6.46
2018	7.5	BN	3.03
Historical Period Average (WY 2003-2018)	***10.5***	-	***3.08***
2019	13.4	W	4.94
2020	8.5	D	2.35
2021	6.4	C (SC)	1.32
2022	7.7	C (SC)	1.56
2023	16.1	W	6.46
Current Period Average (WY 2019-2023)	***8.8***	-	***3.32***

Abbreviations:
AN = Above Normal BN = Below Normal C = Critical Dry D = Dry W = Wet
SC = Shasta Critical WY = Water Year

Notes:
(1) DWR Water Year types are based on the San Joaquin Valley Water Year Hydrologic Classification Index that is based on unimpaired natural water runoff to the San Joaquin Valley, and are as follows: W = wet, AN = above normal, BN = below normal, D = dry, C = critical.
(2) Datasets for WY 2023 are not all readily available. WY 2017 precipitation data are used for WY 2023 based on similar water year type.

9.1.3 Data Sources

☑ 23 CCR § 354.18(e)

Per 23 CCR § 354.18(e), the best available data were used to evaluate the water budget for the Basin. Estimates of water budget components are provided directly by the Model. Some components, such as precipitation and surface water delivery, are input data provided by the GSAs when available, while other components are calculated by the Model (i.e., evapotranspiration, infiltration, stream-groundwater interaction, etc.). The Model uses various sources of data for its input, as discussed in **Appendix H**. All input data and preliminary analysis used to develop the Model for April 1961 to September 2019 (Model Baseline) are from CVHM2 (Traum et al., 2024). Surface water delivery and diversion data were adjusted between WY 2010-2023 based on local data provided by individual GSAs. The Model was extended from October 2019 to September 2023 (extension period) to simulate the most recent conditions of the Basin up to the time of GSP development and cover the defined Current period. Generally, the same data sources were utilized for the extension period, if available, as used for the Model Baseline. However, the following assumptions were made due to unavailable or incomplete data:

- DWR 2019 and 2020 statewide crop mapping were used for WY 2019-2020, while 2021 statewide crop mapping was used for WY 2021-2023;
- Surface water delivery, stream diversion, and municipal groundwater pumping for the extension period were assumed to be the same as the water year with the same water year type and nearest SJV Index from WY 2003-2019.
- Due to the unavailability of the SJV Index and climatic, runoff, and recharge data from the USGS Basin Characterization Model (BCM) for WY 2023, data for WY 2017 were used based on the same water year type.

Data Sources for each water budget component are further described in **Section 9.2** below.

9.2 Water Budget Components

§ 354.18. Water Budget
(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:
(1) Total surface water entering and leaving a basin by water source type.
(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.
(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

A description of the water budget components that comprise inflows and outflows to the land-surface water system and groundwater system is provided below. A brief discussion of methodologies and data sources used to estimate each component for Historical, Current, and Projected water budgets is provided. A more detailed description of methodologies and processes is provided in **Appendix H**. Water budget results for the Historical and Current water budget periods are presented in **Section 9.3** and water budget results for the Projected future scenarios are presented in **Section 9.4**.

9.2.1 Land-Surface Water System Inflows and Outflows

☑ 23 CCR § 354.18(b)(1)

The land-surface water system budget represents the total amount of water entering and leaving the Basin on the ground surface. Per 23 CCR § 354.18(b)(1), **Table WB-2** provides an annual summary of inflows to and outflows from the land-surface water system by water source type for WY 2003-2023. The following sections describe each land-surface water budget component.

Precipitation

Precipitation on lands within the Basin contributes to the overall land-surface water system budget. Total precipitation across the Basin was estimated based on the USGS BCM (Flint et al., 2021). Precipitation falling on the Basin either becomes surface water runoff that is channeled to nearby drainages and streams or wets the near-surface soil. Water in near-surface soil either evaporates or continues to infiltrate into the subsurface, where it can be consumed by agricultural crops and natural vegetation or continues to percolate downwards to the groundwater table.

Evapotranspiration

The largest outflow from the land-surface water system is evapotranspiration (consumptive use) by crops and plants. The USGS BCM evapotranspiration data were utilized to estimate the consumptive use of water in the Basin, including agricultural uses and direct evaporation from surface water bodies and phreatophytes (i.e., groundwater dependent ecosystems [GDEs]) (Flint et al., 2021).

Stream Inflow and Outflow

The primary natural surface water features in the Basin are the San Joaquin River and its tributaries (**Section 7.3.5**, **Figure HCM-23**). The San Joaquin River flows northward along the eastern edge of the Basin. Although it forms the boundary of the Basin over most of its extent, inflow to and outflow from the San Joaquin River is accounted for in calculation of stream inflow and outflow for the land surface water system budget. The calculation also includes exchanges of flows with rivers and tributaries that flow into the San Joaquin River or branch out of it (i.e. Merced River, Kings River, etc.)

On the western side of the Basin, numerous intermittent streams originating in the Coast Range flow east/northeast into the Basin. Most of these intermittent streams do not have channels extending all the way east to the San Joaquin River, exceptions being the channels of Orestimba Creek, Los Banos Creek, and Del Puerto Creek. Most of the Basin's surface water inflows occur in the San Joaquin River, with much lesser quantities occurring in the smaller tributaries.

Portions of precipitation falling on the Basin and applied water that runs off to nearby drainage become surface water runoff that is channeled to nearby drainages and streams, contributing to stream outflows. Several factors influence the rate and volume of surface water runoff, including the intensity and duration of precipitation, soil type and infiltration capacity, slope of the land, land use and land cover, and the presence of impervious surfaces like pavement or buildings.

Return flow from applied water also contributes to stream outflows from the Basin. Applied water is apportioned into consumptive use (i.e., evapotranspiration or ET) by crops and other plants and evaporation from land surface, infiltration past root zone, and runoff and interflow commonly referred to as return flow. Return flow is calculated as a fixed percentage of the total applied water in the Model, a common assumption used in most modeling platforms.

Delivery canals and major diversion structures such as the Delta-Mendota Canal and California Aqueduct are also simulated in the model. The inflow and outflow from these canals are included in calculation of the stream inflow and outflow from the Basin.

Applied Water

Applied water is water directly applied to agricultural crop lands for irrigation use and related cultural practices. Applied water includes surface water delivery and diversions, and groundwater pumping used to meet remaining ET demands. Imported CVP and SWP water has been delivered to the Basin through the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and the Delta-Mendota Canal, in addition to the San Joaquin River (see **Section 7.3.5**). Surface water deliveries from the CVP began in the early 1950s, and from the SWP in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Basin, with CVP supplies used directly by nine Basin GSAs and additionally as part of recharge and exchange programs, as described in **Section 5.1**. By contrast, only Oak Flat Water District receives deliveries from the SWP.

Water is diverted for irrigation at various points along the San Joaquin River by entities within and outside of the Basin. Surface water delivery and diversion data were based on CVHM2 (Traum et al., 2024) and adjusted between WY 2010-2023 based on local data measured and provided by individual GSAs.

Groundwater pumping from private irrigation wells was estimated by the Model using the Farm Process package (FMP2) and Multi-node Well package (MNW2) based on water supply and demand. Municipal and rural pumping estimates are based on datasets compiled by DWR for the C2VSim model, where available, and were otherwise estimated based on U.S. Department of Commerce Census Bureau population datasets and a water use factor of 275 gallons per person per day (Traum & Faunt, 2022).

Stream – Groundwater Interactions

Flows within creeks, streams, and rivers can seep to the underlying groundwater system (i.e., a losing stream condition). Alternatively, groundwater can seep into the surface water feature (i.e., a gaining stream condition). Therefore, leakage signifies a loss of streamflow to groundwater (*stream – groundwater interaction outflow)* and seepage signifies a gain of streamflow from groundwater (*stream – groundwater interaction inflow)*. Stream-groundwater interaction is calculated by the Model based on stream stage, assumed streambed properties, and the surrounding Model-calculated groundwater levels. Stream stage is calculated by the Model based on specified stream channel properties, as described above.

Infiltration

The portion of precipitation and applied water that is neither consumptively used by plants via ET or returned as runoff or return flow to surface water channels percolates past the root zone to recharge groundwater aquifer. This component, infiltration, is calculated by the Model.

Change in Land-Surface Water System Storage

Land-surface water system inflow into the Basin is primarily driven by precipitation, stream inflow, stream-groundwater interaction inflow, and applied water, including groundwater extraction and surface water delivery and diversion. Land-surface water system outflow includes evapotranspiration, infiltration, stream outflow, and stream-groundwater interaction outflow. The differences between the land-surface water system inflow and the land-surface water system outflow are the changes in land-surface water system storage.

9.2.2 Groundwater System Inflows and Outflows

☑ **23 CCR § 354.18(b)(2)**
☑ **23 CCR § 354.18(b)(3)**

The groundwater system budget represents the total amount of water entering and leaving the groundwater system within the Basin. Per 23 CCR § 354.18(b)(2) and (b)(3), **Table WB-3** and **Table WB-4** provide an annual summary of inflows to and outflows from the groundwater system (Upper Aquifer and Lower Aquifer, respectively) by water source type for WY 2003-2023. The following sections describe each of the groundwater budget components.

Groundwater Recharge

Groundwater recharge includes recharge of precipitation, applied water, or artificial recharge. Portions of excess precipitation and applied water infiltrate into the ground and replenish the groundwater system.

Losses from Unsaturated Zone

Losses from unsaturated zone include evaporation and drain outflow from shallow groundwater in areas of shallow groundwater conditions and drains. This primarily occurs in areas that support GDEs and where drains are installed due to shallow groundwater levels. Losses from the unsaturated zone are estimated by the Model based on unsaturated zone ET estimations under FMP package and defined drain heads and estimated groundwater heads under its Drain Return Package (DRT).

Subsurface Inflow and Outflow from Basin Boundaries

Subsurface inflow refers to the movement of groundwater from outside the Basin boundaries into the Basin and leakage from adjacent principal aquifers/aquitards, and subsurface outflow refers to the movement of groundwater from within the Basin to areas outside of the Basin and leakage outflow to adjacent principal aquifers/aquitards. Subsurface inflow and outflow are calculated by the Model based on estimated groundwater elevations and defined aquifer properties and are highly dependent on Model assumptions regarding conditions in the adjacent basins and remain a significant source of uncertainty (**Appendix H**).

Stream-Groundwater Interaction

Stream-groundwater interaction is estimated using stream stage, assumed streambed properties, and surrounding groundwater levels determined by the Model. Leakage of streamflow from creeks, streams, and rivers to groundwater (*stream – groundwater interaction inflow)* and seepage of groundwater into surface water bodies (*stream – groundwater interaction outflow)* affect the available water supply within the Basin and can have considerable impacts on the change in groundwater storage calculated Basin-wide. Stream-groundwater interaction is estimated primarily by the Model through stream properties and parameters defined in the Streamflow Routing Package (SFR), including inflow at headwaters (Traum et al., 2024).

Groundwater Extraction

Groundwater extraction is the process of withdrawing water from the underlying aquifers through wells, pumps, and other infrastructure. Methods used by the Model to calculate agricultural, municipal, and domestic pumping are described in **Section 9.2.1**.

Change in Groundwater Storage

Inflows to the groundwater system comprise groundwater recharge, including recharge of precipitation, applied water, or artificial recharge, subsurface inflow from Basin boundaries or adjacent principal aquifers and aquitards, inflow from stream-groundwater interaction, and water release caused by subsidence. Groundwater system outflows are primarily driven by groundwater extraction, subsurface outflow across Basin boundaries and to adjacent principal aquifers/aquitards, stream-groundwater interaction outflow to the stream network, and losses from the unsaturated zone caused by evapotranspiration and drains. The difference between groundwater inflows and outflows represents the net change in groundwater storage. The change in groundwater storage is calculated by the Model by solving the groundwater flow equation. A positive change in storage indicates an increase in groundwater storage and a negative change in storage indicates a decrease in groundwater storage.

Water Release Caused by Subsidence

Water release caused by subsidence refers to water released to an aquifer on a one-time basis as a result of land subsidence, which is caused by the inelastic consolidation of porous fine-grained material. Water release by subsidence was estimated by the Model through the Subsidence and Aquifer-System Compaction (SUB) package (**Appendix H**) and is representative of changes in aquitard storage. The volume of water release caused by subsidence is associated with an equivalent permanent loss of storage capacity in this Basin. This volume is ultimately added to the change in groundwater storage in estimating the Basin overdraft and sustainable yield. As discussed in **Appendix H**, the Model currently generally overestimates the extent of subsidence in the Basin; therefore, the volume of water release caused by subsidence is also overestimated, leading to conservative estimations of net groundwater storage change and overdraft. Further, sensitivity analyses conducted as part of 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. As such, the Basin overdraft attributable to GSA management has been overestimated and the sustainable yield has been underestimated herein.

9.3 Historical and Current Water Budget

9.3.1 Historical Water Budget

§ 354.18. Water Budget
(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:
(4) The change in the annual volume of groundwater in storage between seasonal high conditions.
(5) If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:
(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.
(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.
(C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.
(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:
(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.

☑ **23 CCR § 354.18(c)(2)**
☑ **23 CCR § 354.18(d)(1)**

The Historical water budget for the Basin was estimated using the Model for the period October 2003 through September 2018, which is defined as the Historical period. Because agricultural water demands, streamflow conditions, surface water supply, and consequently the potential occurrence of overdraft conditions are heavily dependent on water year type, this section provides estimates of average water budget components for each water year type, as well as for the overall 16-year Historical period.

Table WB-2 shows the land-surface water system water budget for the Historical period. Land-surface water system inflows are driven by precipitation and surface water delivery, which are both correlated with water year type. The primary driver of outflows from the land-surface water system is evapotranspiration, which is comparably less correlated with water year type. Therefore, groundwater extraction expected to cover the remainder of the evapotranspiration demand not satisfied by precipitation and surface water delivery, also correlates heavily with water year types, increasing in the drier years and decreasing in the wet and above normal years.

This trend is observed more clearly in the Current water budget due to its more consistent land use definition within the Basin throughout the period. The variability in land use and surface water delivery allocation amounts during the Historical period impacts the relative correlation of groundwater pumping and water year types among years. However, an overall increasing trend in evapotranspiration and groundwater pumping can be observed in the Historical period, indicating growing consumptive use due to the increase in farmed acreage, conversion to crops with higher irrigation demand, and municipal growth.

Table WB-3 and **Table WB-4** show the groundwater system water budget for the Upper Aquifer and the Lower Aquifer, respectively, for the Historical period. Primary inflows to the groundwater system are groundwater recharge and stream-groundwater interaction inflow, while major outflows include pumping and losses from the unsaturated zone.

The Upper Aquifer receives a net subsurface inflow from the Basin boundary but loses a greater average volume to leakage to the Lower Aquifer, leading to a net subsurface outflow (**Table WB-3**). In contrast, the Lower Aquifer loses a net subsurface outflow from the Basin boundary that is smaller than the average volume of water it receives as leakage from the Upper Aquifer. Therefore, the Lower Aquifer shows an average annual net subsurface inflow (**Table WB-4)**. However, this net subsurface inflow, combined with the relatively small inflows from stream-groundwater interaction and groundwater recharge, is considerably smaller than the total groundwater pumping from the Lower Aquifer, leading to water release caused by subsidence and a decrease in Lower Aquifer groundwater storage.

Based on DWR's San Joaquin Valley WY Hydrologic Classification Index for the 16-year Historical averaging period (WY 2003-2018), the period is characterized by sequences of relatively dry and wet conditions resulting in near-average conditions. The climatic effects are clearly reflected in the water budget, whereby both Upper and Lower Aquifers show consistent increases in storage with wetter conditions and decreases in storage under drier conditions (see **Figure WB-3** and **Figure WB-4**).

9.3.1.1 Historical Surface Water Availability and Reliability

☑ **23 CCR § 354.18(c)(2)(A)**

As discussed in **Section 8.2.4**, the introduction of imported water supplies to the Basin in the early 1950s resulted in a decrease in groundwater pumping in some parts of the Basin. During the recent droughts of 2012-2016 and 2020-2022, diminished deliveries of imported and local surface water led to increased pumping of groundwater to meet irrigation demands. During the height of the drought in 2014, CVP and SWP allocations for agricultural water service contractors were 0 percent, Exchange Contractors and refuge deliveries were less than 75 percent, and post-1914 surface water rights in the San Joaquin River watershed were curtailed (Delta-Mendota GSAs, 2022a; USBR 2023). Based on SJREC's contracts, SJREC's surface water allocation is only reduced under Shasta critical years and remains at 100 percent in all other types of water years.

During the Historical period, surface water deliveries in the Basin averaged 1,332,000 acre-feet per year (AFY) annually but fluctuated depending on water year types. Annual surface water deliveries in wet years exceeded the historical period's average but were below average during Shasta Critical years. However, average annual surface water deliveries were above the Historical period's average in wet, above normal, below normal, and dry water years and fell below the Historical period's average in critical and Shasta Critical water years, respectively. This highlights the reliability of surface water supplies in the Basin, which is unique relative to much of the southern Central Valley.

9.3.2 Current Water Budget

§ 354.18. Water Budget
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.
(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:
(1) Current water budget information for temperature, water year type, evapotranspiration, and land use.

☑ **23 CCR § 354.18(c)(1)**
☑ **23 CCR § 354.18(d)(2)**

The Current water budget for the Basin was estimated using the Model for the period October 2019 through September 2023, which is defined as the Current period. Per 23 CCR § 354.18(c)(1), total inflows and outflows are summarized by hydrologic system: (1) land-surface water system, and (2) groundwater system. This section presents results for the Current water budget based on average values for the WY 2019-2023 time period.

As shown in **Table WB-2**, the increasing evapotranspiration demand in the Basin during the Current period is primarily met through additional groundwater extraction as compared to the Historical period. The extreme climatic conditions during the Current period, highlighted in total precipitation and evapotranspiration, caused significant changes in groundwater extraction, stream-aquifer interaction, and stream inflow and outflow.

As shown in **Table WB-3**, the total inflow to the Basin's Upper Aquifer during the Current period were greater than during the Historical period. These greater inflows were reflected in all groundwater inflow components, including groundwater recharge, stream-groundwater interaction, and subsurface inflow from the boundaries. Similarly, total outflows from the Basin's Upper Aquifer were greater than during the Historical period, including significantly greater total groundwater extraction. The overall increases in the Upper Aquifer's volumetric groundwater budget terms led to an overall average annual increase in groundwater storage, largely due to the extremely wet years of 2019 and 2023.

Similar to the Upper Aquifer, total inflow and outflow from the Basin's Lower Aquifer were greater during the Current period when compared to the Historical period (**Table WB-4**). Groundwater extraction and water release caused by subsidence were also greater during the Current period, largely due to the extremely dry period of WY 2020-2022, and the limited recharge of the Lower Aquifer within Basin boundaries.

9.3.3 Change in Groundwater Storage

☑ **23 CCR § 354.18(b)(4)**

Per 23 CCR § 354.18(b)(4), **Figure WB-3, Figure WB-4, Table WB-3** and **Table WB-4** present the annual and cumulative storage change in the Upper and Lower Aquifers along with their respective annual and cumulative volume of water release caused by subsidence. As mentioned in **Section 9.2**, the water release caused by subsidence is a one-time release of water due to compaction of aquitards, is considered a permanent loss of storage, and has been considered when quantifying the Basin's overdraft and sustainable yield. We do note, however, that due to the Model's current overestimation of subsidence rates and extent in the Basin, the water release caused by subsidence is also overestimated, leading to conservative estimates of the overdraft, total storage change, and sustainable yield.

Figure WB-3, Figure WB-4, Table WB-3 and **Table WB-4** present the annual and cumulative storage change and water release caused by subsidence in relation to the water year type, based on DWR's San Joaquin Valley Water Year Hydrologic Classification Index for WY 2003-2023, and averaging period (21-year average [WY 2003-2023], Historical [WY 2003-2018], and Current [WY 2019-2023] periods). The Upper Aquifer shows an average annual storage change of -16,000 AFY, +3,000 AFY, and -11,000 AFY during the Historical, Current, and WY 2003-2023 periods, respectively. The average annual volumes of water release caused by subsidence are -4,000 AFY, -6,000 AFY, and -4,000 AFY during the same periods.

The Upper Aquifer storage change shows a clear correlation with water year types, with increasing storage during Wet and Above Normal years and decreasing storage during Below Normal, Dry, Critical, and Shasta Critical years. While the positive net storage change (accretion) in the Upper Aquifer happens more frequently within the Historical and Current periods, the depletions caused in Critical and Shasta Critical years lead to an overall negative average annual net storage change in both periods.

The Lower Aquifer shows an average annual storage change of -8,000 AFY, -9,000 AFY, and -8,000 AFY during the Historical, Current, and WY 2003-2023 periods, respectively. Although indicating a sustained depletion of storage in all water year types, the storage change in the Lower Aquifer shows correlation with water year types similar to the Upper Aquifer.

The Lower Aquifer shows loss of storage in the form of water release caused by subsidence of approximately -101,000 AFY, -167,000 AFY, and -116,000 AFY during the Historical, Current, and WY 2003-2023 periods, respectively. As groundwater extraction and groundwater levels are the primary factors driving subsidence estimation in the Model, the water release caused by subsidence in the Lower Aquifer is closely coordinated with the annual rates of groundwater extraction and their corresponding impacts on groundwater levels. The water release caused by subsidence is the primary driver of storage losses in the Lower Aquifer and the overdraft estimates.

Overall, the Basin shows an average annual net groundwater storage change of -24,000 AFY, -6,000 AFY, and -19,000 AFY during the Historical, Current, and WY 2003-2023 periods, respectively, indicating a consistent 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 2003-2023 periods, respectively. As stated previously, however, sensitivity analysis conducted as part of Model application suggests that subsidence within the Basin is being overestimated by the Model and further 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. Therefore, a majority of storage losses in the Lower Aquifer and a significant portion of the overall loss of storage in the Basin is not caused by groundwater management in the Basin and cannot be mitigated solely through actions taken in the Basin.

9.3.4 Overdraft Conditions

☑ 23 CCR § 354.18(b)(5)

The Basin has been classified by DWR in its 2019 Basin Prioritization (DWR, 2020b) as a “high priority” basin, and is designated as being in a condition of critical overdraft. With respect to basins in overdraft conditions, DWR has made the following statements:

- “A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.”
- Groundwater overdraft is “... the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. If overdraft continues, significant adverse impacts may occur, including increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts.”
- “Overdraft occurs where the average annual amount of groundwater extraction exceeds the long-term average annual supply of water to the basin. Effects of overdraft can include seawater intrusion, land subsidence, groundwater depletion, and/or chronic lowering of groundwater levels”(DWR, n.d.).

While evaluating basins for critical overdraft conditions in its most recent Bulletin 118 update, DWR considered the time period from WY 1989-2009 (DWR, 2016d). This period was selected because it excludes one of the recent droughts that began in 2012, includes both wet and dry periods, is at least 10 years in length (it is 21 years in length), and includes precipitation close to the long-term average. The water budget information discussed herein covers the period from WY 2003-2023, inclusive of both the Historical and Current periods, and therefore only partially overlaps DWR’s evaluation period. Average annual precipitation and SJV index for the selected period (10.8 inches and 3.1, respectively) are comparably lower than WY 1989-2009 selected by DWR (11.7 inches and 3.2, respectively), confirming the drier overall conditions during WY 2003-2023.

As discussed in **Section 9.3.3**, the Basin has shown an overall declining storage change during WY 2003-2023, losing a combined cumulative storage of -2,940,000 AF, considering both cumulative storage change and cumulative volume of water release caused by subsidence. This equals an average annual decline of -140,000 AFY. These estimated changes in storage are considered conservative and are likely overestimated due to the Model’s overestimation of the rate and extent of subsidence within the Basin, the overall drier conditions experienced during WY 2003-2023 compared to average hydrological conditions, and the fact that the Model does not explicitly remove the portion of subsidence caused by pumping in adjacent basins. The conservative estimations are selected and maintained intentionally to ensure planning and management sufficiency in this GSP, to incorporate the uncertainty in the Model results, and to reflect the potential for the more frequent occurrence of droughts and extreme conditions in the future (as reflected in recent hydrology).

The Basin GSAs have developed a suite of Projects and Management Actions (P/MAs) (see **Section 15**) whose intended benefit is to prevent or eliminate overdraft and avoid Undesirable Results by the statutory SGMA deadline of 2040. Under the projected scenarios, including the climate change scenarios discussed below, the Model calculations indicate that the Basin GSAs will achieve their Sustainability Goal through the implementation of P/MAs and adaptive management efforts (e.g., the Pumping Reduction Plan; **Section 16.1.1**). Significant uncertainty exists regarding the projected future conditions, and the Basin's water budget will be refined over time as additional data are collected and the Model is updated and calibrated. In the interim, the planned P/MAs will continue to be implemented by the GSAs according to the implementation plan outlined **Section 16**.

9.3.4.1 Operation within Sustainable Yield

☑ **23 CCR § 354.18(c)(2)(C)**

The average annual decline in groundwater storage in the Upper Aquifer and Lower Aquifer during the combined Historical and Current periods (WY 2003-2023) was -11,000 AFY and -8,000 AFY, respectively (**Table WB-9** and **Table WB-10**). The total overdraft during the same period, including water release caused by subsidence, was -15,000 AFY and -124,000 AFY in the Upper Aquifer and Lower Aquifer, respectively, highlighting the significant storage loss due to subsidence in the Lower Aquifer.

Groundwater extraction from the Upper Aquifer and Lower Aquifer during the same period was 278,000 AFY and 169,000 AFY, respectively. Groundwater extraction from both aquifers exceeded the range in estimated sustainable yield reported in **Section 9.5** (263,000 to 264,000 AFY for the Upper Aquifer and 45,000 to 111,000 AFY for the Lower Aquifer), leading to the identified overdraft in the Basin.

The sustainable yield is sensitive to climatic conditions, and the Basin experiences storage decreases during dry periods and storage increases during wet periods (see **Figure WB-3** and **Figure WB-4**). Hence, as a metric, the sustainable yield is substantially influenced by the consumption of extracted groundwater and the climatic averaging period, as well as conditions in the adjacent (and hydraulically connected) subbasins. As future climatic conditions are difficult to project, and could result in greater reliance of groundwater storage to balance the water budget (see **Table WB-11**), actions that reduce groundwater consumption (pumping reduction) and increase recharge in both the Basin and adjacent subbasins will support long-term groundwater sustainability.

9.4 Projected Water Budget

§ 354.18. Water Budget
(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:
(4) The change in the annual volume of groundwater in storage between seasonal high conditions.
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:
(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.
(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.
(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.
(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:
(3) Projected water budget information for population, population growth, climate change, and sea level rise.

☑ **23 CCR § 354.18(c)(3)**
☑ **23 CCR § 354.18(d)(3)**

Per the GSP Regulations 23 CCR § 354.18(c)(3), projected water budgets are required to estimate future conditions of water supply and demand within a basin, as well as evaluate the aquifer response to GSP implementation over the planning and implementation horizon. The Model was employed to develop projected water budgets that considered updated inputs for climate-driven variables.

9.4.1 Development of 50-Year Analog Period

☑ **23 CCR § 354.18(c)(3)**

Per the GSP Regulations 23 CCR § 354.18(c)(3)(A), the projected water budgets must use 50 years of historical precipitation, ET, and streamflow information as the basis for evaluating future conditions under baseline and climate-modified scenarios. To develop the required 50 years of projected hydrologic input information, an "analog period" was created by repeating the previous 50 years of historical hydrologic record. Therefore, the hydrology for the projected 50-year analog period is based on the hydrology for actual years 1973 to 2022, which includes sequences of both wet and dry years (as was experienced historically). The mapping of actual years to analog years within the required 50-year projected water budget period applies to the precipitation, ET, and streamflow inputs to the Model.

9.4.2 Development of Projected Water Budget Scenarios

☑ 23 CCR § 354.18(c)(3)

Using the 50-year analog period, five projected water budget scenarios were developed for this analysis:

1) Projected Baseline;
2) Projected 2030 Central Tendency Climate Change;
3) Projected 2070 Central Tendency Climate Change;
4) Projected 2070 Extreme Dry Climate Change; and,
5) Projected 2070 Extreme Wet Climate Change.

The scenarios above represent the Basin water budget using current land use conditions. The Projected Baseline scenario is used for comparison purposes and does not include any expected effects of climate change. The DWR 2030 and 2070 Central Tendency Climate Change scenarios are recommended to reflect what might be considered most likely future conditions. However, there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended Central Tendency scenarios (DWR, 2018c). The DWR 2070 Extreme Dry and Wet Climate Change scenarios enable the exploration of conditions at the bounds of potential future climate change conditions. All five scenarios are used to project the 50-year water budget for the Basin (e.g., WY 2024-2073), and provide insight into the sensitivity of the water budget to uncertainty in future climate conditions.

Section 15 presents additional scenarios that simulate the impacts of the well-defined and soon-to-be-activated P/MAs within the Basin. The primary benefits from these P/MAs include water supply augmentation and groundwater pumping reduction, which collectively support the Basin to achieve its Sustainability Goal and avoid Undesirable Results.

9.4.2.1 Projected Baseline Scenario

Per 23 CCR § 354.18(e)(2)(c), the projected water budget must use "the most recent water supply information as the baseline condition for estimating future surface water supply". The Projected Baseline scenario is for comparison purposes and does not include any expected effects of climate change. As described below, the Baseline Scenario presents the projected water demands through the GSP implementation period:

- Current (2021) land use.
- Precipitation, ET, stream inflows, and stream diversions from the historical simulation period were repeated in the sequence of analog years.
- For surface water delivery and diversion datasets, a combination of recent water years (i.e., WY 2003-2023) is selected based on the water year type of 1973 to 2022 and the corresponding SJV index to best reflect current status of infrastructure and operations within the Basin.

9.4.2.2 Projected Climate Change Scenarios

To estimate potential effects of climate change on the projected water budget, central tendency and extremely dry and wet climate change scenarios were developed using the Climate Period Analysis datasets developed by DWR (DWR, 2018c). Modeling of these scenarios was conducted following the Climate Change Data and Guidance Resource Guide published by DWR (DWR, 2018c), as follows:

- Precipitation and ET were varied using respective climate change scenario change factors. Basin precipitation and ET were consequently changed, as shown in **Table WB-5**.
- Mountain front inflows were varied using respective climate change scenario change factors, while managed stream inflows at reservoirs were adjusted based on CalSim-II results provided.
- Surface water deliveries were varied proportionally to changes resulting from comparing CalSim-II simulations of projected baseline and respective climate change scenarios provided under the same datasets (**Table WB-5**).

9.4.3 Projected Surface Water Supply

☑ **23 CCR § 354.18(c)(3)(C)**

Per the GSP Regulations 23 CCR § 354.18(c)(3)(C), the projected water budgets must use "the most recent water supply information as the baseline condition for estimating future surface water supply." As such, per the above, surface water deliveries were varied proportionally to changes resulting from comparing CalSim-II simulations of projected baseline and respective climate change scenarios provided under the same datasets.

As shown in **Table WB-5**, surface water deliveries in the Basin may decrease by 9 percent or increase by 3 percent, as simulated by 2070 extreme dry and wet scenarios, respectively, while the central tendency scenarios estimate a more moderate decrease of 2 percent to 5 percent in the 2030 and 2070 scenarios, respectively. These relatively small changes in surface water delivery reaffirm the reliability of surface water supplies in the Basin, as discussed in **Section 9.3.1.** Surface water deliveries are also projected to change and increase due to the implementation of P/MAs in the Basin. **Section 15** presents additional information on the estimated future surface water supply volumes and reliability as a result of P/MA implementation.

9.4.4 Projected Water Budget Results

☑ **23 CCR § 354.18(c)(3)**

Results of the projected groundwater budget analyses are summarized in **Table WB-6**, **Table WB-7** and **Table WB-8**. Due to the Projected Baseline's 50-year averaging period and its better alignment with average hydrologic conditions compared to the Current period, evapotranspiration demand and groundwater extraction during this scenario are less than the Current period (**Table WB-6)**. However, both evapotranspiration and groundwater extraction are greater than in the Historical period due to the increased overall demand. Despite minor differences in land surface water system components, the Projected Baseline scenario shows similar trends in its land surface water budget as the Current period, which is reasonably expected due to maintaining the most recent conditions in its simulation.

The Upper Aquifer groundwater budget for Projected Baseline scenario shows a similar average groundwater extraction to the Current period but indicates an overall average annual decrease in its groundwater storage (**Table WB-7**). While groundwater recharge remains similar to the Historical period, the comparatively larger groundwater extraction is supplied through increased boundary flow, stream-groundwater interaction, and decreased losses of unsaturated zones due to decreased groundwater levels in the Basin.

Similar to the Upper Aquifer, the Lower Aquifer groundwater budget for the Projected Baseline scenario shows an increase in groundwater extraction compared to the Historical period that better aligns with the Current period. This incremental increase in groundwater extraction is largely offset by increased net boundary inflow to the Basin. While the water release caused by subsidence decreases in average annual volume compared to both the Historical and Current periods, it remains significant and a large portion of the supply source for the Lower Aquifer groundwater extraction. As mentioned in **Section 9.3.1**, water release caused by subsidence, and consequently, the total loss of storage in the Basin, are overestimated due to the overestimation of the rate and extent of subsidence in the Model. These components are also overestimated in all projected scenarios, leading to conservative estimates of total storage change and benefits from P/MAs. Moreover, a significant portion of subsidence and the associated water release caused by subsidence and total storage loss originate from impacts outside the Basin, as shown from sensitivity analysis scenarios, and are not caused by Basin management nor can be mitigated by actions within the Basin.

It is worth noting that the Projected Baseline scenarios outlined herein, including climate change scenarios, provide a worst-case representation of future conditions in the Basin because they assume the recent and current practices and conditions remain unchanged throughout the 50-year projection (both in the Basin and in the adjacent, hydraulically connected subbasins). However, as discussed in **Section 15**, a suite of P/MAs is planned to be implemented in the Basin to achieve sustainability by 2040 that will significantly change Basin conditions and impact water budget components and changes in groundwater storage. In addition, all neighboring subbasins are complying with the requirements of the SGMA and progressing towards sustainability by 2040, which in turn will improve conditions outside the Basin, change boundary inflows, and reduce subsidence.

While projecting an accurate representation of these changes is currently infeasible, the projected scenarios with P/MAs discussed in **Section 15** present altered future conditions through the implementation of Basin P/MAs (those with quantified benefits and implementation timeline) and assuming progress towards sustainable conditions in neighboring subbasins, equivalent to pre-SGMA conditions.

9.4.4.1 Climate Change Scenarios

☑ 23 CCR § 354.18(d)(3)

Potential climate change effects on the projected water budget were evaluated using the 2030 and 2070 central tendency and 2070 extreme dry and wet climate change scenarios. **Table WB-9**, **Table WB-10** and **Table WB-11** provide a comparison of groundwater budgets simulated for Historical, Current, and Projected periods, including different climate change scenarios, for the Upper Aquifer, Lower Aquifer, and the Basin as a whole, respectively. A general declining trend in Basin conditions is observed in both aquifers in the Projected scenarios, intensified by climate change impacts. Central tendency scenarios project a considerable increase in groundwater extraction, primarily due to expected increases in evapotranspiration, changes in precipitation patterns, reduced surface water deliveries (**Table WB-5**), and further declines in groundwater storage in both aquifers. This decline is more highlighted when water release caused by subsidence is incorporated as a loss in storage.

On the other hand, the wide spectrum of changes projected by extreme dry and wet 2070 climate change scenarios showcase the significant uncertainty in projected Basin conditions. While the extreme 2070 dry climate change scenario depicts a worst-case average condition, comparably worse than the Current period, the extreme wet 2070 climate change scenario indicates average conditions that are comparably better than the Historical and Current periods. This considerable projection uncertainty highlights the fundamental need for adaptive management of the Basin in response to climate change. Therefore, 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 15**.

9.4.5 Assessment of Future Basin Conditions Under P/MA Implementation

As discussed in **Section 9.4.4**, the GSAs plan to address the estimated overdraft and reduce groundwater pumping to within the Sustainable Yield by 2040 through implementation of a suite of Projects and Management Actions (P/MAs) that include supply augmentation, demand management, and a Pumping Reduction Plan (PRP) to mitigate overdraft conditions and adaptively avoid Minimum Thresholds (MTs). These P/MAs are further detailed in **Section 15** and their impact on mitigating overdraft conditions is discussed in **Section 15.6**. This section primarily focuses on the methodology used to simulate projected conditions with P/MAs and their projected impact on achieving Basin's Sustainability Goal while considering the simulation and projection uncertainty.

9.4.5.1 Simulation of Projected Conditions with P/MAs

The Projected Basin condition under the 2030 Central Tendency Climate Change Scenario was used as the basis for the assessment of P/MA impacts, as discussed in **Section 9.4.4.1**. To conduct this simulation, and as described further in **Appendix H**, the following modifications were made to the Projected 2030 Central Tendency Climate Change Scenario in the Model:

- The Tier 1, Tier 2 and Tier 3 P/MAs were "added" directly to the Model to reflect the anticipated location and volume of the associated benefits. For example, new recharge project locations and anticipated volumetric benefits were represented spatially and in time-series in the Model inputs.
- A constant head boundary was assigned near the boundary of the Basin to represent the expected condition wherein the adjacent basins also achieve sustainability (i.e., a minimum of 2015 water levels) by 2040 and thereby reduce the adjacent basin-related impacts to conditions in the Basin.

A portion of the PRP implementation (i.e., the ~42,000 AFY of overdraft reduction) was simulated to occur in the portions of the Basin where pumping reduction was most needed to address overdraft conditions. Additional pumping reductions due to adaptive management to avoid exceedance of Minimum Thresholds (MTs) per the PRP were also simulated, primarily during WY 2026-2039 and in some dry and critical water years in WY 2040-2073, to address projected net losses of storage, address local conditions, and/or address imbalances in the water budget. Implementation of the PRP (in the form of additional pumping reductions when and where needed) appears sufficient to maintain groundwater storage in the Basin at or above WY 2015 conditions for the entire projected period in the Upper Aquifer and during WY 2040-2073 in the Lower Aquifer. This assumes adverse impacts of neighboring basins on the Lower Aquifer will be addressed by WY 2040 under SGMA implementation.

Simulation of P/MA benefits is significantly correlated with the arrangement of historical water years used in the development of the 50-year analog period (**Section 9.4.1**). The correlation stems from the dependency of P/MA implementation on water year type, surface water delivery and estimated evapotranspiration, and availability of surplus streamflow and/or surface water delivery. Therefore, prolonged and frequent drought periods can lead to underestimation of P/MA benefits and overestimation of groundwater declines, loss of storage, and water release caused by subsidence. Acknowledging this source of uncertainty, the GSAs implemented the 50-year analog period as such that it includes significant dry periods within the implementation period (WY 2024-2040) and represents the most recent historical droughts at the end of the projection period. These assumptions were intended to provide conservative estimates of loss of storage in all scenarios and represent worst-case conditions within the implementation period in assessment of compliance with the sustainable management criteria (SMC) and avoidance of Undesirable Results (URs).

Furthermore, the inherent overestimation of the rate and extent of subsidence by the Model and its corresponding overestimation of water release caused by subsidence and total loss of storage also occurs in the projection scenario with P/MAs because of the consistent data and methodology used to simulate all Historical, Current, and Projected water budget scenarios. Sensitivity analysis conducted on the 2030 Central Tendency Climate Change Scenario with P/MAs indicates that up to 50 percent of water released caused by subsidence is not due to groundwater pumping in the Basin and results from operations outside the Basin. Accounting for all these sources of uncertainty and assumptions, projected conditions presented herein are considered conservative in the simulation of P/MA benefits and estimation of total storage loss, which should be considered in assessing the effectiveness of planned Basin management in reaching its Sustainability Goal.

9.4.5.2 Simulated P/MAs and Their Expected Benefits

The suite of P/MAs designed by Basin GSAs is discussed in **Section 15**. A general implementation schedule, also known as a “glide path”, has been developed and is summarized in **Table WB-12** below, to assess sufficiency of P/MAs and to compare and ground truth Model simulations. The estimated average annual benefit from these P/MAs is calculated from the expected benefits and implementation timetable for the Tier 1, Tier 2, and Tier 3 P/MAs, as presented in **Table PMA-2**. For the projects that are dependent on normal to wet-year supplies (e.g., recharge projects), the estimated average annual benefit considers the frequency of certain hydrologic conditions.

As detailed in **Section 16.1.1**, the GSAs have also designed a PRP to mitigate decreasing trends in groundwater levels in some areas of the Basin, subsidence-prone areas, and/or where there is a local imbalance of supplies versus groundwater pumping. The PRP will be implemented by the GSAs to mitigate potential Undesirable Results that may occur before 2040, or beyond as necessary. Further, the GSA(s) that have MT exceedances for two consecutive years due to groundwater management within their respective jurisdictional area will be required to implement a mandatory *Groundwater Allocation Backstop*, as described in **Section 16.1.1.6**.

Table WB-12. Glide Path to Address Average Annual Overdraft under 2030 Central Tendency Climate Change

	Average Annual Volume (AFY) (1)			
	2025	**2030**	**2035**	**2040 and After**
Average Annual Overdraft(2) (2003-2023)	**140,000**	**140,000**	**140,000**	**140,000**
Pumping Reduction	0	25,300	42,100	42,100
Supply Augmentation	58,800	112,700	140,600	151,800
Total Planned P/MAs	***58,800***	***138,000***	***182,700***	***193,900***
Adaptive Management(3): GWL-MT Avoidance Plan, Subsidence Avoidance Plan, and/or Groundwater Allocation Backstop	0	2,000	0	0
Remaining Deficit	***81,200***	***0***	***0***	***0***

Abbreviations:
AFY = acre-feet per yea
GWL-MT = Groundwater Levels Minimum Threshold
P/MA = Projects and Management Actions

Notes:
1. The average annual volume represents the average expected benefits for the five-year period prior to the year shown. For example, the "2030" column represents the average annual benefits expected from P/MAs from 2026-2030. Annual averages consider project implementation dates as well as historical wet-year frequencies for projects reliant on a wet-year water source, and therefore differ from the maximum benefit described in **Section 15.3**.
2. Includes water released caused by Land Subsidence.
3. Calculations provided in this table follow the best available information regarding the P/MAs' timeline, conditions for implementation, and resulting benefits. Adaptive management pumping reductions for each period are calculated as the subtraction of total planned P/MA benefits from the average annual overdraft and assumes perfect efficiency. Actual and/or simulated P/MA efficiency and the resultant necessary pumping reductions may be different from what is shown.

The glide path above presents the estimate of benefits from P/MA implementation based on the best available data and information. The expected benefits indicate that the Basin is expected to reach a balanced water budget by WY 2040 and mitigate its long-term average overdraft through implementation of planned P/MAs. However, many uncertainties exist, particularly related to availability of water supplies for supply augmentation projects and hydrologic conditions under climate change scenarios, as well as impacts to the Basin from conditions and pumping outside of the Basin. Consequently, the GSAs have collectively adopted the PRP, which includes an adaptive management framework, to address potential deficits and/or local conditions stemming from these sources of uncertainty. Furthermore, a sensitivity analysis using a combination of different climate change scenarios and assumptions of P/MA benefits is conducted in **Section 15.6**, indicating sufficiency of the adaptive P/MA framework to mitigate the Basin's overdraft and to support the GSAs to achieve their Sustainability Goal.

9.4.5.3 Projected Groundwater Levels and Avoiding Chronic Lowering of Groundwater Levels Undesirable Results

The 2030 Central Tendency Climate Change Scenario with P/MAs was used to predict future groundwater level conditions with the implementation of the P/MAs and to assess if Undesirable Results[36] would be expected to occur in the Basin between now and 2040.

Following the Model revision and application described in **Section 9.4.5.1**, the hydrographs at 71 of the Representative Monitoring Wells-Water Levels (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.[37] As shown in **Figure WB-5** and **Appendix H**, 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.

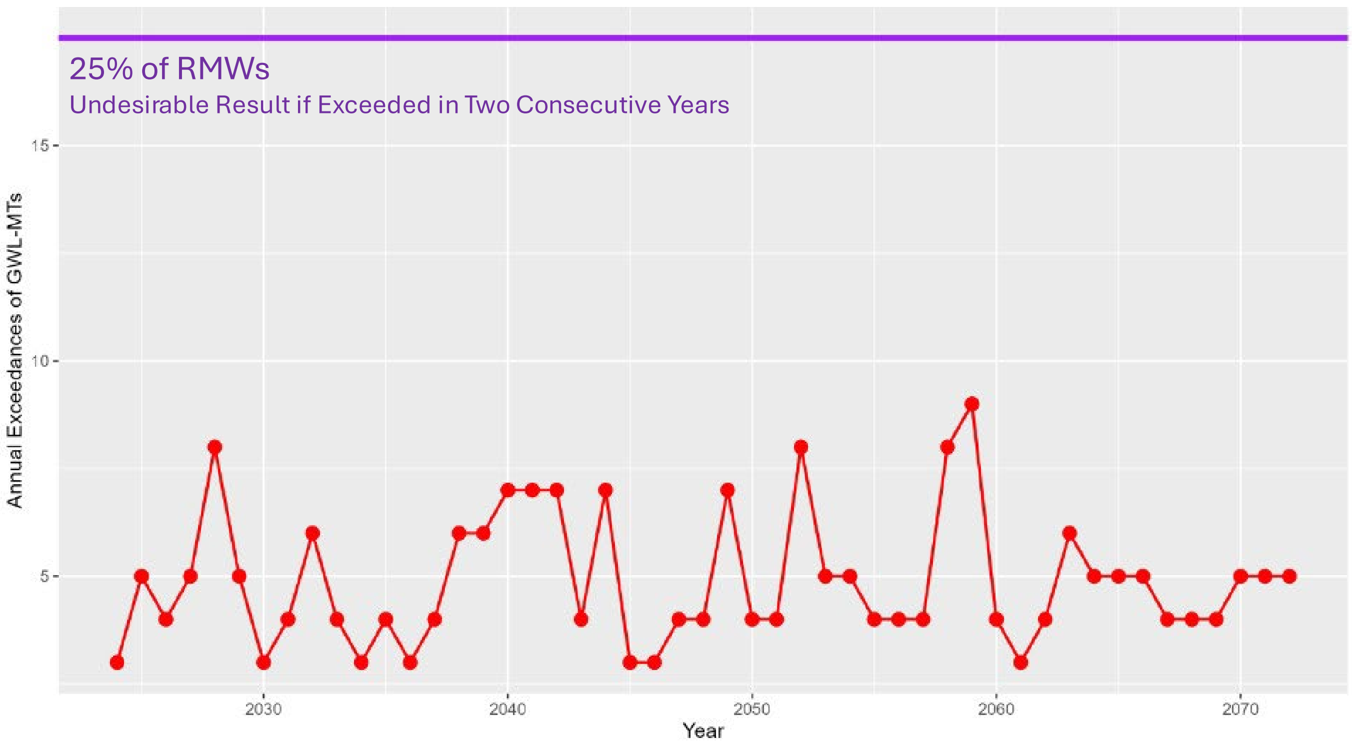


Figure WB-5. Avoidance of Chronic Lowering of Groundwater Levels Undesirable Results Under 2030 Central Tendency Climate Change with P/MAs Scenario

[36] 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)".

[37] 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.

9.4.5.4 Overdraft Elimination by WY 2040

SGMA requires that the Basin achieves sustainability by 2040. Under the assumption that sustainability means the elimination of groundwater overdraft by 2040, then demonstration of overdraft reduction by and following 2040 is critical.

Using the 2030 Central Tendency Climate Change with P/MAs Scenario, the water budget for the Basin was calculated for WY 2024-2073. The WY 2024-2073 period used for this analysis is the same as the Projected period defined in **Section 9.1** and uses a repeat of the historical 50-year period from WY 1973 to WY 2022, as required under 23 CCR § 354.18(c). Development of this 50-year analog period and generation of the 2030 Central Tendency Climate Change with P/MAs Scenario follow the data, methodology, and assumptions outlined in **Section 9.4**. This simulation showcases the achievement of sustainability in the Basin through planned implementation of P/MAs and application of the Basin's adaptive PRP (**Section 16.1.1**) under the assumed climate conditions.

The simulation of P/MA benefits is highly correlated with the sequence of historical water years used to develop the 50-year analog period due to P/MA implementation's dependence on water year type, surface water delivery, estimated evapotranspiration, and the availability of surplus streamflow or surface water delivery. Consequently, prolonged and frequent droughts can lead to underestimating P/MA benefits and overestimating groundwater declines, storage loss, and water release due to subsidence.

The precise projection of future climate is impossible, and what is utilized for planning in this GSP is a single realization of a set of potential climate scenarios with infinite members. Recognizing these uncertainties, the GSAs designed the 50-year analog period to include significant dry periods during the implementation period (WY 2024-2040) and to reflect recent historical droughts at the end of the projection period. Furthermore, the GSAs used the most recent 50-year period available without making any changes to the arrangement of years or data timeseries, assuming an exact repeat of recent hydrology would provide the best available method for planning. These assumptions aim to provide conservative estimates of storage loss and worst-case groundwater conditions during the implementation period (WY 2024-2039) while representing average hydrology in the years between WY 2040-2073.

As shown in **Table WB-14**, the average annual and cumulative storage change in the Upper Aquifer relative to WY 2015 conditions during WY 2016-2040 and WY 2041-2073 is positive, indicating sustainable conditions with no overdraft. The SGMA and DWR proposed methodology for assessing climate change impacts (DWR, 2018c) emphasizes using long-term periodic averages for GSP planning and sustainability evaluation, understanding hydroclimatic variability, and recognizing the need for operational flexibility. However, the adaptive management framework adopted by the GSAs in the Basin allows for the proactive mitigation of overdraft, as demonstrated under this scenario through adaptive management pumping reduction.

Figure WB-6 (a) shows the projected cumulative aquifer storage change relative to WY 2015 conditions in the Upper Aquifer (i.e., the zero cumulative storage change reference value). As shown therein, assuming successful implementation of P/MAs and focused implementation of the PRP, Upper Aquifer storage will remain above WY 2015 levels throughout WY 2016-2073 period.

Due to the significant impact of neighboring basins on Lower Aquifer storage change and subsidence, as discussed in **Sections 9.3.3** and **9.4.4**, the GSAs plan to achieve sustainability by WY 2040 in the Lower Aquifer, assuming that groundwater conditions in the neighboring basins will improve under SGMA implementation and resemble WY 2015 conditions. As shown in **Table WB-14**, the average annual and cumulative storage change in the Lower Aquifer during WY 2016-2040 and WY 2041-2073 relative to WY 2015 conditions are positive, indicating sustainable conditions with no overdraft. Further emphasizing the effectiveness of the GSAs' P/MAs and adaptive management pumping reduction, **Figure WB-6 (b)** shows that Lower Aquifer storage change will remain above WY 2015 levels starting from WY 2040, consistent with the Basin's Sustainability Goal.

The volumes shown in **Table WB-14** and **Figure WB-6** exclude water released by subsidence, representing the change in aquitard storage, due to its irrecoverable nature. However, under the same scenario, the average annual change in aquitard storage during WY 2041-2073 is well within the Model's computational error tolerance, confirming the mitigation of subsidence in the Basin. As discussed in **Section 9.4.4**, the Basin GSAs cannot mitigate the subsidence occurring in the Basin without the expected sustainable conditions in neighboring basins, as groundwater conditions outside the Basin cause more than 50 percent of the observed subsidence within the Basin.

Figure WB-6 (c) shows how the implementation of the P/MAs and adaptive management through the PRP are projected to achieve sustainability at the Basin scale by WY 2040. The distribution of P/MA benefits based on different water year types and the application of the adaptive management (PRP) framework emphasizes the flexibility of the Basin's planning and implementation in absorbing uncertainties due to hydroclimatic variability. The significant improvement in Basin conditions after WY 2035, along with the substantial reduction in the need for adaptive management except in critical water years, showcases the effectiveness of the planned and implemented P/MAs.

Table WB-14. Estimated Aquifer Storage Change Under the 2030 Central Tendency Climate Change with P/MAs Scenario

	WY 2016-2040		WY 2041-2073	
	Average Annual Storage Change (AFY)	Cumulative Storage Change Relative to 2015 (AF)	Average Annual Storage Change (AFY)	Cumulative Storage Change Relative to 2015 (AF)
Upper Aquifer	200	5,600	6,600	217,200
Lower Aquifer	300	7,900	300	10,100
Basin	500	13,500	6,900	227,300

Abbreviations:
AF = acre-feet AFY = acre-feet per year WY = water year

9.5 Sustainable Yield

§ 354.18. Water Budget
(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:
(7) An estimate of sustainable yield for the basin.

☑ **23 CCR § 354.18(b)(7)**

SGMA defines sustainable yield as “the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result” (California Water Code [CWC], §10721(w)). DWR’s BMP #4 Water Budget (DWR, 2016c) further states that “Water budget accounting information should directly support the estimate of sustainable yield for the basin and include an explanation of how the estimate of sustainable yield will allow the basin to be operated to avoid locally defined undesirable results.” Inherent to the codified definition and the BMP statement is the avoidance of the SGMA-specified “Undesirable Results”, which include significant and unreasonable effects for any of the six SGMA Sustainability Indicators, most of which are based either directly or by proxy on groundwater levels.

While no exact method for defining the sustainable yield is required by SGMA or promoted by DWR in its Water Budget BMP, the BMP does emphasize that water budget accounting information should be used. It follows that an estimate of the sustainable yield can be made by subtracting the average annual groundwater extraction, which is negative by definition, from the average annual change in storage (whether positive or negative). This simplified approach provides a sustainable yield estimate corresponding to the total volume of water that, if pumped over the water budget period of interest, would have resulted in zero change in storage due to pumping – a reasonable metric for sustainability.

Since water release caused by subsidence accounts for a majority of the overdraft calculated for the Basin, it has been added to the change of storage for each aquifer as an equivalent of a negative storage change for calculation of sustainable yield. However, it is important to note that this water budget term is a significant source of uncertainty given that the Model is not calibrated for subsidence and currently overestimates the extent and magnitude of subsidence in the Basin. Furthermore, sensitivity analyses conducted as part of the Model application suggest 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. Therefore, the sustainable yield was calculated as a range, considering both the presence and absence of impacts from adjacent groundwater basins on the permanent loss of aquitard storage due to subsidence, represented as water release caused by subsidence. Notwithstanding the uncertainty in subsidence estimation, the sustainable yield is conservatively estimated at approximately 263,000 to 264,000 AFY for the Upper Aquifer and between 45,000 AFY to 111,000 AFY for the Lower Aquifer, summing to 308,000 AFY to 375,000 AFY for the Basin during the WY 2003-2023 period (i.e., the Historical and Current water budget periods).

Table WB-13 provides a summary of the range of potential Sustainable Yield estimates for different selected time periods, similarly considering the presence and absence of impacts from neighboring basins on water release caused by subsidence. Under Historical conditions (WY 2003-2018), the Sustainable Yield estimate is approximately 241,000 to 242,000 AFY for the Upper Aquifer and between 40,000 AFY and 95,000 AFY for the Lower Aquifer, whereas under Current supply and demand conditions (WY 2019-2023), the Sustainable Yield estimate is approximately 326,000 to 328,000 AFY for the Upper Aquifer and between 58,000 AFY and 157,000 AFY for the Lower Aquifer. For the period WY 2003-2023 that is considered for overdraft evaluation, the Sustainable Yield estimate is approximately 263,000 to 264,000

AFY for the Upper Aquifer and between 45,000 AFY and 111,000 AFY for the Lower Aquifer. These historical evaluations produce sustainable yield estimates for the Basin that range from 281,000 AFY to 485,000 AFY and represent a reasonably conservative estimate for planning purposes.

The ranges provided for Sustainable Yield are estimates 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.

9.6 Data Gaps and Sources of Uncertainty

The data and results presented herein to develop water budgets, simulate Historical, Current and Projected conditions in the Basin, and assess climate change impacts are based on the best available data, science, and tools currently available. However, as highlighted below, significant sources of uncertainty exist in the simulation of Basin conditions due to remaining data gaps, complex hydrogeology, 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.

<u>Estimation of Water Use in the Basin</u>

Estimation of water use in the Basin, including groundwater pumping and surface water delivery and diversion information, is primarily based on the assumptions and data made available by the GSAs in the development of the CVHM2 (Traum et al., 2024). While water use data have been collected as part of the Annual Report development in the Basin and further supplemented going back to 2003, there is less data accuracy and completeness prior to the implementation of SGMA. Furthermore, the available groundwater pumping data are not always sufficiently distinguished by principal aquifers.

The Model documentation (Traum et al., 2024) indicates that "CVHM2 was designed to portray general characteristics for examining hydrology at a regional scale; CVHM2 was not designed to reproduce every detail of the Central Valley hydrologic system." Therefore, the GSAs have attempted to fine-tune CVHM2's representation of surface water delivery and groundwater pumping within the Basin to the extent possible based on the best available data. This fine-tuning was implemented on a subregional scale within the Basin and aimed at improving the periodical average representation of conditions in the Model (Historical and Current period average surface water delivery and pumping). However, local differences and departures can still be observed in annual comparisons of water use between Model representation and existing data. In potential future refinements and calibration of the Model, the GSAs will consider improvements to surface water delivery and groundwater pumping representation in a more detailed and fine-scaled approach.

<u>Model Representation of Subsidence</u>

The extent and rate of subsidence are overestimated by CVHM2, as further discussed in **Appendix H**. The overestimation leads to increased volumes of water release caused by subsidence in all water budget periods and results in an overestimation of overdraft and underestimation of the Basin sustainable yield.

Further, sensitivity analyses conducted as part of Model development suggest 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. While the GSAs have decided to incorporate this uncertainty to make more conservative management decisions, the subsidence representation in the Model will need to be adjusted upon availability of better data and further adjustments to the Model (i.e., subsidence calibration).

Model Representation of Conditions Outside the Basin

Due to the hydrogeologic interconnection of the Basin to its neighboring subbasins and the significant impact of subregional conditions on Basin groundwater levels, boundary flows, stream-groundwater interaction, and subsidence, the projection of the Basin's future conditions is necessarily incomplete without more accurately representing the changes occurring outside of the Basin boundary. Such changes are currently infeasible to implement since all neighboring subbasins are in their early years of SGMA implementation. Understanding this significant source of uncertainty, the GSAs have used the Model results to bookend potential future conditions, understand the impacts of pumping outside of the Basin on conditions (water levels and subsidence) within the Basin, and assess their P/MA effectiveness. As progress is made and more data and information become available from the surrounding subbasins, the representation of Basin conditions and projected future conditions within the Model can be improved.

Projection Uncertainty

Projection of Basin conditions is highly dependent on the arrangement of historical years and the corresponding climate conditions, as discussed in **Section 9.4.1**. The 50-year analog period was designed to follow regulation requirements and represent near-average conditions. The arrangement of analog years can vary within the 50-year period but still represent the same average conditions. However, the arrangement of years and the sequence of water year types impact projected conditions during the implementation period (WY 2024-2040) and the projected period (WY 2024-2073), used as the basis for planning and management in this GSP. While the GSP primarily relies on periodical averages and consistently conservative assumptions for planning and management to prepare for worst-case scenarios, these sources of uncertainty should be considered within the context of adaptive management and improved as feasible in the future.

Furthermore, sensitivity analysis using the Model indicates a highly integrated and interrelated hydrogeology between the Basin and its neighboring groundwater subbasins. Therefore, projection of future conditions incorporates significant uncertainty stemming from groundwater management and unknown conditions in those subbasins. The GSP attempts to make conservative assumptions in its water budget estimation by assuming the continuation of current conditions in the Basin and all its neighboring subbasins during the projected period. While the assumption will direct Basin management towards planning for a near worst-case scenario of loss in storage and subsidence, it is expected that conditions around the Basin will progress positively under SGMA and, in turn, help with progress in the Basin. This assumption should be considered in the evaluation of management decisions under this GSP and improved in the future as more information becomes available.

Table WB-2: Annual Land Surface Water System Inflows and Outflows

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)						OUTFLOWS (AFY)					Change in Storage (AFY)
		Precipitation	Surface Water Delivery	Applied Water		Stream-Groundwater Interaction Inflow	Total Inflows	Evapotranspiration	Stream Outflow	Infiltration	Stream-Groundwater Interaction Outflow	Total Outflows	
				Groundwater Extraction	Stream Inflow								
Historical Water Budget (WY 2003 - 2018)													
2003	Below Normal	681,000	1,481,000	389,000	3,564,000	80,000	6,194,000	1,594,000	4,193,000	367,000	40,000	6,194,000	0
2004	Dry	565,000	1,387,000	308,000	3,699,000	76,000	6,035,000	1,271,000	4,403,000	333,000	28,000	6,035,000	0
2005	Wet	1,062,000	1,336,000	248,000	6,928,000	86,000	9,660,000	1,586,000	7,495,000	377,000	202,000	9,660,000	0
2006	Wet	831,000	1,408,000	297,000	10,670,000	91,000	13,296,000	1,534,000	11,268,000	337,000	157,000	13,296,000	0
2007	Critical	355,000	1,288,000	365,000	3,672,000	77,000	5,757,000	1,284,000	4,191,000	242,000	40,000	5,757,000	0
2008	Critical	537,000	1,157,000	448,000	3,206,000	79,000	5,426,000	1,306,000	3,562,000	499,000	59,000	5,426,000	0
2009	Below Normal	491,000	1,233,000	632,000	2,474,000	71,000	4,903,000	1,669,000	2,697,000	515,000	22,000	4,903,000	0
2010	Above Normal	875,000	1,486,000	466,000	3,598,000	81,000	6,506,000	1,813,000	4,001,000	559,000	133,000	6,506,000	0
2011	Wet	991,000	1,375,000	300,000	10,911,000	88,000	13,665,000	1,676,000	11,399,000	382,000	208,000	13,665,000	0
2012	Dry	442,000	1,359,000	347,000	3,658,000	73,000	5,880,000	1,419,000	4,042,000	338,000	81,000	5,880,000	0
2013	Critical	457,000	1,198,000	421,000	2,735,000	81,000	4,892,000	1,337,000	3,012,000	456,000	87,000	4,892,000	0
2014	Critical	331,000	1,220,000	513,000	1,515,000	63,000	3,641,000	1,455,000	1,749,000	348,000	89,000	3,641,000	0
2015	Critical	489,000	1,227,000	501,000	3,249,000	69,000	5,535,000	1,427,000	3,584,000	461,000	63,000	5,535,000	0
2016	Dry	918,000	1,233,000	388,000	4,779,000	76,000	7,393,000	1,635,000	5,199,000	486,000	73,000	7,393,000	0
2017	Wet	1,004,000	1,501,000	428,000	17,444,000	96,000	20,473,000	1,664,000	17,996,000	573,000	240,000	20,473,000	0
2018	Below Normal	465,000	1,426,000	512,000	7,708,000	79,000	10,191,000	1,522,000	8,231,000	342,000	96,000	10,191,000	0
AVERAGE		**656,000**	**1,332,000**	**410,000**	**5,613,000**	**79,000**	**8,090,000**	**1,512,000**	**6,064,000**	**413,000**	**101,000**	**8,090,000**	**0**
%		**8%**	**16%**	**5%**	**69%**	**1%**		**19%**	**75%**	**5%**	**1%**		
Current Water Budget (WY 2019 - 2023)													
2019	Wet	835,000	1,242,000	455,000	10,877,000	80,000	13,489,000	1,695,000	11,161,000	445,000	188,000	13,489,000	0
2020	Dry	537,000	1,228,000	636,000	4,676,000	85,000	7,162,000	1,681,000	4,945,000	455,000	81,000	7,162,000	0
2021	Critical	396,000	1,221,000	606,000	1,514,000	71,000	3,807,000	1,547,000	1,768,000	436,000	56,000	3,807,000	0
2022	Critical	491,000	1,224,000	578,000	1,650,000	66,000	4,010,000	1,590,000	1,860,000	441,000	119,000	4,010,000	0
2023	Wet	1,020,000	1,334,000	544,000	18,607,000	84,000	21,589,000	1,759,000	18,981,000	604,000	245,000	21,589,000	0
AVERAGE		**656,000**	**1,250,000**	**564,000**	**7,465,000**	**77,000**	**10,012,000**	**1,654,000**	**7,743,000**	**476,000**	**138,000**	**10,012,000**	**0**
%		**7%**	**12%**	**6%**				**17%**	**77%**	**5%**			

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Applied water includes imported surface water, diverted water from streams, and groundwater.
(b) Stream inflow and outflow incorporate all flows simulated as part of the Model's Streamflow Routing Package (SFR), including flows simulated in San Joaquin River, California Aqueduct, and Delta-Mendota Canal. Although San Joaquin River forms the boundary of the Basin, it is included in the calculation of stream inflow and outflow to the Basin and accounts for streamflow received from streams outside of the Basin, such as Merced and Kings River.
(c) Change in storage is calculated as the difference between inflows and outflows and is negligible in Land Surface Water Budget.
(d) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.

Table WB-3. Annual Summary of Inflows and Outflows from the Upper Aquifer Groundwater System

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence	Cumulative Change in Groundwater Storage
		Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows			
Historical Water Budget (WY 2003 - 2018)													
2003	Below Normal	304,000	33,000	151,000	488,000	246,000	109,000	80,000	157,000	592,000	-96,000	-8,000	-96,000
2004	Dry	287,000	24,000	144,000	455,000	220,000	87,000	76,000	146,000	530,000	-78,000	3,000	-174,000
2005	Wet	322,000	191,000	141,000	654,000	180,000	120,000	86,000	142,000	528,000	126,000	0	-48,000
2006	Wet	281,000	150,000	146,000	577,000	215,000	110,000	91,000	158,000	574,000	6,000	-3,000	-42,000
2007	Critical	201,000	39,000	146,000	386,000	253,000	66,000	77,000	150,000	546,000	-154,000	-6,000	-196,000
2008	Critical	435,000	51,000	152,000	638,000	287,000	101,000	79,000	167,000	634,000	9,000	-5,000	-187,000
2009	Below Normal	443,000	19,000	172,000	634,000	351,000	109,000	71,000	187,000	719,000	-71,000	-14,000	-258,000
2010	Above Normal	481,000	122,000	170,000	773,000	268,000	134,000	81,000	205,000	688,000	87,000	-2,000	-171,000
2011	Wet	327,000	196,000	162,000	685,000	214,000	122,000	88,000	198,000	621,000	62,000	2,000	-109,000
2012	Dry	285,000	79,000	143,000	507,000	236,000	88,000	73,000	182,000	580,000	-68,000	-5,000	-177,000
2013	Critical	392,000	83,000	151,000	625,000	275,000	102,000	81,000	204,000	662,000	-30,000	-7,000	-207,000
2014	Critical	302,000	88,000	169,000	560,000	310,000	78,000	63,000	209,000	660,000	-95,000	-5,000	-302,000
2015	Critical	403,000	60,000	172,000	634,000	318,000	84,000	69,000	217,000	688,000	-50,000	-4,000	-352,000
2016	Dry	427,000	70,000	159,000	655,000	259,000	93,000	76,000	213,000	641,000	16,000	-2,000	-336,000
2017	Wet	513,000	228,000	179,000	920,000	255,000	162,000	96,000	220,000	733,000	192,000	-5,000	-144,000
2018	Below Normal	294,000	94,000	169,000	557,000	294,000	91,000	79,000	208,000	672,000	-111,000	-4,000	-255,000
AVERAGE		**356,000**	**96,000**	**158,000**	**609,000**	**261,000**	**104,000**	**79,000**	**185,000**	**629,000**	**-16,000**	**-4,000**	
%		**58.5%**	**15.8%**	**25.9%**		**41.5%**	**16.5%**	**12.6%**	**29.4%**				
Current Water Budget (WY 2019 - 2023)													
2019	Wet	398,000	179,000	180,000	757,000	283,000	120,000	80,000	213,000	696,000	64,000	-3,000	64,000
2020	Dry	395,000	77,000	200,000	672,000	375,000	96,000	85,000	243,000	799,000	-122,000	-5,000	-58,000
2021	Critical	383,000	53,000	186,000	622,000	350,000	86,000	71,000	228,000	735,000	-101,000	-12,000	-159,000
2022	Critical	389,000	117,000	195,000	701,000	343,000	82,000	66,000	237,000	729,000	-24,000	-4,000	-183,000
2023	Wet	535,000	232,000	199,000	966,000	295,000	153,000	83,000	240,000	771,000	198,000	-3,000	15,000
AVERAGE		**420,000**	**132,000**	**192,000**	**744,000**	**329,000**	**107,000**	**77,000**	**232,000**	**746,000**	**3,000**	**-6,000**	
%		**56.5%**	**17.7%**	**25.8%**		**44.1%**	**14.3%**	**10.3%**	**31.1%**				

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-4. Annual Summary of Inflows and Outflows from the Lower Aquifer Groundwater System

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence	Cumulative Change in Groundwater Storage
		Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows			
Historical Water Budget (WY 2003 - 2018)													
2003	Below Normal	4,000	7,000	625,000	635,000	143,000	0	0	635,000	777,000	-10,000	-132,000	-10,000
2004	Dry	2,000	5,000	612,000	619,000	88,000	0	0	564,000	652,000	-5,000	-28,000	-15,000
2005	Wet	3,000	10,000	612,000	625,000	67,000	0	0	552,000	620,000	2,000	3,000	-13,000
2006	Wet	2,000	7,000	619,000	627,000	82,000	0	0	566,000	648,000	-5,000	-16,000	-18,000
2007	Critical	1,000	1,000	624,000	626,000	111,000	0	0	572,000	684,000	-14,000	-44,000	-32,000
2008	Critical	4,000	8,000	641,000	653,000	161,000	0	0	611,000	772,000	-6,000	-113,000	-38,000
2009	Below Normal	3,000	3,000	681,000	687,000	281,000	0	0	648,000	930,000	-15,000	-228,000	-53,000
2010	Above Normal	4,000	10,000	680,000	694,000	198,000	0	0	641,000	839,000	-4,000	-141,000	-57,000
2011	Wet	2,000	12,000	639,000	653,000	87,000	0	0	576,000	663,000	4,000	-14,000	-53,000
2012	Dry	2,000	2,000	631,000	635,000	111,000	0	0	599,000	711,000	-14,000	-62,000	-67,000
2013	Critical	3,000	4,000	637,000	644,000	146,000	0	0	639,000	785,000	-10,000	-131,000	-77,000
2014	Critical	2,000	1,000	654,000	657,000	203,000	0	0	640,000	843,000	-17,000	-169,000	-94,000
2015	Critical	3,000	3,000	661,000	666,000	183,000	0	0	661,000	844,000	-10,000	-168,000	-104,000
2016	Dry	3,000	3,000	648,000	653,000	129,000	0	0	651,000	780,000	-10,000	-117,000	-114,000
2017	Wet	5,000	11,000	660,000	677,000	173,000	0	0	622,000	794,000	1,000	-118,000	-113,000
2018	Below Normal	2,000	2,000	684,000	688,000	218,000	0	0	614,000	832,000	-13,000	-131,000	-126,000
AVERAGE		**3,000**	**5,000**	**644,000**	**653,000**	**149,000**	**0**	**0**	**612,000**	**761,000**	**-8,000**	**-101,000**	
%		**0.5%**	**0.8%**	**98.6%**		**19.6%**	**0.0%**	**0.0%**	**80.4%**				
Current Water Budget (WY 2019 - 2023)													
2019	Wet	3,000	9,000	668,000	680,000	172,000	0	0	629,000	801,000	-5,000	-116,000	-5,000
2020	Dry	5,000	4,000	705,000	713,000	260,000	0	0	653,000	914,000	-12,000	-189,000	-17,000
2021	Critical	4,000	3,000	692,000	700,000	256,000	0	0	667,000	923,000	-15,000	-208,000	-32,000
2022	Critical	4,000	2,000	684,000	690,000	235,000	0	0	645,000	881,000	-14,000	-177,000	-46,000
2023	Wet	6,000	13,000	699,000	717,000	249,000	0	0	610,000	860,000	0	-143,000	-46,000
AVERAGE		**4,000**	**6,000**	**690,000**	**700,000**	**234,000**	**0**	**0**	**641,000**	**876,000**	**-9,000**	**-167,000**	
%		**0.6%**	**0.9%**	**98.6%**		**26.7%**	**0.0%**	**0.0%**	**73.2%**				

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-5. Change from Projected Baseline by Scenario

	Scenario	Change (%) from Projected Baseline
Evapotranspiration	2030 Central Tendency	2.2%
	2070 Central Tendency	4.3%
	2070 Extreme Dry	5.3%
	2070 Extreme Wet	3.7%
Precipitation	2030 Central Tendency	3.1%
	2070 Central Tendency	5.5%
	2070 Extreme Dry	-0.2%
	2070 Extreme Wet	23.4%
Surface Water Delivery	2030 Central Tendency	-1.9%
	2070 Central Tendency	-4.9%
	2070 Extreme Dry	-8.8%
	2070 Extreme Wet	2.8%

Table WB-6. Projected Baseline Scenario Land Surface Water System Inflows and Outflows

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)						OUTFLOWS (AFY)					Change in Storage (AFY)
		Precipitation	Surface Water Delivery	Applied Water		Stream-Groundwater Interaction Inflow	Total Inflows	Evapotranspiration	Stream Outflow	Infiltration	Stream-Groundwater Interaction Outflow	Total Outflows	
				Groundwater Extraction	Stream Inflow								
2024	Above Normal	1,035,000	1,477,000	427,000	5,905,000	122,000	8,967,000	1,835,000	6,409,000	586,000	137,000	8,967,000	0
2025	Wet	734,000	1,356,000	516,000	5,555,000	82,000	8,243,000	1,842,000	5,920,000	354,000	127,000	8,243,000	0
2026	Wet	679,000	1,355,000	486,000	5,618,000	67,000	8,205,000	1,711,000	6,045,000	348,000	101,000	8,205,000	0
2027	Critical	479,000	1,217,000	559,000	3,058,000	54,000	5,366,000	1,620,000	3,270,000	409,000	67,000	5,366,000	0
2028	Critical	363,000	1,208,000	537,000	7,108,000	66,000	9,282,000	1,700,000	7,175,000	269,000	138,000	9,282,000	0
2029	Wet	1,229,000	1,250,000	626,000	8,768,000	75,000	11,948,000	2,209,000	8,885,000	590,000	264,000	11,948,000	0
2030	Above Normal	723,000	1,464,000	452,000	6,481,000	80,000	9,199,000	1,817,000	6,799,000	389,000	194,000	9,199,000	0
2031	Wet	801,000	1,226,000	430,000	8,797,000	83,000	11,337,000	1,736,000	9,045,000	403,000	153,000	11,337,000	0
2032	Dry	550,000	1,216,000	496,000	4,526,000	67,000	6,855,000	1,750,000	4,683,000	294,000	128,000	6,855,000	0
2033	Wet	1,005,000	1,336,000	461,000	16,744,000	92,000	19,637,000	1,973,000	17,027,000	333,000	304,000	19,637,000	0
2034	Wet	1,344,000	1,493,000	581,000	20,818,000	113,000	24,349,000	2,276,000	21,296,000	560,000	217,000	24,349,000	0
2035	Above Normal	524,000	1,490,000	438,000	7,783,000	91,000	10,326,000	1,667,000	8,198,000	344,000	117,000	10,326,000	0
2036	Dry	534,000	1,213,000	485,000	6,329,000	75,000	8,636,000	1,729,000	6,449,000	297,000	161,000	8,636,000	0
2037	Wet	885,000	1,353,000	451,000	10,385,000	77,000	13,150,000	1,776,000	10,838,000	390,000	146,000	13,150,000	0
2038	Critical	486,000	1,207,000	490,000	4,717,000	59,000	6,959,000	1,616,000	4,981,000	279,000	83,000	6,959,000	0
2039	Critical	605,000	1,212,000	436,000	4,426,000	58,000	6,736,000	1,650,000	4,704,000	306,000	76,000	6,736,000	0
2040	Critical	508,000	1,315,000	491,000	4,164,000	46,000	6,524,000	1,615,000	4,572,000	259,000	78,000	6,524,000	0
2041	Critical	483,000	1,210,000	554,000	3,062,000	45,000	5,353,000	1,608,000	3,300,000	366,000	79,000	5,353,000	0
2042	Critical	525,000	1,225,000	556,000	3,036,000	50,000	5,392,000	1,581,000	3,282,000	422,000	107,000	5,392,000	0
2043	Critical	658,000	1,236,000	476,000	5,381,000	66,000	7,816,000	1,780,000	5,532,000	337,000	167,000	7,816,000	0
2044	Wet	1,077,000	1,358,000	566,000	5,339,000	79,000	8,419,000	1,730,000	5,824,000	679,000	186,000	8,419,000	0
2045	Critical	578,000	1,218,000	475,000	7,307,000	73,000	9,652,000	1,768,000	7,424,000	284,000	176,000	9,652,000	0
2046	Wet	1,104,000	1,420,000	478,000	10,717,000	86,000	13,806,000	1,861,000	11,198,000	523,000	224,000	13,806,000	0
2047	Wet	835,000	1,368,000	550,000	9,331,000	94,000	12,178,000	1,827,000	9,699,000	448,000	204,000	12,178,000	0
2048	Wet	890,000	1,377,000	583,000	15,436,000	109,000	18,394,000	1,814,000	15,746,000	555,000	279,000	18,394,000	0
2049	Wet	1,574,000	1,404,000	609,000	10,284,000	116,000	13,987,000	2,262,000	10,828,000	723,000	174,000	13,987,000	0
2050	Above Normal	565,000	1,510,000	601,000	5,490,000	79,000	8,246,000	2,039,000	5,783,000	302,000	122,000	8,246,000	0
2051	Above Normal	729,000	1,473,000	527,000	5,577,000	81,000	8,386,000	1,685,000	6,016,000	544,000	141,000	8,386,000	0
2052	Dry	701,000	1,353,000	412,000	4,351,000	73,000	6,890,000	1,705,000	4,785,000	307,000	93,000	6,890,000	0
2053	Dry	530,000	1,283,000	651,000	4,426,000	60,000	6,949,000	1,938,000	4,545,000	357,000	109,000	6,949,000	0
2054	Below Normal	680,000	1,469,000	454,000	4,477,000	55,000	7,135,000	1,683,000	5,007,000	337,000	108,000	7,135,000	0
2055	Dry	566,000	1,365,000	534,000	5,324,000	59,000	7,849,000	1,692,000	5,647,000	363,000	147,000	7,849,000	0
2056	Wet	1,067,000	1,374,000	437,000	10,477,000	70,000	13,426,000	1,933,000	10,901,000	398,000	194,000	13,426,000	0
2057	Wet	828,000	1,408,000	462,000	10,218,000	69,000	12,984,000	1,748,000	10,724,000	362,000	150,000	12,984,000	0
2058	Critical	361,000	1,304,000	629,000	3,878,000	59,000	6,231,000	1,536,000	4,242,000	342,000	111,000	6,231,000	0
2059	Critical	537,000	1,190,000	846,000	3,492,000	59,000	6,123,000	1,833,000	3,663,000	539,000	88,000	6,123,000	0
2060	Below Normal	499,000	1,263,000	798,000	4,021,000	54,000	6,635,000	1,964,000	4,072,000	455,000	144,000	6,635,000	0
2061	Above Normal	885,000	1,475,000	364,000	7,082,000	62,000	9,868,000	1,852,000	7,466,000	371,000	179,000	9,868,000	0
2062	Wet	993,000	1,380,000	515,000	9,617,000	69,000	12,573,000	1,795,000	10,103,000	510,000	165,000	12,573,000	0
2063	Dry	448,000	1,352,000	494,000	3,739,000	57,000	6,090,000	1,611,000	4,083,000	306,000	90,000	6,090,000	0
2064	Critical	453,000	1,210,000	583,000	2,616,000	58,000	4,920,000	1,538,000	2,892,000	439,000	51,000	4,920,000	0
2065	Critical	341,000	1,225,000	524,000	4,069,000	42,000	6,200,000	1,532,000	4,317,000	327,000	24,000	6,200,000	0
2066	Critical	487,000	1,247,000	527,000	5,539,000	52,000	7,852,000	1,530,000	5,831,000	453,000	38,000	7,852,000	0
2067	Dry	921,000	1,231,000	425,000	10,391,000	61,000	13,028,000	1,741,000	10,645,000	490,000	152,000	13,028,000	0
2068	Wet	1,020,000	1,496,000	456,000	13,470,000	87,000	16,530,000	1,716,000	13,962,000	597,000	255,000	16,530,000	0
2069	Below Normal	470,000	1,426,000	540,000	9,162,000	65,000	11,663,000	1,585,000	9,534,000	365,000	179,000	11,663,000	0
2070	Wet	842,000	1,225,000	513,000	9,788,000	81,000	12,449,000	1,735,000	10,064,000	480,000	170,000	12,449,000	0
2071	Dry	529,000	1,227,000	549,000	2,707,000	67,000	5,079,000	1,592,000	2,973,000	432,000	82,000	5,079,000	0
2072	Critical	396,000	1,223,000	601,000	2,234,000	56,000	4,510,000	1,541,000	2,470,000	439,000	60,000	4,510,000	0
2073	Critical	491,000	1,224,000	569,000	2,261,000	54,000	4,599,000	1,575,000	2,508,000	441,000	75,000	4,599,000	0
AVERAGE		**711,000**	**1,323,000**	**524,000**	**6,910,000**	**71,000**	**9,539,000**	**1,757,000**	**7,227,000**	**414,000**	**140,000**	**9,539,000**	**0**
%		**7%**	**14%**	**5%**				**18%**	**76%**	**4%**			

Table WB-6. Projected Baseline Scenario Land Surface Water System Inflows and Outflows

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Applied water includes imported surface water, diverted water from streams, and groundwater.
(b) Stream inflow and outflow incorporate all flows simulated as part of the Model's Streamflow Routing Package (SFR), including flows simulated in San Joaquin River, California Aqueduct, and Delta-Mendota Canal. Although San Joaquin River forms the boundary of the Basin, it is included in the calculation of stream inflow and outflow to the Basin and accounts for streamflow received from streams outside of the Basin, such as Merced and Kings River.
(c) Change in storage is calculated as the difference between inflows and outflows and is negligible in Land Surface Water Budget (Proj).
(d) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.

Table WB-7. Projected Baseline Scenario Annual Inflows and Outflows from the Upper Aquifer Groundwater System

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence	Cumulative Change in Groundwater Storage
		Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows			
2024	Above Normal	508,000	129,000	213,000	850,000	271,000	144,000	122,000	261,000	798,000	51,000	1,000	51,000
2025	Wet	298,000	123,000	217,000	639,000	295,000	86,000	82,000	259,000	722,000	-76,000	-7,000	-25,000
2026	Wet	297,000	100,000	212,000	609,000	288,000	70,000	67,000	251,000	676,000	-63,000	-4,000	-88,000
2027	Critical	358,000	66,000	205,000	628,000	325,000	77,000	54,000	253,000	709,000	-78,000	-3,000	-166,000
2028	Critical	221,000	126,000	218,000	565,000	332,000	89,000	66,000	248,000	735,000	-163,000	-7,000	-329,000
2029	Wet	512,000	257,000	243,000	1,013,000	341,000	133,000	75,000	282,000	831,000	186,000	-4,000	-143,000
2030	Above Normal	335,000	177,000	229,000	741,000	282,000	107,000	79,000	287,000	755,000	-14,000	0	-157,000
2031	Wet	351,000	149,000	224,000	724,000	284,000	90,000	83,000	274,000	732,000	-5,000	-3,000	-162,000
2032	Dry	249,000	117,000	235,000	600,000	314,000	63,000	67,000	273,000	716,000	-111,000	-5,000	-273,000
2033	Wet	285,000	280,000	238,000	803,000	268,000	121,000	91,000	262,000	742,000	63,000	-2,000	-210,000
2034	Wet	488,000	211,000	246,000	945,000	314,000	136,000	113,000	278,000	842,000	105,000	-2,000	-105,000
2035	Above Normal	296,000	115,000	239,000	650,000	287,000	72,000	91,000	278,000	729,000	-80,000	1,000	-185,000
2036	Dry	254,000	145,000	237,000	636,000	311,000	72,000	75,000	273,000	730,000	-89,000	-5,000	-274,000
2037	Wet	342,000	143,000	221,000	706,000	274,000	69,000	77,000	264,000	684,000	25,000	-3,000	-249,000
2038	Critical	241,000	82,000	222,000	545,000	312,000	48,000	59,000	263,000	682,000	-131,000	-6,000	-380,000
2039	Critical	266,000	75,000	212,000	553,000	288,000	45,000	58,000	259,000	650,000	-94,000	-3,000	-474,000
2040	Critical	224,000	77,000	209,000	510,000	293,000	38,000	46,000	252,000	630,000	-118,000	-2,000	-592,000
2041	Critical	321,000	77,000	208,000	606,000	327,000	49,000	45,000	254,000	675,000	-62,000	-7,000	-654,000
2042	Critical	373,000	104,000	215,000	692,000	334,000	53,000	50,000	257,000	694,000	6,000	-8,000	-648,000
2043	Critical	296,000	153,000	216,000	665,000	305,000	72,000	66,000	271,000	714,000	-46,000	-3,000	-694,000
2044	Wet	607,000	181,000	223,000	1,011,000	308,000	98,000	79,000	275,000	761,000	252,000	-2,000	-442,000
2045	Critical	242,000	163,000	214,000	620,000	306,000	80,000	73,000	269,000	727,000	-106,000	-1,000	-548,000
2046	Wet	456,000	210,000	222,000	889,000	284,000	103,000	86,000	273,000	746,000	143,000	0	-405,000
2047	Wet	393,000	189,000	236,000	818,000	319,000	103,000	93,000	284,000	800,000	21,000	-3,000	-384,000
2048	Wet	488,000	251,000	247,000	987,000	338,000	158,000	108,000	289,000	893,000	98,000	-4,000	-286,000
2049	Wet	640,000	165,000	243,000	1,047,000	323,000	178,000	116,000	294,000	911,000	134,000	2,000	-152,000
2050	Above Normal	251,000	119,000	254,000	623,000	353,000	69,000	79,000	299,000	799,000	-172,000	-4,000	-324,000
2051	Above Normal	481,000	137,000	232,000	849,000	319,000	98,000	81,000	289,000	787,000	62,000	0	-262,000
2052	Dry	262,000	91,000	211,000	563,000	276,000	59,000	73,000	264,000	673,000	-108,000	-2,000	-370,000
2053	Dry	306,000	106,000	246,000	658,000	372,000	58,000	60,000	294,000	784,000	-118,000	-8,000	-488,000
2054	Below Normal	295,000	104,000	215,000	613,000	279,000	51,000	55,000	267,000	652,000	-41,000	2,000	-529,000
2055	Dry	320,000	138,000	220,000	677,000	335,000	69,000	59,000	265,000	728,000	-47,000	-4,000	-576,000
2056	Wet	350,000	189,000	219,000	758,000	266,000	73,000	70,000	262,000	671,000	84,000	3,000	-492,000
2057	Wet	315,000	148,000	211,000	674,000	280,000	58,000	69,000	258,000	666,000	7,000	1,000	-485,000
2058	Critical	298,000	106,000	212,000	617,000	347,000	53,000	59,000	255,000	714,000	-88,000	-9,000	-573,000
2059	Critical	471,000	85,000	233,000	789,000	421,000	75,000	59,000	282,000	837,000	-34,000	-14,000	-607,000
2060	Below Normal	393,000	136,000	251,000	780,000	409,000	70,000	53,000	300,000	833,000	-48,000	-5,000	-655,000
2061	Above Normal	325,000	168,000	219,000	711,000	258,000	72,000	62,000	278,000	670,000	35,000	6,000	-620,000
2062	Wet	456,000	162,000	213,000	831,000	289,000	77,000	69,000	267,000	702,000	129,000	0	-491,000
2063	Dry	262,000	88,000	199,000	549,000	298,000	53,000	57,000	257,000	665,000	-112,000	-4,000	-603,000
2064	Critical	386,000	49,000	207,000	642,000	347,000	64,000	58,000	270,000	738,000	-91,000	-5,000	-694,000
2065	Critical	283,000	22,000	206,000	511,000	340,000	48,000	42,000	247,000	676,000	-163,000	-2,000	-857,000
2066	Critical	400,000	35,000	205,000	639,000	343,000	60,000	52,000	241,000	695,000	-54,000	-2,000	-911,000
2067	Dry	432,000	143,000	200,000	774,000	286,000	87,000	60,000	246,000	679,000	94,000	1,000	-817,000
2068	Wet	530,000	249,000	210,000	989,000	277,000	112,000	87,000	270,000	747,000	240,000	2,000	-577,000
2069	Below Normal	314,000	171,000	197,000	682,000	316,000	81,000	64,000	260,000	722,000	-37,000	-3,000	-614,000
2070	Wet	424,000	167,000	213,000	805,000	306,000	82,000	81,000	277,000	747,000	61,000	-3,000	-553,000
2071	Dry	381,000	79,000	202,000	662,000	332,000	74,000	67,000	280,000	753,000	-89,000	-2,000	-642,000
2072	Critical	382,000	57,000	210,000	648,000	353,000	69,000	56,000	282,000	759,000	-107,000	-4,000	-749,000
2073	Critical	389,000	71,000	222,000	682,000	345,000	68,000	54,000	281,000	748,000	-64,000	-2,000	-813,000
AVERAGE		**361,000**	**134,000**	**221,000**	**716,000**	**313,000**	**81,000**	**71,000**	**269,000**	**734,000**	**-16,000**	**-3,000**	
%		**50.4%**	**18.7%**	**30.9%**		**42.6%**	**11.0%**	**9.7%**	**36.6%**				

Table WB-7. Projected Baseline Scenario Annual Inflows and Outflows from the Upper Aquifer Groundwater System

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-8. Projected Baseline Scenario Annual Inflows and Outflows from the Lower Aquifer Groundwater System

Water Year (Oct - Sep)	Water Year Type	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence	Cumulative Change in Groundwater Storage
		Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows			
2024	Above Normal	5,000	8,000	706,000	719,000	155,000	0	0	658,000	814,000	-2,000	-93,000	-2,000
2025	Wet	2,000	4,000	723,000	729,000	222,000	0	0	656,000	878,000	-14,000	-135,000	-16,000
2026	Wet	3,000	2,000	726,000	731,000	198,000	0	0	660,000	858,000	-13,000	-114,000	-29,000
2027	Critical	3,000	1,000	737,000	741,000	234,000	0	0	660,000	894,000	-14,000	-139,000	-43,000
2028	Critical	1,000	12,000	722,000	735,000	205,000	0	0	695,000	900,000	-7,000	-158,000	-50,000
2029	Wet	6,000	7,000	735,000	747,000	286,000	0	0	670,000	955,000	-6,000	-202,000	-56,000
2030	Above Normal	3,000	17,000	720,000	740,000	171,000	0	1,000	670,000	841,000	4,000	-105,000	-52,000
2031	Wet	3,000	3,000	687,000	694,000	145,000	0	0	656,000	801,000	-12,000	-95,000	-64,000
2032	Dry	1,000	11,000	714,000	726,000	182,000	0	0	667,000	849,000	-7,000	-116,000	-71,000
2033	Wet	1,000	24,000	722,000	748,000	194,000	0	1,000	602,000	796,000	11,000	-59,000	-60,000
2034	Wet	4,000	6,000	762,000	771,000	267,000	0	0	655,000	922,000	-11,000	-140,000	-71,000
2035	Above Normal	2,000	1,000	775,000	778,000	150,000	0	0	702,000	852,000	-11,000	-63,000	-82,000
2036	Dry	2,000	16,000	761,000	779,000	174,000	0	1,000	698,000	873,000	-1,000	-93,000	-83,000
2037	Wet	3,000	2,000	752,000	757,000	178,000	0	0	662,000	839,000	-11,000	-71,000	-94,000
2038	Critical	1,000	1,000	754,000	756,000	178,000	0	0	701,000	879,000	-17,000	-106,000	-111,000
2039	Critical	2,000	1,000	729,000	732,000	148,000	0	0	676,000	824,000	-14,000	-78,000	-125,000
2040	Critical	1,000	1,000	756,000	759,000	198,000	0	0	685,000	883,000	-15,000	-109,000	-140,000
2041	Critical	2,000	2,000	742,000	746,000	227,000	0	0	661,000	888,000	-16,000	-126,000	-156,000
2042	Critical	3,000	2,000	745,000	750,000	222,000	0	0	679,000	901,000	-16,000	-135,000	-172,000
2043	Critical	2,000	14,000	731,000	747,000	171,000	0	0	688,000	859,000	-4,000	-108,000	-176,000
2044	Wet	7,000	5,000	748,000	760,000	258,000	0	0	630,000	887,000	-7,000	-120,000	-183,000
2045	Critical	1,000	12,000	727,000	741,000	169,000	0	1,000	655,000	825,000	-3,000	-81,000	-186,000
2046	Wet	5,000	14,000	725,000	745,000	194,000	0	1,000	613,000	808,000	3,000	-66,000	-183,000
2047	Wet	3,000	16,000	767,000	785,000	231,000	0	1,000	653,000	884,000	0	-99,000	-183,000
2048	Wet	5,000	28,000	808,000	840,000	245,000	0	1,000	681,000	926,000	14,000	-100,000	-169,000
2049	Wet	9,000	10,000	812,000	830,000	286,000	0	0	667,000	953,000	1,000	-124,000	-168,000
2050	Above Normal	1,000	4,000	828,000	833,000	248,000	0	0	708,000	957,000	-14,000	-110,000	-182,000
2051	Above Normal	4,000	4,000	823,000	831,000	207,000	0	0	694,000	901,000	-6,000	-64,000	-188,000
2052	Dry	2,000	2,000	749,000	752,000	135,000	0	0	669,000	804,000	-11,000	-41,000	-199,000
2053	Dry	2,000	4,000	818,000	824,000	279,000	0	0	716,000	995,000	-15,000	-156,000	-214,000
2054	Below Normal	3,000	4,000	766,000	773,000	175,000	0	0	656,000	831,000	-6,000	-52,000	-220,000
2055	Dry	3,000	9,000	784,000	796,000	200,000	0	0	698,000	898,000	-8,000	-94,000	-228,000
2056	Wet	3,000	6,000	751,000	760,000	171,000	0	0	616,000	787,000	-4,000	-23,000	-232,000
2057	Wet	2,000	2,000	762,000	767,000	181,000	0	0	633,000	815,000	-9,000	-39,000	-241,000
2058	Critical	2,000	5,000	789,000	796,000	282,000	0	0	648,000	930,000	-14,000	-120,000	-255,000
2059	Critical	5,000	4,000	863,000	872,000	425,000	0	0	691,000	1,116,000	-13,000	-231,000	-268,000
2060	Below Normal	3,000	8,000	877,000	888,000	389,000	0	0	715,000	1,104,000	-11,000	-205,000	-279,000
2061	Above Normal	3,000	11,000	754,000	768,000	106,000	0	0	663,000	769,000	6,000	-7,000	-273,000
2062	Wet	3,000	2,000	772,000	778,000	226,000	0	0	619,000	845,000	-12,000	-55,000	-285,000
2063	Dry	2,000	3,000	761,000	766,000	196,000	0	0	633,000	829,000	-12,000	-51,000	-297,000
2064	Critical	3,000	2,000	799,000	804,000	236,000	0	0	680,000	916,000	-12,000	-100,000	-309,000
2065	Critical	2,000	2,000	762,000	766,000	184,000	0	0	663,000	848,000	-10,000	-72,000	-319,000
2066	Critical	3,000	3,000	749,000	755,000	185,000	0	0	662,000	846,000	-9,000	-82,000	-328,000
2067	Dry	3,000	9,000	714,000	726,000	139,000	0	0	623,000	762,000	1,000	-37,000	-327,000
2068	Wet	5,000	6,000	726,000	738,000	179,000	0	0	590,000	769,000	-1,000	-30,000	-328,000
2069	Below Normal	2,000	8,000	758,000	768,000	224,000	0	0	603,000	827,000	-6,000	-53,000	-334,000
2070	Wet	3,000	3,000	766,000	772,000	206,000	0	0	639,000	846,000	-12,000	-62,000	-346,000
2071	Dry	4,000	3,000	786,000	793,000	218,000	0	0	656,000	874,000	-10,000	-71,000	-356,000
2072	Critical	4,000	3,000	806,000	813,000	248,000	0	0	677,000	925,000	-11,000	-101,000	-367,000
2073	Critical	4,000	3,000	782,000	789,000	225,000	0	0	656,000	880,000	-10,000	-81,000	-377,000
AVERAGE		**3,000**	**7,000**	**761,000**	**770,000**	**211,000**	**0**	**0**	**662,000**	**873,000**	**-8,000**	**-95,000**	
%		**0.4%**	**0.9%**	**98.8%**		**24.2%**	**0.0%**	**0.0%**	**75.8%**				

Table WB-8. Projected Baseline Scenario Annual Inflows and Outflows from the Lower Aquifer Groundwater System

Abbreviations
AFY = acre-feet per year
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-9. Upper Aquifer Water Budget Summary by Scenario

Scenario	Climate Period	Land Use	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence
			Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows		
Historical	WY 2003-2018	Historical	356,000	96,000	158,000	609,000	261,000	104,000	79,000	185,000	629,000	-16,000	-4,000
Current	WY 2019-2023	Current	420,000	132,000	192,000	744,000	329,000	107,000	77,000	232,000	746,000	3,000	-6,000
Overdraft Evaluation Period	WY 2003-2023	Historical & Current	371,000	104,000	166,000	641,000	278,000	104,000	79,000	196,000	657,000	-11,000	-4,000
Projected Baseline	WY 2024-2073 Analog	Projected	361,000	134,000	221,000	716,000	313,000	81,000	71,000	269,000	734,000	-16,000	-3,000
Projected 2030 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	370,000	135,000	227,000	731,000	323,000	83,000	71,000	275,000	752,000	-18,000	-3,000
Projected 2070 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	388,000	137,000	236,000	761,000	340,000	88,000	73,000	283,000	784,000	-19,000	-4,000
Projected 2070 Extreme Dry Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	391,000	133,000	245,000	769,000	367,000	77,000	61,000	292,000	797,000	-23,000	-5,000
Projected 2070 Extreme Wet Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	457,000	151,000	236,000	843,000	321,000	141,000	104,000	284,000	851,000	-4,000	-3,000

Abbreviations
AFY = acre-feet per year
DWR = California Department of Water Resources
P/MA = Project and/or Management Actions
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-10. Lower Aquifer Water Budget Summary by Scenario

Scenario	Climate Period	Land Use	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence
			Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows		
Historical	WY 2003-2018	Historical	3,000	5,000	644,000	653,000	149,000	0	0	612,000	761,000	-8,000	-101,000
Current	WY 2019-2023	Current	4,000	6,000	690,000	700,000	234,000	0	0	641,000	876,000	-9,000	-167,000
Overdraft Evaluation Period	WY 2003-2023	Historical & Current	3,000	6,000	655,000	664,000	169,000	0	0	619,000	788,000	-8,000	-116,000
Projected Baseline	WY 2024-2073 Analog	Projected	3,000	7,000	761,000	770,000	211,000	0	0	662,000	873,000	-8,000	-95,000
Projected 2030 Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	3,000	7,000	778,000	787,000	241,000	0	0	661,000	902,000	-9,000	-106,000
Projected 2070 Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	3,000	7,000	805,000	815,000	281,000	0	0	663,000	944,000	-9,000	-119,000
Projected 2070 Extreme Dry Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	3,000	7,000	800,000	811,000	319,000	0	0	645,000	964,000	-11,000	-142,000
Projected 2070 Extreme Wet Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	5,000	9,000	828,000	841,000	228,000	0	0	704,000	933,000	-4,000	-88,000

Abbreviations
AFY = acre-feet per year
DWR = California Department of Water Resources
P/MA = Project and/or Management Actions
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-11. Basin Water Budget Summary by Scenario

Scenario	Climate Period	Land Use	INFLOWS (AFY)				OUTFLOWS (AFY)					Change in Groundwater Storage	Water Release Caused By Subsidence
			Groundwater Recharge	Stream-Groundwater Interaction Inflow	Subsurface Groundwater Inflow	TOTAL INFLOWS	Groundwater Extractions	Losses from Unsaturated Zones	Stream-Groundwater Interaction Outflow	Subsurface Groundwater Outflow	Total Outflows		
Historical	WY 2003-2018	Historical	359,000	101,000	802,000	1,262,000	410,000	104,000	79,000	797,000	1,390,000	-24,000	-105,000
Current	WY 2019-2023	Current	424,000	138,000	882,000	1,444,000	563,000	107,000	77,000	873,000	1,622,000	-6,000	-173,000
Overdraft Evaluation Period	WY 2003-2023	Historical & Current	374,000	110,000	821,000	1,305,000	447,000	104,000	79,000	815,000	1,445,000	-19,000	-120,000
Projected Baseline	WY 2024-2073 Analog	Projected	364,000	141,000	982,000	1,486,000	524,000	81,000	71,000	931,000	1,607,000	-24,000	-98,000
Projected 2030 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	373,000	141,000	1,004,000	1,519,000	563,000	83,000	72,000	937,000	1,654,000	-26,000	-109,000
Projected 2070 Central Tendency Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	391,000	144,000	1,041,000	1,576,000	621,000	88,000	73,000	946,000	1,728,000	-28,000	-123,000
Projected 2070 Extreme Dry Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	394,000	140,000	1,045,000	1,580,000	686,000	77,000	61,000	936,000	1,761,000	-34,000	-147,000
Projected 2070 Extreme Wet Climate Change	WY 2024-2073 Analog with DWR 2030 Climate Change	Projected	462,000	160,000	1,063,000	1,685,000	549,000	141,000	104,000	989,000	1,783,000	-8,000	-91,000

Abbreviations
AFY = acre-feet per year
DWR = California Department of Water Resources
P/MA = Project and/or Management Actions
WY = Water Year

Notes
(a) Change in storage is calculated as the difference between inflows and outflows.
(b) All numbers shown are rounded to the nearest 1,000. Summation of terms may have minor discrepancies due to rounding errors.
(c) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

Table WB-13. Sustainable Yield Summary

Principal Aquifer	Period	Groundwater Extraction	Changes in Storage	Water Release Caused by Subsidence	Sustainable Yield
Upper Aquifer	Historical Period (2003-2018)	261,000	-16,000	(-3,000; -4,000)	(241,000; 242,000)
	Current Period (2019-2023)	329,000	3,000	(-4,000; -6,000)	(326,000; 328,000)
	Evaluation Period (2003-2023)	278,000	-11,000	(-3,000; -4,000)	(263,000; 264,000)
Lower Aquifer	Historical Period (2003-2018)	149,000	-8,000	(-46,000; -101,000)	(40,000; 95,000)
	Current Period (2019-2023)	234,000	-9,000	(-68,000; -167,000)	(58,000; 157,000)
	Evaluation Period (2003-2023)	169,000	-8,000	(-50,000; -116,000)	(45,000; 111,000)
Basin	Historical Period (2003-2018)	410,000	-24,000	(-49,000; -105,000)	(281,000; 337,000)
	Current Period (2019-2023)	563,000	-6,000	(-72,000; -173,000)	(384,000; 485,000)
	Evaluation Period (2003-2023)	447,000	-19,000	(-53,000; -120,000)	(308,000; 375,000)

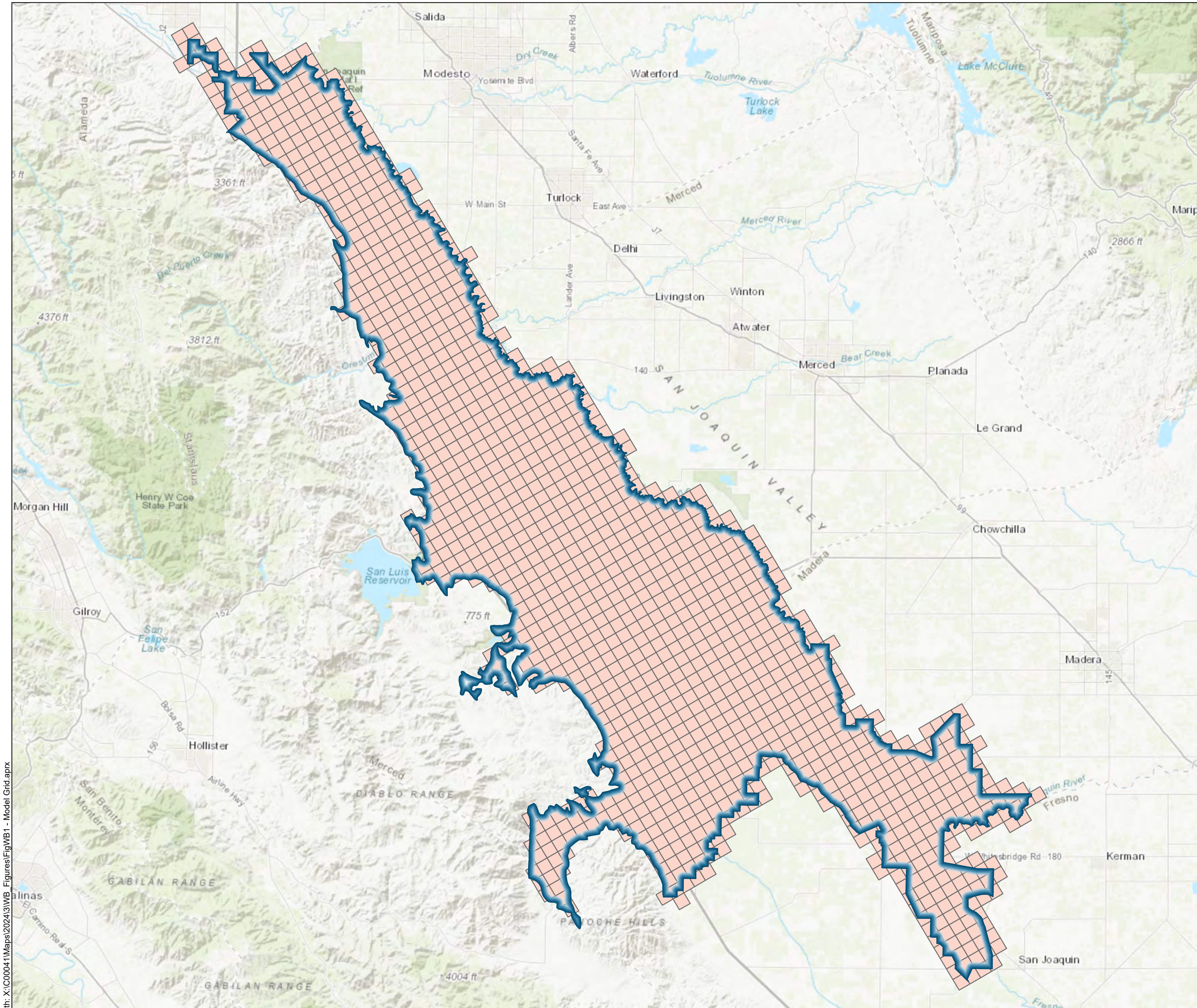
Notes

(a) All numbers shown are rounded to the nearest 1,000. Summation of terms may have negligible departures due to rounding errors.

(b) Water release caused by subsidence is generally overestimated in the Model due to local overestimations of subsidence rates and extent.

(c) Lower and upper bounds of the range for water release caused by subsidence show the component's portion caused by Basin management and its total simulated volume, respectively.

(d) Lower and upper bounds of the range for sustainable yield is calculated based on the range provided for water release caused by subsidence.



Legend

Model Extent and Grid

Delta-Mendota Subbasin (DWR Basin No. 5-022.07)

Abbreviations

CVHM2-SJV = Central Valley Hydrologic Model Version 2 – San Joaquin Valley
DWR = California Department of Water Resources

Sources

1. Groundwater basins and subbasins. California Department of Water Resources. August 25, 2023.
2. CVHM2-SJV is developed by the United States Geological Survey's (USGS).

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Numerical Model Mesh

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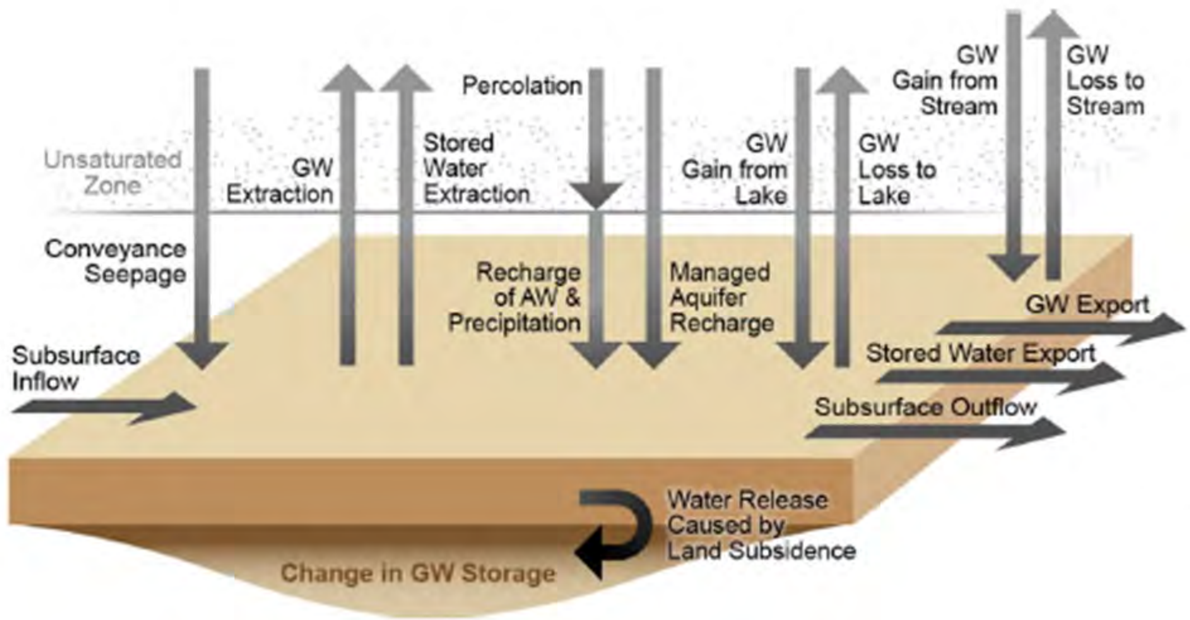
Figure WB-1

Path: X:\C00041\Maps\2024\3\WB_Figures\FigWB1 - Model Grid.aprx



Abbreviations
AW = Applied Water
DWR = Department of Water Resources
GW = Groundwater

Notes:
1. If accommodation or alternative format is needed for this figure, please contact the Plan Manager for assistance.

Sources
1. DWR Handbook For Water Budget Development With or Without Models

Conceptual Water Budget Systems

Delta-Mendota Subbasin
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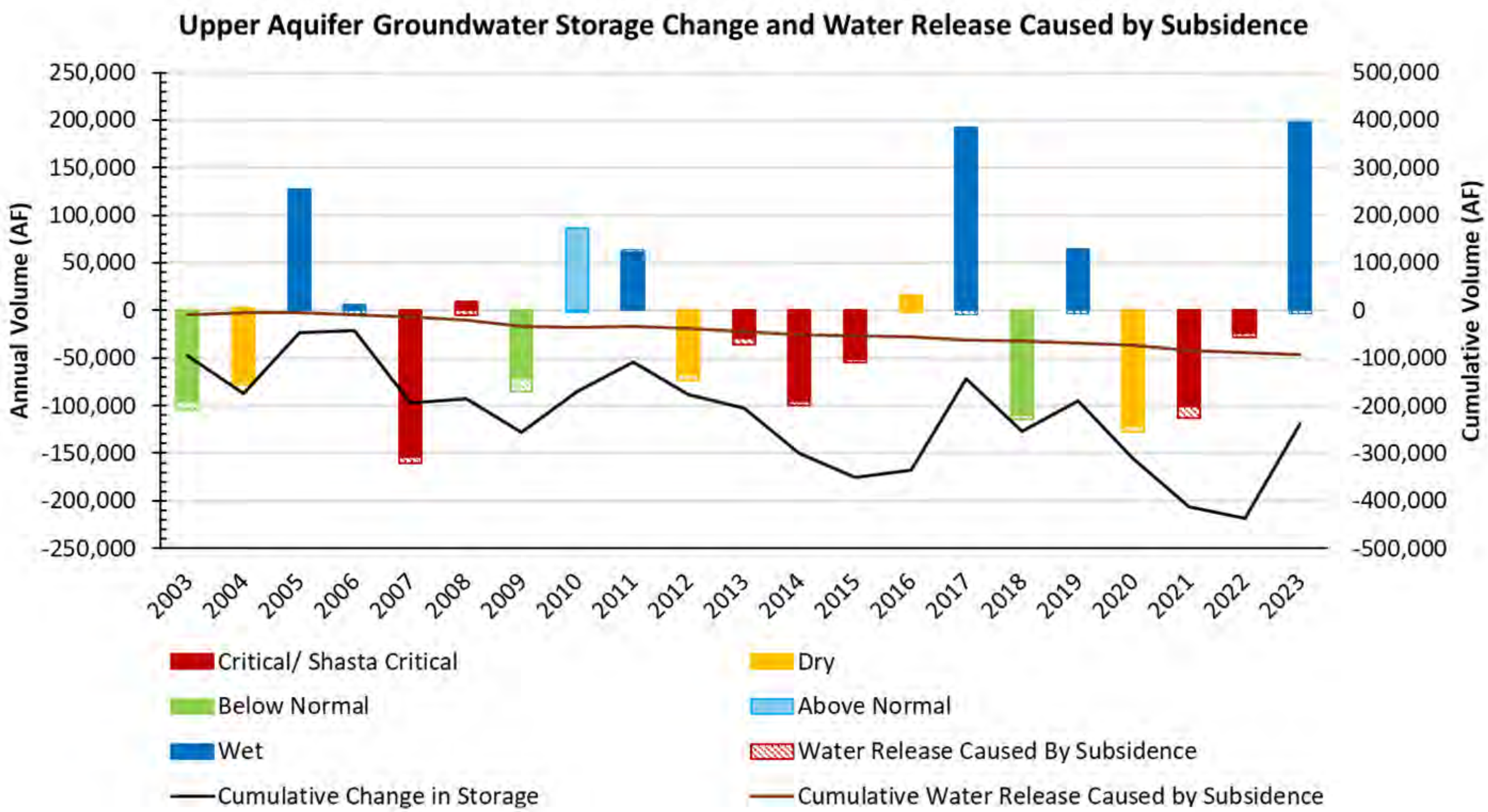
Figure WB-2



Notes:
1. If accommodation or alternative format is needed for this figure, please contact the Plan Manager for assistance.

Abbreviations

AF = acre-feet

SGMA = Sustainable Groundwater Management Act

Annual Groundwater Storage Change, Upper Aquifer

Delta-Mendota Subbasin
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Figure WB-3

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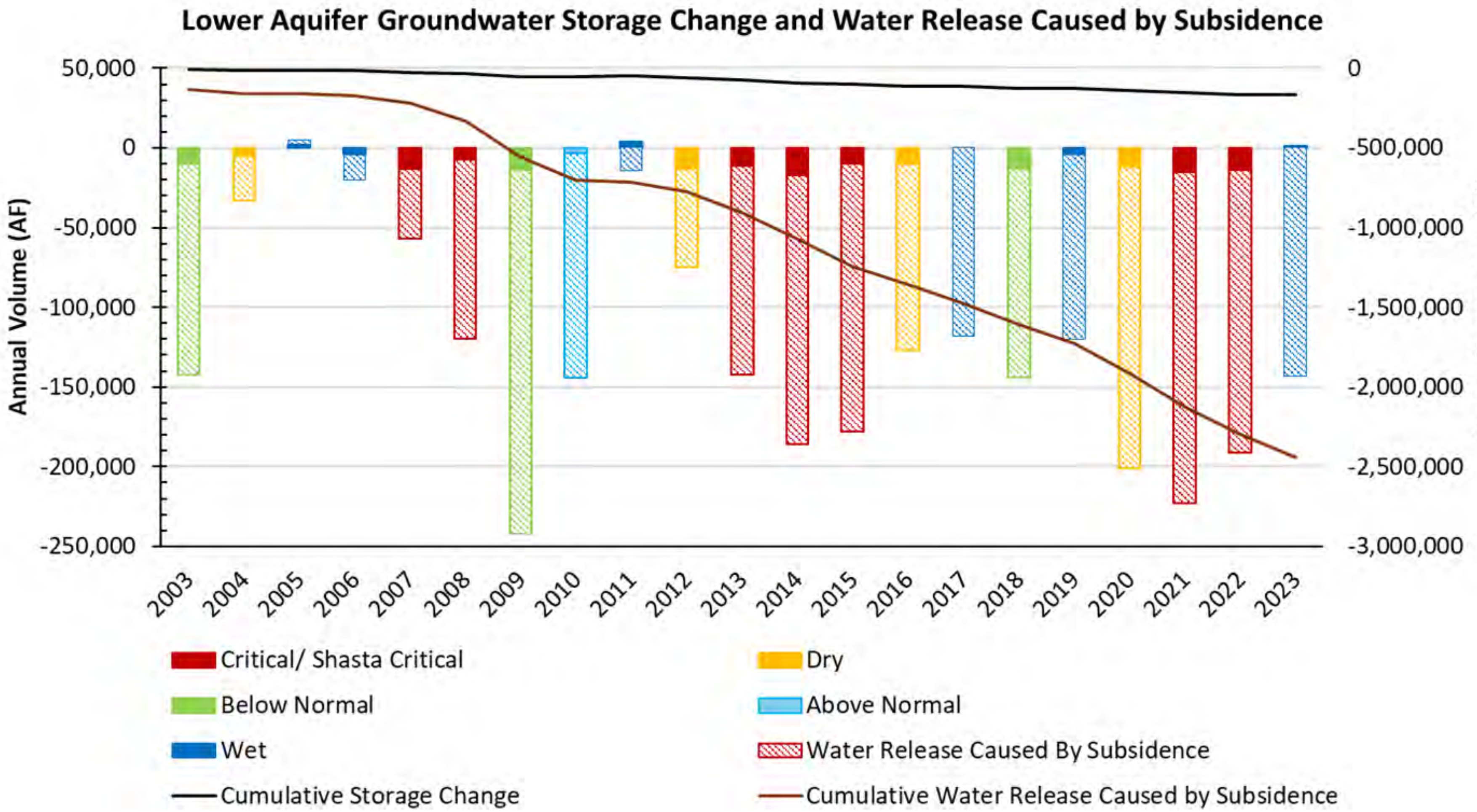

Notes:

1. If accommodation or alternative format is needed for this figure, please contact the Plan Manager for assistance.

Abbreviations

AF = acre-feet

SGMA = Sustainable Groundwater Management Act

Annual Groundwater Storage Change, Lower Aquifer

Delta-Mendota Subbasin
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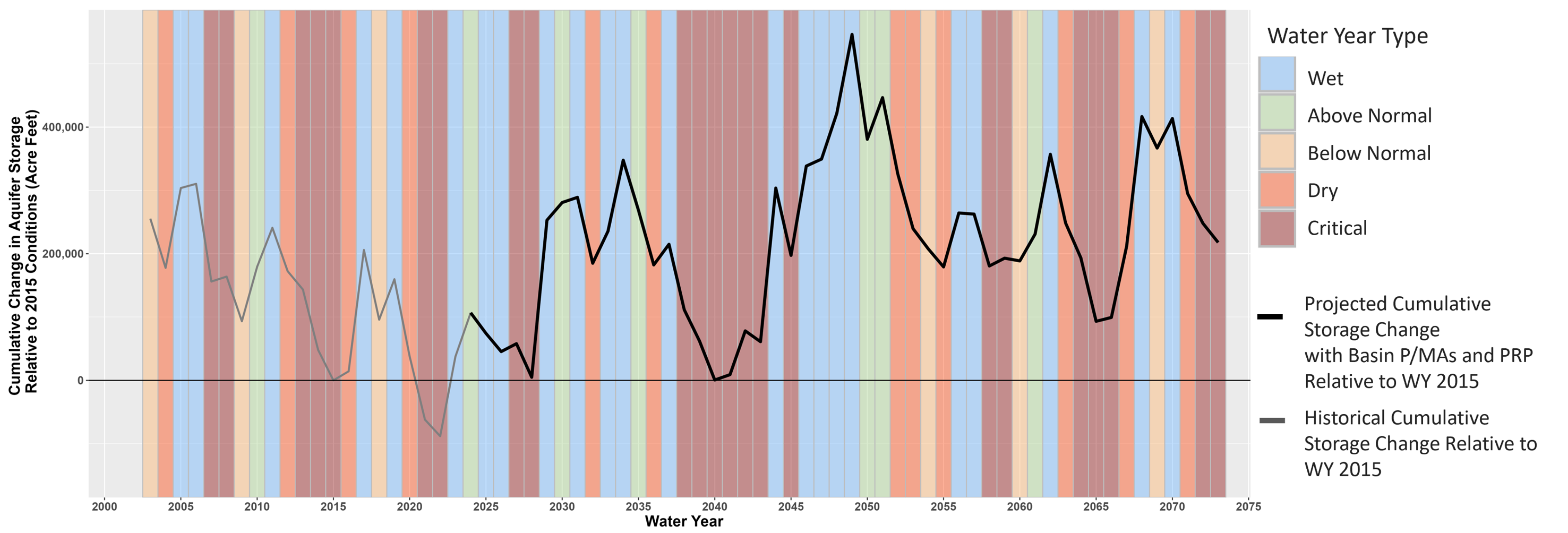
Figure WB-4



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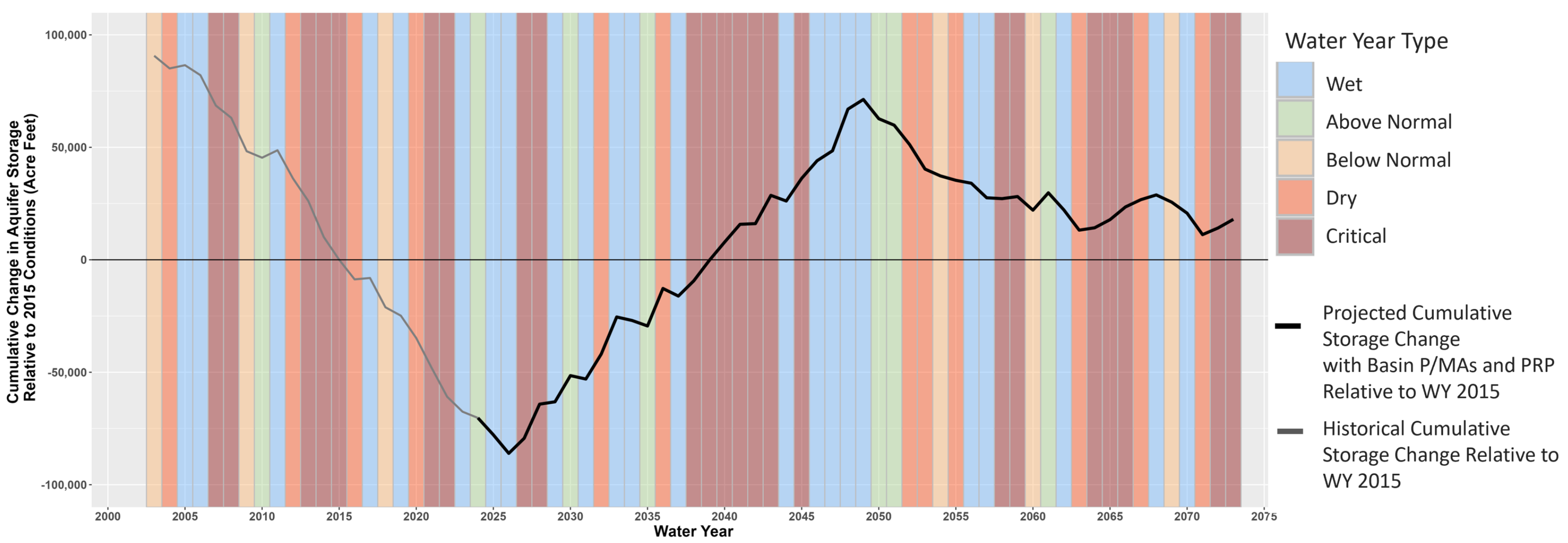
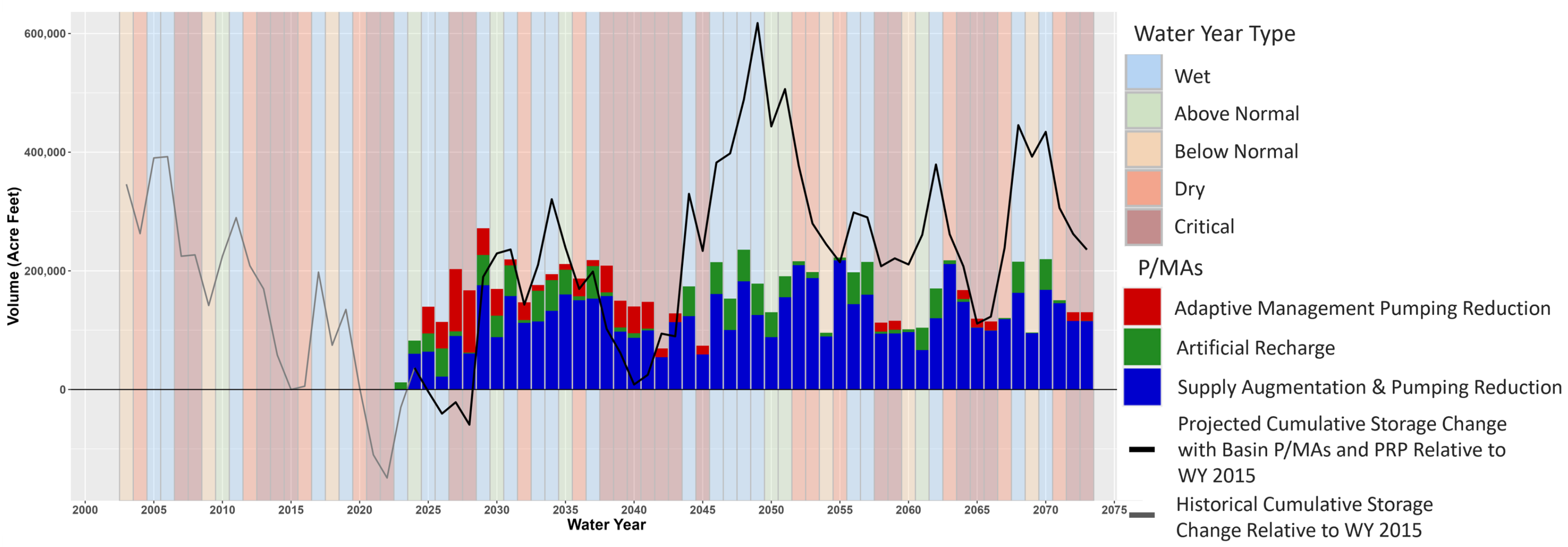


(b)



(c)

Notes
1. If accommodation or alternative format is needed for this figure, please contact the Plan Manager for assistance.

Mitigation of Overdraft and Its Potential Range of Variability

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C00041.09

Figure WB-6

10 MANAGEMENT AREAS

§ 354.20. Management Areas

(a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.

(b) A basin that includes one or more management areas shall describe the following in the Plan:

(1) The reason for the creation of each management area.

(2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.

(3) The level of monitoring and analysis appropriate for each management area.

(4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the *management area, if applicable.*

☑ **23 CCR § 354.20(a)**

The Groundwater Sustainability Agencies (GSAs) within the Delta-Mendota Subbasin (Basin) have not defined any Management Areas at this time. The Basin GSAs collectively decided to develop a single Groundwater Sustainability Plan (GSP) for the Basin and signed and executed a Memorandum of Agreement (MOA) (**Appendix D**), which will supersede the 2018 Coordination Agreement and Cost Sharing Agreement upon adoption of this GSP by the GSAs. The MOA updates the Basin governance structure with an emphasis on GSP implementation and defines seven groups of GSAs (the “GSA Groups”) to guide management of separate portions of the Basin through a Coordination Committee. This structure continues to support localized knowledge and management of the Basin while striving for more coordinated Sustainability Goal, criteria, and objectives.

The GSAs acknowledge that management of the Basin through 23 GSAs introduces complexity to the Basin’s organizational structure. However, the GSAs have also recognized a profound responsibility to local communities to uphold their representation in Sustainable Groundwater Management Act (SGMA) decision-making processes. Notably, a majority of communities (including disadvantaged communities [DACs]) within the Basin are directly represented through their own GSA, which was a deliberate approach aimed to foster direct participation in SGMA matters. The GSAs have chosen to preserve the diversity and inclusion that exists within the 23 GSAs through the Basin’s organizational structure, and each GSA is responsible for SGMA compliance within its jurisdictional area.