KAWEAH SUBBASIN PROBATIONARY HEARING DRAFT STAFF REPORT

May 2024

Table of Contents

Definitions and Abbreviations

2020 GSP(s) – The version of the Kaweah Subbasin Groundwater Sustainability Plans (three GSPs) adopted and submitted to the Department of Water Resources in January 2020 by the East Kaweah, Greater Kaweah, and Mid-Kaweah Groundwater Sustainability Agencies.

2020 GSP(s) Incomplete Determination – The Department of Water Resources' January 28, 2022, determination that the 2020 GSPs were "incomplete" pursuant to California Code of Regulations, title 23, section 355.2, subdivision (e)(2).

2022 GSP(s) – The version of the Kaweah Subbasin Groundwater Sustainability Plans adopted and submitted to the Department of Water Resources in July 2022 by the East Kaweah, Greater Kaweah, and Mid-Kaweah Groundwater Sustainability Agencies.

2022 GSP(s) Inadequate Determination – The Department of Water Resources' March 2, 2023, determination that the 2022 GSPs were "inadequate" pursuant to California Code of Regulations, title 23, section 355.2, subdivision (e)(3).

ACS – American Community Survey, an annual survey conducted by the U.S. Census

AF – Acre-feet

AFY – Acre-feet per year

AMSL – Above Mean Sea Level

Annual Report – The report Groundwater Sustainability Agencies must submit annually to the Department of Water Resources (Wat. Code, § 10728).

Aquifer – Water within a body of porous sediment or rock beneath the Earth's surface. The water in an aquifer is referred to as groundwater.

Aquifer, confined – An aquifer beneath a body or layer of less porous sediment or rock. The confining layer of less porous sediment or rock "traps" the underlying aquifer, which can allow water pressure in the confined aquifer to increase. In the California Central Valley, confined aquifers are often located below unconfined aquifers, so confined aquifers are commonly referred to as "lower" aquifers. Confined aquifers typically provide more water for agricultural use because confined aquifers often hold more groundwater.

Aquifer, semi-confined – An aquifer that is only partially confined by bodies or layers of less porous rock.

Aquifer, unconfined – An aquifer that is not confined by a layer of less porous sediment or rock. In the California Central Valley, unconfined aquifers are

commonly located above confined aquifers, so unconfined aquifers are commonly referred to as “upper” aquifers. Unconfined aquifers typically provide more water for household use because domestic wells are usually not drilled very deep.

B118 or Bulletin 118 – The Department’s report entitled “California’s Groundwater: Bulletin 118.”

Basin – Groundwater basin or subbasin

bgs – Below Ground Surface

Board or State Water Board –State Water Resources Control Board

CASGEM – The California Statewide Groundwater Elevation Monitoring Program

Central Valley Water Board – Central Valley Regional Water Quality Control Board

CEQA – California Environmental Quality Act

CDP – Census Designated Place

CNRA – California Natural Resources Agency

Constituents - Chemical elements and compounds

Coordination Agreement – A legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant Part 2.74 of the California Water Code (Wat. Code, §10721, subd. (d)).

CV-SALTS - Central Valley Salinity Alternatives for Long-Term Sustainability

CWS – Community Water System

DAC – Disadvantaged Community, meaning a community with an annual median household income less than 80 percent of the statewide annual median household income (Wat. Code, § 79505.5).

Data Gap – Refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed (Cal. Code Regs., tit. 23, § 351, subd. (*l*)).

De minimis extractor – A person who extracts, for domestic purposes, two acre-feet or less per year (Wat. Code, § 10721, subd. (e)).

DBCP – 1,2-Dibromo-3-chloropropane

Domestic Purposes – The use of water in homes, resorts, motels, organization camps, campgrounds, etc., including the incidental watering of domestic stock for family

sustenance or enjoyment and the irrigation of not to exceed one-half acre in lawn, ornamental shrubbery, or gardens at any single establishments. The use of water at a campground or resort for human consumption, cooking or sanitary purposes is a domestic use (Cal. Code Regs., tit. 23, § 660).

DWR or Department – Department of Water Resources

EKGSA or East Kaweah GSA – East Kaweah Groundwater Sustainability Agency

EPA – Environmental Protection Agency

ET – Evapotranspiration

Ft – US feet

GAMA Program – Groundwater Ambient Monitoring and Assessment Program

GDEs – Groundwater Dependent Ecosystems

GEARS – Groundwater Extraction Annual Reporting System

GKGSA or Greater Kaweah GSA – Greater Kaweah Groundwater Sustainability Agency

GL- Groundwater Level

Groundwater – Water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water but does not include water that flows in known and definite channels unless included pursuant to Section 10722.5 (Wat. Code, §10721, subd. (g)).

Groundwater-Dependent Ecosystems – (Cal. Code Regs., tit. 23, § 351, subd. (m))

Groundwater Flow –The volume and direction of groundwater movement into, out of, or throughout a basin.

Groundwater Recharge – The augmentation of groundwater, by natural or artificial means (Wat. Code, §10721, subd. (i)).

Groundwater Sustainability Program – Coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.

GSA or Groundwater Sustainability Agency –One or more local agencies that implement the provisions of SGMA (i.e., Part 2.74 of Division 6 of the California Water Code) (Wat. Code, § 10721, subd. (j)).

GSP, Groundwater Sustainability Plan, or Plan – A plan of a groundwater sustainability agency proposed or adopted pursuant to SGMA (i.e., Part 2.74 of Division 6 of the California Water Code) (Wat. Code, § 10721, subd. (k)).

GSP Regulations – California Code of Regulations, title 23, section 350 et seq.

GWQ – Groundwater Quality

ibid – The reference is the same as above. It's an abbreviation of the Latin word "ibīdem," which means "in the same place."

ILRP – Irrigated Lands Regulatory Program

InSAR – Interferometric Synthetic Aperture Radar

Long-term Overdraft –The condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus. Overdraft during a period of drought is not sufficient to establish a condition of long-term overdraft if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

LS – Land Subsidence

Management Area –An area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors (Cal. Code Regs., tit. 23, § 351, subd. (r)).

MCL – Maximum Contaminant Level

Meter – A device that measures groundwater extractions and that meets the requirements of California Code of Regulations, title 23, section 1042.

Mg/L – Milligrams per liter

MKGSA or Mid-Kaweah GSA – Mid-Kaweah Groundwater Sustainability Agency

MO – Measurable Objective – refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

MT – Minimum Threshold – refers to a numeric value for each sustainability indicator used to define undesirable results.

OpenET – Online tool to estimate evapotranspiration via satellite-driven models.

OSWCR – Online System of Well Completion Reports

Overdraft – occurs where the average annual amount of groundwater extraction exceeds the average annual supply of water to the basin.

pCi/L – Picocuries per liter

Plan – See “Groundwater Sustainability Plan.”

Person – Any person, firm, association, organization, partnership, business, trust, corporation, limited liability company, or public agency, including any city, county, city and county, district, joint powers authority, state, or any agency or department of those entities. “Person” includes, to the extent authorized by federal or tribal law and subject to the limitations described in Water Code section 10720.3, the United States, a department, agency or instrumentality of the federal government, an Indian tribe, an authorized Indian tribal organization, or interstate body.

Principal Aquifers – Aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems (Cal. Code Regs., tit. 23, §351, subd. (aa)).

Probationary Basin – Basin for which the State Water Board has issued a determination under California Water Code Section 10735.2.

Recharge - See “Groundwater Recharge” above.

Recharge Area – The area that supplies water to an aquifer in a groundwater basin (Wat. Code, § 10721, subd. (t)).

Report – A report of groundwater extraction as required by Section 5202 of the Water Code that includes the information required by Section 5203 of the Water Code.

RMS or Representative Monitoring Site - A monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

RWQCB – Regional Water Quality Control Board

SAFER - Safe and Affordable Funding for Equity and Resilience

Secondary MCL – Also known as a secondary drinking water standard. Defined in the California Code of Health and Safety, section 116275, subdivision (d), as a standard that specifies maximum contaminant level that, in the judgment of the State Water Board, is necessary to protect the public welfare. Secondary drinking water standards may apply to any contaminant in drinking water that may adversely affect the odor or appearance of the water and may cause a substantial number of persons served by the public water system to discontinue its use, or that may otherwise adversely affect the public welfare.

SGMA – Sustainable Groundwater Management Act

SMC – Sustainable Management Criteria - includes the sustainability goals, undesirable results, minimum thresholds, and measurable objectives outlined within a given GSP.

Sustainability Goal – The existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield (Wat. Code, §10721, subd. (u)).

Sustainable Groundwater Management – The management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

Sustainability Indicator – Any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code section 10721, subd. (x) (Cal. Code Regs., tit. 23, § 351, subd. (ah)).

Sustainable Yield – 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 (Wat. Code, § 10721, subd. (w)).

1,2,3 - TCP – 1,2,3-Trichloropropane

TDS – Total Dissolved Solids

µg/L – Micrograms per liter

UR or Undesirable Result –one or more of the following effects caused by groundwater conditions occurring throughout a basin as described in Wat. Code, § 10721, subd. (x):

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

USGS – United States Geological Survey

Water Budget – An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

Water Year or WY – October 1 to September 30 of the succeeding year

WY 2022 Annual Report – Kaweah Subbasin annual monitoring report, submitted by the three GSAs in April 2023

Executive Summary

This Executive Summary briefly summarizes key sections of the Draft Kaweah Subbasin Groundwater Sustainability Plan (GSP) Assessment Staff Report (Draft Staff Report). A full discussion of these sections is provided in the Draft Staff Report. Where appropriate, the section titles in this Executive Summary refer to the corresponding section in the Draft Staff Report. For example, the “SGMA and State Intervention (Section 2)” section of this Executive Summary covers Section 2 of the Draft Staff Report.

Introduction

The mission of the State Water Resources Control Board (State Water Board) is to preserve, enhance, and restore the quality of California’s water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations. The State Water Board is committed to racial equity and working towards a California where race no longer predicts a person’s access to, or quality of, water resources.

In 2014, the state Legislature passed the historic Sustainable Groundwater Management Act (SGMA) that established a new framework for how groundwater would be managed locally at the basin scale to achieve long-term sustainability. Under SGMA, local agencies are responsible for the sustainable management of their groundwater basins; however, state agencies are responsible for ensuring local groundwater management achieves SGMA's goals. SGMA provides the State Water Board and the California Department of Water Resources (DWR) with oversight of groundwater resources to protect them for use by the communities, farms, and environmental resources that depend upon them. The Kaweah Subbasin (subbasin) is critically overdrafted: on average, water is being pumped out of the basin faster than it is recharged by rain and other sources. Overdraft can cause the land surface to sink, potentially damaging infrastructure and reducing aquifer storage.

In addition, overdraft threatens groundwater levels and drinking water quality and could have disparate impacts on communities that rely on shallow wells. Due to historic and political factors, many of these are economically disadvantaged and communities of color.

The State Water Board recognizes that local public agencies in the Kaweah Subbasin have made significant efforts since the passage of SGMA to form three groundwater sustainability agencies (GSAs) and then develop detailed technical and other information supporting the adoption and implementation of three groundwater sustainability plans (GSPs) for the subbasin. Despite those efforts, in January of 2020, DWR reviewed the three GSPs to determine if the GSPs met SGMA’s requirements and

found the GSPs to be incomplete. Following revisions made by the GSAs in the subbasin, DWR reevaluated the GSPs in March of 2023, determined the GSPs to be inadequate, and referred the subbasin to the State Water Board, as required by SGMA. Consistent with SGMA, the State Water Board may now consider whether to designate the Kaweah Subbasin as a "probationary basin," a term that is used in SGMA to describe a basin in the first stage of state intervention.

The goals of this executive summary are to:

- Describe SGMA and the State Water Board's state intervention process to provide context for the State Water Board's upcoming Kaweah Subbasin Probationary Hearing (Probationary Hearing).
- Briefly describe the demographics, geology, and hydrology of the Kaweah Subbasin; and
- Summarize the recommendations by State Water Board staff, which are actions the State Water Board could take at the Kaweah Subbasin Probationary Hearing. These recommendations are to:
    - Designate the entire subbasin probationary. In the short-term, this would mean most groundwater pumpers in the basin would need to start: 1) measuring their groundwater extractions, 2) reporting extractions to the State Water Board, 3) and paying groundwater extraction fees to the State Water Board. Board staff recommend that most domestic household users (people who use less than two acre-feet per year for domestic purposes only) be exempt from reporting extractions and paying fees.
    - Identify certain deficiencies (issues with the subbasin's current groundwater sustainability plans) and potential actions that the GSAs could take to address them.
    - Not exclude any portions of the subbasin from the probationary status.
    - Require people who extract more than 200 acre-feet per year of groundwater from the subbasin to install and use meters to measure groundwater extractions.
    - Require people extracting groundwater from the wells located in the Friant Kern Canal subsidence management areas to install and use meters to measure their groundwater extractions.
    - Shift the reporting deadline for groundwater extractors from February 1 of each year to December 1.

SGMA and State Intervention (Section 2)

SGMA established a new framework for groundwater management in California. SGMA requires local agencies to form GSAs in high- and medium-priority basins and to develop and implement GSPs. GSAs are responsible for achieving long-term sustainable management of their groundwater basins that avoids certain undesirable results within 20 years of implementing their GSPs.

When DWR, in consultation with the State Water Board, deems the GSP or GSPs in a high-priority or medium-priority basin inadequate,[1] DWR refers the basin to the State Water Board for a determination as to whether to begin the state intervention process.[2] State intervention is additional to local management and intended to be temporary, and is a two-step process:

- The first step of state intervention under SGMA is for the State Water Board to determine, through a public process, whether to place the basin on probation.
- In the second step, through a public process, the State Water Board may implement an interim plan for the basin. This can only happen if deficiencies are not fixed after at least one year of the basin being on probation.

In determining whether to put a basin on probation, the State Water Board analyzes whether deficiencies identified by DWR were sufficiently addressed prior to the probationary hearing. As part of its analysis, and as reflected in State Water Board Resolution 2021-0050, Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access and Anti-Racism, the State Water Board considers the impacts of basin non-compliance on vulnerable communities, including communities of color.

During a probationary period, GSAs would have time to resolve deficiencies identified in their GSPs and the State Water Board would collect data on groundwater extractions, collect fees from certain groundwater users, and may conduct additional investigations. Importantly, the GSA retains its authorities and responsibilities and must continue to implement its GSP regardless of if the basin is in probation.

The State Water Board acknowledges that the Kaweah Subbasin GSAs have stated their intent to make draft amended GSPs available for public comment in May 2024 with a goal of incorporating public comments and submitting amended GSPs to the online DWR SGMA portal in July 2024. This draft staff report reflects Board staff review of the

[1] Wat. Code, § 10735.2, subd. (a)(3).
[2] Wat. Code, § 10735, et seq.

Kaweah Subbasin's 2020 and 2022 GSPs. It will take additional time for Board staff to review and provide feedback if and when amended GSPs are available.

Basin Description (Section 3)

Located in California's Central Valley in the southern portion of the San Joaquin Valley, the Kaweah Subbasin (**Figure ES-1**) is bounded to the north by the Kings Subbasin, the west by the Tulare Lake Subbasin, the south by the Tule Subbasin, and the east by the Sierra Nevada Mountains. The subbasin covers approximately 441,000 acres or about 689 square miles.[3]

The subbasin contains seven localized urban areas, Visalia and Tulare (Mid-Kaweah GSA), Exeter, Farmersville, Woodlake, and a portion of City of Hanford (Greater Kaweah GSA) and City of Lindsay (East Kaweah GSA). According to the American Community Survey 2022 five-year estimate, the Kaweah Subbasin has an estimated population of 296,632 people as of 2022. Most of the land within the subbasin and surrounding areas is used for growing crops and raising livestock. The primary land use designations for urban land are residential, commercial, and industrial. The Kaweah Subbasin is currently managed by the three GSAs, and the full list of member agencies can be found in Section 3.

Groundwater in the subbasin is used for drinking water, agriculture, and wildlife habitat. The subbasin contains several aquifers, which are bodies of rock and/or sand and soil that hold groundwater. These aquifers are separated by layers of clay, which slow the movement of water between aquifers and can act as a barrier.

- The upper aquifer is the shallow unconfined to semi-confined portion of the aquifer. An unconfined aquifer is an aquifer that is not confined, or "trapped," by a layer of less porous sediment or rock. The upper aquifer is present in the west side of the subbasin and shallows toward the middle and is approximately 400 feet deep.
- The lower aquifer occurs below the Corcoran Clay (E-clay). It is confined within the entirety of the western portion of the subbasin, meaning that a layer of less porous sediment or rock "traps" the aquifer. This aquifer is approximately 500 to 1000 feet deep.
- The third aquifer, referred to as a single aquifer system is mainly located in the easter portion of the subbasin where the Corcoran Clay is discontinuous or is absent. This aquifer is approximately 600 feet deep in the middle of the subbasin and shallows toward the east to approximately 400 feet deep.

[3] California Department of Water Resources, 2016.

Groundwater is the main source of water for agricultural and urban land uses, but surface water is also available as a resource. The Kaweah River is the largest and most consistent source of surface water in the subbasin with a 630 square mile watershed area.

For more information on the history, demographics, economy, governance context, groundwater levels, groundwater quality, and subsidence in the subbasin, please refer to Section 3 of the Draft Staff Report.

Recommendations for State Water Board Action (Section 4)

SGMA states, “in those circumstances where a local groundwater management agency is not managing its groundwater sustainably, the State needs to protect the resource until it is determined that a local groundwater management agency can sustainably manage the groundwater basin or subbasin.” In March 2023, DWR determined the Kaweah Subbasin 2022 GSPs to be inadequate. Board staff agree with this determination. Now, the State Water Board may determine whether a probationary designation is warranted. Board staff have reviewed the GSPs, Coordination Agreements, and the DWR staff reports documenting DWR’s review of the GSPs.

Staff recommends the State Water Board designate the subbasin as probationary, and find the following:

The GSPs will allow substantial impacts to people who rely on domestic wells for drinking, bathing, food preparation, and cleaning, as well as impacts to critical infrastructure such as canals (e.g., Friant-Kern Canal), levees, and the aquifer itself within the subbasin. These undesirable results are likely to occur to an extent in the subbasin that will prevent the subbasin from reaching sustainability by 2040, as required by SGMA. Designating the subbasin probationary is needed to ensure the subbasin gets back on track to achieve sustainability by 2040.

Section 4 of the Draft Staff Report explains Board staff recommendations for a potential probationary designation of the subbasin. These recommendations are summarized below.

GSP Deficiencies and Potential Actions to Address Deficiencies (Section 4.1)

Board staff have identified specific deficiencies in the Kaweah Subbasin 2022 GSPs and have outlined potential corrective actions to address those specific deficiencies. The Draft Staff Report also incorporates deficiencies identified by DWR’s determination. Deficiencies that have been identified within the GSPs relate to:

- Chronic lowering of groundwater levels with insufficient management criteria.
- Continued land subsidence (sinking).

- Further degradation of groundwater quality.
- Depletion of interconnected surface water.

A summary of the GSP deficiencies and corrective actions are described in further detail below.

Defining and Avoiding Undesirable Results Related to Chronic Lowering of Groundwater Levels (Deficiency GL – Section 4.1.1)

Under SGMA, one piece of achieving the sustainability objective for a basin is avoiding "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon."[4] Declining groundwater levels can cause shallow wells to go dry or reduce their productivity, increase the energy costs of pumping, bring polluted water closer to well screens (the area where groundwater enters a well), or reduce water available for deep-rooted plants. Declining groundwater levels also makes it more difficult to avoid other, related undesirable results caused by groundwater conditions, including land subsidence and depletions of interconnected surface water.

DWR identified deficiencies in the 2022 GSPs related to Chronic Lowering of Groundwater Levels. Key deficiencies included: 1) the GSPs' goals appear to allow significant and unreasonable impacts to domestic wells and the people that rely on them 2) the GSP's goals do not achieve sustainability, and 3) GSPs plan to measure progress against modeled projections rather than goals that achieve sustainability and avoid harm caused by declining groundwater levels.

Board staff agree with DWR's analysis and further identify deficiencies with 1) the way the GSPs plan to address wells that they would allow to dry (well mitigation plan) and 2) the way that GSPs determined sustainability.

The Staff Report identifies deficiencies and potential actions based on DWR and Board staff analysis. Key deficiencies and potential actions are summarized below:

- **Deficiency**: The GSP's goals do not achieve sustainability.
  Potential Action: Revise goals to prevent overdraft. Ensure feasibility of GSP projects and actions to achieve sustainability goals.
- **Deficiency**: GSPs plan to measure progress against modeled projections rather than goals that avoid harm caused by declining groundwater levels.
  Potential Action: Measure progress toward sustainability relative to goals that avoid harm caused by declining groundwater levels.

[4] Wat. Code, § 10721, subd. (x)(1).

- **Deficiency**: The GSPs' goals appear to allow significant and unreasonable impacts to domestic wells and the people that rely on them potentially leading to many wells going dry.
  Potential Action: Revise goals so that they do not allow significant and unreasonable impacts.

- **Deficiency**: Well mitigation plans lack crucial detail.
  Potential Action: Provide additional details to the well mitigation plans such as implementation schedule, funding source, and eligibility.

Defining and Avoiding Undesirable Results Related to Land Subsidence (Deficiency LS – Section 4.1.2)

Another consideration under SGMA is avoiding "significant and unreasonable land subsidence that substantially interferes with surface land uses."[5] Subsidence is the sinking of land caused by groundwater removal. Land subsidence from excessive groundwater extraction can cause irreversible damage to infrastructure (bridges, roads, pipelines, canals, levees, and buildings) and aqueduct operations. Land subsidence can also diminish the storage capacity of an aquifer, which reduces the available groundwater storage for the future. Importantly, subsidence and its reductions on groundwater storage are often irreversible.

In the Kaweah Subbasin, subsidence is primarily caused by the removal of water from clay layers by groundwater extraction, which causes irreversible subsurface compaction and sinking of the land surface. In the subbasin, pumping from the lower aquifer under the Corcoran Clay, a deep thick clay layer that confines a deeper aquifer system, is likely the primary cause of subsidence. However, subsidence within clay layers outside the extent of the Corcoran clay still occurs and should be addressed.

DWR identified deficiencies in the 2022 GSPs related to subsidence. The key deficiencies included: 1) The GSPs do not justify subsidence sustainable management criteria regarding impacts to the subbasin's conveyance infrastructure and 2) Groundwater level sustainability goals are inconsistent with avoiding subsidence impacts and should be reevaluated.

Board staff agree with and build upon DWR's analysis. Board staff have identified further potential actions to address DWR deficiencies and have identified additional deficiencies regarding 1) subsidence management along the Friant-Kern Canal and 2) efforts to prevent significant impacts to the subbasin's conveyance infrastructure, including the Friant-Kern Canal, which delivers drinking water to over 250,000 people and irrigation water to over 1 million acres of farmland.

---

[5] Wat. Code, § 10721, subd. (x)(5).

The Staff Report identifies deficiencies and potential actions based on DWR's and Board staff's analysis. Key deficiencies and potential actions are summarized below:

- **Deficiency:** The GSPs do not justify subsidence sustainable management criteria regarding impacts to the subbasin's conveyance infrastructure.
  Potential Action: Better quantify subsidence impacts to conveyance infrastructure and adopt more protective sustainable management criteria along the Friant-Kern Canal and elsewhere within the subbasin.

- **Deficiency:** Subsidence impacts are likely to occur due to continued groundwater level declines.
  Potential Action: Establish groundwater level sustainable management criteria that will not cause significant subsidence impacts.

- **Deficiency:** The GSPs and mitigation agreement lack detail on how they plan to avoid subsidence impacts to conveyance infrastructure.
  Potential Action: Develop and implement plans to limit pumping near critical infrastructure with clear triggers for action. Consider not allowing new wells near critical infrastructure. Plan ahead to avoid significant impacts and develop plans to repair damages to critical infrastructure caused by subsidence.

Degraded Groundwater Quality (Deficiency GWQ – Section 4.1.3)

Another consideration under SGMA is avoiding "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."[6] Degradation of water quality can limit local drinking water supplies and other beneficial uses, and SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater, including municipal well operators and public water systems.[7] Water quality degradation that significantly and unreasonably affects the supply or suitability of groundwater for use in drinking water systems is an undesirable result.

DWR did not have deficiencies for Degraded Water Quality, and the GSAs revised portions of the groundwater quality sections of their 2022 GSPs. Board staff reviewed the 2020 and 2022 GSPs and have concerns regarding the potential impacts that the groundwater quality sustainable management criteria, monitoring network, and projects and management actions would have on beneficial uses and users in the subbasin. Key deficiencies and associated potential actions are summarized below:

- **Deficiency**: The GSPs goals are not well described, so it is unclear if the goals would prevent significant and unreasonable impacts.

---

[6] Wat. Code, § 10721, subd. (x)(4).
[7] Wat. Code, § 10723.2.

Potential Action: Clearly describe the impacts that would be considered significant and unreasonable.

- **Deficiency**: The GSPs do not address uranium, a constituent (pollutant) that can be impacted by basin management and that is detected throughout the basin.
  Potential Action: Address uranium in addition to the constituents already addressed.

- **Deficiency**: The GSPs would allow drinking water in some domestic drinking water wells to degrade below drinking water standards because the GSPs apply agricultural water standards to drinking water wells in agricultural areas.
  Potential Action: Revise plans so that drinking water in domestic wells does not degrade below drinking water standards.

- **Deficiency**: The GSAs are not consistent on how they will monitor groundwater quality. They do not clearly monitor impacts to domestic drinking water wells and have inconsistencies in their monitoring networks and reported data.
  Potential Action: Clearly describe how groundwater quality will be monitored for all types of beneficial uses and users. Update tables and figures in the GSPs, Coordination Agreement, and annual reports.

- **Deficiency**: The GSPs do not include plans to help people whose well water is allowed to degrade below drinking water standards. The GSPs do not plan the additional sampling necessary to understand the extent of degraded water.
  Potential Action: Collect and analyze more water samples when drinking water degrades below drinking water standards.

- **Deficiency**: The GSPs do not include plans to help people whose well water is allowed to degrade below drinking water standards. The GSPs do not include the well mitigation planning necessary to restore well water to drinking water standards.
  Potential Action: Develop clear plans to restore access to clean drinking water when it degrades below drinking water standards.

Interconnected Surface Water (Deficiency ISW – Section 4.1.4)

Another consideration under SGMA is avoiding "[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water."[8] Depletions of interconnected surface water within the basin may have adverse impacts on surface water uses, such as degradation or loss of groundwater dependent ecosystems and reduced downstream surface water flow to beneficial users.

[8] Wat. Code, § 10735, subd. (d).

DWR identified depletions of interconnected surface water in their 2020 GSP Incomplete Determination as a deficiency; however, DWR did not include this as a deficiency in their 2022 GSP Inadequate Determination. DWR made the following conclusion after their review of the GSPs in 2022:

> While not yet fully consistent with the requirements of the GSP Regulations, the Agencies' efforts to address this deficiency are sufficient at this time, although further efforts and revisions will be required in subsequent GSP updates to align the sustainable management criteria for interconnected surface water with the GSP Regulations and Department guidance.

(2022 GSP Inadequate Determination, p. 3).

Board staff acknowledge the Kaweah Subbasin's efforts to address data gaps related to depletions of interconnected surface water and their plans to incorporate changes in the 2025 GSP update, however, the current GSPs do not meet the requirements in SGMA statute and GSP Regulations. Key deficiencies and potential actions are summarized below:

- **Deficiency:** The GSPs did not adequately consider beneficial uses and users.
  Potential Action: Consider all beneficial uses and users when setting goals for depletions of interconnected surface water and specifically describe the impacts depletions of interconnected surface water would have on beneficial uses and users.

- **Deficiency:** The GSPs did not provide sufficient justification for minimum thresholds (the lowest acceptable level) for depletions of interconnected surface water.
  Potential Action: Reevaluate minimum thresholds using best available information and best available science and provide compelling information to demonstrate that the thresholds are established at an appropriate limit.

- **Deficiency:** The GSPs did not establish a monitoring network designed to address depletions of interconnected surface water.
  Potential Action: Create an interconnected surface water monitoring network within the Kaweah Subbasin.

Additional Staff Recommendations for State Water Board Action (Sections 4.2-4.4)

Exclusions from Probationary Status

SGMA directs the State Water Board to exclude from probationary status any portions of the basin for which a GSA demonstrates compliance with the sustainability goal.[9] Staff believe no GSAs in the Kaweah Subbasin have demonstrated compliance with the sustainability goal. All three GSAs have adopted and are implementing three GSPs, which DWR has determined to be inadequate. Board staff recommend the State Water Board not exclude any portions of the subbasin from the probationary designation.

Modification to Water Year and Reporting Dates

Board staff do not recommend the State Water Board modify the water year, but staff do recommend modifying the extraction reporting deadline for groundwater extraction reports required pursuant to Water Code Section 5202 by changing it from February 1 to December 1.

Requirements for Installation and Use of Measuring Devices

As part of a probationary designation, the State Water Board may require groundwater extraction reporters to install and use measuring devices, such as flow meters, for measuring their groundwater extractions.

Board staff recommend the State Water Board:

- Require people extracting more than two acre-feet per year for any reason and people extracting water for other than domestic purposes to report their groundwater extractions.
- Require people extracting more than 200 acre-feet per year to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the subbasin.
- Require people extracting groundwater from the wells located in the Friant Kern Canal subsidence sustainable management criteria band to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the subbasin.

[9] Wat. Code, § 10735.2, subd. (e).

- Exclude people who extract two acre-feet or less per year for domestic uses only (de minimis users) from reporting requirements. This exception includes most household users.

Conclusion

Despite significant efforts by GSAs in the Kaweah Subbasin, Board staff's analysis supports DWR's determination that the Kaweah Subbasin 2022 GSPs are inadequate. The current plans allow substantial impacts to communities who rely on domestic wells and to critical infrastructure. The Kaweah Subbasin is therefore unlikely to achieve sustainability by 2040, as required by SGMA.

Addressing deficiencies related to lowering groundwater levels and groundwater quality degradation is also consistent with the State Water Board's mission to ensure every Californian has safe and affordable drinking water as reflected in its commitment to the Human Right to Water and administration of the Safe and Affordable Drinking Water Fund.

Board staff recommend probationary status as a next step for getting the Kaweah Subbasin back on track to achieve sustainability and protect groundwater resources for the communities, farms, and environmental resources that depend on them.

1.0 Purpose and Organization of Staff Report

The purpose of the Staff Report is to inform the State Water Resources Control Board (State Water Board) as it considers whether to designate the Kaweah Subbasin as a probationary basin consistent with the requirements of the Sustainable Groundwater Management Act (SGMA). The Department of Water Resources (DWR) deemed the groundwater sustainability plans (GSPs) for the Kaweah Subbasin to be inadequate. The Staff Report provides the State Water Board staff's characterization of the specific deficiencies in the GSPs, outlines an approach to state intervention for the Kaweah Subbasin, and more generally explains the state intervention process.

The Staff Report consists of five sections of subbasin-specific content regarding state intervention and a final section of references.

- **Section 1.0. Purpose and Organization.** Discusses the purpose of the report and provides an outline of the content.
- **Section 2.0**. **SGMA Background, State Intervention Process, and Equity Considerations.** Details what it means for a subbasin to be deemed inadequate by DWR, provides a history of SGMA and discusses what it means for a groundwater subbasin to go into the state intervention process. This section also includes a discussion of probation, a potential first step in state intervention; the reporting and fee requirements; and an interim plan, the potential second step in state intervention, as well as describing Board consideration of groundwater challenges for disadvantaged communities (DACs).
- **Section 3.0. Historical, Physical, and Demographical Description of the Basin.** Describes the Kaweah Subbasin and contains the geographic, demographic, economic, and governance context within the subbasin, including a history of human use and development. This section also details the Groundwater Sustainable Agencies (GSAs) and their members, beneficial uses of groundwater, geologic history of the basin, and basin hydrology.
- **Section 4.0. Board Staff Recommendations.** Details DWR's inadequate determination and its purpose, and the deficiencies and potential actions to address those deficiencies that have been identified by DWR and Board staff. Also included in this section is a discussion of exclusions from probationary status (Wat. Code, § 10735.2, subd. (e)), modification to water year reporting dates, and requirements for installation and use of measuring devices (Wat. Code, § 10735.2, subd. (c)(3)).
- **Section 5.0. Additional Considerations.** Presents other considerations that Board staff have addressed related to the California Environmental Quality Act (CEQA), the human right to water, and the public trust doctrine.

The State Water Board will consider public comments, this Staff Report, and other relevant information that is presented during its public process as it evaluates whether to designate the Kaweah Subbasin as a probationary basin.

2.0 The Sustainable Groundwater Management Act and State Intervention

Section 2.1 provides general background on SGMA, including its goals and the role it defines for local and state agencies. Section 2.2 then describes the State Water Board's role as a backstop, to protect groundwater and those who depend on it when local efforts alone are inadequate.

2.1 The Sustainable Groundwater Management Act Background

2.1.1 Legislative Enactment of the Sustainable Groundwater Management Act

Groundwater is one of California's greatest natural resources and makes up a significant portion of the state's water supply. Approximately 80 percent of Californians use groundwater for drinking or other household uses. Rain replenishes groundwater each year, but the amount of replenishment (or recharge) varies and depends on local conditions. Overdraft occurs when groundwater pumping removes water faster than precipitation can recharge the groundwater in a basin. Some groundwater basins in California are in a state of critical overdraft causing significant adverse environmental, economic, and social impacts. In some cases, groundwater levels have dropped so low that many existing wells are no longer able to pump water, including domestic supply wells in rural, largely economically disadvantaged communities. Wildlife and ecosystems that rely on shallow groundwater or rivers and streams connected to groundwater can also be adversely affected by low groundwater levels (California Department of Fish and Wildlife, 2019). Excessive pumping has led to land subsidence in some areas, in turn causing damage to critical infrastructure such as levees and canals.

To protect California's groundwater resources, former California Governor Jerry Brown signed a three-bill legislative package in 2014, composed of Assembly Bill 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley). These bills created SGMA, the first legislative act in California to establish a statewide framework for sustainable groundwater management.

SGMA applies to California's alluvial groundwater basins that are designated as high and medium priority by DWR. SGMA requires local public agencies in those basins to form GSAs and develop and implement GSPs. GSAs are responsible for achieving a long-term management of their groundwater basins that avoids "undesirable results" (as defined under SGMA) within 20 years of implementing their GSPs.

SGMA's framework to sustainably manage groundwater at the local level is implemented through a division of governance between GSAs, DWR, and the State Water Board. Under SGMA, governance of groundwater sustainability in a subbasin begins with GSAs. SGMA provides the GSAs with authorities to implement rules and regulations for GSPs, monitor and enforce compliance with plans, and oversee or control groundwater extractions. DWR is the primary state technical assistance and oversight agency in SGMA and is tasked with assessing and evaluating GSPs for compliance with SGMA's requirements. The State Water Board acts when necessary to ensure SGMA is implemented successfully and may temporarily intervene in groundwater management when the proposed management of a groundwater basin is deemed inadequate due to deficiencies in the GSP. The State Water Board's role is discussed further in Section 2.2.

The federal government and federally recognized California Native American Tribes are subject to SGMA only to the extent authorized under federal or tribal law; however, they may voluntarily participate in development or administration of GSPs and in Board SGMA processes (Wat. Code, § 10720.3).

2.1.2 Path to Sustainability

As noted above, SGMA required the formation of GSAs in high- or medium-priority groundwater basins and subbasins (basins) by June 30, 2017. Any local public agency with water supply, water management, or land use responsibilities within a groundwater basin was eligible to be a GSA. The current set of GSAs and the set of local public agencies that compose those GSAs reflect local decision-making. GSAs have authority to create new rules and ordinances to manage groundwater users located within the GSA boundary.

GSAs operating within a given basin are collectively required to ensure groundwater is managed sustainably. To this end, SGMA provides GSAs with authorities to develop and implement GSPs, conduct investigations, register groundwater wells or require installation of meters, require pumpers to report extractions or recharge activities, build and operate projects, gather data, regulate or restrict extractions, and charge fees (Wat. Code, § 10725 et seq.). In developing and updating a GSP, GSAs must create opportunities for public engagement, encourage active involvement of diverse social, cultural, and economic elements of the population within the basin, and inform the public about their progress implementing the GSP (Cal. Code Regs., tit. 23, § 354.10,

subd. (d)). A GSA may also “appoint and consult with an advisory committee consisting of interested parties” as it develops and implements a GSP (Wat. Code, § 10727.8).

GSPs outline how groundwater is to be used and managed without causing the following six undesirable results in the basins: significant and unreasonable declines in groundwater levels, reductions in groundwater storage, intrusion of seawater, degradation of water quality, subsidence of land, and depletions of interconnected surface waters. These are often referred to as the sustainability indicators. GSPs are not required to address undesirable results that occurred before and were not corrected by January 1, 2015 (Wat. Code, § 10727.2, subd. (b)(4)).

SGMA requires that GSAs develop a sustainability goal description for each basin. According to SGMA, the sustainability goal is the implementation of measures identified in that ensure the basin is operated without causing undesirable results (Wat. Code, § 10721, subds. (u), (w)).

2.1.2.1 Define Undesirable Results

GSAs are required to develop a definition of when effects caused by groundwater conditions occurring throughout a basin are considered to be significant and unreasonable for their basin (Cal. Code Regs., tit. 23, § 354.26). The definition of undesirable results includes both a narrative definition and a quantitative definition for each sustainability indicator. The definitions are based on sustainable management criteria (SMC) developed by the GSAs.

2.1.2.2 Define Quantitative Thresholds to Avoid Undesirable Results

To avoid undesirable results and to achieve the basin’s long-term sustainability goals, GSPs must set quantitative minimum thresholds (MTs) and measurable objectives (MOs) for each of the sustainability indicators, as well as interim milestones. MTs quantify groundwater conditions for each applicable sustainability indicator at representative monitoring sites (RMSs) within the basin (Cal. Code Regs., tit. 23, § 354.28). MOs define quantifiable goals for sustainability indicators that maintain or improve sustainable groundwater conditions within the subbasin. Interim milestones define measurable target values for groundwater conditions over increments of five years (Wat. Code, § 10727.2, subd. (b)(1); Cal Code Regs., tit. 23, § 354.30).

2.1.2.3 Achieve Sustainability through Project and Management Actions

GSPs are required to describe project and management actions that the GSA has determined will achieve the sustainability goal for the subbasin (Cal. Code Regs., tit. 23, § 354.44). The project descriptions must include the criteria that would trigger implementation, a timetable for implementation, an explanation of the source and reliability of the water on which the projects rely, and a funding plan (Cal. Code Regs.,

tit. 23, § 355.44). GSPs must provide descriptions of current or future projects to achieve balanced levels of groundwater to reach long-term sustainable conditions. For those groundwater basins experiencing the most severe (critical) overdraft, GSPs were due by 2020 and must achieve groundwater sustainability within 20 years (by 2040). For the remaining high- and medium-priority basins, GSPs were due by 2022, thus requiring them to achieve groundwater sustainability by 2042 unless submitted earlier (Wat. Code, § 10720.7, subd. (a)) (Wat. Code, § 10727.2, subd. (b)).

2.2 State Intervention

When DWR, in consultation with the State Water Board, deems the GSP or GSPs in a basin inadequate (Wat. Code, § 10735.2, subd. (3)), DWR refers the basin to the State Water Board for potential state intervention (Wat. Code, § 10735 et seq.). State intervention is a two-step process. The first step is for the Board to consider and potentially designate a basin as probationary (described in Section 2.2.1). The second step is for the Board to consider and potentially impose an interim plan for the basin (described in Section 2.2.2). During probation, GSAs have at least one year to resolve deficiencies while the State Water Board collects data on groundwater extractions, collects fees from certain groundwater users, and, optionally, conducts additional investigations. If deficiencies have not been resolved after at least one year of probation, the Board may decide to move to the second step.

Importantly, throughout the state intervention process, and even before the Board potentially takes the first step of designating the basin as probationary:

- GSAs retain authorities and responsibilities and must continue to implement their plans.
- The Board may decide not to designate a basin as probationary if deficiencies are addressed before the Board considers probation.
- The state intervention process may end after deficiencies are addressed, but basins may be held in intervention after deficiencies are addressed if the plans for addressing the deficiencies are not being adequately implemented.

Once the Board determines deficiencies have been resolved and plans are being implemented in a manner likely to achieve sustainability in the basin, the Board will end state intervention and GSAs will continue managing their basins at the local level.

2.2.1 Probation – First Potential Step

If DWR determines a GSP for a high- or medium-priority basin in critical overdraft to be inadequate, the State Water Board, after notice and a public hearing, may designate the basin as a probationary basin (Wat. Code, § 10735.2, subd. (a)(3)). Other situations can

also trigger the State Water Board's state intervention authorities (Wat. Code, § 10735.2, subds. (a)(1)-(5)).

The State Water Board can only designate a basin probationary at a public hearing after ample public notice (see Section 2.2.1.1). Following a probationary designation, certain groundwater pumpers in the basin must report information about their groundwater use to the State Water Board (Section 2.2.1.2) and pay associated fees (Section 2.2.1.3). As part of the probationary designation, the State Water Board has discretion to require certain groundwater pumpers to use meters or other specific methods to measure groundwater extractions (Section 2.2.1.4) or to exempt certain categories of pumpers from reporting and fees (Section 2.2.1.4). SGMA directs the State Water Board to exclude from probationary status any portion of a basin for which a GSA demonstrates compliance with the sustainability goal (Section 4.2; Wat. Code, § 10735.2, subd. (e)).

2.2.1.1 Probationary Hearing Process

The State Water Board must provide notice of the hearing at least 90 days before it occurs by publishing the hearing dates on its website and notifying DWR and each city and county overlapping with the basin (Wat. Code, § 10736, subds. (a), (b)(1)-(2)).

In addition, at least 60 days before the hearing, the Board must mail or send by electronic mail notice to all persons known to the Board who extract or who propose to extract water from the basin, or who have made written or electronic mail requests to the Board for special notice of hearing pursuant to SGMA (Wat. Code, § 10736, subd. (b)(3)(B)).

Although not required by the statute, Board staff are providing these draft recommendations for action in the basin, in the form of a draft staff report, to the public for a minimum 60-day public comment period prior to the probationary hearing. Staff also expect to host one or more in-person or virtual public engagement meetings during the public comment period to explain state intervention and receive public comments on staff's recommendations.

2.2.1.2 Reporting

Any person who extracts or pumps groundwater from a probationary basin must file a groundwater extraction report (report) with the State Water Board each year (Wat. Code, § 5202; see possible exceptions below). Reports must be submitted electronically (Cal. Code Regs., tit. 23, § 1032). On May 16, 2017, the State Water Board adopted a resolution for an emergency regulation to help implement SGMA that included electronic filing requirements. The emergency regulation was authorized under Water Code § 348, which allows DWR or the Board to adopt emergency regulations for the electronic filing of reports required under Water Code § 5200 et seq. The Office of Administrative Law approved the final regulation on June 29, 2017.

These reports must include:

- the name and address of the person who extracted groundwater
- the name of the basin from which the water was extracted
- the place of groundwater extraction
- the capacity of the groundwater extraction facilities
- monthly records of the groundwater extractions
- the purpose of use
- a general description of the area in which the water was used, and
- the year groundwater extraction commenced (Wat. Code, § 5203).

Persons extracting groundwater within a basin will be required to begin reporting their extractions to the Board 90 days after any probationary designation (Wat. Code, § 5205). Groundwater extraction reports, by default, are due by February 1 of each year for groundwater extractions made during the previous water year (Wat. Code, § 5202, subd. (b)). However, the Board may modify the water year or reporting date for a report of groundwater extractions (also see Section 4.3) (Wat. Code, § 10735.2, subd. (c)(4)).

Data collected by the State Water Board can be used by GSAs and stakeholders in remedying deficiencies and achieving sustainable groundwater management. If the State Water Board eventually develops an interim plan for a basin, the State Water Board may rely on the data to ensure the interim plan is consistent with water rights priorities, as required by SGMA (Wat. Code, §10735.8, subd. (d)).

2.2.1.3 Fees

The State Water Board will notify well-owners and landowners of their extraction reporting requirements and associated filing fees. Any person that is required to file a groundwater extraction report to the State Water Board is also required to pay a report filing fee (Wat. Code, § 5202, subd. (f)). Fees are required because Water Code section 1529.5 directs the State Water Board to recover the costs of state intervention activities via a schedule of fees. These fees were adopted under the 2017 emergency regulation described above.

The current annual fee for groundwater extractions (excluding de minimis extractions) in a probationary groundwater basin is a base filing fee of $300 per well and $20 per acre-foot (AF) of water extracted in the probationary basin. The State Water Board may amend fees as needed by subsequent emergency regulation (Wat. Code, § 348).

2.2.1.4 Measurement Requirements

All groundwater extractors subject to reporting requirements must submit annual reports that tabulate monthly records of groundwater extractions. The measurements of the extractions must be made by a methodology, water-measuring device, or combination thereof satisfactory to the Board (Wat. Code, § 5203, subd. (e)). The State Water Board's Options for Measuring Extraction Volumes guidance document identifies acceptable ways to measure extractions (California State Water Resources Control Board, 2022b). Options include a totalizing flowmeter, the run time method, or other methods as evaluated and approved in advance by staff on a case-by-case basis.

For basin on probation or subject to an interim plan, the State Water Board can require extractors to install meters to measure and report their groundwater extractions accurately, or the State Water Board can specify other means for measuring and reporting groundwater extractions (Wat. Code, § 10735.2, subd. (c)(3)).

Default Exemption for De Minimis Users

A well owner who extracts two acre-feet (AF) or less of groundwater per year from a parcel of land for domestic purposes only is defined as a "de minimis user" under the SGMA statute. De minimis users in probationary basins are exempt from reporting and fees unless the State Water Board determines reporting information from those users is necessary to sustainably manage the basin (Wat. Code, § 10735.2, subd. (c)(2)).

Optional Exemption from Reporting for Certain Classes or Categories of Users

The State Water Board may choose to exclude certain classes or categories of groundwater extractions from extraction reporting and associated fees (Wat. Code, § 10735.2, subd. (c)). Specifically, the State Water Board could exempt classes or categories of extractors subject to a local plan or program that adequately manages groundwater within a portion of the basin if extractors are likely to have a minimal impact on basin withdrawals.

2.2.2 Interim Plan – Second Potential Step

The potential second step of state intervention involves the development and implementation of an interim plan for the basin by the State Water Board. The Board may develop an interim plan for the probationary basin one year after the probationary designation of the basin if the Board, in consultation with DWR, determines that a GSA(s) has not remedied the deficiencies that resulted in designating the basin as probationary (Wat. Code, § 10735.4, subd. (c)).

If the State Water Board adopts an interim plan, it would temporarily manage groundwater in the basin pursuant to the interim plan until the local agencies could

demonstrate their ability to resume sustainable management of the basin. An interim plan is intended to be a temporary measure to protect groundwater until the State Water Board determines that locally led management complies with SGMA's requirements. An interim plan will include corrective actions, a schedule for those actions, monitoring, and enforcement (Wat. Code, § 10735.8, subd. (b)). An interim plan will likely focus on reducing groundwater use in the basin to sustainable levels as soon as practical. An interim plan may include elements of an existing plan or adjudication that the Board finds would help meet the basin's sustainability goal.

2.2.3 Equity Considerations in State Water Board Decisions

The State Water Board mission—to preserve, enhance, and restore the quality of California's water resources and drinking water—is strengthened by the Board's commitment to racial equity and environmental justice[10] (California State Water Resources Control Board, 2021). The State Water Board acknowledges and condemns inequities, past and present, in water access, affordability, and quality. The Board seeks to proactively use existing processes and authorities to help address structures and practices that may perpetuate these inequities. These considerations have informed the analyses employed in this report, as well as the determination of deficiencies, and proposed corrective actions identified herein. Some of these proposed actions, if implemented, would both help address past and present inequities and resolve GSP deficiencies by addressing groundwater supply and quality impacts related to management actions. Proposed actions would ensure, where appropriate, that sufficient mitigation measures are in place to protect communities from chronic lowering of groundwater levels and other undesirable results that are significant and unreasonable. The State Water Board will continue to engage with and consider the needs of potentially affected DACs and Black, Indigenous, and people of color (BIPOC) communities in the Kaweah Subbasin as it implements its responsibilities under SGMA.

[10] For the State Water Board, racial equity is achieved when race can no longer be used to predict life outcomes (that is, when racial information does not help explain patterns of outcomes) and when outcomes for all groups are improved. For the State Water Board, environmental justice means the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. One way that inequities can relate to outcomes for water users is through the likelihood of success of policies and efforts. Theory and numerous case studies of local organizations with roles in the management of groundwater or other natural resources with common-pool properties, for example, suggest those organizations may be more likely to succeed where more resource users perceive the organizations and outcomes as fair (Ostrom, 2012).

It is estimated that in California 9.4 million people, 25% of the state's population, live in DACs. In the San Joaquin Valley approximately 2.2 million people, 55% of the state's population, live in DACs (Fernandez-Bou, et al., 2021). The geography of DACs is a product of urban segregation, redlining, and the racialized exclusion from public benefits that occurred as people of color were pushed outside of city limits, into industrial and service worker areas, or relegated to far flung farmworker camps where they often experienced degraded and exploitative conditions (London, et al., 2021).

DACs often are served by small public water systems and rely on groundwater either in whole or in part for their water supply. Their groundwater wells often are shallow and thus are more susceptible to water quality issues or the risk of going dry if the groundwater level is lowered. While the public water systems serving DACs still are required to maintain essential resources and meet public health requirements, these systems are less likely to have the resources (e.g., infrastructure and financing) of more affluent communities to respond adequately to water supply or water quality emergencies. Systems serving DACs may be unable to treat their water source, find alternative supplies for a contaminated drinking water source, deepen their wells, or build new wells. As a result, DACs may be more vulnerable than other municipalities and cities to impacts on surface water and groundwater supplies. Section 3.3 includes information regarding the history of human occupation and development of the San Joaquin Valley and Kaweah subbasin and existing inequalities in water access, affordability, and quality.

3.0 Basin Description

The basin is the default physical scale at which SGMA responsibilities and authorities, at the state and local levels, apply.

3.1 Geographic Context

Located in California's Central Valley in the southern portion of the San Joaquin Valley, the Kaweah Subbasin (subbasin) (**Figure 3-1**) is bounded:

- to the north by the Kings Subbasin,
- to the west by the Tulare Lake Subbasin,
- to the south by the Tule Subbasin,
- to the east by the Sierra Nevada Mountains.

The subbasin covers approximately 441,000 acres or about 689 square miles (2020 Coordination Agreement, p. 22). The land of the subbasin slopes southwestern from slightly higher elevations along the eastern margins of the subbasin toward the western

boundary (**Figure 3-2**). The highest elevations within the subbasin are approximately 930 ft Above Mean Sea Level (AMSL) and occur along the eastern boundary of the subbasin. The lowest elevation area within the subbasin is located southwest of the city of Corcoran at the southwest corner of the subbasin boundaries, where the elevation is approximately 190 ft. AMSL. Drainage within the subbasin generally flows in a southwesterly direction towards the Tulare Lake bed. The Kaweah River and St. Johns River are the two major streams in the subbasin, with the Kaweah River being the primary source of surface recharge to the area (California Department of Water Resources, 2004). Drainage from the Kaweah River is mostly diverted within the subbasin via multiple canals and natural channels operated by numerous agencies and other water right owners. The Kaweah River ultimately discharges onto Tulare Lake bed only during periods of above-normal precipitation and flood events.

3.2 Geologic Context

The Kaweah Subbasin sits in the south-central segment of the San Joaquin Valley. The San Joaquin Valley is a linear sediment filled depression, typically known as a structural trough. The sediments overlay crystalline basement rocks (Bartow, 1991). The structural trough is approximately 200 miles long and 70 miles wide and is filled with 32,000 ft of marine and continental sediments at its greatest depth (California Department of Water Resources, 2004). Sediments were deposited during inundation of the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coastal Range mountains, respectively. These sediments of loose clay, silt, sand, or gravel deposited by flowing water are known as alluvial deposits. When deposited away from direct connection to the ocean, they are known as continental deposits. Continental deposits form an alluvial wedge that thickens from the eastern edge of the valley toward the structural trough. The axis, or center line, of sediment deposition is beneath and slightly west of the rivers, lakes, sloughs, and marshes, and marks the current and historic artery of surface water drainage in the San Joaquin Valley.

See **Figure 3-3** for a map of the geology of the subbasin.

3.2.1 Geologic History

The subbasin within the San Joaquin Valley is geologically complex, has evolved on a geologic time scale, and was dominated by a pattern of movement of the earth's crust – a tectonic regime, with a presence of one crustal plate descending below the edge of another, known as a subduction zone, along the western continental margin (Bartow, 1991). During the Late Mesozoic and early Cenozoic (145 to 65.5 million years ago) a structural process of lateral crustal compression and deformation, a mountain building phase known as the Cordilleran Orogeny, took place, and the Farallon Plate subducted under the North American Plate (**Figure 3-4**). This tectonic geological process began to develop the following:

- An accretionary prism (marine sediments scraped off from the Farallon Plate), now known as the Costal Range Mountains
- A continental volcanic arc, creating the batholith that would become the Sierra Nevada Mountains
- A forearc basin (region between a subduction zone and the mountain belt), which was beginning to develop the Central Valley where the subbasin is located

The Kaweah Subbasin was originally connected to the Pacific Ocean. Its connection to marine water periodically flooded the forearc basin, allowing deep marine sediment deposition (Bartow, 1991). As the rising mountains from the Coastal Ranges blocked the flow between the forearc basin and the Pacific Ocean and the Sierra Nevada Mountains continued to uplift, erosion and deposition of the surrounding mountains filled the valley over millions of years.

The sediment depositional history of the San Joaquin Valley, from deepest to relatively shallow sediments, can be divided into several periods:

- Late Mesozoic and early Cenozoic: The San Joaquin Valley was part of a forearc basin that was open to the Pacific Ocean as deep marine sediment was deposited in the basin.
- Late Miocene: The San Andreas Fault to the west of the forearc basin shifted movement and began to close off the area that now forms the San Joaquin Valley from the ocean, creating an extensive inland sea where marine sediments of the Etchegion Formation and San Joaquin Formation were deposited.
- Pliocene: The San Joaquin Basin west of the San Andreas Fault continued to close off, causing the extensive inland sea to shallow. Marine sediments were deposited in the shallowing sea bottom.
- Late-Pliocene and early-Pleistocene: The San Joaquin Valley began to evolve into its current form. Tulare Formation sediments were eroded from the uplifting mountains and deposited into the subsiding valley.
- Pleistocene: Quaternary sediments filled the basin and were deposited on alluvial fans and along the San Joaquin Basin axis by the rivers and streams emanating from the adjoining mountains.
- Late-Pleistocene: Aggrading alluvial fans cut off the flow of the San Joaquin Rivers to the sea due to glacial and wet climate events (Atwater, et al., 1986). Large-scale lacustrine deposits (formed at lake bottoms) accumulated in the shallow lakes that developed as a result of the internal drainage. This is also when the Corcoran Clay (Croft, 1972) was deposited in the San Joaquin Valley.

3.2.2 Stratigraphy

The general stratigraphy underlying the Kaweah Subbasin includes young and old alluvial deposits, flood-basin deposits, lacustrine and marsh deposits, continental deposits, marine rocks of the San Joaquin Formation, and Basement Rocks (2020 Coordination Agreement, Appendix 1, p. 16; **Figure 3-5**). This geology of the subbasin is generally representative of the regional geology underlying surrounding subbasins. Within the Kaweah Subbasin, the top of the San Joaquin formation has historically represented the base of the freshwater aquifer system. The water-bearing formations consist of older Pleistocene alluvium, younger Holocene alluvium, and continental deposits of Pliocene and Pleistocene age (California Department of Water Resources, 2004). A more descriptive discussion of the subbasin's underlying stratigraphy and water bearing units is presented in Section 3.5.2. A summary of the subbasin's stratigraphy can be found in Table 2-3.

3.3 Human Use and Development

California Native American Tribes have inhabited the southern Central Valley since time immemorial. For thousands of years, much of the Kaweah Subbasin was covered by the Tulare Lake, the largest freshwater body west of the Mississippi and a shallow, highly biologically productive water system fed by the Kings, Kaweah, and Tule Rivers, among other streams (**Figure 3-6**).

Prior to European contact, the southern Central Valley held one of the densest populations of peoples north of Mexico (Cook, 1955, pp. 31-80). California Native Americans in the Kaweah Subbasin hunted and managed a wide variety of game on the lakeshore and on the lake itself, fished and managed fisheries in the lakes and streams, and cultivated a variety of pines, oaks, and grasses. Tules, many of which were located on islands that dotted the Lake, also provided material for building boats, baskets, and dwellings.

Since time immemorial, the Sierra Miwok and the Valley Yokut have tended to the landscape of the Central Valley. There are several California Native American tribes with cultural, ancestral, traditional, subsistence, and spiritual ties to the land within the Kaweah Subbasin, including: the Big Sandy Rancheria of Western Mono Indians, the Kings River Choinumni Farm Tribe, the North Fork Mono Tribe, the Santa Rosa Rancheria Tachi Yokut Tribe, the Tule River Indian Tribe, and the Wuksache Indian Tribe/Eshom Valley Band (NAHC 2023, personal communication, 11 May). What Europeans were seeing when they encountered the rich diversity of people, plants, animals, and landscapes (more than 2,000 native plant species are endemics and grow nowhere else on earth) and when they "admired the grand vistas of Yosemite and the gold and purple flowers carpeting the Central Valley were the fertile gardens of the Sierra Miwok and Valley Yokuts Indians, modified and made productive by centuries of harvesting, tilling, sowing, pruning, and burning" (Anderson, 2005, pp. 3, 13-14).

Indigenous Californian land and water management

As part of land, plant, and animal management, Native Californians managed water resources, and practiced flood control and erosion control (Blackburn & Anderson, 1993, p. 21). Since time immemorial, Native Californians adapted to variable climate conditions by managing water to keep ground waters close to valley surfaces, to keep springs and streams usable, and to benefit plant and animal species.

Irrigation "was an indigenous technique, practiced long before the Spanish and other Europeans introduced their agricultural knowledge." Written accounts of at least two communities – the Owens Valley Paiute and the Eureka Valley Indians – describe the irrigation techniques they used (Anderson, 2005, pp. 42, 137; Blackburn & Anderson, 1993, pp. 19, 33, 45, 239-330). Native Californians used groundwater to supplement surface water. For example, the Cahuilla people developed natural springs and groundwater wells, including digging walk-in wells as a water source during times of scarcity for personal consumption, food processing and preparation, personal hygiene, medicinal uses, spiritual and ceremonial uses, production of household items, the construction of dwellings, and spiritual practices.[11]

When Europeans arrived, they were witnessing the culmination of centuries, or perhaps millennia, of the use of sophisticated practices and traditional knowledge that allowed plants, animals, and ecosystems to thrive (Blackburn & Anderson, 1993, p. 151 citing Heizer and Elsasser, 1980). Although Native Californians faced many challenges to practicing traditional land and water management after European contact,[12] expertise persists, traditional techniques endure and have been revived in many places, and in some cases are integrated with state and local agencies land management practices.[13]

European Contact

The Spanish did not build any missions in the interior of California, but they did visit the Central Valley.

---

[11] Trial Motion, Memorandum and Affidavit (October 21, 2014), *Agua Caliente Band of Cahuilla Indians v. Coachella Valley Water District*, et al. (C.D. Cal., Case No. 5:13-cv-00883-JGB-SP) (2014 WL 11152398).

[12] Governor's Exec. Order No. N-15-19 (June 18, 2019).

[13] For examples of Tribal, public and private funding efforts, e.g., "Partnering and Learning from Tribes to Integrate Traditional Ecological Knowledge" article, Yurok Condor Restoration Program website, California Department of Fish and Wildlife Tribal Affairs website. (California's Fourth Climate Assessment, Summary Report of Tribal and Indigenous Communities within California)

Later immigrants saw the grasslands of the Central Valley, the interior of the coastal range, and the Sierra foothills as prime ranching land, moving into the valley from 1836 to 1848, with at least one Mexican land grant made in the area north of Tulare Lake: Laguna de Tache ranch, located on approximately 48,800 acres between present-day Kingsburg and present-day Laton (Smith & Secrest, 2004). From the 1820s to the 1840s, hunters and trappers came overland, followed by the gold rush of 1849, which brought a rapid influx of tens of thousands of people to California and major physical change to water and the environment.

Ranchers, herders, and speculators jockeyed for land and rights up and down the San Joaquin Valley (Smith & Secrest, 2004). In 1853, hydraulic mining eclipsed other mining activities when it was discovered that forceful jets of water at hillsides would reveal gold-bearing alluvium. As extensive networks of reservoirs, flumes, ditches, and iron pipes were built to carry billions of gallons of Sierran water to hydraulic mining operations, waste mud and gravel washed downstream forcing rivers out of their banks, causing major flooding, sweeping away farm structures, drowning cattle, and wiping out orchards (Anderson, 2005, p. 99). Prior to contact with Europeans, the valley landscape consisted of large swaths of brackish and freshwater marshes, which are “among the most productive ecosystems on earth” (Barbour, et al., 1993). In 1850, Congress passed the Swamp Land Act, which encouraged the reclamation of swampy “overflow” lands. Landowners and speculators began forming canal and ditch companies that corralled previously freely flowing streams, sloughs, and marshes into new channels, drying the land and making it more suitable for ranching and farming. The remaining marsh land in the Central Valley is now a fraction of what once existed (Mason, 1957, p. 55).

Groundwater Development

Reclamation efforts resulted in more acreage being available for crop farming, which drove agricultural innovation, which in turn drove further interest in developing land for agriculture. Diversion and channelization of regional surface waters resulted in significantly less water flowing through the Kaweah Subbasin to Tulare Lake. By 1899, Tulare Lake had lost nearly 60,000 acres and was largely dry (U.S. Bureau of Reclamation, 1970; Smith & Secrest, 2004). Modification of the surface water systems would continue through the 20th century with the completion of several large dams in the region, including Pine Flat Dam on the Kings River in 1954, Success Dam on the Tule River in 1961, and Terminus Dam on the Kaweah River in 1962. Nevertheless, as surface supplies dwindled, people in the region turned to groundwater supplies. The end of the 19th century saw the first development of pump-driven irrigation wells, driven by steam and gasoline engines, in the San Joaquin Valley. The land area irrigated by pumped wells increased from approximately 39,000 acres in 1909 to almost 160,000 acres in 1921 in Tulare County alone (Austin, 2013).

Even in the early days of the rapid development of groundwater use there was recognition that groundwater pumping lowered the water table, resulting in the need to sink deeper and deeper wells to keep up production (Smith & Secrest, 2004; Anderson, 2005, p. 97). People who came from East, Southeast, and South Asia, south of the border with Mexico, from states affected by the Dust Bowl, and from the Great Migration (of Black farmers from the South) were employed as farm laborers (Pannu, 2012, pp. 231-232). Historically exclusionary policies meant that they were not able to incorporate into towns and cities, often increasing dependance on shallow groundwater wells for domestic and farm use. Depletion of the aquifers has posed increasing threats to the ability of these communities to access needed water for health, sanitation, and farming, which is often exacerbated by a lack of representation, investment, and exclusion from infrastructure services (Pannu, 2012). In 1980, DWR Bulletin 118-80 identified the Kaweah Subbasin as being subject to conditions of critical overdraft. Water levels in the Kaweah Subbasin declined about 12 feet on average from 1970 through 2000 (U.S. Bureau of Reclamation, 2015, pp. 7-44). Some wells in the Kaweah Subbasin had groundwater levels decline up to 20 feet in the 2010 to 2014 period (U.S. Bureau of Reclamation, 2015, pp. 7-44).

3.4 Native American Tribes, Demographics, Economy, and Governance Context

The subbasin contains seven localized urban areas, the cities of Visalia and Tulare (Mid Kaweah GSA), the communities of Exeter, Farmersville, Woodlake, and a portion of City of Hanford (Greater Kaweah GSA) and City of Lindsay (East Kaweah GSA). The Mid Kaweah GSA has an 11-member Advisory committee and a joint powers agreement between the City of Tulare, City of Visalia, and Tulare Irrigation District (2022 Mid Kaweah GSP, p. xxiii). The Greater Kaweah GSA have five participating authority members including County of Tulare, Kaweah Delta Water Conservation District, Kings County Water District, Lakeside Irrigation Water District, and St. Johns Water District (2022 Greater Kaweah GSP, p. 12). East Kaweah GSA is made of seven participating member agencies including County of Tulare, City of Lindsay, and several irrigation districts (2022 East Kaweah GSP, p. 15; **Figure 3-7**).

California Native American Tribes

According to the California Native American Heritage Commission, Native American tribes which may have knowledge of cultural resources in the subbasin include the Big Sandy Rancheria of Western Mono Indians, the Kings River Choinumnativni Farm Tribe, the North Fork Mono Tribe, the Santa Rosa Rancheria Tachi Yokut Tribe, the Tule River Indian Tribe, and the Wuksache Indian Tribe/Eshom Valley Band (Native American Heritage Commission, 2023).

Demographics

According to the United States Census Bureau, the average annual household income, within the Kaweah Subbasin in 2022 is $71,600, significantly less than the California median household income of $101,066 (American Community Survey, 2022). The area is predominantly rural with approximately 90,929 housing units and an average population density of 425 people per square mile[5]. Most of the land within the subbasin and surrounding areas is used for growing crops and raising livestock (2022 Coordination Agreement, Appendix 1, p. 12).

According to the American Community Survey (ACS) 2022 five-year estimate, the Kaweah Subbasin has an estimated population of 296,632 people as of 2022. Approximately 60.6% of the population is Hispanic or Latino, 31% white, 1.8% black, 4.0% Asian, 2.3% identified as multi or other, and approximately 0.3% Native American.

Economies

Agriculture (growing crops and raising livestock) and food processing are the top two industries within the Kaweah Subbasin. Agriculture is the largest private employer in Kings County and Tulare County. Kings County produced a gross value of approximately $2.6 billion in agricultural crops and products in 2022 (Kings County Department of Agriculture, 2022).Tulare County produced a gross value of approximately $8.6 billion in agricultural commodities in 2022 (Tulare County, 2022). Milk is the leading agricultural commodity in Kings County and Tulare County with a combined value of approximately $2.7 billion in 2022 (Kings County Department of Agriculture, 2022; Tulare County, 2022). The Tulare and Kings County crop reports information are reported directly by the industry. Food processing is a major employer in Kings and Tulare counties.

As The Public Policy Institute of California has noted:

> Like many agriculturally dependent regions, the [San Joaquin] valley faces significant socioeconomic challenges, including a high rate of unemployment and pockets of extreme rural poverty that worsen when the farm economy suffers. The region also faces difficult public health challenges in which farming plays a role, including unsafe drinking water in many small rural communities and some of the nation’s worst air quality.

(Hanak, et al., 2017; Hang, et al., 2021)

3.4.1 Groundwater Sustainability Agencies

The Kaweah Subbasin is currently managed by three GSAs, with each GSA comprising multiple member agencies (**Figure 3-8**). A list of the GSAs and their member agencies

is in **Table 3-1**. SGMA requires each basin to have one or more GSAs that collectively will implement one or more plans for the entire basin.[14]

Table 3-1 – Kaweah Subbasin Groundwater Sustainability Agencies

GSA	Member Agency	Date of GSA Formation
East Kaweah GSA	• Lindmore Irrigation District • Lindsay-Strathmore Irrigation District • Exeter Irrigation District • Ivanhoe Irrigation District • Stone Corral Irrigation District • City of Lindsay • County of Tulare	05/31/2017
Greater Kaweah GSA	• County of Tulare • Kaweah Delta Water Conservation District • Kings County Water District • Lakeside Irrigation Water District • St. Johns Water District	05/01/2017
Mid-Kaweah GSA	• City of Tulare • City of Visalia • Tulare Irrigation District	09/14/2015

A coordination agreement has been established among the three GSAs to ensure development and implementation of multiple GSPs within the Kaweah Subbasin and to promote the appropriate coordination of GSP elements to support sustainable management (2022 Coordination Agreement, p. 5).

3.5 Basin Hydrology - Groundwater

The Kaweah Subbasin hydraulic boundaries are defined by DWR and water management areas, but the actual physical water-bearing formations extend into adjacent areas of the Tulare Basin hydrologic area. Based on current and historical groundwater elevation maps, horizontal groundwater barriers do not appear to exist in

[14] Wat. Code, § 10735.2, subd. (a)(2); Wat. Code, § 10735.2, subd. (a)(4)

the subbasin (**Figures 3-9a and 3-9b**; California Department of Water Resources, 2004).

Groundwater and surface water from the Sierra Nevada flow into the Kaweah subbasin, which in turn drains into the Tulare Lake drainage subbasin (**Figure 3-10**; California Department of Water Resources, 2004). Groundwater flow is generally southwestward, toward the Tulare Lake Subbasin. However, there are small groundwater depressions north and south of Visalia and at the subbasin's northwest corner. In 1999, a groundwater depression was located in the central western portion of the subbasin. The average annual precipitation is seven to thirteen inches, increasing eastward (California Department of Water Resources, 2004).

3.5.1 Beneficial Uses of Groundwater

DWR surveyed land uses within the subbasin area in 2021 (**Figure 3-11**). The subbasin area contains approximately 81.4% agricultural and 15.1% urban land use designations. Agricultural land, including field crops, grain, and hay crops, pasture, citrus, and deciduous fruit and nuts (California Natural Resources Agency, 2021). The primary land use designations for urban land are residential, commercial, and industrial, though in the 2021 statewide crop mapping data, approximately 15% of the subbasin was classified as "urban unspecified". Groundwater is the main source of water for agricultural and urban land uses (California Department of Water Resources, 2017). According to data reported by GSAs in the WY 2022 Annual Report, the annual total groundwater extraction volume was approximately 924,900 AF and the annual total water use in the subbasin was 1,078,300 AF (Annual Report, WY 2022).

3.5.1.1 Drinking Water

The subbasin contains seven incorporated cities: Exeter, Farmersville, Lindsay, Tulare, Visalia, and Woodlake. These cities in the Kaweah subbasin use groundwater for drinking water. Exeter, Farmersville, Woodlake, and a portion of Tulare. meet the criteria of disadvantaged communities (**Figure 3-12**). Water systems in Exeter, Lindsay, Tulare, and Visalia have a "failing" status per the State Water Board's 2023 Drinking Water Needs Assessment (California State Water Resources Control Board, 2023c). The "failing" status is due to specific analytes in their water systems exceeding primary Maximum Contaminant Levels (MCL). Lindsay, Tulare, and Visalia water systems exceed the MCL for nitrate. Exeter and Visalia water systems exceed the MCL for 1,2,3-trichloropropane. Tulare's water system exceeds the MCL for combined uranium. Lastly, Lindsay's water system exceeds the MCLs for total haloacetic acids, total trihalomethanes, and perchlorate (California State Water Resources Control Board, 2023c).

Within the subbasin, the communities of Ivanhoe, Lemon Cove, Plainview, and Strathmore, are Census Designated Places (CDPs)[15]—concentrations of population that are not incorporated as cities, towns, or villages. The estimated population of the CDPs is 7801 (American Community Survey, 2022). Ivanhoe, Plainview and Strathmore CDPs are designated as severely DACs. Of these CDPs, Lemon Cove, Plainview and Strathmore are also noted as failing systems (California State Water Resources Control Board, 2023c). Lemon Cove and Plainview have a "failing" status per SAFER due to nitrates concentration exceeding primary MCL in their water systems.

Domestic wells and community water systems in DACs and communities of color are typically disproportionately impacted by poor drinking water quality (Pace, et al., 2022, pp. 88-97). These are significant issues: there are now around 450 "disadvantaged unincorporated communities" in the eight counties of the San Joaquin Valley[16] and "over 30% of the population [of the San Joaquin Valley] lives in unincorporated areas with little infrastructure to support clean drinking water, sewage treatment and other services" (Hang, et al., 2021, footnotes omitted).

Regarding water quality, "the region is a hot spot for unsafe drinking water, a problem that is most acute for small, poor, rural communities…" (Hanak, et al., 2019). A "pervasive problem is the accumulation of nitrate in groundwater, due to decades of intensive use of nitrogen fertilizer and dairy manure on fields. The nitrate problem is most acute for small community and domestic wells that are relatively shallow, where nitrate concentration is often higher" (Hanak, et al., 2017). Additionally, other studies have noted that values of shallow groundwater in drainage problem areas are as high as 40,000 mg/L (Beard & Green, 1994; Fujii & Swain, 1995).

One indicator of water quality issues for drinking water users is dependency on a community water system (CWS) that is out of compliance with standards or requirements. As mentioned above, three of the four CWS in the Kaweah Subbasin are listed as failing for reasons related to water quality, treatment, and supply shortage or drought risk (California State Water Resources Control Board, 2023c). In both disadvantaged unincorporated communities and economically disadvantaged cities in the San Joaquin Valley, "people of color are 84% and 83%, respectively, of those served by out-of-compliance CWSs. These levels are roughly 10 percentage points higher than the overall representation of this group in the population" (London, et al., 2021). Domestic wells in the subbasin could also be experiencing water quality impacts, but specific monitoring data is not available.

---

[15] CDPs are concentrations of population that are not incorporated as cities, towns, or villages.

[16] San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern counties.

3.5.1.2 Agriculture

In water year 2022, the subbasin used groundwater and surface water to farm approximately 312,000 acres of crops (California Natural Resources Agency, 2021). Agriculture uses approximately 91 percent of the total groundwater use (approximately 842,700 AFY) and 99% of the total surface water use (approximately 151,900 AFY) (Annual Report, WY 2022). Between 1996 and 2022, cotton acreage experienced the greatest change with a decrease of more than 130,000 acres (approximately 92%) in Tulare County and over 230,000 acres (approximately 97%) in Kings County. Around the same period, permanent crops (such as almonds, stone fruit, and pistachios) substantially increased. Permanent crops increased by approximately 159,240 acres (55%) in Tulare County and by approximately 89,940 acres (330%) in Kings County. As of 2022, permanent crops continue to be grown in the subbasin and cover the largest agricultural acreage, followed by field crops and citrus (Kings County Department of Agriculture, 2022; Tulare County, 2022). (**Figure 3-13** displays the subbasin's crop use from 1993 (Tulare County) and 1996 (Kings County). **Figure 3-11** displays the subbasin's crop use in 2021 (California Natural Resources Agency, 2021).

Tulare County's total crop and livestock gross production value was $8.6 billion in 2022. This represents a 6.5% increase from the previous year (Tulare County, 2022). In Kings County, the gross value of crop and livestock gross production was $2.5 billion in 2022. This represents a 10.7% increase from the previous year (Kings County Department of Agriculture, 2022).

3.5.1.3 Environment

Potential environmental beneficial uses of groundwater include providing water for natural habitat found along portions of public navigable waterways located in the subbasin. The Kaweah River, running from the northeast to the center of the subbasin, for example, is a public navigable waterway with natural habitat. Natural habitat is also present within a portion of the federal Atwell Island Recreation Area that is located within the southeast portion of the subbasin (**Figures 3-14a and 3-14b**).

In all, The Natural Communities Commonly Associated with Groundwater dataset (NC dataset), identified 644 individual groundwater-dependent ecosystems (GDEs) within the Kaweah Subbasin GSP Area (Plan Area). Those GDEs constitute 0.9% of all land (3,875.3/441,056.0 acres). Of the total GDE area, 80.3% (3,111.3 acres) is within the Greater Kaweah GSA boundary. Of the remaining GDE area 13.3% (516.7 acres) is within the East Kaweah GSA boundary and 6.4% (247.3 acres) within the Mid-Kaweah GSA boundary.

The NC dataset further designates identified GDEs as either terrestrial (vegetative) or wetland. Of the 644 GDEs within the Plan Area, 315 (48.9%) are vegetative and 329 (51.1%) are wetland. However, vegetative GDEs constitute 76.2% (2,954.6 acres) of

total GDE area within the Plan Area. Within the Mid-Kaweah GSA boundary, 91.1% (225.2 acres) of total GDE area is vegetative.

Across the Plan Area, the *Quercus lobata* (Valley Oak) alliance is the most dominant vegetation type (51.3%, 1,516.8 acres). While the species is not rare, it is estimated that 90% of *Q. lobata* stands that existed before European contact have been destroyed and the remaining stands are threatened by the introduction of non-native species and modifications to water regimes. Importantly, mature trees are negatively affected by the lowered water table. Similarly, the *Salix goodingii* (Goodding's Willow) alliance is the second most represented GDE (28.1%, 830.7 acres). The National Wetland Inventory (NWI) designated *S. goodingii* as an obligate wetland species. Furthermore, *S. gooddingii* grows best when groundwater depth is < 3.5 m (11.5 feet) (Stromberg, et al., 2007) and suffers significantly with groundwater decline rates of 4.0 cm (1.6 inches) or more per day (Horton & Clark, 2001).

The distribution and composition of GDEs within GSA boundaries mirrors those across the entire plan area. The *Q. lobata* alliance is most dominant within the boundaries of both the Greater Kaweah GSA (54.9%, 1,296.7 acres) and the Mid-Kaweah GSA (95.7%, 215.4 acres). Conversely, the *S. goodingii* alliance is dominant within the East Kaweah GSA boundary (64.2%, 236.4 acres). More importantly, three (3) *Schoenoplectus (actus or californicus)* (Hardstem and California Bulrush respectively) alliance GDEs are found in the Greater Kaweah GSA boundary, totaling 6.7 acres. Both *Schoenoplectus* species are obligate wetland species according to the NWI and are indicative of high habitat value for wildlife. Furthermore, for thousands of years, tule-dominated stands, including stands of this *Schoenoplectus* alliance, have been responsible for deep layers of peat. Anthropogenic alteration of peat layers has contributed to slumping to as much as 10.0 m (32.8 feet) below sea level of the delta islands.

Riverine, lower perennial, unconsolidated bottom, permanently flooded wetlands (riverine wetlands) are the most dominant wetland GDE type across the Plan Area (44.8%, 412.3 acres). However, 97.3% (401.2 acres) of all riverine wetland area is within the Greater Kaweah GSA boundary, and in particular follows the Kaweah River network east, northeast of Visalia. The only seeps and springs GDEs identified are within the East Kaweah GSA boundary, and these comprise 0.2 acres.

3.5.2 Aquifer Framework

The Kaweah Subbasin aquifer system exhibits a complex geological structure. The western and central portions of the Subbasin comprise both unconfined and semi-confined aquifers located above the Corcoran Clay, and a confined aquifer located beneath it. In the eastern portion of the Subbasin, where the Corcoran Clay is absent, the upper and lower aquifers merge into a single, unconfined or semi-confined aquifer unit (**Figure 3-5**).

The principal groundwater aquifers within the subbasin occur primarily in the coarser-grained Sierran sediment deposits that form alluvial fans along the Kaweah River, Kings River, Tule River, and streams that drain from the Sierra Nevada Mountains into the southeastern portion of the subbasin. Alluvial fans also form along streams that drain from the Coast Ranges into the west portion of the subbasin. The Tulare Formation, which is comprised of these fan deposits, is one of the most important water-bearing formations in the subbasin (2020 Coordination Agreement, Appendix 1, Chapter 2).

The eastern portion of the subbasin, also known as the Kaweah River fan, consists of deposits from the Sierra Nevada which are divided into three stratigraphic units: younger alluvium (highly permeable sand and silty sand), older alluvium (moderately permeable, major productive aquifer horizon in Subbasin), and continental deposits (2022 MKGSP, Appendix 2A, p. 23).

The Kaweah Subbasin aquifer system is composed of several distinct hydrogeologic units with varying degrees of permeability and water quality. The older alluvium, characterized by moderate to high permeability, serves as the primary aquifer and overlies the continental deposits. Younger alluvium, also moderately to highly permeable, consists of arkosic beds composed of sand and silty sand. Flood-basin deposits, characterized by poor permeability, are composed of silt, clay, and fine sand. Notably, groundwater within these deposits often exhibits poor quality. Underlying the flood-basin deposits are the lacustrine and marsh deposits, consisting of blue, green, or gray silty clay and fine sand. These deposits contain clay beds that function as aquitards, controlling both vertical and lateral groundwater movement. The most prominent of these aquitards is the Corcoran clay, which underlies the western half of the subbasin at depths ranging from 200 to 500 feet (California Department of Water Resources, 2004) In the eastern portion of the subbasin, groundwater exists in unconfined and semi-confined conditions, whereas the presence of the Corcoran Clay in the western half confines the groundwater (California Department of Water Resources, 2004).

Physiography (geography that deals with physical features of the earth), weathering characteristics, and soils have typically been used to map formations in the subbasins within the Central Valley. However, classifying stratigraphic units (layers of sedimentary rock) in the subsurface has been challenging since lithology (type of rock formation) variations are not distinct (Bertoldi, et al., 1991). As a result, most groundwater studies of the Central Valley define hydrogeologic units—aquifers and confining units—rather than stratigraphic units (Faunt, 2009). In the Kaweah Subbasin 2022 GSP, the hydrogeologic setting was simplified for the Hydrogeologic Conceptual Model. The subbasin is divided into three different aquifer zones for groundwater level monitoring:

- Single Aquifer System (SAS) is comprised of the upper and lower aquifers, which merge into a single aquifer unit that is semiconfined and located in the eastern portion of the Subbasin. This merged zone consists of younger alluvium (highly

permeable sand and silty sand), older alluvium (moderately permeable, major productive aquifer horizon), and continental deposits. (2022 Mid-Kaweah GSP, Appendix 2A, p.24).

- Upper Aquifer System (UAS) is the shallow unconfined aquifer above the Corcoran Clay, which is located on the central and western portion of the subbasin. It is made up of flood-basin deposits (poorly permeable silt, clay, and fine sand), younger alluvium (beds of moderately to highly permeable sand and silty sand), and older alluvium (moderately to highly permeable, major productive aquifer in Subbasin) (2022 MKGSP, Appendix 2A, p.23).
- Lower Aquifer System (LAS) is the confined portion of the aquifer below the Corcoran Clay, which is located on the central and western and portion of the Subbasin. The Corcoran Clay is at depths ranging from 200 to 500 ft and is discontinuous in the eastern portion of the subbasin. (2022 MKGSP, Appendix 2A, p.24).

3.5.3 Groundwater Levels

PPIC indicates that “Long-term depletion of the [San Joaquin Valley] region’s aquifers” can be traced to the 1930s (Hanak, et al., 2017), Board staff confirmed ongoing groundwater level declines in the Subbasin by evaluating groundwater level data from the past 75 years, although the declines appear substantially more significant since 2000.

Board staff analyzed groundwater level data from the California Statewide Groundwater Elevation Monitoring (CASGEM) Program to determine long term groundwater level trends. CASGEM data are often spatially and temporally inconsistent, as CASGEM wells are not all systemically monitored at the same time. To reduce the impact of disproportionate spatial and temporal monitoring, staff analyzed data from wells with:

- Groundwater level data from at least 40 percent of the years in the study period of 1948 to 2023
- At least one groundwater measurement after the year 2000

Of the 1,153 wells available in CASGEM, 546 met the criteria to analyze trends in spring groundwater levels and 490 met the criteria to analyze trends in fall groundwater levels. The wells were then analyzed for trends at the 90% confidence level using a Mann Kendall test, which is a common statistical test for detecting trends.

- For spring, 43% (236) of the wells had a negative trend, 27% (149) had a positive trend, and the remaining (161) had no trend at the 90% confidence level.
- For fall, 37% (181) of the wells had a negative trend, 23% (115) had a positive trend, and the remaining 40% (194) had no trend at the 90% confidence level.

Staff's long-term trend analysis revealed more significant declines in groundwater levels after 2000. To better understand the recent changes in groundwater level, staff also analyzed the trend in groundwater elevation data from 2000 to 2023 using wells with:

- Groundwater level data from at least 42 percent (10 years) of the years in the study period of 2000 to 2023

Of the 1,153 wells available in CASGEM, 362 met the criterion to analyze trends in spring groundwater levels and only 64 met the criterion to analyze trends in fall groundwater levels.

- For spring, 94% (342) of the wells had a negative trend, 0% (0) had a positive trend, and the remaining 6% (20) had no trend at the 90% confidence level.
- For fall, 84% (54) of the wells had a negative trend, 0% (0) had a positive trend, and the remaining 16% (10) had no trend at the 90% confidence level.

Further, these analyses indicate that: (1) groundwater levels had relatively stable trends prior to 2000, and (2) groundwater levels in the subbasin have been in decline since the mid-1980s, with the largest magnitude declines after year 2000. Importantly, staff note that a significant number of wells in the subbasin are missing groundwater level measurements from 2012 to 2023, which may influence the results of trend analysis for 1948 to 2023 by not capturing the decline after 2012. The trend analysis from 1948-2023 is biased towards the period prior to this large data gap.

3.5.4 Groundwater Recharge

Groundwater recharge in the subbasin primarily occurs through surface water infiltration from the Kaweah River, which flows westward from the Sierra Nevada through the Kaweah Subbasin (California Department of Water Resources, 2004).

Based on the 2022 Annual Report, East Kaweah GSA, Greater Kaweah GSA, and Mid-Kaweah GSA were implementing four groundwater recharge projects in the subbasin (Annual Report, WY 2022). Two projects, the Lindsay Basin for EKGSA and the Paregien Basin Expansion for GKGSA, were put into construction and nearly completed by the end of 2022. Both are slated to be completed during WY 2023. The remaining two projects, the Lewis Creek Recharge Project for EKGSA and Okieville Basin for MKGSA, have finalized design plans and construction is anticipated to begin in WY 2023 with a completion goal of early WY 2024. In addition, each GSA is continuing to make progress on recharge projects during SGMA implementation as described in the annual reports and GSPs (Annual Report, WY 2022).

3.5.5 Groundwater Storage

In 1995, DWR estimated the total storage capacity of the Kaweah Subbasin based on an estimated specific yield of 10.8% and water level data collected by DWR and well

owners who volunteered data. According to the calculations, the total groundwater storage capacity of the basin is approximately 15.4 million AF to a depth of 300 ft, and approximately 107 million AF to the base of fresh groundwater, often treated as the “bottom” of a basin (California Department of Water Resources, 2004). These same calculations estimate 11.6 million AF of groundwater to a depth of 300 ft stored in the subbasin as of 1995 (California Department of Water Resources, 2004). In 1989, the United States Geological Survey created a three-dimensional groundwater flow model and estimated the amount of stored groundwater in the subbasin as of 1961 was 34 million AF to a depth of less than 1000 ft (California Department of Water Resources, 2004).

The 2022 Coordination Agreement indicates that there was a decrease in storage of 2,428,487 AF (average 65,635 AF/WY) for the 37-year period between 1981-2017. The subbasin receives inflow of groundwater from the Kings Subbasin from the north and mountain front recharge along the eastern edge of the Kaweah Subbasin. Groundwater outflow occurs to the west into the Tulare Lake Subbasin and to the south into the Tule Subbasin.

In the Groundwater Modeling Report, the GSAs ran a total of five forecast models for the 20-year period between 2020-2040 with the baseline water years of 1991-2017. The five models are listed below (2022 Coordination Agreement, Appendix 7).

- Case 1, Base No-Action Scenario: Base Case Run with averaged water year repeated and adjusted to account for long term trend due to climate projections
- Case 2, Variable Base No-Action Scenario: Base case with historical sequence of wet and dry years
- Case 3, Reversed Variability Base No-Action Scenario: Base case with reversed historical sequence of wet and dry years
- Case 4, Future Management Actions Only: Built on the Base No-Action Scenario but with Pumping Reductions
- Case 5, Future Projects and Management Actions: Built on the Base No-Action Scenario but with Pumping Reductions and Projects

Table 3-2 - Forecasted Changes in Groundwater Storage from Groundwater Modeling Report

Case	Cumulative Change in Storage (Acre-Feet) for 2020	Cumulative Change in Storage (Acre-Feet) for 2036 - 2040

1	-26,352	-1,501,901
2	418,089	-1,815,704
3	661,219	-588,650
4	-18,819	-810,436
5	-7,625	-316,370

From this report, the Kaweah GSAs estimate a safe yield of 720,000 AFY and the average annual groundwater pumping in the basin during the current water budget period at 798,000 AF. The GSAs estimated that a reduction in deficit of 121,000 AF through the implementation of projects and management actions will ensure sustainable operations.

3.5.6 Groundwater Quality

Groundwater quality in the subbasin varies spatially (including depth) and is impacted by both natural and anthropogenic (human caused) water quality constituents. Generally, groundwater quality improves with depth, with the poorest quality groundwater being within the unconfined and semi-confined aquifers (see Section 3.5.2, above, for aquifer information). These shallow zones are primarily degraded by anthropogenic constituents such as total dissolved solids (TDS), nitrate, measured as N (nitrogen), and other anthropogenic constituents from agricultural land use. The highest quality groundwater is typically in the deeper confined aquifer, below the E-clay in the western portion of the subbasin. The confined aquifer is generally unimpacted by anthropogenic constituents unless improperly constructed wells or other conduits allow for mixing of the higher and lower quality waters, such as wells screened between multiple aquifers. However, significant pumping in the confined aquifer may increase concentrations of naturally occurring constituents such as arsenic. Arsenic and other constituents can be released from reduced pore waters within clays through dewatering and compaction of clay layers related to subsidence.

Several existing water quality programs either conduct sampling programs or require regulated entities (such as public water systems or state small water systems) to sample groundwater in the subbasin for Title 22 constituents (Cal. Code Regs., tit. 22, § 64431 et seq.; Cal. Code Regs., tit. 22, § 64441 et seq.). Agencies that regulate and/or monitor groundwater quality in the subbasin include:

- State Water Board

    - Division of Drinking Water (regulatory)
    - Groundwater Ambient Monitoring and Assessment (GAMA) (monitoring)
- Central Valley Regional Water Quality Control Board (Central Valley Water Board)
    - Irrigated Lands Regulatory Program (ILRP) (regulatory)
    - Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) (regulatory)
- U.S. Geological Survey (monitoring)
- Department of Water Resources (DWR) (monitoring)
- Department of Pesticide Regulation (DPR) (regulatory)

These agencies collect groundwater quality samples from wells within the unconfined, semi-confined, and confined aquifers within the subbasin. Groundwater quality data from these agencies' programs can be accessed through GAMA's groundwater information system tool (California State Water Resources Control Board, 2023b).

3.5.6.1 Key Constituents

Board staff developed the SGMA Groundwater Quality Visualization Tool (California State Water Resources Control Board, 2023d) to help GSAs and other interested parties identify the groundwater quality constituents that each GSP should address. The tool uses data from the GAMA dataset to summarize per-basin constituents that: 1) may be influenced by basin-wide groundwater management and 2) exceed regulatory thresholds. The tool identifies constituents that have exceeded regulatory standards in three or more wells since 2015.

As of December 2023, the tool identifies nine such constituents for Kaweah, as listed in **Table 3-3**, below. Four hundred and ninety-four (46%) of wells sampled for these nine constituents had concentrations exceeding regulatory standards (see **Figure 3-15**). The actual extent and impact of these constituents is likely much greater since most wells are not part of a monitoring network or regularly monitored for water quality impacts. Moreover, this tool does not address whether all constituents are consistently monitored in the subbasin, so there may be other water quality issues in the subbasin that are not identified by the tool.

Table 3-3 - Summary of Water Supply Wells in the Kaweah Subbasin Exceeding Regulatory Water Quality Thresholds for Selected Constituents

Constituent	Regulatory Threshold	Wells above Regulatory Threshold (%)	Risk
Nitrate as Nitrogen*	10 mg/L	40%	Decreases the ability for blood to carry oxygen to tissues. Acute high dose ingestion of nitrate can cause additional health risks and possible death. (U.S. Environmental Protection Agency, 2006)
1,2,3-Trichloropropane	0.005 µg/L	17%	Risk of cancer (U.S. Environmental Protection Agency, 2009)
Arsenic	10 µg/L	10%	Digestive health, motor health, may cause cancer, and more (Agency for Toxic Substances and Disease Registry, 2007)
Uranium	20 pCi/L	8%	Kidney damage and risk of cancer (U.S. Environmental Protection Agency, 2001)
Gross Alpha radioactivity	15 pCi/L	8%	Risk of cancer (U.S. Environmental Protection Agency, 2001)
Perfluorooctanoic acid	5.1 ng/L**	6%	Risk of cancer (U.S. Environmental Protection Agency, 2017)
Perfluorooctanoic Sulfonate	1.1 ng/L**	6%	Risk of cancer (U.S. Environmental Protection Agency, 2017)

Total Dissolved Solids (TDS)	500 – 1000 mg/L *	1%	No health risk at SMCL (U.S. Environmental Protection Agency, 2017)
Tetrachloroethene (PCE)**	5 µg/L	1%	Impaired cognitive and motor neurobehavioral performance (U.S. Environmental Protection Agency, 2012)

* Assuming that nitrate + nitrite samples are nitrate since nitrite was not detected in the Subbasin above the MCL of 1mg/L, post-2015
**Also known as Tetrachloroethylene or Perchloroethylene

3.5.6.2 Driving Mechanisms

Constituent concentrations in groundwater are dependent on physical and chemical influences. Examples of physical influences include changes in groundwater levels, gradients, source water recharge volumes, and quality of recharge water. Examples of chemical influences include reduction/oxidation (redox) conditions of groundwater (which can cause mobilization, mineralization, or adsorption of constituents) and radioactive decay of elements (Jurgens, et al., 2009).

Many studies suggest that groundwater level decline and subsidence may increase constituent concentrations by changing the physical and chemical influences on constituent concentrations (Levy, et al., 2021; Haugen, et al., 2021; Smith, et al., 2018).

For example:

- Shallow constituents, which typically exist in the top of the unconfined aquifer, may migrate downward with the water table resulting in those constituents being pulled downward into well screens at deeper depths.
- Continued groundwater level decline at different rates may alter groundwater elevation gradients which may cause constituents to migrate along new flow paths.
- Well users may encounter new constituents as wells are drilled deeper into the aquifer where there are often higher concentrations of arsenic, uranium, and TDS.
- Artificial recharge or changes in groundwater levels that alter redox conditions may cause the mobilization of constituents (e.g., Haugen, et al., 2021).
- Groundwater overdraft and resulting subsidence may expel pore water from compacted clay layers, increasing arsenic concentrations (Smith, et al., 2018;

Underhill, 2023; Erban, et al., 2013). Arsenic can pose a significant threat to human health for people who depend on groundwater for drinking purposes (U.S. Environmental Protection Agency, 2023).

- Improperly constructed or sealed wells may act as conduits for constituents of concern into confined and unconfined aquifers (California Department of Water Resources, 1991).

3.5.6.3 Impacts to Drinking Water Users

Eight of the nine constituents listed in Table 3-3 pose health risks to drinking water users. As shown in Table 3-3, these constituents pose health risks by causing digestive issues (arsenic), mobility and visual issues (arsenic), kidney disease (uranium), respiratory issues (nitrate), and cancer (arsenic, gross alpha, 1,2,3-TCP, and uranium) (U.S. Environmental Protection Agency, 2001; Agency for Toxic Substances and Disease Registry, 2007). The remaining constituent in Table 3-3, TDS, does not pose a significant health risk but is assigned a Secondary Maximum Contaminant Level (SMCL) of 500 mg/L for taste, staining, hardness, and other non-health risk factors.

3.5.7 Subsidence

Land subsidence impacts in the subbasin have been attributed to groundwater management processes, predominantly over pumping in areas where fine-grained sediments overlie coarser grained sediments (U.S. Geological Survey, 2018). As water is pumped and removed from sediment pore space, the sediment structure collapses, land surface elevations decline, and groundwater storage capacity is lost. Land subsidence in the basin can impact infrastructure, increase flooding due to sinking of levees, and permanently reduce aquifer storage.

The Kaweah Subbasin has experienced significant subsidence since the early 1920s as a result of groundwater development and overdraft conditions. Since the 1950s, there has been an estimated amount of subsidence of over 25 feet in some portions of the subbasin (California Department of Water Resources, n.d.). Subsidence rates generally increase to the west and southwest towards the margins with the Tulare Lake and Tule Subbasins. Within the last two decades, improved remote sensing technology has vastly improved our understanding of subsidence within the San Joaquin Basin and its relation to different land uses (Lees, et al., 2022). Specifically, interferometric synthetic aperture radar (InSAR) uses radar images to remotely sense surface elevation changes over time. InSAR data has been available for the subbasin since 2015 and has provided annual rates and cumulative subsidence amounts. Since 2015, the subbasin has experienced over 5.5 feet of subsidence in the western portion, with annual rates of over one foot/year in some years (**Figure 3-16**).

3.6 Basin Hydrology - Surface Water

The Central Valley Water Board's Tulare Lake Basin Plan summarizes surface water systems in the Tulare Lake hydrological region, which includes the Kaweah Subbasin:

> The Kings, Kaweah, Tule, and Kern Rivers, which drain the west face of the Sierra Nevada Mountains, are of excellent quality and provide the bulk of the surface water supply native to the basin. Imported surface supplies, which are also of good quality, enter the basin through the San Luis Canal/California Aqueduct System, Friant-Kern Canal, and the Delta-Mendota Canal. Adequate control to protect the quality of these resources is essential, as imported surface water supplies contribute nearly half the increase of salts occurring within the basin.
>
> Buena Vista Lake and Tulare Lake, natural depressions on the valley floor, receive flood water from the major rivers during times of heavy runoff. During extremely heavy runoff, flood flows in the Kings River reach the San Joaquin River as surface outflow through the Fresno Slough. These flood flows represent the only significant outflows from the basin.
>
> Besides the main rivers, the basin also contains numerous mountain streams. These streams have been administratively divided into eastside streams and westside streams using Highway 58 from Bakersfield to Tehachapi. Streams from the Tehachapi and San Emigdio Mountains are grouped with westside streams. In contrast to eastside streams, which are fed by Sierra snowmelt and springs from granitic bedrock, westside streams derive from marine sediments and are highly mineralized, and intermittent, with sustained flows only after extended wet periods.

(Central Valley Regional Water Quality Control Board, 2018).

In the Kaweah Subbasin, the Kaweah River flows from the Sierra Nevada and drains westerly towards the Tulare Lake bed. Terminus Dam and Reservoir (Lake Kaweah), which are located east of the subbasin boundary, provide seasonal storage of Kaweah River flows. Dry Creek and Yokohl Creek are tributaries that enter the Kaweah River below Terminus Reservoir (Lake Kaweah) and produce significant quantities of water during flood periods. The Kaweah River divides into St. Johns River and Lower Kaweah River at McKay Point, which is then diverted and distributed through a system of natural channels and canals. St. Johns River flows northwesterly through the northern part of the subbasin, and then changes direction and flows southwesterly where it is joined by Cottonwood Creek. Lower Kaweah River conveys water to a series of distributary channels and canals throughout the central and southerly portions of the subbasin and outflows from the subbasin occur through Mill Creek to Cross Creek and from Elk Bayou to the Tule River in the southeasterly portion of the subbasin (2020 Coordination Agreement, Appendix 1, pp. 33-35).

A combination of pipes, canals, and ditches deliver surface water from natural rivers and imported sources throughout the subbasin. The Wutchumna Ditch diverts water from the Kaweah River and flows parallel to and slightly north of the St. Johns River. The Friant-Kern Canal runs the length of the East Kaweah GSA, generally following the eastern border of the subbasin. Water is diverted from the Friant-Kern Canal to Tulare Irrigation District at a large Parshall flume and into the St. Johns River. Additionally, a turnout on the Friant-Kern Canal provides for releases directly into the Lower Kaweah River, and the Ketchum Ditch diverts water from the St. Johns River and discharges into the Lower Kaweah River. The remainder of the Kaweah Subbasin primarily conveys water via the Main Intake Canal which delivers commingled Kaweah River and Central Valley Project waters for use in the Tulare Irrigation District (2020 Coordination Agreement, Appendix 1, pp. 34-35). **Figure 3-17** displays surface water bodies and canals in the Kaweah Subbasin.

The principal local source of surface water in the subbasin is the Kaweah River. In the subbasin, the reaches of the Kaweah River (below Lake Kaweah) support the following beneficial uses:

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PRO)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Ground Water Recharge (GWR)

(Central Valley Regional Water Quality Control Board, 2018).

The Kaweah River System, which includes all streams in the subbasin, is fully appropriated year-round. Fully appropriated stream systems are stream systems that have insufficient supply for new surface water right applications for diversions at any time of the year (California State Water Resources Control Board, 1998).

4.0 Recommendations for Board Action

SGMA states, “in those circumstances where a local groundwater management agency is not managing its groundwater sustainably, the State needs to protect the resource until it is determined that a local groundwater management agency can sustainably manage the groundwater basin or subbasin.” To ensure SGMA is implemented successfully, the State Water Board may temporarily intervene in groundwater management after DWR determines that the proposed management of a groundwater basin is inadequate due to deficiencies in the basin GSP(s) (Wat. Code § 10735 et. Seq).

GSPs for critically overdrafted high- and medium-priority basins had to be adopted and submitted to DWR for their assessment by January 31, 2020 (Wat. Code § 10735.2, subd. (a)(2)). The Kaweah Subbasin 2020 GSPs were submitted to DWR in January 2020, and DWR posted the GSPs to their website and established a 75-day comment period on February 19, 2020. DWR had two years within the GSPs’ submittal date to issue a written assessment and a determination of the status of the GSPs. On January 28, 2022, DWR gave the Kaweah Subbasin 2020 GSPs an incomplete determination and the Kaweah GSAs had 180 days to address the GSP deficiencies identified in DWR’s Incomplete Determination of the 2020 Kaweah Subbasin GSPs. The Kaweah GSAs revised their GSPs which were submitted to DWR on July 27, 2022, and were posted to DWR’s website on August 1, 2022. DWR evaluated the 2022 GSPs and determined that the GSPs did not sufficiently correct the deficiencies identified in DWR’s incomplete determination. DWR officially determined the Kaweah Subbasin 2022 GSPs as “inadequate” on March 2, 2023.

The State Water Board now must determine whether a probationary designation is warranted (See Section 2.2.1.1). Board staff have reviewed the GSPs and the DWR staff reports documenting DWR’s review of the GSPs. Staff concur with DWR’s determination that the Kaweah GSPs are inadequate, and staff analyses indicate the Kaweah GSAs are not managing their groundwater sustainably. Board staff note:

- The GSPs’ SMC will allow substantial impacts to people who rely on domestic wells for human consumption, cooking, and sanitary purposes and on infrastructure such as canals, levees, as well as impacts to the aquifer itself within the subbasin.
- Based on the above, the Kaweah GSAs are not on track to achieve sustainability by 2040. Designating the subbasin probationary is critical for getting the basin back on track to achieve sustainability by 2040.

Staff therefore recommend the State Water Board designate the subbasin as a probationary basin.

The State Water Board may designate a basin probationary if state intervention authorities are triggered and after providing notice and holding a public hearing (Wat. Code, § 10735.2, subd. (a)). The overall goal of probation is to gather information to help local GSAs address deficiencies in their plans, so they can sustainably manage their groundwater resources as soon as possible. During a probationary designation, the State Water Board will require many groundwater extractors to report their extractions, which will help resolve data gaps related to groundwater use, and Board staff will provide guidance to GSAs working to develop an adequate sustainability plan (or plans). Concurrently, GSA efforts to fix deficiencies should continue.

After GSAs have adopted a revised plan (or plans) that resolve the deficiencies, they can seek to exit probationary status by submitting the plan (or plans) to the State Water Board. If the State Water Board determines that deficiencies are addressed, the Board may resolve to have the GSA (or GSAs) exit probation; however, if the Board does not believe that the plan (or plans) are being adequately implemented, it may decide to continue probation (Wat. Code, § 10735.8, subd. (g)(4)). If deficiencies are not addressed after a year, the State Water Board can take steps to manage groundwater more directly by developing and adopting, after noticing and a hearing, an interim plan for the basin. An interim plan is intended to temporarily manage the basin until GSAs can develop and implement an adequate plan or plans. A probationary determination is the first step to addressing continued overdraft while also resolving plan deficiencies. This step is required before the State Water Board can move to the step of developing an interim plan.

The following sections explain staff recommendations for a probationary determination:

- Section 4.1 recommends identification of specific GSP deficiencies and potential actions to address deficiencies.
- Section 4.2 recommends that no areas in the subbasin be excluded from probationary status.
- Section 4.3 recommends that the groundwater extraction annual reporting deadline be altered such that:
    - Users who are required to report their extractions do so by December 1 of each year for the previous water year.
- Section 4.4 recommends that:
    - Users extracting 2 AFY or less for domestic purposes only be excluded from reporting groundwater extractions and paying fees.
    - Users extracting more than 2 AFY for any reason be required to report groundwater extractions and pay fees.

- Users extracting more than 200 AFY for any reason be required to install flow meters.
- Users extracting from the wells adjacent to the Friant-Kern Canal be required to install flow meters.

4.1 Groundwater Sustainability Plan Deficiencies and Potential Actions to Address Deficiencies

The State Water Board acknowledges that the Kaweah GSAs have stated their intent to make revised GSPs available for public comment in May 2024 with a goal of incorporating public comments and submitting revised GSPs to the DWR portal in July 2024. This draft staff report is a reflection of Board staff review of the Kaweah Subbasins 2020 incomplete determination and 2022 inadequate determination. Once revised GSPs are available to Board staff it will take some additional time for staff to review and incorporate any substantive changes into the staff report.

If the State Water Board designates a basin as probationary, the Board must identify the specific deficiencies and potential actions to address the deficiencies (Wat. Code, § 10735.6, subd. (a)). This Staff Report incorporates deficiencies identified in DWR's determination. For the Kaweah Subbasin 2022 GSPs, Board staff reviewed the GSPs and identified additional key issues generally within the scope of DWR deficiencies. These additional deficiencies are similar to the recommended corrective actions that DWR identified for basins with approved plans. Board staff are also considering the time it would take for basins to address deficiencies and exit probation. While other basins began implementing plans in 2020 that are now approved, the Kaweah Subbasin does not yet have a plan that will achieve sustainable groundwater management by 2040. In order to meet the 20-year timeline, plan deficiencies should be addressed now, including the additional Board-identified issues that are similar to the DWR-identified recommended corrective actions that other basins with approved plans are already working to address.

Below, Board staff have identified specific deficiencies within the Kaweah Subbasin 2022 GSPs and Coordination Agreement and have outlined potential actions to address those specific deficiencies. Deficiencies that have been identified within the GSPs generally include but are not limited to: (1) chronic lowering of groundwater levels with insufficient SMC; (2) continued land subsidence; (3) further degradation of groundwater quality, and (4) depletions of interconnected surface water.

DWR's 2022 Inadequate Determination evaluates the subbasin's 2022 GSPs against the deficiencies DWR identified for the 2020 GSPs in DWR's 2020 GSP Incomplete Determination. Consequently, for each of the four overarching deficiencies, Board staff describe relevant portions of the 2020 GSPs, DWR's 2020 Incomplete Determination, and the 2022 GSPs. Staff then break down the deficiency into components. Finally, staff

identify potential actions to address the deficiency components. Some actions contribute to addressing more than one deficiency, and staff identified more than one potential action for some deficiencies.

The potential actions to address the deficiencies provide the GSAs with a possible path out of state intervention and State Water Board oversight. Ultimately, the State Water Board will evaluate any updated and adopted GSPs as a whole and will determine whether the GSAs have addressed the deficiencies, whether the GSPs are consistent with SGMA, and whether the GSAs are implementing the GSPs in a manner that the Board finds will likely achieve the sustainability goal.

In some cases, a GSP revision may resolve a deficiency identified by the Board, but the Board may find the revision adversely affects other management criteria. For example, if the plain-language definition of an undesirable result is revised, then the quantitative undesirable result and minimum thresholds may no longer adequately represent the significant and unreasonable conditions that the basin is trying to avoid, and the measurable objectives may no longer provide operational flexibility about the minimum thresholds.

Additionally, the Board may consider how GSPs that do not meet SGMA's mandate to sustainably manage groundwater by avoiding undesirable results affect other Board programs and policies. For example:

- Chronic lowering of groundwater levels can impact shallow domestic wells, many of which are located in communities of color. Failure to avoid this undesirable result (Wat. Code, § 10721, subd. (x)(1)) may also be inconsistent with or impact:
    - The Human Right to Water Resolution (California State Water Resources Control Board, 2016)
    - The Racial Equity Resolution (California State Water Resources Control Board, 2021)
    - The Policy implementing the Safe and Affordable Funding for Equity and Resilience (SAFER) Program Fund Expenditure Plan (California State Water Resources Control Board, 2023e)
    - Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells (California Department of Water Resources, 2021)
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies (Wat. Code, § 10721, subd. (x)(4)) may also be inconsistent with or impact:
    - Antidegradation Policy (California State Water Resources Control Board, 1968)

- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water (Wat. Code, § 10721, subd. (x)(6)) may also be inconsistent with or impact:
    - Tribal beneficial uses of water (California State Water Resources Control Board, 2017)
    - The Board's public trust obligations (see section 5.3)

The Board may only amend or rescind a probationary designation decision after providing appropriate public notice of the proceeding (Wat. Code, § 10736, subds. (b), (c)).

Roadmap to Proposed Deficiencies

Table 4-1, below, summarizes the deficiencies described in Sections 4.1.1 through 4.1.4. See the following sections for additional detail on each deficiency including potential actions to address the deficiencies. **Appendix A** summarizes the text in Sections 4.1.1 through 4.1.4, including the sub deficiencies, what SGMA requires, a summary of deficiencies, and potential actions to correct the deficiencies.

Table 4-1 – Summary of Proposed State Water Board Deficiencies

Deficiency Groundwater Levels (GL)-1 – The 2022 GSPs do not clearly define undesirable results for the chronic lowering of groundwater levels for the subbasin.
Deficiency GL-2 – The GSAs did not select minimum thresholds based on avoiding undesirable results and significant and unreasonable impacts to beneficial uses and users.
Deficiency GL-3 – The GSAs do not thoroughly explain the effects groundwater level minimum thresholds have on other sustainability indicators, such as groundwater storage, subsidence, degradation of groundwater quality, and depletions of interconnected surface water.
Deficiency GL-4 – The Mitigation Program Framework provided in the GSPs lacks necessary detail.
Deficiency Land Subsidence (LS)-1 - The GSPs do not provide reasonable justification for subsidence SMCs involving the subbasin's water conveyance infrastructure.

Deficiency LS-2 - The GSPs do not adequately define the relationship between other sustainability indicator Sustainability Management Criteria and potential subsidence impacts.
Deficiency LS-3 – Significant impacts to conveyance infrastructure and undesirable results are expected under projected subsidence rates without mitigation.
Deficiency Groundwater Quality (GWQ)-1 – The 2022 GSPs do not clearly define the conditions that would be considered an undesirable result.
Deficiency GWQ-2 – Sustainable Management Criteria in the 2022 GSPs are not consistent with GSP Regulations.
Deficiency GWQ-3 – Water quality monitoring networks are not consistent with the GSP Regulations.
Deficiency GWQ-4 – Management actions are not responsive to water quality degradation.
Deficiency Interconnected Surface Water (ISW)-1 – The GSPs, in setting Sustainable Management Criteria for depletions of ISW, did not adequately describe the impacts of those criteria on beneficial uses and users.
Deficiency ISW-2 – The GSPs did not establish Minimum Thresholds for depletions of ISW that are consistent with GSP Regulations.
Deficiency ISW-3 – The GSPs did not establish a monitoring network designed to address depletions of ISW.

4.1.1 Deficiency GL – Defining and Avoiding Undesirable Results Related to Chronic Lowering of Groundwater Levels

Under SGMA, one piece of achieving the sustainability objective for a basin is avoiding "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon." (Wat. Code § 10721, subd. (x). Lowering groundwater levels can cause shallow wells to go dry or reduce their productivity, increase the energy costs of pumping, bring polluted water closer to well screens (the area where groundwater enters a well), or reduce water available for deep-rooted plants (see definition of groundwater-dependent

ecosystems in the Definitions and Abbreviations section). Lowering groundwater levels also makes it more difficult to avoid other, related undesirable results caused by groundwater conditions, including subsidence and depletions of interconnected surface water.

DWR concluded that the Kaweah Subbasin 2022 GSPs do not adequately justify their approach for developing SMC for chronic lowering of groundwater levels. DWR also concluded that the SMC would likely result in significant and unreasonable impacts on beneficial uses and users. Board staff have built on DWR's analysis, noting the 2022 GSPs do not clearly describe undesirable results and minimum thresholds for the chronic lowering of groundwater levels. Board staff also notes that the GSAs' proposed Mitigation Program Framework in the 2022 GSP and each GSA's mitigation plan lacks specific details to mitigate the chronic lowering of groundwater levels with the projects and management actions proposed in the 2022 GSPs.

Table 4-2 – Summary of Department of Water Resources' Chronic Lowering of Groundwater Levels Deficiency and Relevant Components of the 2020 and 2022 Kaweah Subbasin Groundwater Sustainability Plans

2020 GSP	DWR's 2020 GSP Incomplete Determination	2022 GSP	DWR's 2022 GSP Inadequate Determination
The 2020 GSPs described criteria for sustainability based on declining groundwater level trends into the future with no new projects or management actions.	The GSPs did not set sustainable management criteria for chronic lowering of groundwater levels as required by SGMA and the GSP Regulations and did not describe the relationship between groundwater level minimum thresholds and other sustainability indicators.	The 2022 GSPs approach is based on a framework of data, which has data gaps on active well locations, and a mitigation program to mitigate certain impacts to active wells.	GSAs have not taken sufficient action to correct the deficiency related to the definition of undesirable results, minimum thresholds, and significant and unreasonable impacts the subbasin is attempting to avoid.

4.1.1.1 Kaweah Subbasin 2020 Groundwater Sustainability Plan

This subsection and subsequent subsections describe the portions of each GSP or DWR determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 GSPs' definition of an undesirable result related to chronic lowering of groundwater levels reads: "[U]ndesirable results for groundwater levels may be significant and unreasonable when basin wide loss of industrial, municipal, and domestic pumping well capacity occurs due to lowering groundwater levels" (2020 Coordination Agreement, Appendix 6.4).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

Minimum thresholds are the numeric values used to define undesirable results. Measurable objectives are specific quantifiable goals for the maintenance or improvement of groundwater conditions to achieve the sustainability goal for the basin.

The 2020 GSPs described an undesirable result as occurring when one-third of the representative monitoring sites in all three GSA jurisdictions combined exceed their respective MT groundwater levels (2020 Coordination Agreement, Appendix 6.4.2). The 2020 GSPs made a preliminary determination that the undesirable result of one-third of the representative monitoring sites exceeding MTs represents a sufficient number of monitoring sites within the subbasin, and that undesirable result is caused by over-pumping or nominal groundwater recharge operation during drought periods (2020 Coordination Agreement, Appendix 6.4.1).

The GSAs set minimum thresholds for groundwater level at projected 2040 groundwater levels based on declining groundwater level trends observed over a selected base period. This approach is based on hydrograph trends analysis of pumping and recharge regimes devoid of any GSP projects and management actions. The 2020 GSPs calculated the percentage of wells expected to be completely dewatered by 2040 and determined that the percentage of dewatered wells would not constitute an undesirable result (2020 Coordination Agreement, Appendix 6.4.2). From the well impact evaluation for the subbasin, 236 of the 696 domestic wells with well construction information would go dry and five of the 206 municipal wells with well construction information would go dry (2020 GKGSP, p. 5-8). The Greater Kaweah GSA and Mid-Kaweah GSA justified the MT level impacts to wells stating, “undesirable results will not occur at water levels above these 2040 projections, barring significant and unreasonable impacts on existing wells and freshwater in storage within the Kaweah Subbasin” (2020 GKGSP p. 5-3; 2020 MKGSP, p. 5-3). The GSAs set the MTs based on declining groundwater levels rather than the site-specific depletion of supply that could lead to undesirable results (2020 Coordination Agreement, Appendix 6).

Well Impact Mitigation

The three GSPs included frameworks to potentially mitigate for impacts to wells. However, the three GSPs did not mention plans for well impact mitigation that would lessen the significance of impacts to wells from groundwater level declines allowed in the GSPs. The EKGSA intended to develop a Well Observation Program which will monitor, evaluate, and notify pumpers of potential impacts and possible actions that may be taken to avoid or minimize undesirable results (2020 EKGSP, Section 3.4.1.1, p. 3-18). Also, the EKGSA may create a Drinking Water Wells Protection Program that could include a combination of different strategies that provide solutions to gather critical data, protect groundwater quality and quantity, and provide safe and affordable

drinking water to the residents of the EKGSA (2020 EKGSP, Section 5.3.2.1, p. 5-35). The GKGSA and MKGSA will consider several measures to offer funding and technical assistance to impacted domestic well owners and small water systems. However, both GKGSA and MKGSA stated that none of the assistance measures listed in the GSPs has been approved to be carried out, and an economic analysis to evaluate these measures and any other future assistance will be forthcoming prior to any actions being taken by the GSAs (2020 GKGSP, Section 7.3.6, pp.7-72 to 7-73; 2020 MKGSP, Section 7.4.8, pp. 7-44 to 7-45).

Projects and Management Actions

Many projects and management actions were identified in the 2020 GSPs. The projects included increase recharge and management actions, modified surface water deliveries, a fallowing program, and groundwater extraction allocations to meet the sustainability goal for the basin. The GSPs stated that projects would add approximately 39,300 AFY and management actions would save approximately 52,900 AFY if the projects and management actions were implemented by 2040. The combination of projects and management actions is expected to provide a total of 92,200 AFY in reducing the groundwater deficit in the subbasin. (2020 Coordination Agreement, Appendix 7).

The discussion of projects and management actions did not specify the criteria that would trigger implementation, a timetable for implementation, a description of how the GSAs would meet costs, or an explanation of the source and reliability of the water necessary for the supply augmentation projects.

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The East Kaweah GSP provided an explanation of the relationship between groundwater level MT and the other sustainability indicators but did not provide a description of how the undesirable results of other sustainability indicators would be avoided. (2020 EKGSP, Section 3.4.1.2.2, p. 3-20). The Greater Kaweah and Mid-Kaweah GSPs did not provide a description of the relationship between groundwater level MT on the other sustainability indicators nor how the undesirable results of other sustainability indicators would be avoided. In conclusion, DWR noted in its 2020 GSP Incomplete Determination that the 2020 GSP minimum threshold description should include, “the relationship between these minimum thresholds and each sustainability indicator to show how these basin conditions would avoid undesirable results for each sustainability indicator.”

4.1.1.2 Department of Water Resources’ 2020 Groundwater Sustainability Plan Incomplete Determination

In the January 28, 2022, DWR incomplete determination letter, DWR stated that the, “The [2020] Plan does not set sustainable management criteria for chronic lowering of

groundwater levels in the manner required by SGMA and the GSP Regulations" (2020 GSP Incomplete Determination, p. 9). DWR noted that the GSAs collectively did not define undesirable results and minimum thresholds for chronic lowering of groundwater levels in a manner required by SGMA and the GSP regulations. Instead, the GSAs developed sustainable management criteria based on an extrapolation of past groundwater level trends into the future (2020 Coordination Agreement, Appendix 6). The GSAs based their groundwater level management regime on preventing the rate of decline from becoming worse than years preceding SGMA since dealing with the impacts of groundwater level decline have historically been standard practice for groundwater users. DWR noted that this approach lacks documentation on the avoidance of significant and unreasonable depletion of supply. DWR also noted that the GSAs assessed the impacts to wells after establishing minimum thresholds rather than determining the effects that would be significant and unreasonable to the uses and users of groundwater and then setting minimum thresholds to avoid those conditions (2020 GSP Incomplete Determination, pp. 11-12).

The GSAs proposed well impact assessment and mitigation programs for well owners and those who rely on wells for water supply. DWR responded stating that if these programs are intended to mitigate impacts caused by declining groundwater levels, the GSPs need to provide specific details of the programs, what the programs will achieve, and how they will be managed (2020 GSP Incomplete Determination, p. 12).

Lastly, DWR noted that the GSPs do not consider how minimum thresholds developed for chronic lowering of groundwater levels will affect other related sustainability indicators.

Plain-Language Definition of an Undesirable Result

DWR assessed the GSAs' definition of an undesirable result related to chronic lowering of groundwater levels and concluded the following:

> None of the GSPs describe specific effects of chronic lowering of groundwater levels and depletion of supply that would be significant and unreasonable and would therefore constitute an undesirable result. Instead, each GSP states that an undesirable result would occur if groundwater level decline exceeded the defined minimum thresholds in more than a third of the Subbasin's representative monitoring sites. But those minimum thresholds are not based on the site-specific depletion of supply that could lead to undesirable results. Instead, each GSP projects groundwater levels based on an extrapolation of historical trends, predominantly groundwater level declines, as observed at representative monitoring sites over a base period… the GSPs then set the minimum threshold at groundwater levels projected to occur in 2040.

(ibid., p 9-10).

> In reassessing sustainable management criteria related to lowering groundwater levels, the GSAs should first determine effects that would be significant and unreasonable to the uses and users of groundwater in the Subbasin and then set minimum thresholds to avoid those conditions.

(ibid., p. 12).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR staff concluded that:

> the [2020] GSPs did not define metrics for undesirable results and minimum thresholds based on the chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply that the GSAs intend to avoid through the implementation of the Plan, including the potential effects on the beneficial uses and users in the Subbasin. Instead, the GSPs developed sustainable management criteria based on an extrapolation of past groundwater level trends into the future.

(ibid., p. 9).

DWR noted that the GSPs do not define metrics for undesirable results and minimum thresholds based on avoiding a significant and unreasonable depletion of groundwater supply that are informed by and considering, the relevant and applicable beneficial uses and users in their subbasin. DWR stated:

> All three GSPs base their groundwater level management regime on preventing the rate of decline from becoming worse than the rate that existed in the 11 years immediately preceding SGMA, but none document that the approach to setting undesirable results and minimum thresholds for groundwater levels was related to, or based on, avoidance of significant and unreasonable depletion of supply. Department staff do not consider that this approach reasonably complies with the requirements of SGMA and the GSP Regulations.

(ibid., p. 11).

DWR also noted that the GSPs did not describe the specific effects from the chronic lowering of groundwater levels and depletion of supply that would be significant and unreasonable to beneficial uses and users of groundwater, on land uses and property interests, and other potential effects and, therefore, constitute an undesirable result:

> The GSAs conclude that the impacts of continuing the pre-SGMA rate of groundwater level decline (e.g., increased lift costs or total loss of production capacity for users that rely on wells for drinking water) before 2040 is generally an acceptable outcome because dealing with those effects historically has been

> ‘standard practice’ for groundwater users, comparable to dealing with economic inflation However, as discussed above, these effects were not first determined to be less than significant, with minimum thresholds defined to maintain groundwater at or above levels that would avoid worse conditions.

(ibid., p. 12).

Lasty, DWR noted that the GSPs do not consider how minimum thresholds developed for one sustainability indicator will affect other related sustainability indicators:

> a GSP must demonstrate that sustainable management criteria established for one sustainability indicator will not produce undesirable results in any others. Department staff do not find evidence in the GSP that indicates the GSAs considered the effects of the groundwater level sustainable management criteria, which allow for continued lowering of levels, on the other sustainable management criteria.

(ibid., p. 12).

Department of Water Resources’ 2020 Groundwater Sustainability Plans Corrective Actions

DWR staff proposed a two-part corrective action to address the water level deficiency in the 2020 GSPs. Firstly, DWR staff recommended that:

> The GSAs must revise the [2020] Plan to define sustainable management criteria for the chronic lowering of groundwater levels by utilizing information specific to the Subbasin. The GSAs should first characterize undesirable results by describing the significant and unreasonable effects that could be, or are being caused by, lowering groundwater levels that the GSAs are seeking to avoid…. Next, the GSAs should revise minimum thresholds to quantify groundwater conditions which represent a point in the Subbasin that, if exceeded, may cause undesirable results.

(ibid., p. 13).

Secondly, DWR staff recommended that:

> If the GSAs intend to rely on mitigation actions to address impacts that would occur as a result of the continued lowering of groundwater levels as a means to support the reasonableness of their sustainable management criteria, then the GSPs should be revised to include specific details of the mitigation measures that will be enacted, including the schedule for implementation and other details that will allow the Department to assess their feasibility and likely effectiveness.

(ibid., p. 13).

4.1.1.3 Kaweah Subbasin 2022 Groundwater Sustainability Plans Submission and Water Year 2022 Annual Report

The GSAs submitted revised GSPs to DWR on July 27, 2022, in compliance with the 180-day resubmittal deadline. While not considered in DWR's assessment of the 2022 GSPs, the GSAs also filed the WY 2022 Annual Report for the subbasin on March 31, 2023.

Plain-Language Definition of an Undesirable Result

The GSAs revised the plain-language definition of an undesirable result related to chronic lowering of groundwater levels to read: "[t]he GSAs within the Kaweah Subbasin have determined that undesirable results for groundwater levels may be significant and unreasonable when a subset of existing and active wells is dewatered" (2022 Coordination Agreement, Appendix 6.4.2).

The GSAs view the following impacts from lowering groundwater levels as "significant and unreasonable" results that would directly impact the long-term viability of beneficial uses and users as follows (ibid., Appendix 6.4):

- Inability of the groundwater aquifer to recover in periods of average/above average precipitation following multi-year drought periods
- Dewatering of a subset of existing wells below the bottom of the well
- Substantial increase in costs for pumping groundwater, well development, well construction, etc., that impact the economic viability of the area
- Adverse effects on health and safety
- Interfere with other sustainability indicators

The GSAs identify "groundwater pumping in excess of natural and artificial recharge over a multi-year period that includes both wetter than average and drier than average conditions" as the primary cause leading to undesirable results of chronic lowering of groundwater levels.

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The GSAs did not revise the quantitative definition of an undesirable result nor measurable objectives. However, the GSAs did revise the definition of Minimum Thresholds.

The revised definition of minimum threshold reads, "Minimum thresholds (MTs) are derived from groundwater elevations that protect at least 90% of all water supply wells drilled since January 1, 2002, in each analysis zone, and that do not result in a greater

rate of decline over water years 2020 to 2040 than experienced over a specific historical time period" (2022 Coordination Agreement, Appendix 6-1, p. 6).

A total of 3,353 water supply well records are used to calculate the minimum threshold for the subbasin. The 3,353 water supply wells considered consists of wells installed since January 1, 2002, with completed depths, screen depths, locations of wells, and included in DWR's Well Completion Report dataset. The GSAs stated that, "well records drilled since 2002 are used for analysis to filter out wells that may have been abandoned or no longer represent typical modern depths for active wells and current groundwater elevation" (ibid., Appendix 6-1, p. 3). The GSAs noted that approximately one-third of the wells drilled from 2002 on did not have well completion depths and could not be used in the analysis. Depending on location, the 3,353 water supply wells were organized in 39 spatial analysis zones and groundwater elevations that would be protective of 90% of wells were determined for each zone. The analysis zones are delineated to group wells that would experience similar impacts by accounting for GSP management areas, groundwater elevations, aquifer characteristics, beneficial user type, land use, and similar completed well depths.

The GSAs considered the higher groundwater elevation of Methodology 1 and 2 for establishing minimum threshold for each analysis zone. Methodology 3 was considered situationally.

> Methodology 1 protects at least 90% of water supply wells as described in the analysis. The GSAs stated, "The 90% threshold was chosen in acknowledgment that it is impractical to manage groundwater to protect the shallowest wells" and that the water supply is based on known and active wells (ibid., Appendix 6-1, p. 7). The GSAs acknowledge that 10% of wells shallower than the protected elevation may be impacted and are in the process of establishing a well mitigation program to assist impacted well owners.
>
> Methodology 2 extrapolates groundwater level trends for individual representative monitoring sites over a selected base period out to 2040. The GSAs stated, "In all cases the trend [for methodology 2] is a decline with a rate that varies across the Subbasin" (ibid., Appendix 6-1, p. 26).
>
> Methodology 3 was considered if the minimum threshold estimation from Methodology 1 and 2 was determined to be anomalously low compared to neighboring monitoring sites. Minimum thresholds were raised to an elevation by interpolating minimum threshold contours.

The 2022 GSPs included a Mitigation Program Framework to, "mitigate for continued overdraft pumping for groundwater levels and land subsidence" (2022 Coordination Agreement, Appendix 6-3). The 2022 GSPs noted that, "numerous wells may be impacted during the implementation period between 2020 and 2040 as a result of continued lowering of groundwater levels" and that the GSAs are in the process of

establishing a Mitigation Program Framework to assist impacted well owners (ibid., Appendix 6-3). Each of the three GSAs will be implementing their own mitigation plan based on this framework (ibid., Appendix 6-3). The Mitigation Program Framework noted that each GSA will have the mitigation program implemented by June 30, 2023.

Each GSA will develop a funding mechanism to meet the specific GSA needs. The Mitigation Program Framework anticipated funding to be available from fees, charges, and penalties as well as grant funding. In parallel, the GSAs will coordinate with local NGOs that may provide assistance to the mitigation program.

Although not mentioned in DWR's inadequate determination, Board staff acknowledge the outreach effort the GSAs took to draft the Mitigation Program Framework. The efforts include hosting multiple public meetings to receive feedback on the mitigation program, developing an alert system to notify well users of potential impacts, and providing communications in multiple languages.

Projects and Management Actions

There were no substantive changes to the projects and management actions from the 2020 GSPs to the 2022 GSPs. However, the WY 2022 Annual Report noted that the GSAs had developed and implemented groundwater demand reduction management actions to reduce groundwater pumping (Annual Report, WY 2022).

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The three GSPs individually evaluated the relationship between potential effects of groundwater level MTs on other sustainability indicators.

East Kaweah GSP

> Groundwater storage – Groundwater storage capacity varies throughout the EKGSA due to the bedrock present in the GSP area. The amount of storage within the aquifer was a limiting factor in several of the eastern threshold regions that have a shallower aquifer due to presence of bedrock. However, the EKGSA does not describe how the groundwater level MTs would avoid undesirable results for groundwater storage (2022 EKGSP, Section 3.4.1.2.2, p. 3-20).
>
> Groundwater quality – The EKGSA noted that groundwater quality has not been directly correlated with groundwater levels and will assess the relationship as additional data is made available (ibid., Section 3.4.1.2.2, p. 3-20).
>
> Interconnected surface water – The EKGSA acknowledged that there is presently not enough data to use groundwater level to assess interconnected surface water and intends to implement an Interconnected Surface Water Work Plan to fill the data gap (ibid., Section 3.4.1.2.2 p. 3-20).

Land subsidence – The EKGSA has not experienced significant subsidence within its boundary, which limits the impact and correlation that the lowering of groundwater levels has on land subsidence. EKGSA is setting a separate minimum threshold for land subsidence based on impacts on critical infrastructure. However, the EKGSA does not describe how the groundwater level MTs would avoid undesirable results for land subsidence (ibid., Section 3.4.1.2.2 p. 3-20).

Greater Kaweah GSP

Groundwater storage – The GKGSA stated that groundwater level MTs are identical to groundwater storage MTs. The GKGSA also stated that the groundwater level MTs would not result in an undesirable loss of groundwater storage even though groundwater levels are expected to continue to decline to 2040 (2022 GKGSP, Section 5.3.5.3, p. 5-15).

Groundwater quality – The GKGSA acknowledged that the chronic lowering of groundwater level MTs may affect groundwater quality. Changes in groundwater elevation could change groundwater gradients causing poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. Also, lowered groundwater levels can mobilize contaminants that may occur at depth or draw down contaminants that are found closer to the ground. Since the chronic lowering of groundwater level MTs are lower than historical levels, new depth dependent contaminants could potentially be mobilized and impact beneficial uses and users (ibid., Section 5.3.5.3, p. 5-15).

Interconnected surface water – The GKGSA did not assess how the groundwater level MTs would impact interconnected surface water and lists interconnected surface water as a data gap (ibid., Section 5.3.5.3, p. 5-15).

Land subsidence – Groundwater levels are expected to continue to decline to the MTs and as a result, land subsidence is expected to occur in parts of the GKGSA, but the GKGSA does not describe how the groundwater level MTs would avoid undesirable results for land subsidence. (ibid., Section 5.3.5.3, pp. 5-15).

Mid-Kaweah GSP

Groundwater storage – The MKGSA stated that groundwater level MTs are used to derive groundwater storage MTs and will not result in an undesirable loss of groundwater storage. However, the MKGSA does not explain how groundwater level MTs would not result in an undesirable loss of groundwater storage even though groundwater levels are expected to continue to decline to 2040 (2022 MKGSA, Section 5.3.4.3, p. 5-7).

Groundwater quality – The MKGSA acknowledged that the groundwater level MTs may affect groundwater quality. Changes in groundwater elevation could change groundwater gradients causing poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. Also, lowered groundwater levels can mobilize contaminants that may occur at depth or draw down contaminants that are found closer to the ground. Since the chronic lowering of groundwater level MTs are lower than historical levels, new depth dependent contaminants could potentially be mobilized and impact beneficial uses and users (ibid., Section 5.3.4.3, pp. 5-7 to 5-8).

Interconnected surface water – The MKGSA stated that the groundwater level MTs would not change the existing condition of surface water in the GSP area since groundwater levels are below 60 feet and normally disconnected from surface water (ibid., Section 5.3.4.3, p. 5-8).

Land subsidence – The MKGSA acknowledge that additional land subsidence is expected to occur if groundwater levels decline to the groundwater level MTs, but the MKGSA does not describe how the groundwater level MTs would avoid undesirable results for land subsidence (ibid., Section 5.3.4.3, p. 5-8).

4.1.1.4 Proposed State Water Board Deficiencies

In DWR's 2022 GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSAs had not corrected the chronic lowering of groundwater levels deficiency in their 2022 GSPs. DWR's 2022 GSP Inadequate Determination states:

> Overall, Department staff believe the GSAs have taken great strides; however, conclude the GSAs have not taken sufficient action to address the [chronic lowering of groundwater level] deficiency. (2022 GSP Inadequate Determination, p. 12).

Board staff concur with DWR's findings in their 2022 GSP Inadequate Determination and hereby incorporate it by reference. In addition, Board staff have identified additional issues with the GSAs' minimum thresholds and their proposed mitigation program.

Below, Board staff break down deficiencies for the subbasin related to lowering of groundwater levels. Deficiencies from DWR's inadequate determination are incorporated into the deficiencies identified below. Deficiencies include:

- GL-1: Identified by DWR.
- GL-2: Identified by DWR. Additional concerns noted by Board staff.
- GL-3: Identified by DWR.
- GL-4: Identified by DWR. Additional concerns noted by Board staff.

Deficiency Groundwater Levels (GL)-1 - The 2022 GSPs does not clearly define undesirable results for the chronic lowering of groundwater levels for the subbasin.

What SGMA Requires: The GSP Regulations require a GSA to "describe...the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users and land uses and property interests (Cal. Code Regs., tit. 23, § 354.26).

Deficiency: DWR noted in its 2020 GSP Incomplete Determination that the 2020 GSPs did not define undesirable results for the chronic lowering of groundwater levels that would be considered significant and unreasonable. In the 2022 Coordination Agreement, undesirable result for chronic lowering of groundwater levels is defined as occurring when one-third of the monitoring sites exceed the respective minimum threshold groundwater elevation and states that "undesirable results are defined by the quantity of wells completely dewatered by 2040 if Minimum Thresholds are met or exceeded" (2022 Coordination Agreement, Appendix 6). DWR noted in the 2022 GSP Inadequate Determination that the 2022 GSPs described causes leading to undesirables results but did not describe the specific effects they are trying to avoid. The 2022 GSPs generally identified several "significant and unreasonable" impacts from lowering groundwater levels such as "substantial increased costs for pumping groundwater" and "adverse effects on health and safety" but does not clearly explain what conditions would constitute undesirable results.

Without a clear description of the specific conditions the Plans are meant to avoid, the GSAs cannot evaluate whether the minimum thresholds will be managed to achieve sustainability, and the State and the Department cannot evaluate the likelihood of the Plan to attain sustainability goals or monitor progress towards any sustainability goal under the Plans.

Board staff propose Potential Action GL-1 to address the deficiency.

Potential Action GL-1 – Define the undesirable result for the chronic lowering of groundwater levels and explain how significant and unreasonable effects will be avoided.

GSAs should prioritize engaging with representatives from the range of users in the subbasin, including domestic well owners, small farmers, infrastructure managers, state and federal fish and wildlife agencies, advocates, and others. The groundwater level conditions that are considered significant and unreasonable should reflect consensus decision-making that incorporates most of the use in the subbasin, particularly uses vulnerable to chronic lowering of groundwater levels. Board staff are encouraged by the

outreach conducted by the GSAs during the development of the individual GSA mitigation plans and support a similar approach on defining the undesirable results for the chronic lowering of groundwater levels. The definition of an undesirable result should be specific enough that GSAs and others can evaluate, over time, whether any quantitative definition of an undesirable result accurately represents those groundwater conditions the GSAs are trying to avoid.

Deficiency GL-2 – The GSAs did not select minimum thresholds based on avoiding undesirable results and significant and unreasonable impacts to beneficial uses and users.

What SGMA Requires: The GSP Regulations requires GSAs to establish minimum thresholds that quantify groundwater conditions for chronic lowering of groundwater levels to avoid undesirable results (23 Cal. Code Regs., tit. 23, § 354.28(a)).

Deficiency: DWR noted in its 2020 GSP Incomplete Determination that the 2020 GSP minimum threshold description should include, “information and criteria relied upon to establish and justify the minimum thresholds supported by the basin setting and qualified by uncertainty in the understanding of the basin setting.” In response, the GSAs developed three methodologies to determine the groundwater level MTs in 39 analysis zones using information of 3,353 water supply well in the subbasin. DWR acknowledged in the 2022 GSP Inadequate Determination that the 2022 GSPs made changes in the process for selecting for minimum thresholds at each representative monitoring site but noted that the GSAs narrowed the field of wells by only considering wells installed since January 1, 2002, with completed depths, screen depths, locations of wells, and included in DWR’s Well Completion Report dataset. The assumptions behind this approach raise questions, mainly whether the wells selected are representative of the basin as a whole, or whether certain categories of uses and users are disproportionately represented among the class of wells excluded from calculations, thus putting them at greater risk of experiencing undesirable results. The GSAs also do not provide specific information in the Plan demonstrating that this approach is statistically objective. In reviewing the methods for the selection of minimum thresholds, DWR staff concluded minimum thresholds have not been selected based on the avoidance of undesirable results and significant and unreasonable impacts to beneficial uses and users as required by the GSP Regulations and specified in the corrective action.

Board staff concur with DWR's findings in their 2022 GSP Inadequate Determination and further questions how Methodology 2 used in selecting minimum threshold would avoid undesirable results. Methodology 2 extrapolates groundwater level trends for individual representative monitoring sites over a selected base period out to 2040 and “in all cases the trend is a decline with a rate that varies across the Subbasin” (2022 Coordination Agreement, Appendix 6-1, p. 26). Methodology 2 is the most common of the three methodologies for determining minimum thresholds for an analysis zone.

Board staff question how Methodology 2 would be consistent with SGMA objectives since minimum thresholds would be set at declining groundwater levels projected to 2040.

Board staff propose Potential Action GL-2 to address the deficiency.

Potential Action GL-2 – Select minimum thresholds to avoid undesirable results and significant and unreasonable impacts to beneficial uses and users.

GSAs should provide information and justify how undesirable results and unreasonable impacts to beneficial uses and users would be avoided with selected minimum thresholds. Demonstrate that the selected MTs and projects and management actions will maintain or achieve sustainable groundwater management. Describe the effects of MTs on beneficial uses and users relative to groundwater level conditions on January 1, 2015. If groundwater levels under the subbasin GSPs would be worse (significantly lower) in 2040 as compared to January 1, 2015, explain how the decline is not significant and unreasonable. Expand the dataset of well records to ensure the records are representative of the basin as a whole when estimating the number of wells that may be impacted by declining groundwater levels. Describe the number and types of wells impacted based on the methodologies selected for groundwater level MTs.

Deficiency GL-3 - The GSAs do not thoroughly explain the effects groundwater level MTs have on other sustainability indicators, such as groundwater storage, subsidence, degradation of groundwater quality, and depletions of interconnected surface water.

What SGMA Requires: The GSP Regulations require the GSA to determine how basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators. (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(2)).

Deficiency: DWR noted in its 2020 GSP Incomplete Determination that the 2020 GSP minimum threshold description should include, “the relationship between these minimum thresholds and each sustainability indicator to show how these basin conditions would avoid undesirable results for each sustainability indicator” (2020 GSP Incomplete Determination, p. 13). DWR noted in the 2022 GSP Inadequate Determination that each GSP provided a response in the 2022 GSPs which included an explanation of the relationship between groundwater level minimum thresholds and other sustainability indicators. However, DWR noted that, “none of the GSPs have thoroughly explained how water level minimum thresholds will not cause undesirable results for other sustainability indicators” (2022 GSP Inadequate Determination, p. 10). The EKGSP states that due to the bedrock present within the GSP area, groundwater storage was accounted for when establishing groundwater level MTs. Water level correlation for subsidence, water quality, and interconnected surface water was either not present or unknown; therefore, an explanation of how groundwater levels MTs would

avoid undesirable results for these sustainability indicators was not described (2022 EKGSP, Section 3.4.1.2.2). The MKGSP and GKGSP claim that no impact to groundwater storage is expected due to the close correlation to water levels and the use of water levels as a proxy (2022 MKGSA, Section 5.3.4.3 and 2022 GKGSP, Section 5.3.5.3). Both GSPs acknowledge that groundwater levels will drop below historical lows and there is a potential for new depth dependent contaminants to be mobilized and affect beneficial uses and users. The GSPs do not discuss whether this could cause undesirable results. Both GSPs also acknowledge groundwater levels will continue to decline during GSP implementation, and subsidence will occur. However, the GSPs does not explain how undesirable results for subsidence will be avoided.

Board staff propose Potential Action GL-3 to address the deficiency.

Potential Action GL-3 – Describe the relationship between groundwater level minimum thresholds to each sustainability indicator.

Provide a description of how the groundwater level minimum thresholds would avoid undesirable results for each sustainability indicator in addition to describing the relationship between groundwater level minimum thresholds to other sustainability indicators. Revise groundwater level minimum thresholds as necessary to avoid undesirable results for other sustainability indicators and as data gaps for each sustainability indicator are filled.

Deficiency GL-4 – The Mitigation Program Framework provided in the GSPs lacks necessary detail.

What SGMA Requires: Although SGMA and the GSP Regulations do not require development of a well impact mitigation plan, many GSAs have proposed to couple such plans with MTs to allow for greater groundwater level declines while avoiding undesirable results.

Deficiency: DWR noted in the 2022 GSP Inadequate Determination that the Mitigation Program Framework proposed in the adapted 2022 Coordination Agreement is labeled as ‘draft’ and ‘for discussion purpose only’ and is unclear of the GSA’s commitment to this framework (2022 GSP Inadequate Determination, p. 12). The 2022 Coordination Agreement included a Mitigation Program Framework which describes the minimum requirements each GSA has agreed to implement (2022 Coordination Agreement, Appendix 6-3). Each mitigation Program will include a claim process to address impacts to water supply wells and critical infrastructure. The Framework identifies potential mitigation options if the GSAs determine impacts are due to groundwater levels or subsidence. However, the Mitigation Program Framework lacks details to assess the feasibility and likely effectiveness of the mitigation actions. DWR also noted that “the scope of the mitigation plans must be revisited given they are focused on the narrowed

subset of wells discussed in [the definition for minimum threshold for the chronic lowering of groundwater levels]" (2022 GSP Inadequate Determination, p. 12).

Board staff concur with DWR and further note that the Mitigation Program Framework and the GSA mitigation plans lacks specific details on appropriate funding sources, complexity and timeliness on mitigation processes, and an implementation schedule.

Since the DWR 2022 Incomplete Determination, Board staff acknowledge the progress the GSAs are making on outreach, funding, and process on the Mitigation Program Framework as well as the individual GSA mitigation plans.

Board staff propose the below Potential Action GL-4 to address the deficiency.

Potential Action GL-4 – Establish accessible, comprehensive, and appropriately funded well impact mitigation programs that mitigate impacts to all wells affected by lowering of groundwater levels or degradation of water quality. Develop well mitigation programs with clear triggers, eligibility requirements, implementation schedule, and funding sources.

As appropriate depending on the GSAs revised SMC and other projects and management actions, the GSAs should develop mitigation plans that include mitigation for both declining groundwater levels and water quality impacts. The mitigation plans should:

- Identify clear triggers for well mitigation that avoid undesirable results (e.g., employ mitigation prior to a well losing supply).
- Identify adequate and highly reliable funding sources for mitigation efforts commensurate with the magnitude of impacts allowed under the GSAs' MTs; demonstrating adequate funding may involve projecting out fee revenues to demonstrate financial capacity that matches expected need.
- Prioritize program accessibility by defining broad eligibility requirements, avoiding reimbursement-based mitigation that may not be accessible to low-income well users, offering translated program materials, and partnering with trusted community leaders and organizations in program development and roll-out.
- Identify approaches for preventing even the temporary loss of safe and reliable drinking water supplies, due to basin management, for people reliant on wells. For example, GSAs may proactively contact the owners of wells that are at risk of impacts from groundwater level declines or water quality degradation. Coordinating proactively with well owners may also reduce the overall financial costs of mitigation by reducing or eliminating the need for interim water supplies.

Mitigation options may include:

- Replacing or deepening wells.

- Support for expansion of public water system boundaries to private well communities or consolidation of smaller drinking water systems dependent on at-risk wells with larger public water systems. This would involve identifying vulnerable areas where consolidation or extension of service is feasible. Consolidation efforts may include: (1) providing financial assistance, particularly for low-cost intertie projects that are adjacent to larger systems, (2) working with County Planning agencies to ensure that communities served by at-risk wells are annexed into the service areas of larger water systems to limit barriers to future interties, and (3) facilitating outreach and introductions between small water systems and owners of domestic wells and larger water systems to assist in developing future partnerships.
- (For water quality degradation) Well water treatment (point-of-entry (POE)) for wells impacted by arsenic, nitrate, 1,2,3-Trichloropropane (1,2,3-TCP), and 1,2-Dibromo-3-chloropropane (DBCP) (California State Water Resources Control Board, 2022a), drilling new wells completed in aquifers with better water quality, consolidation of existing water systems, or expanding service areas for existing public water systems not facing water quality impacts.

GSAs should not plan to fund well mitigation via the Safe and Affordable Drinking Water Fund administered through the State Water Board. This funding program was designed for addressing legacy impacts that are not within the scope of SGMA and not for addressing impacts caused by groundwater management actions or inactions by GSAs.

4.1.2 Deficiency LS – Defining and Avoiding Undesirable Results Related to Land Subsidence

Another consideration under SGMA is avoiding “significant and unreasonable land subsidence that substantially interferes with surface land uses.” (Wat. Code, § 10721, subd. (x) (5)). Land subsidence from excessive groundwater extraction can cause irreversible damage to infrastructure and aqueduct operations. Land subsidence can also diminish the storage capacity of an aquifer, which reduces the amount of available water for the future.

The Department of Water Resources (DWR) noted encouraging progress presented in the 2022 GSPs, but ultimately determined that sufficient action was not taken to address subsidence deficiencies. DWR noted that that the Kaweah Subbasin 2022 GSP does not adequately justify its approach for developing SMC for subsidence related to the Friant-Kern Canal and other conveyance infrastructure (See Table 4-3 below). DWR also concluded that additional work is required to evaluate the relationship between Chronic Lowering of Groundwater Levels SMC and potential subsidence impacts in the subbasin.

Table 4-3 – Summary of Department of Water Resources' Land Subsidence Deficiency and Relevant Components of the 2020 and 2022 Kaweah Subbasin Groundwater Sustainability Plans

2020 GSP	DWR's 2020 GSP Incomplete Determination	2022 GSP	DWR's 2022 GSP Inadequate Determination
Mid-Kaweah GSP and Greater Kaweah GSP defined undesirable results for land subsidence in the subbasin based on historical rates observed within the subbasin.	Greater and Mid-Kaweah GSPs do not define sustainable management criteria and metrics for undesirable results based on the amount of subsidence that would substantially interfere with all land surface uses and users.	The Coordination Agreement updates definitions of significant and unreasonable results for the entire subbasin, and the Plans established two sets of minimum thresholds for areas within a two-mile buffer zone of the Friant-Kern Canal and for all areas outside of the canal buffer zones. Undesirable results definitions were expanded to include rates and cumulative subsidence amounts associated with impacts to infrastructure (i.e., deep wells and conveyance canals).	DWR was not able to fully evaluate how the management criteria for chronic lowering of groundwater levels will affect localized subsidence rates. DWR suggests further analysis comparing water levels and subsidence rates at collocated facilities, especially for the area outside of the canal buffer zone.
East Kaweah GSP defines undesirable results as unreasonable impacts to critical infrastructure (i.e., Friant-Kern Canal). Conflicting sustainable management criteria are defined in the plan	The discordant management criteria for undesirable results and allowable subsidence amounts along the Friant-Kern Canal may prevent the subbasin from reaching sustainability.	Sustainable management criteria were defined to protect the Friant-Kern Canal through the entire subbasin. The East Kaweah GSP established a minimum threshold of 9.5 inches of cumulative	The Plan does not explain how it was determined that approximately 10 inches or greater amount of subsidence would result in a 10 percent or more capacity loss in the subbasin's

2020 GSP	DWR's 2020 GSP Incomplete Determination	2022 GSP	DWR's 2022 GSP Inadequate Determination
along the Friant-Kern Canal.		subsidence within the two-mile wide buffer zone. This is associated with a projected 10 percent capacity reduction within the canal.	conveyance infrastructure. The GSAs should explicitly describe the analysis that went into establishing the 10 percent capacity criteria.

4.1.2.1 Kaweah Subbasin 2020 GSP

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement defined an undesirable result for land subsidence as "Land subsidence may be considered significant and unreasonable if there is a loss of a functionality of a structure or a facility to the point that, due to subsidence, the structure or facility cannot reasonably operate without either significant repair or replacement" (2020 Coordination Agreement, Appendix 6, p. 7). Both Greater and Mid-Kaweah GSAs did not qualify or define metrics for undesirable results based on the amount of subsidence that would substantially interfere with land surface uses (2022 GSP Incomplete Determination, p. 14). The East Kaweah GSA further defined undesirable results to address potential impacts to the Friant-Kern Canal: "The criteria for an undesirable result will be the significant loss of functionality of a structure or a facility to the point that, due to subsidence, the feature cannot be operated as designed requiring either retrofitting or replacement" (2020 East Kaweah GSP, p. 182).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2020 Coordination Agreement described an undesirable result as "An undesirable result will occur when one-third of the subbasin subsidence monitoring sites exceed their respective minimum thresholds" (2020 Coordination Agreement, p. 7). MOs and MTs were based on projected groundwater flow model output values for the years 2025, 2030, 2035, and 2040 at various representative monitoring sites in the basin.

Representative Monitoring Sites and Monitoring Network

The 2020 Coordination Agreement outlined a subsidence monitoring network consisting of 32 benchmark stations across the three GSAs. There are 14 stations located within

Greater Kaweah, eight located within Mid-Kaweah, and 10 located within East Kaweah. The network primarily utilizes National Geodetic Survey (NGS) benchmarks, GPS data from GAGE (Geodetic Facility for the Advancement of Geoscience), and Interferometric Synthetic Aperture Radar (InSAR) data from DWR, and local program benchmark units (2020 Coordination Agreement, p. 49).

Infrastructure Mitigation

The 2020 GSPs did not outline specific actions or plans to mitigate impacts to infrastructure related to subsidence. The GSPs' SMC allowed for continued subsidence within the subbasin. The 2020 Coordination Agreement states: "Additional data and coordination between subbasins are recommended to better understand the effects of groundwater management on the mitigation of land subsidence" (2020 Coordination Agreement, p. 139).

Projects and Management Actions

The 2020 Coordination Agreement and GSPs generally outlined project and management actions either as demand reduction, supply augmentation, or improvements to subsidence monitoring networks (2020 Coordination Agreement, p. 123; 2020 Coordination Agreement, Appendix 5, p. 13). The 2020 Coordination Agreement did not outline subbasin-wide projects and management actions specifically related to improving subsidence conditions. The GSPs outlined multiple projects mainly reliant on future recharge projects and water delivery improvements. The GSPs described potential management actions including pumping restrictions, allocation frameworks, additional fees and incentives, and expansions of well metering efforts.

4.1.2.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

On January 28, 2022, DWR released the Kaweah Subbasin Determination Letter regarding the subbasin's GSPs. In this letter, DWR identified a deficiency in the 2020 Plans related to subsidence SMC:

Deficiency 2. The Plans do not set sustainable management criteria for subsidence in the manner required by SGMA and the GSP Regulations (2020 GSP Incomplete Determination, p. 14).

Plain-language Definition of an Undesirable Result

The 2020 DWR GSP Incomplete Determination stated that "…the GSAs have not defined undesirable results and minimum thresholds for subsidence in a manner consistent with SGMA and the GSP Regulations" (2020 GSP Incomplete Determination, p. 13). DWR specifically noted that Greater and Mid-Kaweah GSAs did not define

metrics for undesirable results that were based on the amount of subsidence that would substantially interfere with land surface users in their respective portions of the subbasin (ibid., p.14).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR determined there were issues with the definitions for subsidence undesirable results and other SMC that the GSAs established in the 2020 GSPs. DWR stated:

> Because Mid-Kaweah and Greater Kaweah did not define subsidence criteria based on conditions that would substantially interfere with land surface uses and users in the Subbasin, Department staff have no basis for evaluating whether continued subsidence predicted by the Plans (potentially 15 feet in the next 20 years in the southwest portion of the Subbasin) would cause significant and unreasonable impacts to land surface uses.

(2020 GSP Incomplete Determination, p. 15).

DWR continued to indicate that more coordination and technical studies were warranted to "…inform not only the selection of sustainable management criteria but also the types and timing of projects and management actions that would be needed to avoid the significant and unreasonable effects" (ibid., p. 15).

DWR further noted discrepancies in the GSAs subsidence minimum thresholds that created inconsistencies in groundwater management between the subbasins GSPs around the Friant-Kern Canal. DWR noted "Greater Kaweah GSPs nor the Kaweah Subbasin Coordination Agreement explain how up to 24 inches of subsidence in the Greater Kaweah area can be accommodated without interfering with the 9.5-inch limit set by East Kaweah to protect the conveyance capacity of the Friant-Kern Canal" (ibid., p. 16). The Determination Letter specified that this discrepancy needed to be reconciled.

Department of Water Resources' 2020 Groundwater Sustainability Plan Corrective Actions

DWR recommended a two-part corrective action for the identified subsidence deficiency:

a. Mid-Kaweah and Greater Kaweah must define sustainable management criteria for land subsidence in the manner required by SGMA and the GSP Regulations. The GSAs should develop criteria, including minimum thresholds, measurable objectives, interim milestones, and undesirable results based on the amount of subsidence that would substantially interfere with land surface uses. Developed criteria should be supported with information on the effects of subsidence on land

surface beneficial uses and users and the amount of subsidence that would substantially interfere with those uses and users.

b. Following changes to the GSPs described in Corrective Action 2a, Greater Kaweah also must explain how their minimum thresholds in the vicinity of identified critical infrastructure (i.e., the Friant-Kern Canal) will not substantially interfere with the Canal's use (identified by East Kaweah GSA as an undesirable result). Address how the amount of potential cumulative subsidence allowed for by Greater Kaweah's subsidence rates, which currently exceeds the amount identified by East Kaweah that would cause an undesirable result, are compatible or provide revised rates for the eastern portion of the Subbasin that are compatible.

(ibid., p. 17).

4.1.2.3 Kaweah Subbasin 2022 Groundwater Sustainability Plan Submission

The Kaweah Subbasin was given 180 days to address the deficiencies identified by DWR in its 2020 GSP Determination Letter. The subbasin resubmitted the GSPs on July 27, 2022, for DWR's second evaluation.

Plain-language Definition of an Undesirable Result

The plain-language definition of an undesirable result remained unchanged from the 2020 Coordination Agreement, and is defined as, "Land subsidence may be considered significant and unreasonable if there is a loss of a functionality of a structure or a facility to the point that, due to subsidence, the structure or facility cannot reasonably operate without either significant repair or replacement" (2022 Coordination Agreement, Appendix 6, p. 9).

While the general definition of an undesirable result remained unchanged, the GSAs outlined considerable additions involving impacts to infrastructure within the subbasin. The undesirable results outlined within the 2022 Coordination Agreement include negative impacts to deep well infrastructure (well collapses), and capacity impacts to the Friant-Kern Canal, local flood control channels, and certain main supply channels (ibid., p. 11).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2022 Coordination Agreement outlined a new two-part quantitative definition of subsidence undesirable results to better protect the Friant-Kern Canal. The 2022 Coordination Agreement stated that a separate method for identifying an undesirable result will be used for a one-mile band on either side of the Friant-Kern Canal, where "if any of the MT elevations in that band reach an MT elevation that will be viewed as a

UR" (2022 Coordination Agreement, Appendix 6, p. 11). For all other areas of the subbasin outside of the Friant-Kern Canal band, the definitions of undesirable results remained unchanged from 2020 Plans.

In East Kaweah GSA, subsidence minimum thresholds remained tied to potential capacity loss within the Friant-Kern Canal. Minimum thresholds were set at 9.5 inches as both a maximum annual rate and maximum cumulative amount (2022 EKGSP, p. 3-44). The 9.5-inch minimum threshold was determined based on an estimated associated capacity loss of 10 percent within the Friant-Kern Canal, which was determined to be an undesirable result.

Outside of the Friant-Kern Canal Band, the Plans also establishes a minimum threshold related to collapsing well casings at no more than 9 feet of subsidence. The plans also established the maximum rate of subsidence at 0.67 feet per year. The 2022 Coordination Agreement further established that an undesirable result will occur when one-third of the subbasin RMSs outside the Friant-Kern Canal band decline below their respective MT elevations at the annual fall measurement (2022 Coordination Agreement, Appendix 6, p. 11). All minimum threshold elevations were derived by extrapolating the results of a 1D subsidence model developed at Stanford University to create a spreadsheet prediction tool calibrated by InSAR data. The measurable objective for subsidence was updated to zero feet at RMS sites.

Representative Monitoring Sites and Monitoring Network

The subsidence monitoring network outlined in the 2022 Coordination Agreement remained unchanged from the methods in the 2020 Coordination Agreement. However, both East Kaweah and Mid-Kaweah made proposed updates to their monitoring networks. East Kaweah proposed an additional six monitoring benchmarks along the Friant-Kern Canal, as well as an additional benchmark near the community of Plainview (2022 East Kaweah GSP, p. 4-21). Mid-Kaweah GSA also proposed the addition of 24 survey markers created through Tulare Lake Irrigation District to monitor subsidence along its distribution canals (2022 Mid-Kaweah GSP, p. 4-4).

Infrastructure Mitigation

In 2022, the GSAs outlined a Mitigation Program Framework comprised of the respective GSA's new mitigation plans to address the continued and expected overdraft conditions prior to 2040 and associated subsidence impacts to drinking water wells and other potential infrastructure in the subbasin. The Kaweah Subbasin Mitigation Program Amendment 1.0 created in June 2023 outlined the process for potential mitigation implemented at the GSA level (Kaweah Subbasin Mitigation Program Amendment 1.0, p. 4). Importantly, the Mitigation Program Framework does not require GSAs to include critical infrastructure in their mitigation programs, but indicated that such infrastructure

(i.e., agricultural and industrial wells, canals, bridges, utilities, etc.) could be included on an at-will basis (ibid., p. 9).

Projects and Management Actions

The 2022 Coordination Agreement did not outline Project and Management actions specific to land subsidence or provide any updates. The 2022 GSPs and 2022 Water Year Annual Report provided individual project updates. In general, the projects outlined by the GSAs to address subsidence impacts were through demand reduction, supply augmentation, or improvements to subsidence monitoring networks. Additional Management Actions were outlined in the 2022 GSPs and discussed further in the 2022 Annual Report in response to the third year of dry conditions and growing impacts to wells (Annual Report, WY 2022, p. 4-3). Significant additions included the Mid-Kaweah Emergency Ordinance limiting groundwater extractions and further developing pumping allocations for Greater and East Kaweah GSAs. The 2022 Coordination Agreement also outlined an additional management strategy involving regional canal infrastructure. Since the cost of repairing subsidence impacts to the Friant-Kern Canal and other local canals was deemed too expensive for the subbasin, pumping restrictions to stabilize groundwater levels will be imposed (2022 Coordination Agreement, Appendix 6, p. 12).

4.1.2.4 Proposed State Water Board Deficiencies

DWR's 2022 GSP Inadequate Determination dated March 2, 2023, found that the subsidence deficiency for the Kaweah Subbasin was not corrected in the 2022 GSPs submitted on July 27th, 2022. DWR's 2022 GSP Inadequate Determination states, "Department staff conclude sufficient action has not been taken to address the deficiency associated with subsidence" (2022 GSP Inadequate Determination, p. 15).

Board staff concur with DWR's findings in the 2022 GSP Inadequate Determination and hereby incorporate them by reference. Board staff have also identified additional, related issues. Below, Board staff describe the Kaweah Subbasin subsidence deficiencies, incorporating DWR's inadequate determination as appropriate.

Deficiencies include:

LS-1 and LS-2: Identified by DWR. Additional concerns noted by Board staff.

LS-3: Identified by Board staff.

Deficiency Land Subsidence (LS)-1 - The GSPs do not provide reasonable justification for subsidence SMCs that involves the subbasin's water conveyance infrastructure

What SGMA Requires: The GSP Regulations require a GSA to "describe... the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the

criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users, land uses, and property interests (Cal. Code Regs., tit. 23, § 354.26).

Deficiency: The 2022 Coordination Agreement and East Kaweah GSP indicate that the Friant-Kern Canal and other conveyance structures are critical infrastructure within the subbasin, and that an undesirable result would occur if the capacity of the canals was significantly impacted. DWR noted in its 2022 Inadequate Determination that "…the Plan does not explain how it was determined that approximately 10 inches or greater amount of subsidence would result in a 10% or more capacity loss in the Subbasin's conveyance infrastructure. The GSAs should explicitly describe the analysis that went into establishing the 10% capacity criteria" (2022 GSP Inadequate Determination, p. 15). There is not a clear justification provided by the GSPs that explains why 9.5 inches is correlated to a 10 percent reduction in canal capacity.

Potential Action LS-1a – Clearly define the subsidence conditions that would result in an undesirable result for the basin and provide enough detail that associated MTs can be determined (Cal. Code Regs., tit. 23 § 354.28)

The GSAs should provide greater justification for their SMC selection regarding the Friant-Kern Canal and other conveyance infrastructures within the subbasin. DWR notes "The GSAs should explicitly describe the analysis that went into establishing the 10% capacity criteria" (2022 GSP Inadequate Determination, p. 15). While the subbasin's only critical infrastructure includes the Friant-Kern Canal, it is Board staff's understanding that the 10 percent capacity loss SMC definition applies to multiple identified conveyance structures within the subbasin. DWR's deficiency description indicated that a justification for this SMC should be at the subbasin level. While the GSAs have presented an approach to updating subsidence SMC in response to DWR's 2022 GSP Inadequate Determination, the GSAs should also include justification for the 10 percent capacity SMC that applies to any other identified infrastructure within the subbasin or add clarification to which structures this definition applies.

A Memorandum of Approach document was submitted to the State Water Board in June 2023. This Memorandum outlines specific tasks related to subsidence the GSAs have identified and plan to complete. The Memorandum indicates that the subbasin is planning to complete an additional technical memorandum and GSP revisions justifying the approach used in determining why approximately 10 inches of Subsidence leads to a 10 percent capacity reduction along the Friant-Kern Canal. The GSAs should diligently continue with this effort and coordinate with Board staff on the progress of this activity to incorporate revisions into the updated GSPs. The GSAs should also continue their efforts regarding Subsidence Task 2 outlined in the Memorandum to justify a 10% capacity reduction undesirable result, and if not already included within the scope, should add clarification regarding to which infrastructure the 10 percent capacity reduction applies.

Potential Action LS-1b – Establish an annual subsidence rate MT that is less than the estimated cumulative subsidence amount expected to significantly impact the Friant-Kern Canal

The East Kaweah GSA set minimum threshold parameters for the Friant-Kern Canal buffer zone as both an annual subsidence rate and maximum cumulative amount. Both values are set at 9.5 inches of subsidence, which is estimated to correlate with a 10 percent capacity reduction. While it is important to recognize both measures of subsidence, Board staff find it more reasonable to set a more protective annual rate of subsidence that is less than the estimated maximum cumulative amount the Friant-Kern Canal can experience without causing undesirable results. This would allow for earlier detection of potential subsidence impacts and mitigation opportunities prior to reaching the maximum cumulative amount of subsidence for the Canal, which represents an undesirable result. The current minimum threshold approach does not allow for adaptive management strategies prior to reaching an undesirable result, which is a minimum threshold exceedance at one RMS site within the buffer zone.

Deficiency LS-2 - The GSPs do not adequately define the relationship between groundwater level SMC and potential subsidence impacts

What SGMA Requires: The GSP Regulations require a GSA to describe "The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators" (Cal. Code Regs., tit. 23, § 354.28 (b) (2)). More specific to DWR's determination, the GSP Regulations also require that minimum thresholds for chronic lowering of groundwater levels shall be supported by potential effects on other sustainability indicators" (Cal. Code Regs., tit. 23, § 354.28 (c) (1) (B)).

Deficiency: The DWR 2022 Inadequate Determination notes "knowing that groundwater level minimum thresholds are below historical lows and subsidence will continue to occur, the GSP has not provided an explanation of how undesirable results for subsidence will be avoided" (2022 GSP Inadequate Determination, p. 10). Both Mid-Kaweah and Greater Kaweah GSPs have similar language indicating that Chronic Lowering of Groundwater level SMC allows for additional groundwater level declines while the GSAs implement the GSPs, and that associated additional subsidence is expected to occur. Board staff concur with DWR's assessment that the GSPs do not adequately evaluate the potential impacts of groundwater level SMC on subsidence rates. Board staff found that estimated subsidence amounts at associated groundwater level minimum thresholds and measurable objectives are substantially higher than subsidence minimum threshold values, with up to an estimated 18 feet of subsidence occurring by 2040 in the western portion of the subbasin (Technical Approach for Setting Subsidence SMC, p. 25). Since groundwater level minimum thresholds are set below

historical lows and subsidence is expected to continue, it is unclear how subsidence undesirable results will be mitigated or avoided.

Board staff propose the below Potential Action LS-2 to address the deficiency.

Potential Action LS-2 – Update and establish more protective SMC definitions so water level declines do not cause subsidence undesirable results

DWR notes that "…Department staff believe the GSAs must consider the impacts of water levels so as not to cause undesirable results for subsidence" (2022 GSP Inadequate Determination, p. 10). The GSAs have set a relatively high threshold for when subsidence undesirable results may occur, only when one-third of RMS sites reach their minimum thresholds. This may allow for the protraction or increase in localized subsidence rates in portions of the subbasin outside of the Friant-Kern Canal buffer zone without exceeding the undesirable results definition. DWR further notes that the GSAs could consider completing an analysis that compares collated groundwater water level and subsidence RMS sites to better evaluate localized conditions. Board staff concur with this deficiency note and recommend that further analysis is completed to ensure future localized subsidence is minimized and does not cause undesirable results in the subbasin.

The GSAs have proposed a series of actions to address this deficiency. Subsidence Tasks 3 and 4 of the 2023 Memorandum of Approach describe updated approaches to revising subsidence SMC definitions and coordinating subsidence and groundwater level SMC. The outlined approach in this Memorandum includes a two-step process to establishing more protective subsidence minimum thresholds. The approach proposes that if updated subsidence minimum thresholds are shallower than groundwater level minimum thresholds, then subsidence SMC will control future management. Regardless of the MT groundwater level chosen, Board staff believe these efforts need to ensure that updated water level SMC definitions will not cause subsidence undesirable results.

In conjunction with completing the above analyses and SMC definition updates, the GSAs should also consider establishing more protective SMC definitions that reduce the chance that large-magnitude, localized subsidence could occur without triggering an undesirable result outside of the Friant-Kern Canal buffer zone. Reducing the undesirable result threshold value, currently set at exceedances at one-third of RMS sites, will help ensure that localized subsidence and potential impacts to infrastructure are identified and mitigated sooner. Large variations in groundwater level declines could lead to a higher potential for localized dry well susceptibility and increased mitigation costs.

Deficiency LS-3 – Significant impacts to conveyance infrastructure and undesirable results are expected under projected subsidence rates without mitigation

What SGMA Requires: Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include projects and management actions, summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44).

In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3), (5)).

Deficiency: Critical infrastructure mitigation is not required under the Mitigation Program Framework, and at the same time subsidence models suggest minimum threshold exceedances are expected along water conveyance infrastructure (Technical Approach for Setting Subsidence SMC, p. 33). Specifically, the Technical Approach indicates that there are multiple conveyance structures that will be significantly impacted by expected subsidence rates and states that these structures/extents should be included in the GSA's mitigation plans (ibid., p. 40). It is Board staff's understanding that mitigation for critical infrastructure, including the Friant-Kern Canal and other conveyance structures is not required by the GSA mitigation plans.

Board staff propose the below Potential Actions LS-3 to address the deficiency.

Potential Action LS-3a – Restrict pumping near critical infrastructure and other conveyance structures to avoid undesirable results

Board staff recognize the progress GSAs have made in regard to setting allocation frameworks and emergency pumping restrictions; however, these efforts appear to be general approaches for irrigated lands within each GSA's covered area. Allocation frameworks are essential to meeting groundwater level measurable objectives and avoiding both groundwater level decline and subsidence undesirable results, but more targeted pumping restrictions may be required near water conveyance infrastructure to ensure subsidence undesirable results do not occur. The 2022 Coordination Agreement states that "other management strategies like pumping restrictions to stabilize groundwater levels will be imposed instead" to avoid undesirable results to the Friant-Kern Canal (2022 Coordination Agreement, Appendix 6, p. 12). The 2022 Coordination Agreement also indicates that additional pumping reductions may be necessary to avoid subsidence undesirable results to local conveyance canals. Board staff note that no

specific demand management frameworks were established to avoid undesirable results along water conveyance infrastructure. GSAs should establish detailed demand management programs that clearly identify the duration, volume, and spatial extent of pumping restrictions required to avoid undesirable results for conveyance infrastructure.

Potential Action LS-3b – Revise the mitigation program to include conveyance infrastructure expected to experience significant impacts with clear mitigation triggers and funding sources

Board staff understand that while critical infrastructure and other conveyance infrastructure are mentioned in the current mitigation program, mitigation is optional for the GSAs. Analysis conducted by the GSAs indicates that multiple conveyance structures within the subbasin are expected to experience significant impacts due to differential subsidence. Board staff believe that significant infrastructure damage expected from subsidence should be mitigated and estimates for repair should be completed under the mitigation program. GSAs should also develop mitigation plans to fund and repair conveyance infrastructure if pumping restrictions are not effective. Importantly, funding for conveyance infrastructure should be developed through GSA activities, and State funding should not be relied upon to fix capacity issues within impacted conveyance structures.

4.1.3 Deficiency GWQ – Defining and Avoiding Undesirable Results Related to Degraded Groundwater Quality

Another consideration under SGMA is avoiding “significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies” (Wat. Code, § 10721, subd. (x)(4)). Degradation of water quality can limit local water supplies and beneficial uses, and SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater such as: drinking water uses (Municipal, Public Water system, and Domestic well), agricultural uses, and environmental uses (Wat. Code, § 10723.2). Water quality degradation that significantly and unreasonably affects the supply or suitability of groundwater for use in drinking water systems is an undesirable result. SGMA also requires that each GSP shall develop a sufficient monitoring network (Cal. Code Regs § 354.34).

DWR did not have deficiencies for Degraded Water Quality, and the GSAs revised portions of the groundwater quality sections of their 2022 GSPs. The Kaweah GSAs improved the groundwater quality undesirable result (UR) definitions from their 2020 GSPs by presenting a coordinated and consistent UR definition in their 2022 GSPs and 2022 Coordination Agreement. The minimum threshold (MTs) and measurable objectives (MOs) did not change between the 2020 and 2022 GSPs. Board staff reviewed the 2020 and 2022 GSPs and have concerns regarding the potential impacts

that the groundwater quality SMC, monitoring network, and projects and management actions would have on beneficial uses and users in the subbasin.

4.1.3.1 Kaweah Subbasin 2022 GSPs and Water Year 2022 Annual Report

This subsection and following subsections describe portions of the 2022 GSPs, 2022 Coordination Agreement, and Water Year 2022 Annual Report that are relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The GSPs state that significant and unreasonable undesirable results may occur if 1) groundwater quality is adversely impacted by groundwater pumping and recharge projects and 2) these impacts result in groundwater no longer being generally suitable for agricultural irrigation and/or domestic use (2022 Coordination Agreement, Appendix 6).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

A water quality undesirable result will occur if one-third of all subbasin representative water quality monitoring sites exceed minimum thresholds (MTs) due to GSA management actions and/or projects. The GSAs set MTs according to established drinking water maximum contaminant levels (MCLs) or the agricultural water quality objectives (WQOs), depending on dominant groundwater use (more than 50% of the pumping within a determined area).

The GSPs further specify that a single MT exceedance is not considered an MT exceedance. Instead, GSPs consider MTs exceeded only when average concentrations exceed MTs for 10 years (that is, an MT is exceeded only after the 10-year-running average concentration exceeds the MT):

- EKGSA specified that their water quality MT exceedance is based on 10-year running averages for their constituents at monitoring locations.
- MKGSA updated their 2022 GSP to reflect using 10-year average concentrations of each constituent to compare to MTs in their subsequent annual reports (the 10-year average was not originally included in their SMC section).
- GKGSA's GSP does not discuss using 10-year running averages for their COCs, but the Kaweah Subbasin's WY 2022 Annual Report displays MT exceedances based on constituents' 10-year average for all three GSAs.

GKGSA and MKGSA established MOs at 75% of the MCLs or Agricultural WQOs. EKGSA's measurable objective for groundwater quality is to have no unreasonable

increase in concentration caused by groundwater pumping and recharge efforts. EKGSA states they will take action if a COC concentration 10-year average reaches 80% of the recognized standard.

The Kaweah GSPs and Coordination Agreement include a high-level discussion on potential impacts to beneficial uses and users but do not provide further detail.

Table 4-4. Table of regulatory thresholds and water quality objectives (2022 GSPs: Table 5-3 for MKGSA, Table 5-7 for GKGSA, Table 3-7 for EKGSA)

		MKGSA		GKGSA		EKGSA	
	Constituent (unit)	**MT**	**MO**	**MT**	**MO**	**MT**	**MO**
Drinking water/ municipal (MCL)	As (ug/L)	10	7.5	10	7.5	10	
	NO3 (as N) (mg/L)	10	7.5	10	7.5	10	
	Cr-VI (ug/L)	10	7.5	10	7.5	20	
	DBCP (ug/L)	0.2	0.15	0.2	0.15	0.2	
	1,2,3 -TCP (ug/L)	0.005	0.0038	0.005	0.0038	0.005	
	PCE (ug/L)	5	3.8	5	3.8		
	PCATE (ug/L)	6	4.5	6	4.5	6	
	Na (mg/L)	NA	NA	NA	NA	50	
	Cl (mg/L)	500	375	250	188	500	
	TDS (mg/L)	1000	750	1000	750	1000	
Agricultural (Ag WQO)	As (ug/L)			100	75		
	Na (mg/L)	69	52	69	52	69	
	Cl (mg/L)	106	80	106	80	106	
	TDS (mg/L)	450	338	450	338	1000	
	pH, upper	8.4	7.9				
	pH, lower	6.5	7				
	Conductivity (µs/cm)	700	525				
	Boron (ug/L)	700	525				

Monitoring

The Kaweah GSPs rely on existing local, state, and federal programs for their groundwater quality monitoring. Most of the groundwater quality monitoring wells are public supply wells along with some agricultural wells. Board staff have found significant discrepancies with the number of monitoring wells presented by various GSA documents. The Kaweah Subbasin Coordination Agreement states that the GSAs will utilize a total of 285 wells for monitoring groundwater quality. The Coordination Agreement indicates that there are 240 water quality monitoring wells in the Kaweah Subbasin: 70 in EKGSA, 60 in GKGSA, and 110 in MKGSA (2022 Coordination Agreement, Appendix 2). However, the GSAs' WY 2022 Annual Report indicates that the Kaweah Subbasin has 228 total wells for monitoring groundwater quality: 32 in EKGSA, 80 in GKGSA, and 116 in MKGSA (Annual Report, WY 2022, Tables 5-2 to 5-5). The GSAs do not address the differences in monitoring well counts among their GSPs, Coordination Agreement, and WY 2022 Annual Report.

Multiple maps provided by the GSAs show discrepancies in the number and locations of monitoring wells. The 2022 Coordination Agreement includes a map that depicts groundwater quality representative monitoring sites (RMS), but it only depicts public water system wells and does not include the agricultural wells that are used for monitoring (**Figure 4-1)**. EKGSP's Figure 4-1 and MKGSP's Figure 4-6 show locations of both the public water system and agricultural wells in their water quality monitoring network (EKGSP has the same monitoring network for groundwater levels and quality). GKGSP's Figure 4-5 shows the locations of existing groundwater quality sampling sites for public water supply but does not show locations of agricultural monitoring wells. The GKGSP does not include a table listing all of the water quality monitoring wells with well information (Well ID, well location, well type, aquifer, etc.).

To help address data gaps in the monitoring network, DWR will be constructing new monitoring wells for all three GSAs as part of DWR's Technical Support Services program, and these wells will be used for both groundwater level and quality monitoring.

Projects and Management Actions

The Kaweah GSPs do not have any projects or management actions that directly address degraded groundwater quality.

4.1.3.2 Proposed State Water Board Deficiencies and Potential Actions to Address Deficiencies

As stated previously, DWR did not identify any groundwater quality deficiencies in their inadequate determination for the Kaweah 2022 GSPs. Nevertheless, Board staff have identified their own deficiencies regarding the GSAs' SMC methodology and monitoring network.

Deficiency Groundwater Quality (GWQ)-1 – The 2022 GSPs do not clearly define the conditions that would be considered an undesirable result.

What SGMA Requires: The GSP Regulations require a GSA to "describe...the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users and land uses and property interests (Cal. Code Regs., tit. 23, § 354.26).

Deficiency: The 2022 GSPs and coordination agreement define an undesirable result as when "groundwater quality is adversely impacted by groundwater pumping and recharge projects and these impacts result in groundwater no longer being generally suitable for agricultural irrigation and/or domestic use" (2022 Coordination Agreement, Appendix 6). The GSPs do not clearly describe how the subbasin would determine if SMC exceedances are impacted by groundwater pumping and recharge projects as opposed to other factors. The GSAs and the State Water Board therefore cannot evaluate whether the proposed SMC are adequate or if the broader quantitative definition of an undesirable result would guide day-to-day basin management as appropriate for avoiding plain-language undesirable results.

Moreover, Board staff note that an undesirable result is defined in part by the "groundwater conditions occurring throughout the basin" rather than by conditions caused by groundwater management (Water Code § 10721 subd. (x)). Undesirable result definitions should therefore not require GSAs to demonstrate that the results are caused by their management of the basin. If basin management actions cannot mitigate or eliminate undesirable results, the GSPs should explain why.

Potential Action GWQ-1 – Clearly define the conditions of an undesirable result.

At a minimum, GSPs should clearly explain how they would determine the water quality impacts of:

- **Projects and management actions:** Board staff note that recharge projects could result in the mobilization of shallow constituents into wells. Recharge projects may influence the migration of legacy constituents within the vadose zone (unsaturated zone between the ground surface and the top of the water table) or may change groundwater conditions that may favor the mobilization of constituents not previously in solution.
- **Subsidence:** Subsidence can mobilize constituents as the aquifer matrix or clay layers compact, as oxic groundwater levels decline, or as flooding frequency or severity increase (Galloway, et al., 1999; Haugen, et al., 2021; Smith, et al.,

2018). Much of the Kaweah Subbasin has subsided due to continued and extensive groundwater extractions, so the GSP should consider associated impacts when assessing the relationship between basin management and degraded groundwater quality, allowing continued subsidence, or switching to pumping of the shallow aquifer to avoid subsidence.

- **Continued pumping:** Continued pumping may increase constituent concentrations via declining groundwater levels. Board staff also note that continued pumping in certain areas of the subbasin may cause changes in groundwater flow direction and/or gradients. These changing gradients may allow existing constituents to migrate to new areas.

Deficiency GWQ-2 – Sustainable Management Criteria in the 2022 GSPs are not consistent with GSP Regulations.

What SGMA Requires: The GSP Regulations require GSAs to base their MTs for degradation of water quality on "the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." Also, GSAs must consider "local, state, and federal water quality standards applicable to the basin" in setting MTs (Cal. Code Regs., tit. 23, § 354.28, subd. (c)(4)). In describing MTs, GSPs must describe how MTs "may affect the interests of beneficial uses and users of groundwater or land uses and property interests" (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(4)).

The Basin Setting shall include "groundwater quality issues that may affect the supply and beneficial uses of groundwater" (Cal. Code Regs § 354.16, subd. (d)) and MT shall be based on "concentrations of constituents determined by the Agency to be of concern for the basin…" (Cal. Code Regs § 354.28 subd. (c)(4)). GSPs are not required to address undesirable results that occurred before, and were not corrected by, January 1, 2015.

Deficiency: Board staff note multiple deficiencies concerning water quality SMCs in the 2022 GSPs. The deficiencies are summarized below as GWQ-2a to GWQ-2c.

Deficiency GWQ-2a – The GSPs' definition of an undesirable result would result in delayed identification of significant and unreasonable impacts and therefore delayed basin management.

The GSPs require that average constituent concentrations at one-third of RMS exceed MTs under a 10-year running average before being considered an undesirable result. Board staff note that this method may allow for drinking water supply wells to degrade substantially below drinking water standards before being considered an undesirable result. This may result in delayed management or mitigation of water quality undesirable results.

Potential Action GWQ-2a – The GSPs should revise their undesirable results and MT definitions to avoid delayed identification of significant and unreasonable impacts.

The GSPs should clarify how the criteria defining when undesirable results occur in the Subbasin were established, the rationale behind the approach, and why it is consistent with avoiding the significant and unreasonable effects associated with groundwater pumping and other aspects of the GSAs' implementation of their GSPs. For changes to the GSPs, staff recommend the following:

- The GSPs should discuss the water quality considered suitable for agricultural irrigation and domestic use and how the proposed SMC relate to existing groundwater quality regulatory requirements in the Subbasin (e.g., Irrigated Lands Regulatory Program, Drinking Water Standards, and Central Valley Salinity Alternatives for Long-Term Sustainability).
- The GSPs should revise their UR definition that states that one-third of all subbasin RMS need to exceed MTs due to GSA management actions and/or projects. The one-third criteria should be re-evaluated to protect the water quality of more beneficial uses.
- The GSPs should revise their definitions of the MTs for degraded water quality to account for short-term impacts of degraded water quality on beneficial uses or justify the implementation of a 10-year running average using the best available data and explain how the MT is sufficient to avoid undesirable results.

Deficiency GWQ-2b – The GSPs do not consider all constituents with known exceedances nor justify not setting SMC for constituents with known exceedances.

The 2022 GSPs do not consider all known constituents with regulatory exceedances in the Basin Setting. The Basin Setting should include all groundwater quality issues that may affect the supply and beneficial uses of groundwater (Cal. Code Regs § 354.16, subd. (d)). Nor do the GSPs establish SMC for all known constituents with regulatory exceedances.

Potential Action GWC-2b – The GSPs should use the best available data when defining constituents and set SMC for all constituents in the basin that may impact beneficial uses and users.

GSPs should establish SMC for all known constituents with regulatory exceedances unless they demonstrate that constituent exceedances are not a concern for the basin (Cal. Code Regs § 354.28 subd. (c)(4)). The Board developed the SGMA Groundwater Quality Tool to provide guidance to GSAs in determining which constituents GSPs should consider. The tool uses the Board's GAMA water quality database to identify

constituents with exceedances in three or more basin wells. GSPs should consider these constituents in their Basin Settings and establish associated SMC unless they demonstrate that exceedances are not a concern for the basin. For the Kaweah GSPs, the GSPs should at least consider uranium in their Basin Setting and groundwater quality SMC sections. GSPs should also establish SMC for uranium if appropriate.

Deficiency GWQ-2c – MTs based on agricultural standards are applied to domestic wells and SMC do not consider domestic well users.

The GSAs set MT concentrations at each RMS well based on drinking water quality standards (MCLs) or agricultural water quality objectives (WQOs). The suite of analytes differs between the two groups of RMS wells. The type of water quality standard depends on the majority of the beneficial use in a designated area. The GSPs do not explain how this MT approach protects domestic well users in areas with majority agricultural pumping. This approach allows drinking water wells in agricultural areas to degrade below drinking water standards, particularly for arsenic, nitrate, 1,2,3-TCP, and other constituents with significant human health consequences.

Potential Action GWQ-2c – Revise criteria to categorize RMS and describe potential impacts to all beneficial uses and users.

Water quality SMC for drinking water wells should not be based on agricultural standards. If the GSAs choose to categorize RMS, they should ensure that RMS still protect all beneficial uses and users within the subbasin rather than the majority of groundwater use. The GSPs should therefore incorporate and consider domestic wells users based on known domestic well locations using DWR's OSWCR data. If any drinking water wells are present within an area, or if the designated beneficial use is municipal and domestic supply, then GSAs should categorize the RMS well as drinking water. Additionally, the GSAs should set the radius for the RMS based on known distances or extents of contaminants.

GSAs should consider impacts to all beneficial uses and users within the subbasin, especially domestic users, and describe them consistent with the goals of SGMA.

Deficiency GWQ-3 – Water quality monitoring networks are not consistent with the GSP Regulations

What SGMA Requires: The GSP Regulations require GSPs to include a description of the monitoring network objectives for the basin, including how the GSA will "monitor impacts to the beneficial uses or users of groundwater" (Cal. Code Regs., tit. 23, § 354.34, subd. (b)(2)). The monitoring network must be "capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate [GSP] implementation" (Cal. Code Regs., tit. 23, §

354.34, subd. (a)). Data collected must be of “sufficient quality, frequency, and distribution” to characterize and evaluate groundwater conditions (Cal. Code Regs., tit. 23, § 354.32).

GSAs “may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin”, known as RMSs (Cal. Code Regs., tit. 23, § 354.36). GSAs identify MTs, MOs, and Interim Milestones at these sites. “The designation of [an RMS] shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area” (Cal. Code Regs., tit. 23, § 354.36, subds. (a) & (c)).

Deficiency: Board staff note multiple deficiencies concerning monitoring networks in the 2022 GSPs. The deficiencies are summarized below as GWQ-3a and GWQ-3b.

Deficiency GWQ-3a – Monitoring networks do not clearly monitor impacts to domestic drinking water wells.

The GSPs do not demonstrate that the monitoring networks for water quality allow the GSAs to monitor impacts to domestic drinking water wells. The GSAs primarily use public supply wells to represent drinking water wells. Public supply wells are often deeper than domestic wells and are constructed in a way to avoid groundwater containing constituents of concern. As a result, the water quality readings in public supply wells are likely not representative of conditions in shallow domestic wells.

Potential Action GWQ-3a – Add description of how the existing monitoring networks effectively monitor impacts to shallow well users.

The GSPs should demonstrate how the groundwater quality monitoring networks will be used to monitor impacts to shallow well users; this should include a more robust discussion of how the GSAs will leverage groundwater quality data from other programs (e.g., Irrigated Lands Regulatory Program, CV-SALTS) and the specific data gaps to be filled by new monitoring wells. If further evaluation indicates that groundwater quality at shallow wells is a data gap, the GSAs should develop a plan and timeline for monitoring water quality in the shallow aquifer.

Deficiency GWQ-3b – Discrepancies in monitoring networks and reported data.

Board staff have identified discrepancies in the monitoring network descriptions among several of the GSAs’ documents. Staff are also uncertain about the reported percent of MT exceedances for the subbasin’s water quality RMS as described in the GSAs’ WY 2022 Annual Report.

Board staff have identified discrepancies in the monitoring network descriptions among several of the GSAs’ documents. Staff are also uncertain about the reported percent of MT exceedances for the subbasin’s water quality RMS as described in the GSAs’ WY 2022 Annual Report.

- **Monitoring Network**: As described in the monitoring part of this section, the number of monitoring wells in the Kaweah Subbasin and in each GSA differs among the 2022 Coordination Agreement, the 2020/2022 GSPs, and the WY 2022 Annual Report. The Coordination Agreement's map showing monitoring sites for the entire subbasin only displays public water system wells and does not include agricultural wells. EKGSA has significantly fewer monitoring wells listed in the WY 2022 Annual Report compared to their 2020/2022 GSP, and it is difficult to determine the overlap between the two lists due to a lack of a common well identification or name. GKGSA's GSP does not have any tables or figures that show all the wells used to monitor groundwater quality.
- **Reported Data**: Table 5-2 in the WY 2022 Annual Report displays the counts of MT exceedances, the count of total RMS wells, and the percent of exceedances for each constituent of concern. Staff note that the report records 228 total RMS wells (includes both public water system and agricultural wells) for each constituent, but the water quality summary tables that show the 10-year average constituent concentrations for each RMS may indicate that the total wells sampled may be less than 228 for the constituents, thus affecting the percent of exceedances (Annual Report, WY 2022, Tables 5-3 to 5-5). Using total RMS wells instead of total sampled RMS wells for each constituent results in lower calculated percent of exceedances and misrepresents water quality conditions in the monitoring network.

  For each RMS well, the water quality summary tables either show the 10-year average concentration value or a dash for the nine (EKGSA) or ten (GKGSA and MKGSA) constituents. The GSAs do not provide a key or any clarification on whether the dashes mean a non-detection, a zero value, or if the wells did not test for a specific constituent. Previous annual reports with water quality summary tables (Annual Reports, WY 2020 and 2021) had both dashes and zeros recorded in the tables with no instruction on what the dashes indicated. The WY 2022 Annual Report has significantly more dashes and no zero values recorded in the water quality summary tables.

  If the dashes in the water quality summary tables indicate that RMS wells are not monitoring for a constituent, the count of total wells should be less than 228 and the calculated percent of exceedances should increase. For example, the annual report states that the primary COC in the Kaweah Subbasin is Nitrogen, which has 25 percent of exceedances or 57 MT exceedances for 228 total wells (Annual Report, WY 2022, p. 5-3). However, the total number of RMS wells with 10-year average concentrations and no dashes is 180 wells, which would make the percent of exceedances 32 percent and very close to the one-third undesirable result threshold.

Potential Action GWC-3b – The GSAs should clearly define which wells are RMS monitored for GSP implementation and update tables and figures in their Coordination Agreement, individual GSPs, and annual reports.

Staff recommend the following:

- **Monitoring Network:**
    - The GSAs update Figure A-2-2 in their Coordination Agreement to display all groundwater quality monitoring network wells (both public water system and agricultural).
    - The GSAs coordinate to have consistent well counts for their individual and basin-wide monitoring networks and update the values in their Coordination Agreement, individual GSPs, and annual reports.
    - EKGSA draws a connection between their GSP's table of water quality monitoring wells (Table 4-3) and the EKGSA water quality summary table in the Kaweah Subbasin Annual Report (Table 5-3), preferably by Well ID.
    - GKGSA includes a list of all wells that are being used to evaluate the degradation of groundwater quality within the subbasin and specify the RMS that are being monitored for groundwater quality in their GSP. GKGSA's GSP should also include a map that depicts the RMS locations and type of well to demonstrate sufficient distribution to characterize basin groundwater quality.
- **Reported Data:**
    - The GSAs should be clear on whether or not RMS are monitoring for all constituents. If they are, and RMS wells have non-detections or zero values, they should state that.
    - The GSAs should provide a key or written clarification in annual reports on what the dashes in the water quality summary tables indicate (non-detect, zero value, no monitoring).
    - If RMS wells are not monitoring for all constituents of concern, the GSAs should adjust the count of total wells before calculating percent of MT exceedances.

Deficiency GWQ-4 – Management actions are not responsive to water quality degradation.

What SGMA Requires: Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The GSAs must include projects and management actions

“that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent” (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(1)).

The description must include project management actions, summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44).

In reviewing GSPs, DWR must consider, among other questions, “whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan” (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3)).

Deficiency: Board staff note multiple deficiencies concerning management actions in the 2020/2022 GSPs. The deficiencies are summarized below as GWQ-4a and GWQ-b.

Deficiency GWQ-4a – Additional sampling is not triggered when MTs are exceeded.

The 2020/2022 GSPs do not include management actions that are responsive to MT exceedances. Board staff note that elevated concentrations of arsenic, nitrate, uranium, gross alpha, and other constituents can severely impact human health. It is difficult to understand how GSAs can avoid significant and unreasonable impacts from degradation of groundwater quality if MT exceedances don’t trigger additional monitoring to better characterize risks to beneficial uses and users.

Potential Action GWQ-4a – Plan additional sampling when water quality is degraded.

GSAs should plan to install additional RMS wells where projects and management actions are implemented and should increase sampling frequency when MTs are exceeded. This is especially true for exceedances of MCLs, as elevated concentrations of these thresholds can severely impact human health. MT exceedances should therefore trigger further sampling to better understand the risk to drinking water beneficial uses and users, especially domestic well users. Additional sampling could include more frequent sampling as well as sampling additional nearby wells, completed within the same aquifer, to understand the extent of the increased concentrations and potential impacts to beneficial uses and users.

Deficiency GWQ-4b – Well mitigation plans do not address water quality degradation.

The GSAs are developing mitigation plans to address impacts due to declining groundwater levels and land subsidence. These plans should also mitigate degradation

of water quality. As Board staff note in Deficiency GWQ-3a above, elevated concentrations of some constituents severely impact human health. It may be difficult for GSAs to avoid significant and unreasonable impacts from degradation of groundwater quality without a well mitigation plan that can be reasonably implemented to address water quality degradation. Relatedly, MT exceedances have already been noted in the WY 2022 Annual Report, but GSAs only state an intention to work with local ILRP coalitions as a follow-up.

Deficiency GWQ-4b is addressed by Groundwater Level Potential Action GL-5 above.

4.1.4 Deficiency ISW – Defining and Avoiding Undesirable Results Related to Depletions of Interconnected Surface Water

Another consideration under SGMA is avoiding "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water" (Wat. Code § 10721, subd. (x)(6)). GSP Regulations define interconnected surface water (ISW) as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted" (Cal. Code Regs, tit. 23, § 351, subd. (o)). Depletions of ISW within the basin may have adverse impacts on surface water uses, such as degradation or loss of groundwater dependent ecosystems (GDEs) and reduced downstream surface water flow for beneficial uses and users.

DWR identified depletions of ISW in their 2020 GSP Incomplete Determination as a deficiency; however, DWR did not include this as a deficiency in their 2022 GSP Inadequate Determination. DWR made the following conclusion after their review of the GSPs in 2022:

> "...While not yet fully consistent with the requirements of the GSP Regulations, the Agencies' efforts to address this deficiency are sufficient at this time, although further efforts and revisions will be required in subsequent GSP updates to align the sustainable management criteria for interconnected surface water with the GSP Regulations and Department guidance."
>
> (2022 GSP Inadequate Determination, p. 3).

Table 4-5 – Summary of Department of Water Resources' Interconnected Surface Water Deficiency and Relevant Components of the 2020 and 2022 Kaweah Subbasin Groundwater Sustainability Plans

2020 GSP	DWR's 2020 GSP Incomplete Determination	2022 GSP	DWR's 2022 GSP Inadequate Determination

The GSPs identified locations where ISW is likely present but were not coordinated in their management efforts.	DWR stated that the GSPs do not sufficiently and consistently characterize ISW nor define sustainable management criteria for the depletion of those ISW in the manner required by SGMA and GSP Regulations.	The Greater Kaweah GSP and East Kaweah GSP identified ISW as a data gap and are implementing a work plan to incorporate key data into their 2025 GSP update.	DWR concluded that the groundwater sustainability agencies' efforts are sufficient at this time, although further revisions will be required in subsequent GSP updates.
The Greater Kaweah GSP did not develop sustainable management criteria for ISW even though they identified possible areas with ISW.		The Greater Kaweah GSP and East Kaweah GSP set preliminary sustainable management criteria for depletions of ISW. Currently, the MT is set at 50 percent channel losses in select waterways due to groundwater pumping and the MO is set at 30 percent channel losses in select waterways due to groundwater pumping.	
The East Kaweah GSP used groundwater level thresholds as a proxy for depletions of ISW but did not adequately justify that this is an appropriate proxy.		The East Kaweah GSP is no longer using groundwater level thresholds as a proxy for depletions of ISW.	

Board staff acknowledge the Kaweah Subbasin's efforts to address data gaps related to depletions of ISW and their plans to incorporate changes in the 2025 GSP update. However, the current GSPs do not: 1) adequately consider beneficial uses and users, 2) provide sufficient justification for MTs, and 3) establish a monitoring network to address depletions of ISW.

While other subbasins began implementing plans to avoid depletions of ISW in 2020 that are now approved by DWR (e.g., Paso Robles and Santa Cruz Mid County), the Kaweah Subbasin does not yet have an adequate plan to address depletions of ISW and achieve groundwater sustainability by 2040. To meet this 20-year timeline, the Kaweah GSAs must adequately define, monitor, and assess ISW within the basin in accordance with SGMA statute and DWR Regulations. Failure to reasonably assess ISW may produce undesirable results, likely causing significant and unreasonable impacts to surface water users prior to the 2025 GSP evaluation period.

The following subsections describe the portions of each GSP or DWR determination relevant to the proposed Board deficiencies.

4.1.4.1 Kaweah Subbasin 2020 Groundwater Sustainability Plans

The GSAs submitted GSPs to DWR by January 31st, 2020, in compliance with the deadline established for high-priority and medium-priority basins per SGMA statute.

Identification of Interconnected Surface Water

The 2020 East Kaweah GSP stated that most surface waters within their region are considered losing channels (loss of streamflow to groundwater); however, “some upper reaches of the creeks near the foothills and the Kaweah River upstream of McKays Point are more likely to be relatively neutral to gaining stream reaches during times of year” (2020 EKGSP, p. 2-71). A figure was included that identified possible ISW based on depths to groundwater being 30 feet during Spring of 2015, and an area on Lewis Creek that is known to have a perched aquifer (ibid., p. 2-73).

The 2020 Greater Kaweah GSP stated that “groundwater levels throughout the majority of the Kaweah Subbasin do not appear to support Interconnected Surface Waters or Groundwater Dependent Ecosystems” and assumed that an unsaturated zone exists between surface water and groundwater within the Greater Kaweah GSA boundary based on depths to groundwater being greater than 30 feet in 2014 (2020 GKGSP, p. 2-2). The 2020 Greater Kaweah GSP did not identify possible ISW; however, Appendix 1 of the 2020 Coordination Agreement and the 2020 East Kaweah GSP indicated that streams in the eastern portion of the subbasin may be interconnected (2020 Coordination Agreement, Appendix 1, p. 145; 2020 EKGSP, p 2-71). The 2020 Coordination Agreement stated that “Streams located in the eastern portion of the Subbasin, generally between the Friant Kern Canal eastward to McKay Point...are more likely to be relatively neutral to gaining stream reaches during limited times of the year” (2020 Coordination Agreement, Appendix 1, p. 145). Since the Greater Kaweah GSA’s boundary extends into the eastern portion of the subbasin, the GSA should have indicated the possibility of ISW existing particularly in the upper reaches of the Kaweah River.

The 2020 Mid-Kaweah GSP did not identify ISW within the Mid-Kaweah GSA boundary, stating: “The MKGSA jurisdictional area is located on the valley floor portion of the Subbasin, many miles west of the aquifer forebay area along the Sierra foothills. As such, all reaches of the Kaweah River, slough channels, and distributaries, both natural and man-made, have been disconnected from the underlying water table for many decades and current depth to groundwater in the upper principal aquifer is 60 to 220 feet bgs in the MKGSA…For this reason, there are no interconnected surface waters in the MKGSA management area and such interconnection is not likely to occur in the future” (2020 MKGSP, p. 5-16).

Plain-language Definition of an Undesirable Result

The 2020 East Kaweah GSP used groundwater level measurements as a proxy measurement for depletions of ISW and did not provide a clear plain-language definition of an undesirable result.

The 2020 Greater Kaweah GSP did not define undesirable results for depletions of ISW, stating that “[n]o interconnected surface waters have been identified in any Kaweah Subbasin GSAs as described more thoroughly in the basin setting. Thus, criteria were not established” (2020 GKGSP, p. 3-10).

Even though the 2020 Mid-Kaweah GSP did not identify ISW within the GSA’s boundary, a plain-language definition of an undesirable result for depletions of ISW was provided. The 2020 Mid-Kaweah GSP stated “Depletions of interconnected surface waters are minimal and, to the extent they occur, impact only vegetation along the banks of unlined channels within the forebay regions of the aquifer system where natural channels exhibit gaining reaches from time to time. Undesirable results may occur should any such groundwater dependent vegetation disappear from locations of known historic existence or if depletions negatively impact deliveries of surface water to downstream rights holders” (2020 MKGSP, p. 3-4).

Quantitative Definition of an Undesirable Result, Minimum Thresholds, Measurable Objectives, and Associated Impacts

The 2020 East Kaweah GSP described an undesirable result as occurring “when one-third of the representative monitoring sites in all three GSA jurisdictions exceed their respective minimum threshold water level elevations” (2020 EKGSP, p. 3-17). Minimum thresholds were established for each threshold region “…based on historic rate of decline and enough operational flexibility to maintain delivery during a 10-yr drought”; minimum thresholds were summarized in Table 3-2 of the GSP (ibid., p. 3-21 - 3-22).

The 2020 Greater Kaweah and Mid-Kaweah GSPs did not identify ISW within their GSA boundaries; therefore, they did not establish SMC for depletions of ISW.

Representative Monitoring Sites and Monitoring Network

The 2020 East Kaweah GSP proposed to monitor depletions of ISW by using the monitoring network developed for groundwater levels as a proxy. The GSP did not have a network to specifically monitor groundwater-surface water interconnections and relied on groundwater contours and local knowledge to identify possible ISW (ibid., p. 4-22).

The 2020 Greater Kaweah GSP proposed to implement groundwater level monitoring in the upper reaches of the Kaweah River and St. Johns River to evaluate if conditions are changing in areas with potential GDEs and a depth to groundwater less than 50 feet (2020 GKGSP, p. 4-18).

The 2020 Mid-Kaweah GSP did not establish a monitoring network for depletion of ISW since ISW was not identified within the GSA boundary (2020 MKGSP, p. 4-14).

Projects and Management Actions

Projects included in the 2020 East Kaweah GSP that pertain to depletions of ISW include the following: Lewis Creek Recharge Project, Cottonwood Creek Recharge Project, Yokohl Creek Recharge Project, and the Rancho de Kaweah Water Management & Banking Project. The goals of these projects are primarily to stabilize groundwater levels and increase groundwater storage, but secondary benefits may include minimizing depletions of ISW (2020 EKGSP, pp. 5-3 to 5-17).

Projects and management actions included in the 2020 Greater Kaweah and Mid-Kaweah GSPs were not developed specifically to address depletions of ISW.

4.1.4.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In DWR's 2020 GSP Incomplete Determination dated January 28, 2022, DWR staff identified a deficiency for depletion of ISW:

> Deficiency 3 - The Plan does not consistently identify interconnected surface water systems, or the quantity and timing of depletion of those systems due to groundwater use. The Plan does not consistently define sustainable management criteria for depletion of interconnected surface water in the manner required by the GSP Regulations.
>
> (2020 GSP Incomplete Determination, p. 17).

DWR staff further noted that:

1. While the Plan identifies locations where interconnected surface water is likely present in the Subbasin, it is not coordinated in its management efforts for the depletion of interconnected surface water.

2. The Greater Kaweah GSP documents areas with likely interconnected surface water, as does the Coordination Agreement, but the Greater Kaweah GSA has not developed sustainable management criteria for interconnected surface water.

3. The East Kaweah GSP elected to use groundwater level thresholds as a proxy for the depletion of interconnected surface water, but do not demonstrate adequate evidence showing those levels are an appropriate proxy.

   (2020 GSP Incomplete Determination - Statement of Findings, p. 3).

Department of Water Resources' 2020 Groundwater Sustainability Plan Corrective Actions

To address this deficiency, DWR staff recommended that the Greater Kaweah GSP define SMC for depletions of ISW since the presence of ISW was identified in the GSA boundary or, alternatively, identify depletions of ISW as a data gap and provide a plan to close the data gap. DWR staff also recommended that the East Kaweah GSP demonstrate that using groundwater level thresholds is a reasonable proxy for addressing depletions of ISW or, alternatively, identify depletions of ISW as a data gap and provide a plan to close the data gap. DWR staff specified that the plan to address this data gap must include how the GSAs will:

1. Acquire or develop data and tools to identify interconnected surface water reaches, and the quantity and timing of the depletion of interconnected surface water due to groundwater use for interconnected surface water systems identified in the Plan.

2. Develop sustainable management criteria based on the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses and users of surface water.

   (2020 GSP Incomplete Determination, p. 21 - 22).

4.1.4.4 Kaweah Subbasin 2022 Groundwater Sustainability Plan Submission

The GSAs submitted revised GSPs to DWR on July 27th, 2022, in compliance with the 180-day resubmittal deadline.

Identification of Interconnected Surface Water

The 2022 East Kaweah GSP did not contain any revisions pertaining to the identification of potential ISW.

The 2022 Greater Kaweah GSP indicates that the presence of ISW is not well understood within the GSA boundary and the GSA will be implementing a work plan to identify the presence of ISW (2022 GKGSP, p. 5-42). In addition, the GSP includes a figure that highlights areas where groundwater was within 30 feet of the surface in 2015 and 2017; these areas will be further evaluated to identify possible ISW via the work plan (2022 GKGSP, p. 5-44).

The 2022 Mid-Kaweah GSP did not contain any revisions pertaining to the identification of potential ISW. The GSP continues to indicate that ISW does not exist within the GSA boundary.

Plain-language Definition of an Undesirable Result

The 2022 East Kaweah and Greater Kaweah GSPs identify depletions of ISW as a data gap. The GSAs plan to gather additional information and update the definition of an undesirable result for depletions of ISW in their 2025 GSP update. The 2022 Coordination Agreement states:

> At the current time (July 2022), the primary criteria and metric for defining and quantifying adverse impacts and undesirable results will be the estimated percentage of losses within potentially interconnected channels, measured as a rate of volume of depletion of surface water, until the work plan provides more information. Currently, there is not sufficient data to definitively set rate of depletions on other data. Increased channel losses reduce the amount of surface water that can be delivered throughout the Kaweah Subbasin. Delivery of surface water is a critically important part of sustainably managing the Kaweah Subbasin, thus impacts that reduce the ability to deliver surface water can become significant and unreasonable and ultimately lead to an undesirable result.

(2022 Coordination Agreement, Appendix 6, p. 17).

Additionally, the 2022 East Kaweah and Greater Kaweah GSPs describe potential effects of depletions of ISW as:

- Increased losses in interconnected surface waterways used for surface water conveyance, reducing water supply reliability and volumes.
- Negatively and significantly impacting the health of riparian and/or groundwater dependent ecosystems.
- Violating laws and doctrines governing California's surface water rights.

(ibid., p. 18).

The 2022 Mid-Kaweah GSP removes the plain language definition of an undesirable result for depletions of ISW that was previously included in the 2020 GSP. Mid-Kaweah

demonstrates that ISW is not present within their region, and for this reason, does not need to develop SMC for depletions of ISW (2022 MKGSP, p. 5-54).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2022 East Kaweah and Greater Kaweah GSPs do not have sufficient data to definitively establish SMC, but they anticipate that their collection of additional data and development of an analysis tool will provide necessary information to refine the SMC by the next GSP update in 2025. Currently, the preliminary MT is set at 50 percent channel losses in select waterways due to groundwater pumping and the preliminary MO is set at 30 percent channel losses in select waterways due to groundwater pumping (2022 Coordination Agreement, Appendix 6, p. 17).

Both GSPs established preliminary flow rates for selected waterways that would lead to an undesirable result based on 50 percent channel loss (MT) and 30 percent channel loss (MO). The East Kaweah GSP summarizes the estimated rates for potentially interconnected portions of surface waterways, which includes the Kaweah River, Antelope Creek, Yokohl Creek, Cottonwood Creek, Lewis Creek and Frazier Creek (2022 EKGSP, p. 3-36). The Greater Kaweah GSP summarizes the estimated rates for potentially interconnected portions of surface waterways, which includes the Kaweah River, Dry Creek, Lower Kaweah River, St. Johns River, and Yokohl Creek (2022 GKGSP, p. 5-47).

The 2022 East Kaweah GSP describes associated impacts of the preliminary MT as the following: “[f]ifty percent channel loss negatively impacts surface water users and water rights holders’ ability to receive and beneficially use critical and limited surface water supplies in the Kaweah Subbasin. Riparian/groundwater dependent ecosystem health may also be impacted at 50% channel loss” (2022 EKGSP, p. 3-34). The 2022 Greater Kaweah GSP describes associated impacts of the preliminary MT as the following: “[b]ased on the local experience, typical losses in these channels have varied annually and seasonally but have been on the order of 30% of the flows in the channels. In dry periods these losses have increased. Losing half or more of the surface water supply may be considered significant and unreasonable given the importance of surface water supplies in the Kaweah Subbasin. Thus, the GKGSA has set starting MT for interconnected surface waters based on estimated 50% loss of the respective waterway’s flow, data permitting” (2022 GKGSP, pp. 5-45 to 5-46).

Representative Monitoring Sites and Monitoring Network

The East Kaweah and Greater Kaweah GSAs revised their 2022 GSPs to include ISW monitoring as a data gap and therefore did not establish a comprehensive monitoring network. The GSAs plan to fill these data gaps through implementing an ISW Data Gap Work Plan. The GSAs plan to identify new monitoring locations (by utilizing existing

wells or installing new wells) to better understand groundwater interactions with surface water (2022 EKGSP, p. 4-22; 2022 GKGSP, pp. 4-17 to 4-18).

Projects and Management Actions

The East Kaweah and Greater Kaweah GSAs updated the management actions in their 2022 GSPs to include an ISW Data Gap Work Plan. The purpose of this work plan is to obtain more information and better understand the presence of ISW within their boundaries, evaluate impacts caused by groundwater extractions, and refine the SMCs currently established for depletions of ISW. The work plan consists of the following four phases:

1. Fill data gaps and conduct further research (October 2022 – June 2024)
2. Develop an analytical tool (March 2023 – December 2023)
3. Determine and analyze ISW (January 2024 – July 2024)
4. Refine SMC and incorporate updates into the 2025 GSPs (July 2024 – January 2025)

Phase 1 includes gathering additional data and research pertaining to:

- Groundwater levels
- Pumping well locations, its beneficial uses, and estimated quantity
- Stream flow and/or estimated hydrology
- Presence of riparian habitat and/or GDEs
- Soils/geological considerations
- Influence of the mountain front recharge

Phase 2 consists of developing an analytical tool that will quantify surface water depletions with respect to groundwater extractions. Currently, the GSAs do not have a tool selected to perform this analysis.

Phase 3 consists of evaluating the information gathered from phase 1 and utilizing the analytical tool developed in phase 2 to estimate the impacts groundwater extraction has on surface water depletion. During this phase the GSAs aim to refine the SMC for depletions of ISW within their boundaries.

Phase 4 includes incorporating the refined SMC for depletions of ISW into their 2025 GSP updates.

(EKGSP, pp. 5-5 to 5-56; GKGSP, pp. 7-91 to 7-97).

4.1.4.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSP's actions to address depletions of ISW are sufficient at this time in light of future DWR guidance. However, the plans do not fully comply with the GSP Regulations and improvements should be made to avoid undesirable results. DWR states that "The Department will continue to support GSAs in this regard by providing, as appropriate, financial and technical assistance to GSAs, including the development of guidance describing appropriate methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water caused by groundwater extractions" (2022 GSP Inadequate Determination, p. 20).

Board staff find it necessary to include depletions of ISW as a deficiency due to SGMA's timeline for achieving sustainability by the year 2040, where significant progress should be achieved by the 2025 evaluation period. The GSPs have plans for closing data gaps related to depletions of ISW; however, these plans describe actions in generalities and lists future tasks that the GSAs still need to resolve. Board staff appreciate the GSAs' efforts to address this data gap and acknowledge that guidance for addressing depletions of ISW is still being developed by DWR; however, if the GSAs' plans fail to sufficiently manage depletions of ISW by the 2025 evaluation period, then undesirable results may continue or worsen in the subbasin.

Board staff recommend that the GSAs refer to guidance provided by DWR, when available, and continue implementing their work plan to better understand groundwater and surface water interactions and establish sufficient SMCs. Below are further deficiencies and potential actions for the subbasin related to depletions of ISW. Some potential actions may be duplicative to actions the GSAs are planning to implement; however, Board staff list these actions to ensure the GSAs make progress to minimize the risk of undesirable results occurring in the subbasin.

Deficiency Interconnected Surface Water (ISW)-1 – The GSPs, in setting SMC for depletions of ISW, did not adequately describe the impacts of those criteria on beneficial uses and users.

What SGMA Requires: GSP Regulations require GSPs to describe "the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users, land uses, and property interests (Cal. Code Regs., tit. 23 § 354.26). Additionally, the GSPs must set their MTs for depletions of ISW at "the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" (Cal. Code Regs., tit. 23 § 354.28, subd. (c)(6)). In describing MTs, GSPs must describe how MTs

"may affect the interests of beneficial uses and users of groundwater or land uses and property interests" (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(4)).

Deficiency: The 2022 East Kaweah and Greater Kaweah GSPs identify beneficial uses and users related to ISW to be surface water users, riparian and/or groundwater dependent ecosystems, and water rights holders. The GSPs describe potential effects of depletions of ISW as increased losses in interconnected surface waterways used for surface water conveyance, reducing water supply reliability and volumes, negatively and significantly impacting the health of riparian and/or groundwater dependent ecosystems, and violating laws and doctrines governing California's surface water rights. Additionally, the GSPs state that "[d]elivery of surface water is a critically important part of sustainably managing the Kaweah Subbasin, thus impacts that reduce the ability to deliver surface water can become significant and unreasonable and ultimately lead to an undesirable result" (2022 Coordination Agreement, Appendix 6, pp. 17-18).

The East Kaweah and Greater Kaweah GSPs did not adequately describe the potential effects on beneficial uses and users of groundwater and surface water that may result from depletions of ISW, particularly for environmental users within the subbasin. Without a clear understanding of the potential effects on beneficial uses and users and a clear definition of what is considered "significant and unreasonable," it is difficult for GSAs and Board staff to evaluate whether the MTs are appropriate for avoiding undesirable results.

Potential Action ISW-1 - Consider all beneficial uses and users when setting SMC for depletions of ISW and specifically describe the impacts of those criteria on beneficial uses and users.

Board staff identified the following surface water beneficial uses in the subbasin per the Central Valley Regional Water Quality Control Board's Water Quality Control Plan for the Tulare Lake Basin: municipal and domestic supply, agricultural supply, industrial service/processes supply, water contact recreation, warm freshwater habitat, wildlife habitat, and groundwater recharge (Central Valley Regional Water Quality Control Board, 2018).The GSAs must ensure that all beneficial uses of surface water are considered when establishing SMC for depletions of ISW. The GSAs can refer to these surface water beneficial uses as a starting point to identify the assigned beneficial uses for streams within the Kaweah Subbasin.

Board staff also identified vegetation within the subbasin that is commonly associated with shallow groundwater levels near the surface, called phreatophytes, using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). The most abundant phreatophytes within the Kaweah Subbasin includes *Quercus lobata (*Valley Oak), *Salix gooddingii* (Goodding's Willow), and *Populus fremontii*

(Fremont Cottonwood) (California Department of Water Resources, 2023). The GSAs can refer to the NC dataset as a starting point to identify phreatophytes and wetlands, especially near potential ISW, within the subbasin and determine what conditions cause negative impacts on these species and describe how depletions of groundwater and surface water may affect their habitat. The GSAs should also identify threatened and endangered species that are considered environmental users of groundwater and/or surface water and update their description of how depletions of ISW would affect these species. The GSAs may refer to the Critical Species LookBook to identify threatened and endangered species within their subbasin that are likely impacted by groundwater management (Rohde, et al., 2019).

Additionally, the definition of an undesirable result should be specific enough that GSAs and others can evaluate, over time, whether any quantitative definition of an undesirable result accurately represents the conditions the GSAs are trying to avoid. The GSAs should consider their analysis on beneficial uses and users and provide a qualitative and quantitative description of what would be considered “significant and unreasonable.” It is important to provide a clear description of these conditions with enough detail of potential adverse impacts on identified beneficial uses and users so that the GSAs and Board staff can evaluate whether basin management efforts are appropriate for avoiding undesirable results.

Deficiency ISW-2 – The GSPs did not establish MTs for depletions of ISW that are consistent with GSP Regulations.

What SGMA Requires: The GSP Regulations require GSAs to describe “the information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting” (Cal. Code Regs., tit. 23 § 354.28(b)(1)). Also, MTs established for depletions of ISW must be supported by "(A) The location, quantity, and timing of depletions of interconnected surface water" and "(B) A description of the groundwater and surface water model used to quantify surface water depletion" (Cal. Code Regs., tit. 23 § 354.28(c)(6)).

Deficiency: The 2022 East Kaweah and Greater Kaweah GSPs establish MTs for depletions of ISW at 50 percent channel loss in their respective waterway’s flows due to groundwater pumping. This threshold is solely based on limited local experience, and the GSPs state that the extent of channel losses caused by groundwater pumping is not understood (2022 EKGSP, p. 3-34; 2022 GKGSP, p. 5-45).

The MTs established by the GSPs are not supported with best available information, best available science, or a model that quantifies surface water depletion. Impacts of losing half of surface water flow due to groundwater pumping are not thoroughly assessed in the GSPs. Surface water depletion can have devastating impacts on

ecological functions, water supply, and water quality. For example, depletion of surface water can cause pollutant concentrations to increase as surface water flows decrease which can negatively impact aquatic species and vegetation. The USGS Circular 1461 evaluated impacts that flow modifications (such as low-flow magnitude and frequency) have on streams and rivers and found that "[i]n most regions, the health of streams and rivers is increasingly impaired where flows are more severely modified" (Carlisle, et al., 2019, p. 49).

Surface water depletion can be caused by a variety of other factors in addition to groundwater pumping, such as changes in precipitation, land use, and water management. The GSAs should consider other factors that can impact surface water flows when establishing MTs for depletions of ISW. Failure to consider other factors can result in threshold values that allow for substantial losses of surface water flows which can cause significant and unreasonable effects prior to reaching the established MT.

Potential Action ISW-2 – Establish MTs for depletions of ISW that are consistent with GSP regulations.

The GSAs should reevaluate the MTs and provide information to justify that the established threshold is set at an appropriate level. According to DWR's Draft Sustainable Management Criteria BMPs, the GSAs can conduct preliminary activities such as 1) understand the basin setting, 2) inventory existing monitoring programs, and 3) engage interested parties within the basin (California Department of Water Resources, 2017, p. 3). These preliminary activities will help the GSAs better understand the subbasin conditions prior to establishing MTs. Additionally, the GSAs should use a model to quantify surface water depletion to support their MTs. Approaches for monitoring and understanding streamflow depletion by wells is discussed in the USGS Circular 1376. These approaches include field techniques, analytical modeling, and numerical modeling (Barlow & Leake, 2012, pp. 50-72). The GSAs can refer to this guidance as a starting point to better understand groundwater and surface water interaction within their subbasin and update the MTs accordingly.

Deficiency ISW-3 – The GSPs did not establish a monitoring network designed to address depletions of ISW.

What SGMA Requires: The GSP Regulations require GSAs to implement a monitoring network for depletions of ISW that is designed to monitor surface water and groundwater, characterize the spatial and temporal exchanges between surface water and groundwater, and calibrate and apply tools and methods necessary to calculate depletions of surface water caused by groundwater extractions (Cal. Code Regs., tit. 23 § 354.34(c)(6)).

Deficiency: The 2022 East Kaweah GSP does not have a monitoring network to monitor groundwater and surface water interactions. Current knowledge is based on

groundwater contours from groundwater level monitoring data from Spring 2015 and local insights. The 2022 Greater Kaweah also does not have a monitoring network in place to monitor groundwater and surface water interactions. Both GSAs plan to establish a monitoring network for depletions of ISW by June of 2024, but there is a lack of detail on monitoring site locations and monitoring frequency.

At this time, groundwater elevation and streamflow data are lacking in the East Kaweah and Greater Kaweah GSPs. Without a sufficient monitoring network, it is not possible to accurately identify ISW, establish SMC, and evaluate progress towards achieving sustainable groundwater management within the subbasin.

Potential Action ISW-3 – Create a monitoring network within the Kaweah Subbasin for depletions of ISW that is consistent with GSP Regulations.

Board staff recommend creating a dedicated ISW monitoring network by identifying or constructing shallow wells within a reasonable distance from surface waters and associated surface water monitoring sites. The GSAs can utilize their existing groundwater level monitoring network as much as possible but will likely need to construct additional monitoring wells to characterize groundwater levels near streams. According to DWR's Monitoring Network BMPs, the "[n]etwork should extend perpendicular and parallel to stream flow to provide adequate characterization to constrain model development" (California Department of Water Resources, 2016, p. 21). Additionally, the GSAs may need to construct stream gauges to obtain better streamflow monitoring data. The addition of shallow screened wells and stream gauges will better characterize the spatial and temporal exchanges between surface water and groundwater.

4.2 Exclusions from Probationary Status

The State Water Board must exclude from probation any portions of the basin for which a GSA demonstrates compliance with the sustainability goal (Wat. Code, § 10735.2, subd. (e)). Staff believe no GSAs in the subbasin have demonstrated compliance with the sustainability goal. The three GSAs have adopted and are implementing three developed GSPs, which DWR has determined to be inadequate. Staff recommends the State Water Board not exclude any portions of the subbasin from the probationary designation.

4.3 Modification to Water Year and Reporting Dates

Staff do not recommend the State Water Board modify the water year for reporting extractions, but staff do recommend modifying the extraction reporting deadline for groundwater extraction reports required pursuant to Water Code section 5202.

4.3.1 Proposed Change

For basins designated probationary, SGMA requires groundwater extraction data for the preceding water year be submitted to the State Water Board by February 1 of each year (Wat. Code § 5202, subd. (b)). Board staff recommend modifying the extraction reporting deadline for reporters in the Kaweah Subbasin to December 1 of each year. Staff do not recommend any modifications to the water year.

4.3.2 Justification

As stated in section 4.0 above, the overall goal of a probationary designation is to gather information to help local GSAs address deficiencies in their plans so they can sustainably manage their groundwater resources as soon as possible without outside help.

Requiring extraction reports be submitted to the State Water Board by December 1 of each year rather than February 1 will make extraction data available to staff, and GSAs if requested, two months sooner compared to relying on the default reporting date. Obtaining these data sooner means that staff and GSAs will fill data gaps sooner, potentially enabling GSAs to better address plan deficiencies and forestalling the need for the Board to develop and implement an interim plan. If GSAs do not address plan deficiencies, the earlier reporting deadline will give staff additional time to evaluate extraction reporting information when evaluating the need to develop an interim plan.

Groundwater pumpers subject to reporting in a probationary basin must begin measuring and recording extractions 90 days after the probationary designation (Wat. Code, § 5202). If the State Water Board designates the subbasin probationary on November 5, 2024, pumpers would start recording extractions on February 3, 2025.

4.4 Requirements for Installation and Use of Measuring Devices

As part of a probationary designation, the State Water Board may require groundwater extraction reporters to install and use measuring devices, such as flow meters, for measuring their groundwater extractions (Wat. Code § 10735.2, subd. (c)(3)).

4.4.1 Proposed Requirement

Board staff recommend the Board:

- Require any person extracting more than two AFY and any person extracting water for anything other than domestic purposes to report their groundwater extractions.

- Require people extracting more than 200 AFY to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the basin.
- Require people extracting groundwater from the wells located in the Friant-Kern Canal subsidence SMC band to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the basin.
- Exclude people who extract two AF or less per year for domestic uses only (de minimis extractors) from reporting requirements.

These recommendations are specific to the water use and landownership patterns of the Kaweah Subbasin, as described below in Section 4.4.1.3.

4.4.1.1 Importance of Measuring Groundwater Extractions with Meters

Despite the importance of monitoring water for management purposes, most agricultural water use worldwide—both from groundwater and surface water—remains unmetered (Organization for Economic Co-operation and Development, 2015). In the United States, only 36% of groundwater irrigation wells are equipped with flow meters (U.S. Department of Agriculture, 2019), with large monitoring gaps in states such as California that have experienced severe aquifer depletion over recent decades (Scanlon, et al., 2012; Liu, et al., 2022). Many western states affected by long-term overdraft and severe drought conditions have begun requiring meters on groundwater extractions to fill these data gaps (e.g., Idaho Code § 42-701; Idaho Eastern Snake Plain Aquifer measurement order; Oregon ORS 540.435; Oregon ORS 537.780; Washington RCW 90.44.450; Arizona § 45-604 Water measuring devices, Montana Rule 36.12.1211, New Mexico statewide groundwater measurement specifications, Colorado well metering, Wyoming meter selection specification, Nevada NRS 534.180 and NRS 534.193).

The sustainable management of groundwater conditions under SGMA will be difficult without measuring groundwater extractions by the subbasin's groundwater users. Estimating the volume of groundwater extractions using indirect methods can provide valuable information such as total water use. However, these methods have drawbacks. For example, satellite measurements of evapotranspiration (ET) cannot be used to estimate groundwater extractions for sectors that do not apply groundwater for irrigation purposes (e.g., dairy operations, groundwater exports, commercial uses, and oil and gas injection). Estimates of groundwater extractions using crop water demand can vary due to climatic conditions, such as rainfall or temperature, and involves determining and monitoring agricultural practices, which can be a challenge (Meza-Gastelum, et al., 2022).

The most appropriate and robust method for collecting groundwater use data is the measurement of groundwater extractions by metering devices. Requiring well owners to

install meters and report groundwater extractions will help improve analysis of groundwater conditions and lead to more effective management of groundwater in the subbasin. Board staff recommend that the Board 1) require groundwater extractors who extract over 200 AFY of groundwater to install meters, 2) require groundwater extractors who extract groundwater in the Friant-Kern Canal subsidence SMC band to install meters, and 3) encourage other extractors using less than 200 AFY of groundwater to install meters voluntarily to improve the accuracy of pumping measurements in the subbasin.

4.4.1.2 Existing GSA Requirements for Metering in the Subbasin

Presently, none of the three GSAs in the subbasin have a measuring device requirement according to the Plans and Annual Reports.

4.4.1.3 Rationale for Proposed Meter Requirement

Accurate measurement of groundwater extraction with meters will fill key data gaps that limit our understanding of overdraft conditions and effects on all beneficial uses in the subbasin. In order to evaluate potential thresholds for requiring meters, Board staff used OpenET[17] to estimate how much water is used by groups of landowners (grouped by water use) in the subbasin. While using ET data alone has limitations mentioned above, this was the best proxy for groundwater use in the subbasin that staff could use to evaluate potential thresholds. Staff evaluated OpenET data for water year 2022 (October 2021-September 2022) for the subbasin to evaluate water use. At this time, surface water accounted for 14% of total water use which included mainly State Water Project allocations and Kaweah River surface water diversions (Annual Report, WY 2022). The remaining 86% of consumed water was supplied by groundwater (ibid.).

Board staff summarized OpenET data for each non-residential parcel and consolidated the water use for all parcels owned by each parcel owner. Water users of more than 200 AFY of water as measured by OpenET:

- Are 1127 parcel owners (or 30.4% of 3,704 owners of non-residential parcels in the subbasin).
- Own 83.5% of lands in the subbasin.
- Use 85.4% of water in the subbasin.

[17] OpenET provides satellite-based estimates of the total amount of water that is transferred from the land surface to the atmosphere through the process of evapotranspiration [OpenET website].

Staff find that the proposed requirement that all groundwater extractors of more than 200 AFY install meters will provide accurate extraction information for a large percentage of groundwater use in the basin while only impacting a small percentage of all groundwater extractors. If, after collecting reports, staff find that meters are needed for well owners extracting less than 200 AFY in order to evaluate basin conditions and potentially implement an interim plan, staff may adjust meter requirements for groundwater extractors in the subbasin via subsequent State Water Board action.

5.0 Additional Considerations

This section describes how the state intervention process is CEQA exempt and details the State Water Board's obligations to consider the Human Right to Water and the Public Trust Doctrine.

5.1 The California Environmental Quality Act

Pursuant to Water Code section 10736.2, the California Environmental Quality Act (Division 13 [commencing with Section 21000] of the Public Resources Code) does not apply to the State Water Board's designation of a basin as probationary under SGMA.

5.2 Human Right to Water

Assembly Bill 685 (2012) made California the first state in the nation to legislate the Human Right to Water. Section 106.3 of the Water Code states that "every human being has the right to safe, clean, affordable, and accessible water for human consumption, cooking, and sanitary purposes." The State Water Board holds the Human Right to Water as a top priority and core value and Senate Bill 200 tasks them with administration of the Safe and Affordable Drinking Water Fund.

5.2.1 Human Right to Water in the Subbasin

Access in the subbasin to safe, clean, and affordable water to human consumption would be enhanced by addressing the recommended deficiencies related to lowering groundwater levels (Section 4.1.1) and groundwater quality degradation (Section 4.1.3). According to the DWR's My Dry Wells tool (as of January 2024), 792 household wells have been reported as dry since 2014, 678 of those reported dry since 2015. 144 wells were reported dry in 2022, 34 in 2023, and thus far in 2024 there have been no household wells reported dry in the Subbasin There are twelve reported State Small Water Systems within the subbasin (California State Water Resources Control Board, 2023a). Wells going dry within the subbasin due to a lack of local management pose a significant threat to human health and safety. Even when hauled water is available extreme conservation is usually required, and sanitary conditions can continue to

degrade. Homes without an adequate supply of water are not habitable (Civ. Code § 1941.1). According to the State Water Board analysis, six of these systems are considered At-Risk (Colonial Motel, Ezell WS #2, Gonzales WC, Paradise Colony Co-op WS, Story WS, and Walker-Mangiaracina WS), and the remaining six are Potentially-At-Risk (Christians In Action, Hall & Burnett WC, Hillside Trailer Park, Hwy 99 & Caldwell WC, Self Made Real Caldwell WC, and Teresa St Houses WS). If management leads to a drop in groundwater elevations to MTs, there is a risk of dewatering more domestic and public supply wells; those risks are summarized earlier in this document.

5.3 Public Trust

5.3.1 General Principles and Brief History

The public trust doctrine is rooted in ancient Roman codes and English Common law judicial opinions about public rights to use water, air, wildlife, and common spaces that are held in trust by the sovereign for the benefit of the public. The sovereign in the public trust doctrine refers to the entity charged with protecting resources within the public trust. Within SGMA, the entities acting on the behalf of the people are the State of California and local jurisdictions implementing SGMA California incorporated English Common Law into its legal framework prior to statehood and subsequent California legal decisions have explicitly recognized that the public trust doctrine provides for protection of coastlines, navigable surface waters, their non-navigable tributaries, aquatic resources, and the ecosystems that rely on them.

In a 2018 decision, Environmental Law Foundation v. State Water Resources Control Board (2018) 26 Cal.App.5th 844 (Environmental Law Foundation), the court recognized that “the public trust doctrine applies if extraction of groundwater adversely impacts a navigable waterway to which the public trust doctrine does apply” (26 Cal.App.5th at 859.). Environmental Law Foundation concerned increased pumping of groundwater near the Scott River, which had greatly affected the Scott River system and, in some years, left the system nearly dry. The court found that the passage of SGMA had not preempted application of the public trust doctrine and that both “coexist and neither occupies the field to the exclusion of the other” (Id. at pp. 854, 855.).

5.3.2 The Public Trust Doctrine in the SGMA Context

When the state or its subdivisions are engaged in the planning and allocation of water resources, the public trust doctrine requires consideration of the potential impacts of groundwater extractions on public trust resources and protection of those resources where feasible. This duty arises in the SGMA context because SGMA involves the planning (Wat. Code, § 10727) and allocation (Wat. Code, § 10726.4) of water resources. Moreover, sustainable management under SGMA is defined as avoiding undesirable results in a basin, including “[d]epletions of interconnected surface water

that have significant and unreasonable adverse impacts on beneficial uses of surface water" (Wat. Code, § 10721, subd. (x)(6).). GSPs that meet SGMA's requirements will assist in evaluating impacts to public trust resources, such as fish and wildlife beneficial uses, because they will include a physical description of groundwater-surface water interaction in the basin and, if applicable, monitoring and management of changes in surface flow and surface water quality caused by groundwater extraction in the basin (Wat. Code, § 10727.2, subds. (a)(2), (d)(2)).

5.3.3 Public Trust Doctrine in the Subbasin

The record snowfall and precipitation in the Sierra Nevada and Tulare Basin this past winter (2022-23), amplified in part by extreme precipitation events and climate change, points to a future hydrology where flooding is expected to occur more frequently. Portions of the western Tule Subbasin were flooded in spring 2023, and the year's massive snowpack was posing continued flood risk in the basin. Sustainable groundwater management efforts in the subbasin should consider how altered hydrologic, surface water and flooding patterns may impact public trust resources. This should include consideration of public trust when operating or permitting wells in places where groundwater and surface water may be connected.

6.0 References

Agency for Toxic Substances and Disease Registry, 2007. *Draft Toxicological Profile for Arsenic,* Washington DC: Department of Health and Human Services.

American Community Survey, 2022. [Online]
Available at:
https://data.census.gov/table/ACSDP5Y2022.DP05?y=2022&d=ACS%205-Year%20Estimates%20Data%20Profiles

Anderson, K., 2005. *Tending the Wild: Native American Knowledge and the Management of California's Natural Resources.* Oakland: University of California Press.

Atwater, B. F. et al., 1986. A fan dam for Tulare Lake, California, and implications for the Wisconsin glacial history of the Sierra Nevada. *Geological Society of America Bulletin,* 97(1), pp. 97-109.

Austin, J., 2013. *Floods and droughts in the Tulare Lake Basin.* Three Rivers: Sequoia Natural History Association.

Barbour, M., Pavlik, B., Drysdale, F. & Lindstrom, S., 1993. *California's Changing Landscapes: Diversity and Conservation of California Vegetation.* Sacramento: California Native Plant Society.

Barlow, P. M. & Leake, S. A., 2012. Streamflow Depletion by Wells - Understanding and Managing the Effects of Groundwater Pumping on Streamflow. *U.S. Geological Survey Circular 1376,* p. 84.

Bartow, J. A., 1991. *The Cenozoic evolution of the San Joaquin Valley, California,* Washington DC: U.S. Geological Survey.

Beard, J. B. & Green, R. L., 1994. The Role of Turfgrasses in Environmental Protection and Their Benefits to Humans. *Journal of Environmental Quality,* 23(3), pp. 452-460.

Bertoldi, G. L., Johnston, R. H. & Evenson, K., 1991. *Ground Water in the Central Valley, California - A Summary Report,* Washington DC: U.S. Geological Survey.

Blackburn, T. & Anderson, K., 1993. Before the Wilderness: Environmental Management by Native Californians. *Ballena Press Anthropological Papers No. 40.*

California Department of Fish and Wildlife, 2019. *Fish & Wildlife Groundwater Planning Considerations.* [Online]
Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=170185&inline

California Department of Water Resources, 1991. *California Well Standards: Water Wells, Monitoring Wells, Cathodic Protection Wells,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2004. *Bulletin 118 Update 2004- Basin Report 5-22.11, Kaweah Subbasin.* [Online]
Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/5_022_11_KaweahSubbasin.pdf

California Department of Water Resources, 2016. *Best Management Practices for the Sustainable Management of Groundwater: Monitoring Networks and Identification of Data Gaps,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2017. *Draft Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2021. *Groundwater Management Principles & Strategies to Monitor, Analyze, & Minimize Impacts to Drinking Water Wells: A Framework for State Actions to Support Drought Resilient Communities,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2022. *Incomplete Determination of the Revised 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley - Kaweah Subbasin,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2023. *Inadequate Determination of the Revised 2020 Groundwater Sustainability Plans Submitted for the San Joaquin Valley - Kaweah Subbasin,* Sacramento: California Department of Water Resources.

California Department of Water Resources, 2023. *Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset Viewer.* [Online]
Available at: https://gis.water.ca.gov/app/NCDatasetViewer/

California Department of Water Resources, n.d. *SGMA Data Viewer Online Interactive Map.* [Online]
Available at:
https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#currentconditions

California Natural Resources Agency, 2021. *Provisional Statewide Cropping Mapping.* [Online]
Available at: https://data.cnra.ca.gov/dataset/statewide-crop-mapping

California State Water Resources Control Board, 1968. *Statement of Policy with Respect to Maintaining High Quality of Waters in California: Resolution No. 68-16,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 1998. *In the Matter of the Declaration of Fully Appropriated Stream Systems in California: Order WR 98-08,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 2016. *Adopting the Human Right to Water as a Core Value and Directing its implementation in Water Board Programs and Activities: Resolution No. 2016-0010,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 2017. *Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions: Resolution No. 2017-0027,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 2021. *Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism: Resolution No. 2021-0050,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 2022a. *2022 Drinking Water Point of Use Point-of-entry Report,* Sacramento: California State Water Resources Control Board.

California State Water Resources Control Board, 2022b. *Options for Measuring Extraction Volumes.* [Online]
Available at:
https://www.waterboards.ca.gov/water_issues/programs/sgma/docs/reporting/measuring_gw.pdf

California State Water Resources Control Board, 2023a. *Combined Risk Domestic Wells and State Small Water Systems.* [Online]
Available at:
https://gispublic.waterboards.ca.gov/portalserver/rest/services/Hosted/Combined_Risk_Domestic_Wells_and_State_Small_Water_Systems/FeatureServer.

California State Water Resources Control Board, 2023b. *GAMA Groundwater Information System.* [Online]
Available at: https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/

California State Water Resources Control Board, 2023c. *SAFER Dashboard Failing and At-Risk Drinking Water Systems.* [Online]
Available at: https://data.ca.gov/dataset/safer-failing-and-at-risk-drinking-water-systems [Accessed 2024].

California State Water Resources Control Board, 2023d. *SGMA Groundwater Quality Visualization Tool.* [Online]

Available at: https://www.waterboards.ca.gov/water_issues/programs/sgma/water-quality-visualization-tool.html

California State Water Resources Control Board, 2023e. *State of California FY 2023-24 Fund Expenditure Plan Safe and Affordable Drinking Water Fund,* Sacramento: California State Water Resources Control Board.

Carlisle, D. M. et al., 2019. Flow Modification in the Nation's Streams and Rivers. *U.S. Geological Survey Circular 1461,* p. 75.

Central Valley Regional Water Quality Control Board, 2018. *Water Quality Control Plan for the Tulare Lake Basin Third Edition,* s.l.: Central Valley Regional Water Quality Control Board.

Cook, S., 1955. The Aboriginal Population of the San Joaquin Valley, California. *University of California Press, Anthropological Records,* 16(2).

Cook, S., 1978. Historical demography. *Handbook of the North American Indians,* Volume 8, pp. 91-98.

Croft, M. G., 1972. *Subsurface Geology of the Later Tertiary and Quaternary Water-Bearing: Vol.1.,* Washington DC: U.S. Government Printing Office.

East Kaweah Groundwater Sustainability Agency, 2020. *Groundwater Sustainability Plan,* California: East Kaweah Groundwater Sustainability Agency.

East Kaweah Groundwater Sustainability Agency, 2022. *First Amended Groundwater Sustainability Plan,* California: East Kaweah Groundwater Sustainability Agency.

Erban, L., Gorelick, S., Zebker, H. & Fendorf, S., 2013. Release of arsenic to deep groundwater in the Mekong Delta, Vietnam, linked to pumping-induced land subsidence. *Proceedings of the National Academy of Sciences,* 110(34), pp. 13751-13756.

Faunt, C. C., 2009. Groundwater Availability of the Central Valley Aquifer, California. *U.S. Geological Survey Professional Paper 1766,* p. 225.

Fernandez-Bou, A. et al., 2021. Underrepresented, understudied, underserved: Gaps and opportunities for advancing justice in disadvantaged communities. *Environmental Science & Policy 122,* Volume 122, pp. 92-100.

Fujii, R. & Swain, W., 1995. *Areal distribution of selected trave elements, salinity, and major ions in shallow ground water, Tulare Basin, Southern San Joaquin Valley, California,* s.l.: U.S. Geological Survey.

Galloway, D. L., Jones, D. R. & Ingebritsen, S. E., 1999. Land Subsidence in the United States. *U.S. Geological Survey Circular 1182,* Volume 1182.

Garcés, F. T., 1900. *On the Trail of a Spanish Pioneer: The Diary and Itinerary of Francisco Garcés (missionary Priest) in His Travels Through Sohora, Arizona, and California, 1775-1776: (Vol.1.).* New York: F.P. Harper.

Greater Kaweah Groundwater Sustainability Agency, 2020. *Groundwater Sustainability Plan,* California: Greater Kaweah Groundwater Sustainability Agency.

Greater Kaweah Groundwater Sustainability Agency, 2022. *First Amended Groundwater Sustainability Plan,* California: Greater Kaweah Groundwater Sustainability Agency.

Hanak, E. et al., 2019. *Water and the Future of the San Joaquin Valley,* s.l.: Public Policy Institute of California.

Hanak, E. et al., 2017. *Water Stress and a Changing San Joaquin Valley,* s.l.: Public Policy Institute of California.

Hang, K. et al., 2021. *Investing in California's San Joaquin Valley Communities,* s.l.: s.n.

Haugen, E. A., Jugens, B. C., Arroyo-Lopez, J. & Bennett, G. L., 2021. Groundwater development leads to decreasing arsenic concentrations in the San Joaquin Valley, California. *Science of the Total Environment,* Volume 771.

Horton, J. L. & Clark, J. L., 2001. Water table decline alters growth and survival of Salix gooddingii and Tamarix chinensis seedlings. *Forest Ecology and Management,* 140(2-3), pp. 239-247.

Jurgens, B. C., McMahon, P. B., Chapelle, F. H. & Eberts, S. M., 2009. *An Excel® Workbook for Identifying Redox Processes in Ground Water,* Virginia: U.S. Geological Survey.

Kaweah Subbasin Groundwater Sustainability Agencies, 2021. *Kaweah Subbasin Annual Monitoring Report Water Year 2020 (OCT. 2019 - SEP. 2020),* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kaweah Subbasin Groundwater Sustainability Agencies, 2022a. *Kaweah Subbasin Annual Monitoring Report Water Year 2021 (OCT. 2020 - SEP. 2021),* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kaweah Subbasin Groundwater Sustainability Agencies, 2022b. *Kaweah Subbasin Coordination Agreement,* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kaweah Subbasin Groundwater Sustainability Agencies, 2023a. *Draft Kaweah Subbasin Mitigation Program Amendment 1.0,* California: Kaweah Subbasin Groundwater Sustainability Agencie.

Kaweah Subbasin Groundwater Sustainability Agencies, 2023b. *Kaweah Subbasin Annual Monitoring Report Water Year 2022 (OCT. 2021 - SEP. 2022),* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kaweah Subbasin Groundwater Sustainability Agencies, 2023c. *Kaweah Subbasin Groundwater Sustainability Plan Annual Report Water Years (2019-2022),* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kaweah Subbasin Groundwater Sustainability Agencies, 2023d. *Technical Approach for Developing Subsidence Sustainable Management Criteria in the Kaweah Subbasin,* California: Kaweah Subbasin Groundwater Sustainability Agencies.

Kings County Department of Agriculture, 2022. *Kings County Department of Agriculture 2022 Crop Report,* s.l.: s.n.

Lees, M., Knight, R. & Smith, R., 2022. Development and application of a 1D compaction model to understand 65 years of subsidence in the San Joaquin Valley. *Water Resources Research,* 58(e2021WR031390).

Levy, Z. et al., 2021. Critical Aquifer Overdraft Accelerates Degradation of Groundwater Quality in California's Central Valley During Drought. *Geophysical Research Letters,* 48(17), p. e2021GL094398.

Liu, P.-W.et al., 2022. Groundwater depletion in California's Central Valley accelerates during megadrought. *Nature Communications,* 13(1), p. 7825.

London, J. et al., 2021. Disadvantaged unincorporated communities and the struggle for water justice in California. *Water Alternatives,* 14(2), pp. 520-545.

Mason, H. L., 1957. *A flora of the Marshes of California.* Berkeley: University of California Press.

Meza-Gastelum, M. A. et al., 2022. Review of Groundwater Withdrawal Estimation Methods. *Water,* 14(17), p. 2762.

Mid-Kaweah Groundwater Sustainability Agency, 2020. *Groundwater Sustainability Plan,* California: Mid-Kaweah Groundwater Sustainability Agency.

Mid-Kaweah Groundwater Sustainability Agency, 2022. *First Amended Groundwater Sustainability Plan,* California: Mid-Kaweah Groundwater Sustainability Agency.

Native American Heritage Commission, 2023. *Personal Communication* [Interview] (11 May 2023).

Organization for Economic Co-operation and Development, 2015. *Drying Wells, Rising Stakes: Towards Sustainable Agricultural Groundwater Use, OECD Studies on Water,* Paris: OECD Publishing.

Ostrom, E., 2012. Polycentric Systems: Multilevel Governance Involving a Diversity of Organizations. In: *Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms.* Oxford: Oxrord Academic, pp. 105-125.

Pace, C. et al., 2022. Inequities in Drinking Water Quality Among Domestic Well Communities and Community Water Systems, California, 2011–2019. *American Journal of Public Health,* 112(1), pp. 88-97.

Pannu, C., 2012. Drinking Water and Exclusion: A Case Study from California's Central Valley. *Calif. L. Rev., 100.*

Rohde, M. M. et al., 2019. *Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management,* San Francisco: The Nature Conservancy.

Scanlon, B., Faunt, C., Longuevergne, L. & McMahon, P. B., 2012. Groundwater depletion and sustainability of irrigation in the US High Plains and Central Valley. *Proceedings of the National Academy of Sciences,* 109(24), pp. 9320-9325.

Shipek, F., 1991. Kumeyaay Plant Husbandry: Fire, Water, and Erosion Management Systems. *Before the Wilderness, originally published in the Seventh Annual California Indian Conference, Sonoma State University.*

Smith, R., Knight, R. & Fendorf, S., 2018. Overpumping leads to California groundwater arsenic threat. *Nature Communications,* 9(1), p. 2089.

Smith, W. & Secrest, W., 2004. *Garden of the Sun: A History of the San Joaquin Valley, 1772-1939.* 2nd ed. Fresno: Linden Publishing.

Stromberg, J. C. et al., 2007. Altered stream-flow regimes and invasive plant species: the Tamarix case. *Global Ecology and Biogeography,* 16(3), pp. 381-393.

Tulare County, 2022. *Tulare County Crop and Livestock Report,* s.l.: s.n.

U.S. Bureau of Reclamation, 1970. *A Summary of Hydrologic Data for the Test Case on Acreage Limitation in Tulare Lake,* Sacramento: United States Bureau of Reclamation, Region 2.

U.S. Bureau of Reclamation, 2015. *Coordinated Long-Term Operation of the Central Valley Project and State Water Project: Final Environmental Impact Statemen,* Sacramento: U.S. Department of the Interior, Mid-Pacific Region, Bay-Delta Office.

U.S. Department of Agriculture, 2019. *2018 Irrigation and Water Management Survey,* Washington, D.C.: USDA.

U.S. Environmental Protection Agency, 1984. *Land subsidence in the San Joaquin Valley, California, as of 1980,* Washington DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, 2001. *Radionuclides Rule: A Quick Reference Guide.* [Online]
Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=30006644.txt

U.S. Environmental Protection Agency, 2006. *Consumer Factsheet on: Nitrates/Nitrites,* Washington DC: Environmental Protection Agency.

U.S. Environmental Protection Agency, 2009. *IRIS Toxicological Review of 1,2,3-Trichloropropane,* Washington DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, 2012. *IRIS Toxicological Review of Tetrachloroethylene (Perchloroethylene),* Washington DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, 2017. *Secondary Drinking Water Standards: Guidance for Nuisance Chemicals.* [Online]
Available at: https://protectyourwater.net/files/2019/09/EPA-secondary-drinking-water-Regs.pdf

U.S. Environmental Protection Agency, 2023. *Drinking Water Standards and Regulations National Primary Drinking Water Regulations.* [Online]
Available at: https://www.epa.gov/dwreginfo/drinking-water-regulations

U.S. Geological Survey, 2018. *Land Subsidence.* [Online]
Available at: https://www.usgs.gov/special-topics/water-science-school/science/land-subsidence

Underhill, L., 2023. *Subsidence-Induced Arsenic Mobilization Into Groundwater of California's Central Valley,* Fresno: Doctoral dissertation, California State University.

Appendix A – Summary Table of Proposed Deficiencies and Potential Actions to Address Deficiencies

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Groundwater Levels (GL)-1 – The 2022 GSPs do not clearly define undesirable results for the chronic lowering of groundwater levels for the subbasin.	The GSP Regulations require a GSA to "describe...the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users and land uses and property interests (Cal. Code Regs., tit. 23, § 354.26).	**DWR Inadequate Determination summary**: The 2022 GSPs describes the causes leading to undesirable results but does not clearly define undesirable results consistent with the GSP Regulations. The 2022 GSP does not describe how significant and unreasonable effects will be avoided. **Board additional issues**: None.	**Potential Action GL-1** – Define the undesirable result for the chronic lowering of groundwater levels and explain how significant and unreasonable effects will be avoided.
Deficiency GL-2 – The GSAs did not select minimum thresholds based on avoiding undesirable results and significant and unreasonable impacts to beneficial uses and users.	The GSP Regulations requires GSAs to establish minimum thresholds that quantify groundwater conditions for chronic lowering of groundwater levels to avoid undesirable results (Cal. Code Regs., tit. 23, § 354.28(a)).	**DWR Inadequate Determination summary**: Minimum thresholds have not been selected based on the avoidance of undesirable results and significant and unreasonable impacts to beneficial uses and users as required by the GSP Regulations and specified in the corrective action. **Board additional issues**: Board staff questions how selected minimum thresholds would avoid undesirable results when minimum thresholds are set at declining groundwater levels projected to 2040.	**Potential Action GL-2** – Select minimum thresholds to avoid undesirable results and significant and unreasonable impacts to beneficial uses and users.
Deficiency GL-3 – The GSAs do not thoroughly explain the effects groundwater level MTs have on other sustainability indicators, such as groundwater storage, subsidence, degradation of groundwater quality, and depletions of interconnected surface water.	The GSP Regulations require the GSA to determine how basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators. (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(2)).	**DWR Inadequate Determination summary:** The DWR Inadequate Determination noted the following, "none of the GSPs have thoroughly explained how water level minimum thresholds will not cause undesirable results for other sustainability indicators, in particular subsidence and water quality." **Board additional issues**: None.	**Potential Action GL-3** – Describe the relationship between groundwater level minimum thresholds for each sustainability indicator. Revise groundwater level minimum thresholds as necessary to avoid undesirable results for other sustainability indicators.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GL-4 – The 2022 Coordination Agreement's discussion of the Mitigation Program Framework lacks specific details.	Although SGMA and the GSP Regulations do not require development of a well impact mitigation plan, many GSAs have proposed to couple such plans with MTs to allow for greater groundwater level declines while avoiding undesirable results.	**DWR Inadequate Determination summary:** The Mitigation Program Framework proposed in the adapted 2022 Coordination Agreement is labeled as 'draft' and 'for discussion purpose only' and is unclear of the GSA's commitment to this framework. The Mitigation Program Framework lacks details to assess the feasibility and likely effectiveness of the mitigation actions. DWR also noted that the scope of the mitigation plans must be revisited given the GSAs have focused on the narrowed subset of wells. **Board additional issues:** Board staff notes that the Mitigation Program Framework and the GSA mitigation plans lacks specific details on appropriate funding sources, complexity and timeliness on mitigation processes, and an implementation schedule.	**Potential Action GL-4** – Establish accessible and appropriately funded well impact mitigation programs that mitigate impacts to all wells affected by lowering of groundwater levels and degradation of water quality. Develop well mitigation programs with clear triggers, eligibility requirements, implementation schedule, and funding sources. (This action supports addressing both Deficiency GL-4 and Deficiency GWQ-4b.)
Deficiency Land Subsidence (LS)-1 - The GSPs do not provide reasonable justification for subsidence SMC that involves the subbasin's water conveyance infrastructure.	The GSP Regulations require a GSA to "describe...the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users, land uses, and property interests (Cal. Code Regs., tit. 23, § 354.26).	**DWR Inadequate Determination summary:** The GSPs did not explain the methodology or how it was determined that approximately 10 inches or greater amount of subsidence would result in a 10% or more capacity loss in the subbasin's conveyance infrastructure. The GSAs should explicitly describe the analysis that went into establishing the 10% capacity criteria. **Board additional issues**: Board staff note that minimum threshold definitions include both an annual subsidence rate and maximum cumulative amount of 9.5 inches of subsidence. Board staff find it more reasonable to set a lower minimum threshold annual subsidence rate that is more protective and will allow for earlier detection of potential subsidence impacts along the Friant-Kern Canal.	**Potential Action LS-1a** – Clearly define the subsidence conditions that would result in an undesirable result for the subbasin and provide enough detail so that associated MTs can be determined (Cal. Code Regs., tit. 23 § 354.28). **Potential Action LS-1b** – Establish an annual subsidence rate MT that is less than the estimated cumulative subsidence amount expected to significantly impact the Friant-Kern Canal.
Deficiency LS-2 - The GSPs do not adequately define the relationship between groundwater level SMC and potential subsidence impacts.	The GSP Regulations require a GSA to describe "The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs., tit. 23, § 354.28 (b)(2)). More specific to DWR's determination, the GSP Regulations also require that minimum thresholds for chronic lowering of groundwater levels shall be supported by potential effects on other sustainability indicators." (Cal. Code Regs., tit. 23, § 354.28 (c)(1)(B)).	**DWR Inadequate Determination summary:** DWR determined that the GSPs has not provided an explanation of how undesirable results for subsidence will be avoided with current groundwater level SMC. Considerable additional subsidence is expected to occur if groundwater levels are reduced to groundwater level SMC, and the GSPs do not adequately evaluate the potential impacts of groundwater level SMC on subsidence rates. **Board additional issues**: Board staff note that undesirable results definition, which is currently established as exceedances at one-third of RMS sites, may still allow for considerable localized subsidence impacts to infrastructure.	**Potential Action LS-2** – Update and establish more protective SMC definitions so water level declines do not cause subsidence undesirable results.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency LS-3 – Significant impacts to conveyance infrastructure and undesirable results are expected under projected subsidence rates without mitigation.	Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include projects and management actions, summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44). In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3), (5)).	**DWR Inadequate Determination summary:** None. **Board additional issues**: • **Infrastructure Impacts** – Critical infrastructure mitigation is not required under the Mitigation Program Framework, despite expected significant impacts along water conveyance infrastructure due to differential subsidence.	**Potential Action LS-3a** – Restrict pumping near critical infrastructure and other conveyance structures to avoid undesirable results. **Potential Action LS-3b** - Revise the mitigation program to include conveyance infrastructure expected to experience significant impacts with clear mitigation triggers and funding sources.
Deficiency Groundwater Quality (GWQ)-1 – The 2022 GSPs do not clearly define the conditions that would be considered an undesirable result.	The GSP Regulations require a GSA to "describe...the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users and land uses and property interests (Cal. Code Regs., tit. 23, § 354.26).	**DWR Inadequate Determination summary**: None. **Board issues**: The 2022 GSPs and coordination agreement define an undesirable result as when "groundwater quality is adversely impacted by groundwater pumping and recharge projects and these impacts result in groundwater no longer being generally suitable for agricultural irrigation and/or domestic use" (2022 Coordination Agreement, Appendix 6). The GSPs do not clearly describe how the subbasin would determine if SMC exceedances are impacted by groundwater pumping and recharge projects as opposed to other factors. The GSAs and the State Water Board therefore cannot evaluate whether the proposed SMC are adequate or if the broader quantitative definition of an undesirable result would guide day-to-day basin management as appropriate for avoiding plain-language undesirable results.	**Potential Action GWQ-1** – Clearly define the conditions of an undesirable result. Explain how GSAs would determine the water quality impacts of: • Projects and management actions • Subsidence • Continued pumping

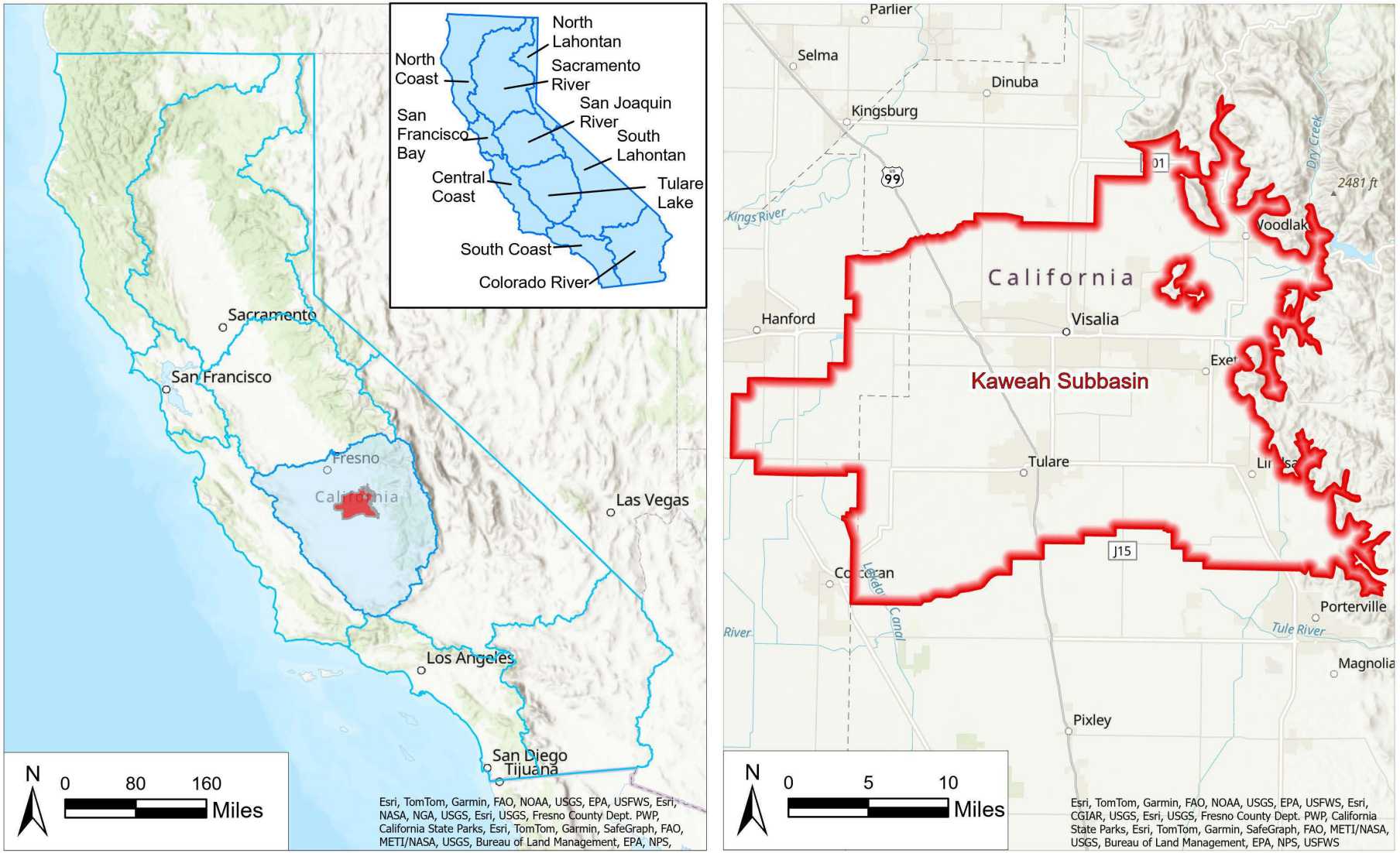
Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-2 – Sustainable Management Criteria in the 2022 GSPs are not consistent with GSP Regulations. **Deficiency GWQ-2a** – The GSPs' definition of an undesirable result would result in delayed identification of significant and unreasonable impacts and therefore delayed basin management. **Deficiency GWQ-2b** – The GSPs do not consider all constituents with known exceedances nor justify not setting SMC for constituents with known exceedances. **Deficiency GWQ-2c** – MTs based on agricultural standards are applied to domestic wells and SMC do not consider domestic well users.	The GSP Regulations require GSAs to base their MTs for degradation of water quality on "the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." Also, GSAs must consider "local, state, and federal water quality standards applicable to the basin" in setting MTs (Cal. Code Regs., tit. 23, § 354.28, subd. (c)(4)). In describing MTs, GSPs must describe how MTs "may affect the interests of beneficial uses and users of groundwater or land uses and property interests." (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(4)). The Basin Setting shall include "groundwater quality issues that may affect the supply and beneficial uses of groundwater" (Cal. Code Regs § 354.16, subd. (d)) and MT shall be based on "concentrations of constituents determined by the Agency to be of concern for the basin…" (Cal. Code Regs § 354.28 subd. (c)(4)).	**DWR Inadequate Determination summary:** None. **Board issues**: **Deficiency GWQ-2a** – The GSPs require that average constituent concentrations at one-third of RMS exceed MTs under a 10-year running average before being considered an undesirable result. Board staff note that this method may allow for drinking water to degrade substantially below drinking water standards before being considered an undesirable result. This may result in delayed management or mitigation of water quality undesirable results. **Deficiency GWQ-2b** – The GSPs do not consider all the constituents with exceedances, specifically uranium (This is based on the SGMA Groundwater Quality Visualization Tool). **Deficiency GWQ-2c** – MTs for RMS in agricultural areas are based on Water Quality Objectives rather than MCLs. This means that water quality in domestic wells could degrade below drinking water standards without being considered an undesirable result.	**Potential Action GWQ-2** – Update Sustainable Management Criteria to be consistent with GSP Regulations. • **Potential Action GWQ-2a** – Revise the undesirable results and MT definitions to avoid any significant and unreasonable impacts. • **Potential Action GWQ-2b** – Use the best available data when defining constituents and set SMC for all constituents in the subbasin that may impact beneficial uses and users. • **Potential Action GWQ-2c** – Revise criteria to categorize RMS and describe potential impacts to all beneficial uses and users.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-3 – Water quality monitoring networks are not consistent with the GSP Regulations. **Deficiency GWQ-3a** – Monitoring networks do not clearly monitor impacts to domestic drinking water wells. **Deficiency GWQ-3b** – Discrepancies in monitoring networks and reported data.	The GSP Regulations require GSPs to include a description of the monitoring network objectives for the basin, including how the GSA will "monitor impacts to the beneficial uses or users of groundwater" (Cal. Code Regs., tit. 23, § 354.34, subd. (b)(2)). The monitoring network must be "capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate [GSP] implementation." (Cal. Code Regs., tit. 23, § 354.34, subd. (a)). Data collected must be of "sufficient quality, frequency, and distribution" to characterize and evaluate groundwater conditions (Cal. Code Regs., tit. 23, § 354.32). GSAs "may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin...", known as RMSs (Cal. Code Regs., tit. 23, § 354.36). GSAs identify MTs, MOs, and Interim Milestones at these sites. "The designation of [an RMS] shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area" (Cal. Code Regs., tit. 23, § 354.36, subds. (a) & (c)).	**DWR Inadequate Determination summary**: None. **Board issues**: **Deficiency GWQ-3a –** The GSPs do not demonstrate that the monitoring networks for water quality allow the GSAs to monitor impacts to domestic drinking water wells. The GSAs primarily use public supply wells to represent drinking water wells. Public supply wells are often deeper than domestic wells and are constructed in a way to avoid groundwater containing constituents of concern. As a result, the water quality readings in public supply wells are likely not representative of conditions in shallow domestic wells. **Deficiency GWQ-3b** – State Water Board staff have identified discrepancies in the monitoring network descriptions among the GSPs, Coordination Agreement, and Water Year (WY) 2022 Annual Report. Staff are also uncertain about the reported percent of MT exceedances for the subbasin's water quality RMS as described in the GSAs' WY 2022 Annual Report.	**Potential Action GWQ-3** – Update the water quality monitoring networks to be consistent with GSP Regulations. • **Potential Action GWQ-3a** – Add description on how the existing monitoring networks effectively monitor impacts to shallow well users. • **Potential Action GWQ-3b** – Clearly define which wells are RMS monitored for GSP implementation and update tables and figures in the Coordination Agreement, individual GSPs, and annual reports.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-4 – Management actions are not responsive to water quality degradation. **Deficiency GWQ-4a** – Additional sampling is not triggered when MTs are exceeded. **Deficiency GWQ-4b** – Well mitigation plans don't address water quality degradation.	Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The GSAs must include projects and management actions "that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent" (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(1)).	**DWR Inadequate Determination summary**: None. **Board issues**: **Deficiency GWQ-4a** – Board staff note that elevated concentrations of arsenic, nitrate, uranium, gross alpha, and other constituents can severely impact human health. It is difficult to understand how GSAs can avoid significant and unreasonable impacts from degradation of groundwater quality if MT exceedances don't trigger additional monitoring to better characterize risks to beneficial uses and users. **Deficiency GWQ-4b** – The GSAs are developing mitigation plans to address impacts due to declining groundwater levels and land subsidence. These plans should also mitigate degradation of water quality.	**Potential Action GWQ-4** – Update management actions to be responsive to water quality degradation. • **Potential Action GWQ-4a** – Plan additional sampling when water quality is degraded. • **Potential Action GWQ-4b** – Include water quality in well mitigation programs with clear triggers, eligibility requirements, metrics, and funding sources. (This action supports addressing both Deficiency GL-4 and Deficiency GWQ-4b.)
Deficiency Interconnected Surface Water (ISW)-1 – The GSPs, in setting SMC for depletions of ISW, did not adequately describe the impacts of those criteria on beneficial uses and users.	GSP Regulations require GSPs to describe "the processes and criteria relied upon to define undesirable results applicable to the basin." This description must include the cause of past or potential undesirable results, "the criteria used to define when and where the effects of the groundwater conditions cause undesirable results," and the potential effects of undesirable results on groundwater uses and users, land uses, and property interests (Cal. Code Regs., tit. 23 § 354.26). Additionally, the GSPs must set their MTs for depletions of ISW at "the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" (Cal. Code Regs., tit. 23 § 354.28, subd. (c)(6)). In describing MTs, GSPs must describe how MTs "may affect the interests of beneficial uses and users of groundwater or land uses and property interests" (Cal. Code Regs., tit. 23, § 354.28, subd. (b)(4)).	**DWR Inadequate Determination summary**: None. **Board additional issues**: The GSPs did not adequately describe the potential effects on beneficial uses and users of groundwater and surface water that may result from depletions of ISW, particularly for environmental users within the subbasin. Without a clear understanding of the potential effects on beneficial uses and users and a clear definition of what is considered "significant and unreasonable," it is difficult for GSAs and Board staff to evaluate whether the MTs are appropriate for avoiding undesirable results.	**Potential Action ISW-1** – Consider all beneficial uses and users when setting SMC for depletions of ISW and specifically describe the impacts of those criteria on beneficial uses and users.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency ISW-2 – The GSPs did not establish MTs for depletions of ISW that are consistent with GSP Regulations.	The GSP Regulations require GSAs to describe "the information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting" (Cal. Code Regs., tit. 23 § 354.28(b)(1)). Also, MTs established for depletions of ISW must be supported by "(A) The location, quantity, and timing of depletions of interconnected surface water" and "(B) A description of the groundwater and surface water model used to quantify surface water depletion" (Cal. Code Regs., tit. 23 § 354.28(c)(6)).	**DWR Inadequate Determination summary**: None. **Board additional issues**: The MTs established by the GSPs are not supported with best available information, best available science, or a model that quantifies surface water depletion.	**Potential Action ISW-2 –** Establish MTs for depletions of ISW that are consistent with GSP regulations.
Deficiency ISW-3 – The GSPs did not establish a monitoring network designed to address depletions of ISW.	The GSP Regulations require GSAs to implement a monitoring network for depletions of ISW that is designed to monitor surface water and groundwater, characterize the spatial and temporal exchanges between surface water and groundwater, and calibrate and apply tools and methods necessary to calculate depletions of surface water caused by groundwater extractions (Cal. Code Regs., tit. 23 § 354.34(c)(6)).	**DWR Inadequate Determination summary**: None. **Board additional issues**: The GSPs do not have a monitoring network in place to monitor groundwater and surface water interactions, and current knowledge is based on groundwater level contours and limited local knowledge. Without a sufficient monitoring network, it is not possible to accurately identify ISW, establish SMC, and evaluate progress towards achieving sustainable groundwater management within the subbasin.	**Potential Action ISW-3** – Create a monitoring network in the Kaweah Subbasin for depletions of ISW that is consistent with GSP Regulations.

Appendix B - Figures



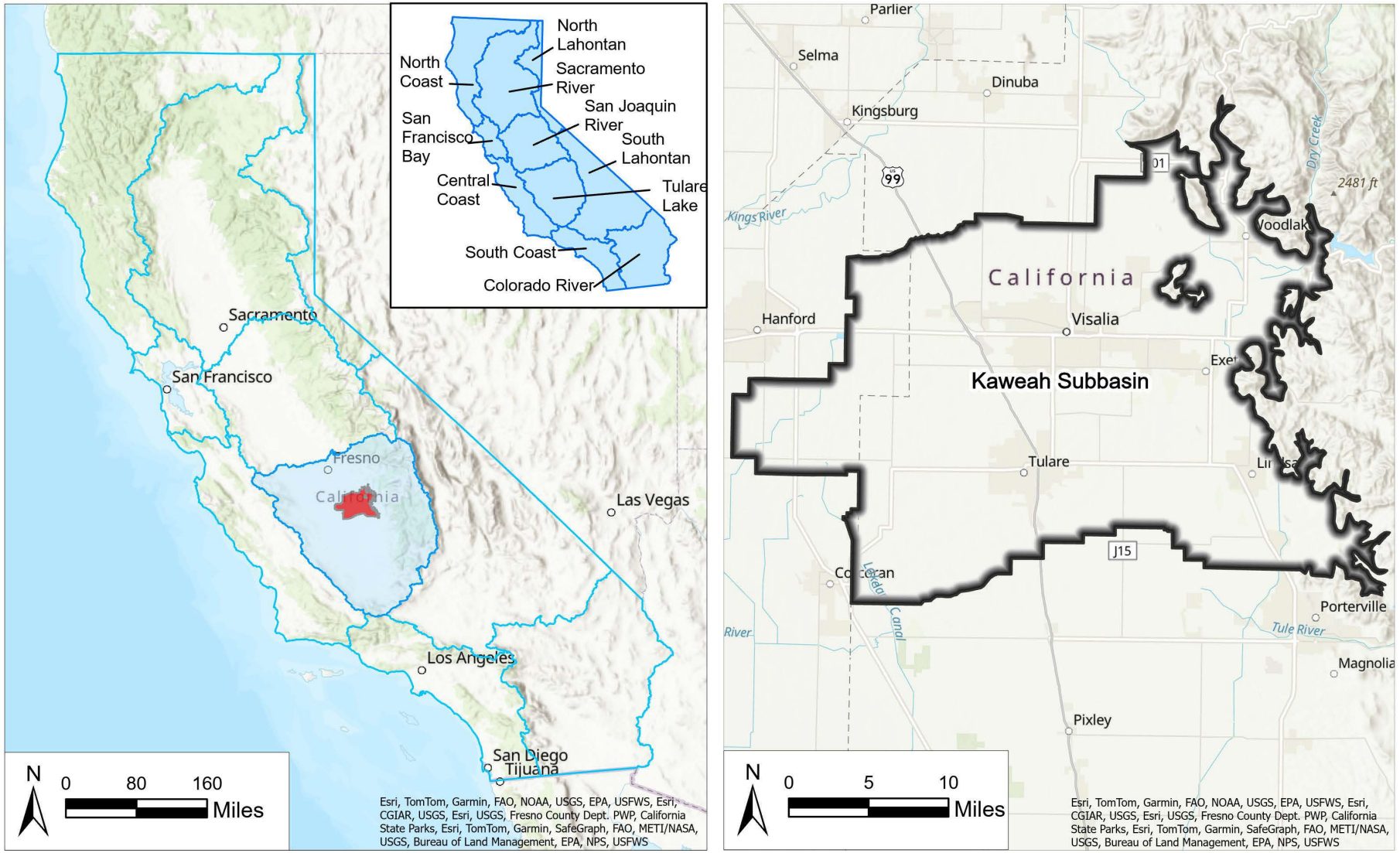
Kaweah Subbasin

Hydrologic Regions

Figure ES-1

Overview of the Kaweah Subbasin

Draft Staff Report Kaweah Subbasin
May 2024



Kaweah Subbasin

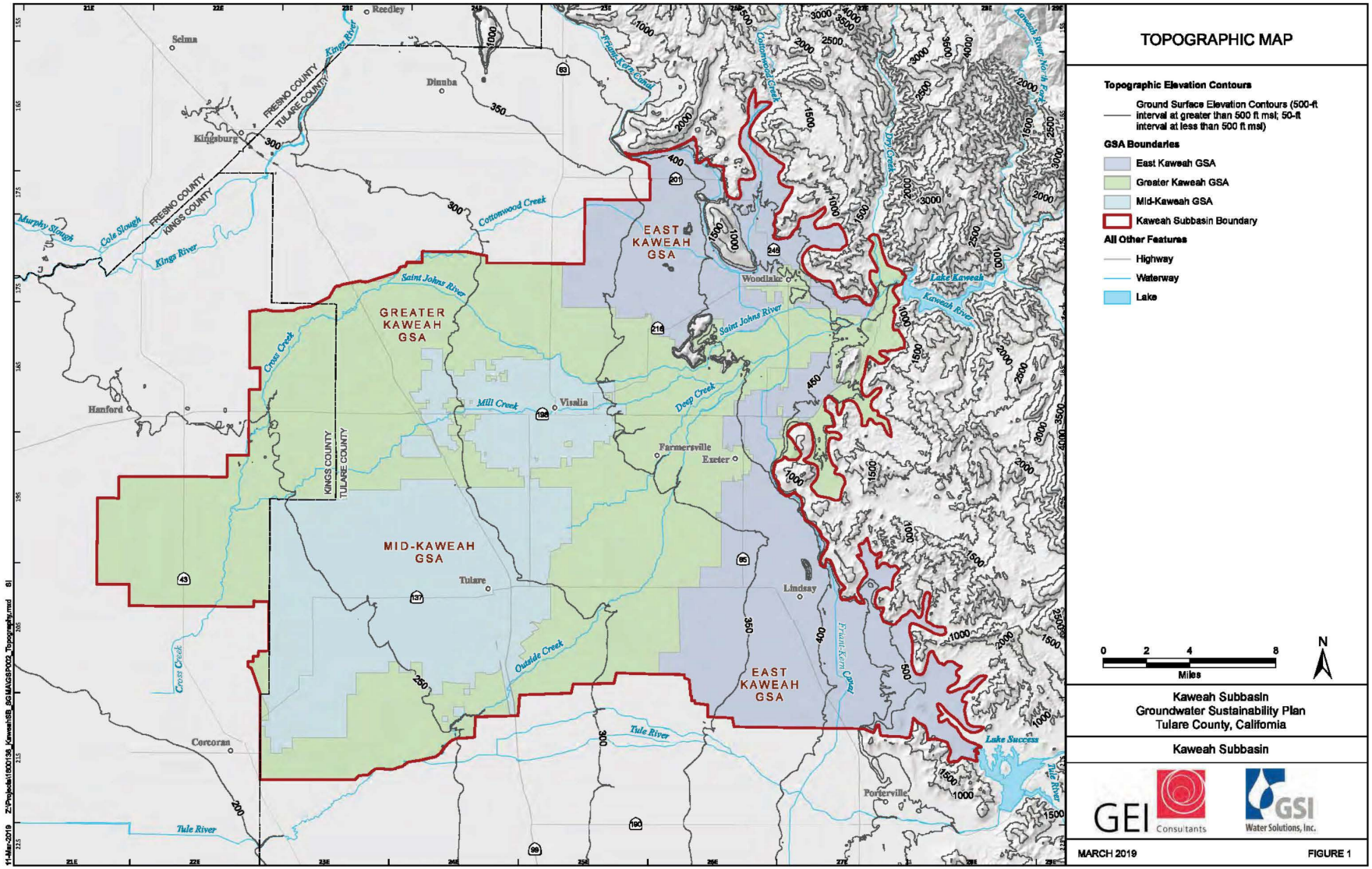
Hydrologic Regions

Figure 3-1

Overview of the Kaweah Subbasin

Draft Staff Report Kaweah Subbasin
May 2024

Figure 3-2: Topographic Map of the Kaweah Subbasin
Excerpt from the Kaweah Coordination Agreement



Draft Staff Report Kaweah Subbasin
May 2024

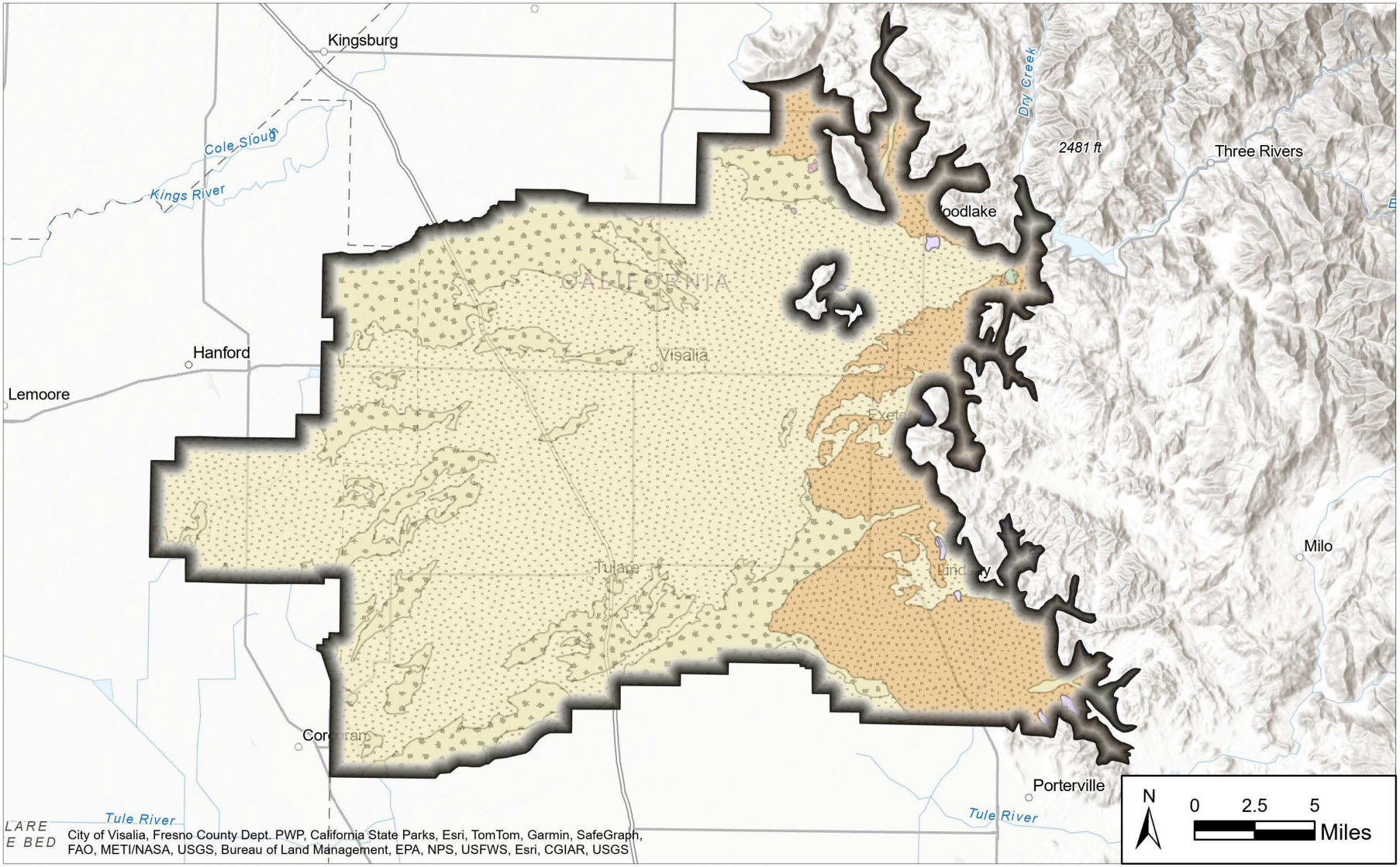


Figure 3-3

Geology of the Kaweah Subbasin

Draft Staff Report Kaweah Subbasin
May 2024

Data Source:
The Geologic Atlas of California (1:250,000 scale) Fresno Sheet

Figure 3-4: The Cordilleran Orogeny

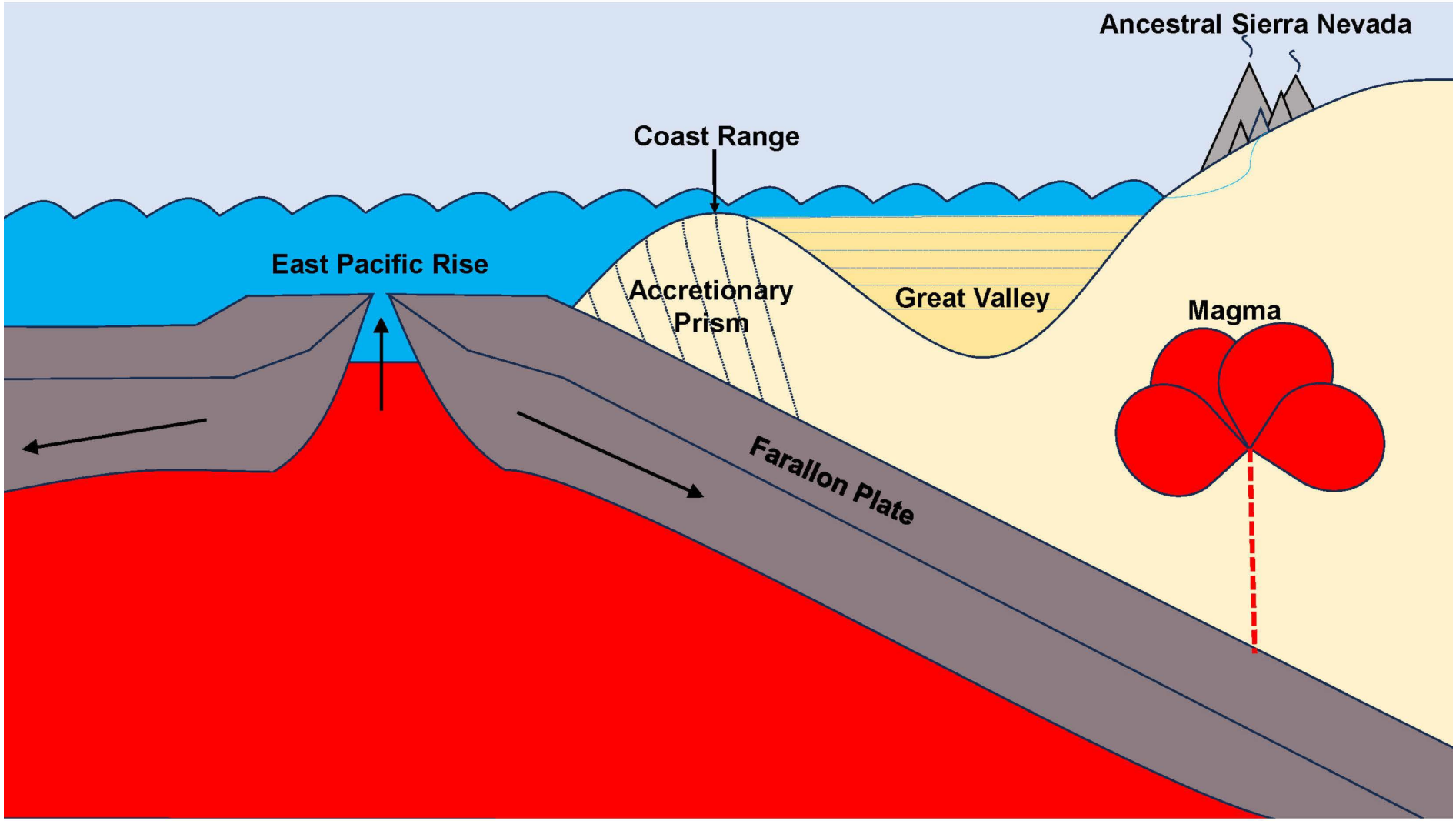


Figure 3-5: Cross Section B
Excerpt from the Kaweah Coordination Agreement

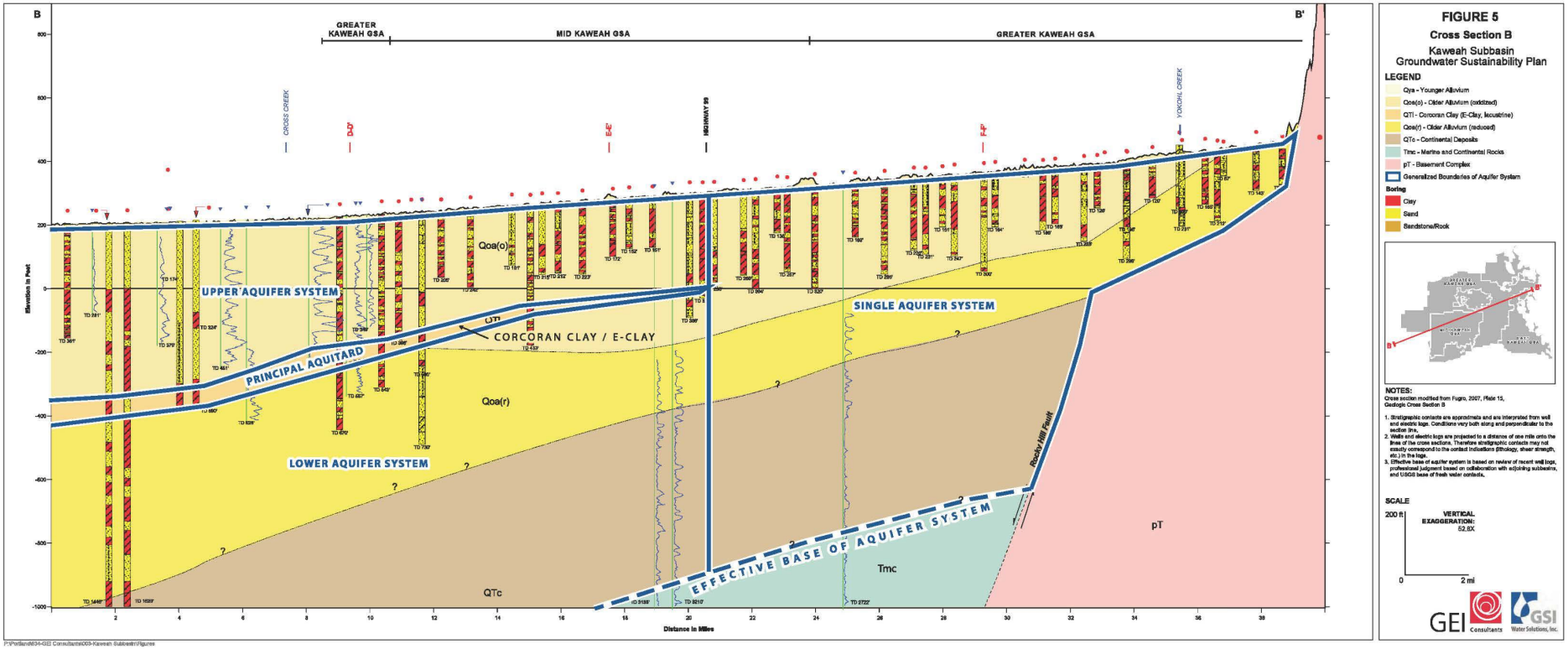
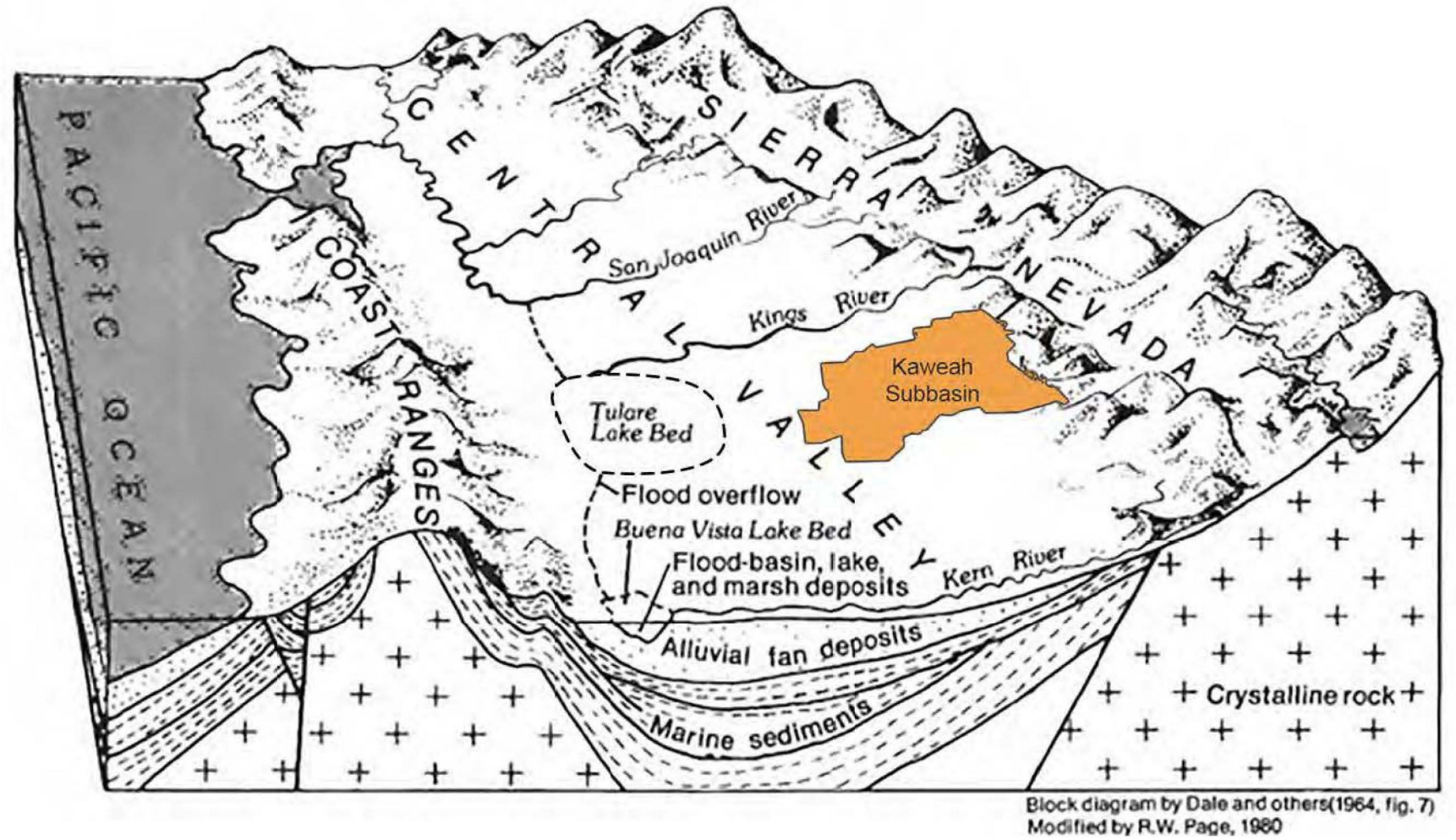


Figure 3-6: Isometric Block Diagram of Central San Joaquin Valley
Excerpt from the Kaweah Coordination Agreement



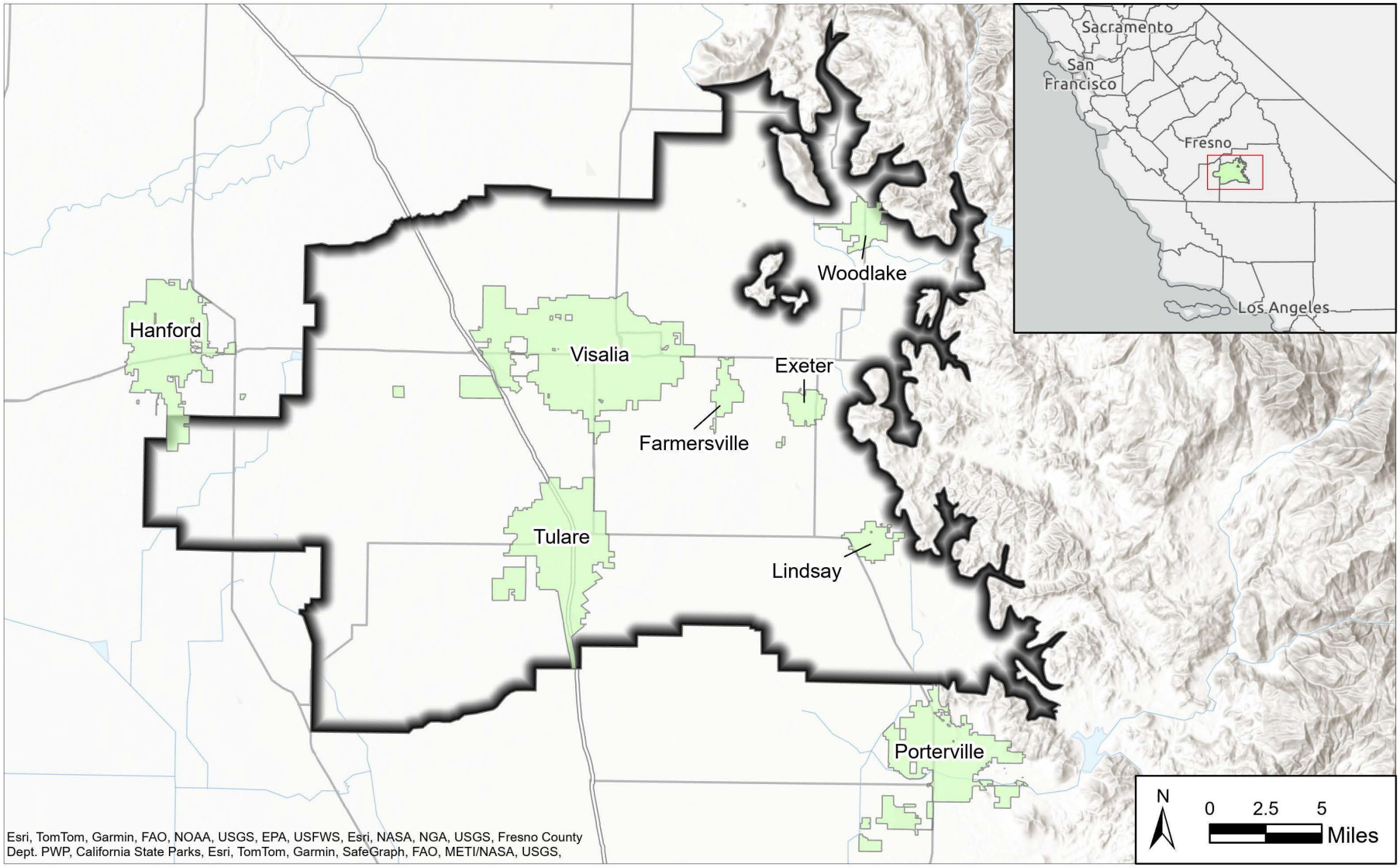


Figure 3-7

Cities in the Kaweah Subbasin

Kaweah Subbasin

Cities

Data Source:
California Department of Forestry and Fire Protection
-Accessed October 2023

https://data.cnra.ca.gov/dataset/california-incorporated-cities1

Draft Staff Report Kaweah Subbasin
May 2024

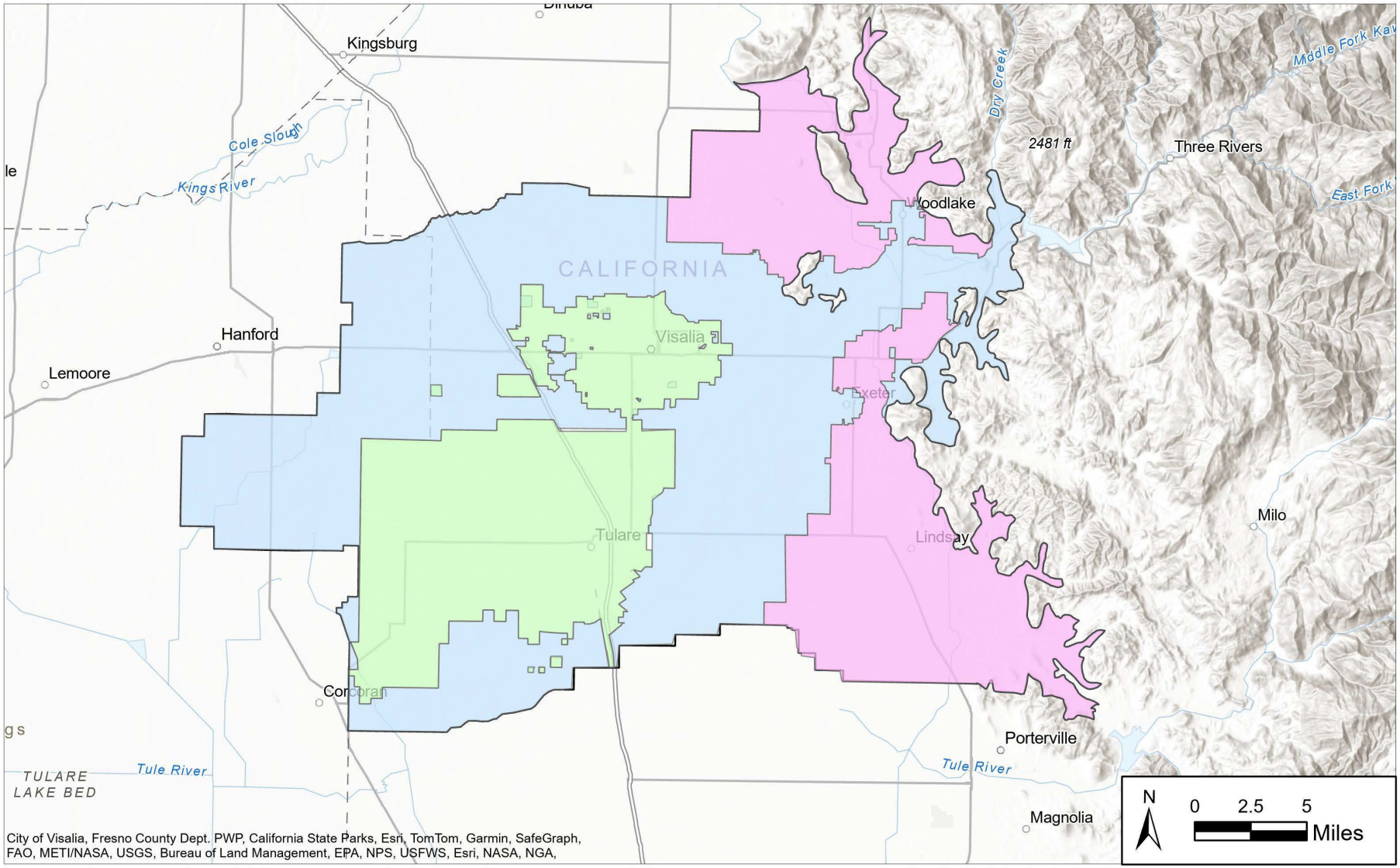


Figure 3-8

Groundwater Sustainability Agencies in the Kaweah Subbasin

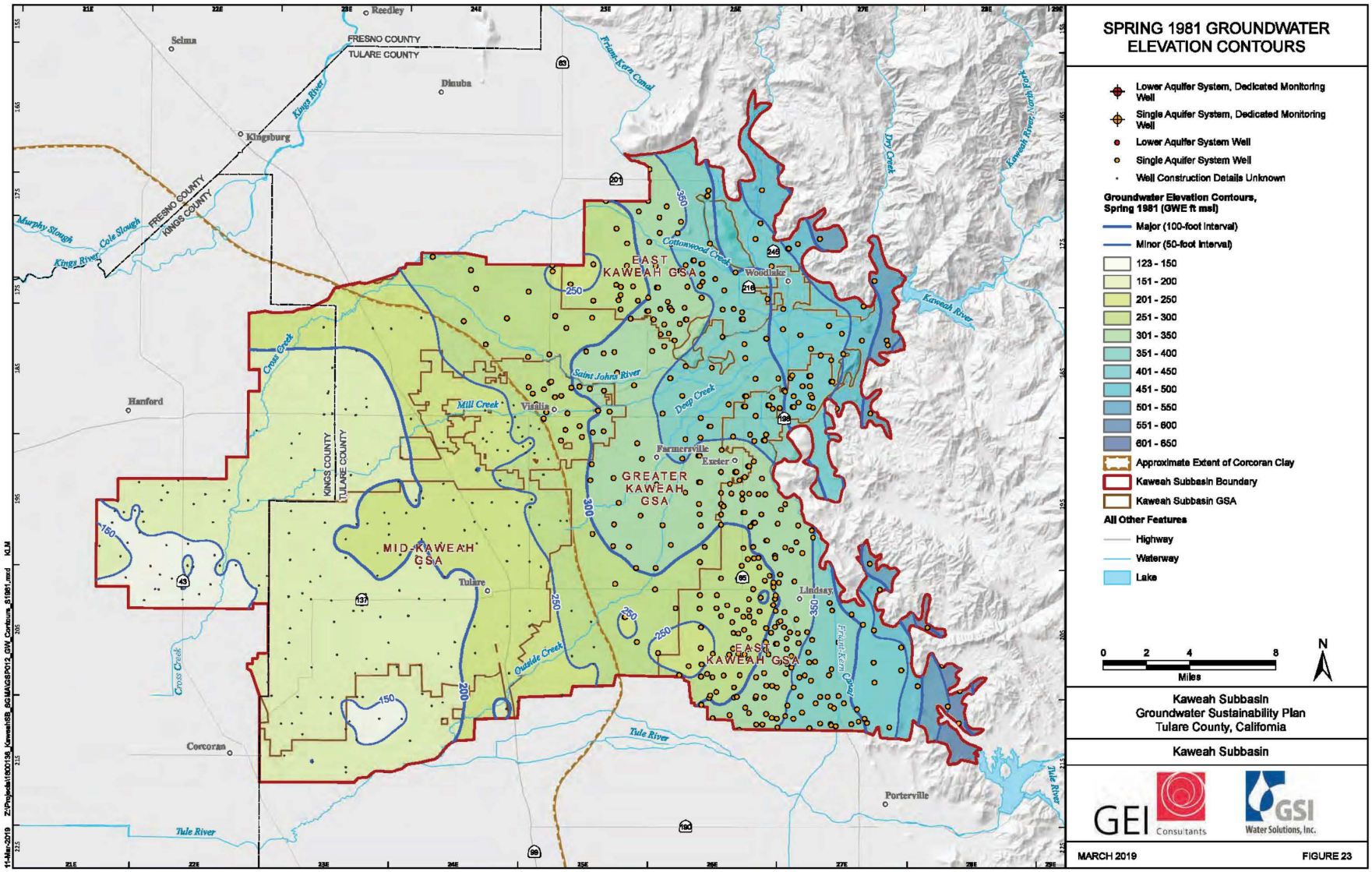
Draft Staff Report Kaweah Subbasin
May 2024

- Mid-Kaweah GSA
- Greater Kaweah GSA
- East Kaweah GSA
- Kaweah Subbasin

Data Source:
DWR SGMA Portal
-Accessed December 2023

https://sgma.water.ca.gov/portal/gsa/print/7
https://sgma.water.ca.gov/portal/gsa/print/281
https://sgma.water.ca.gov/portal/gsa/print/314

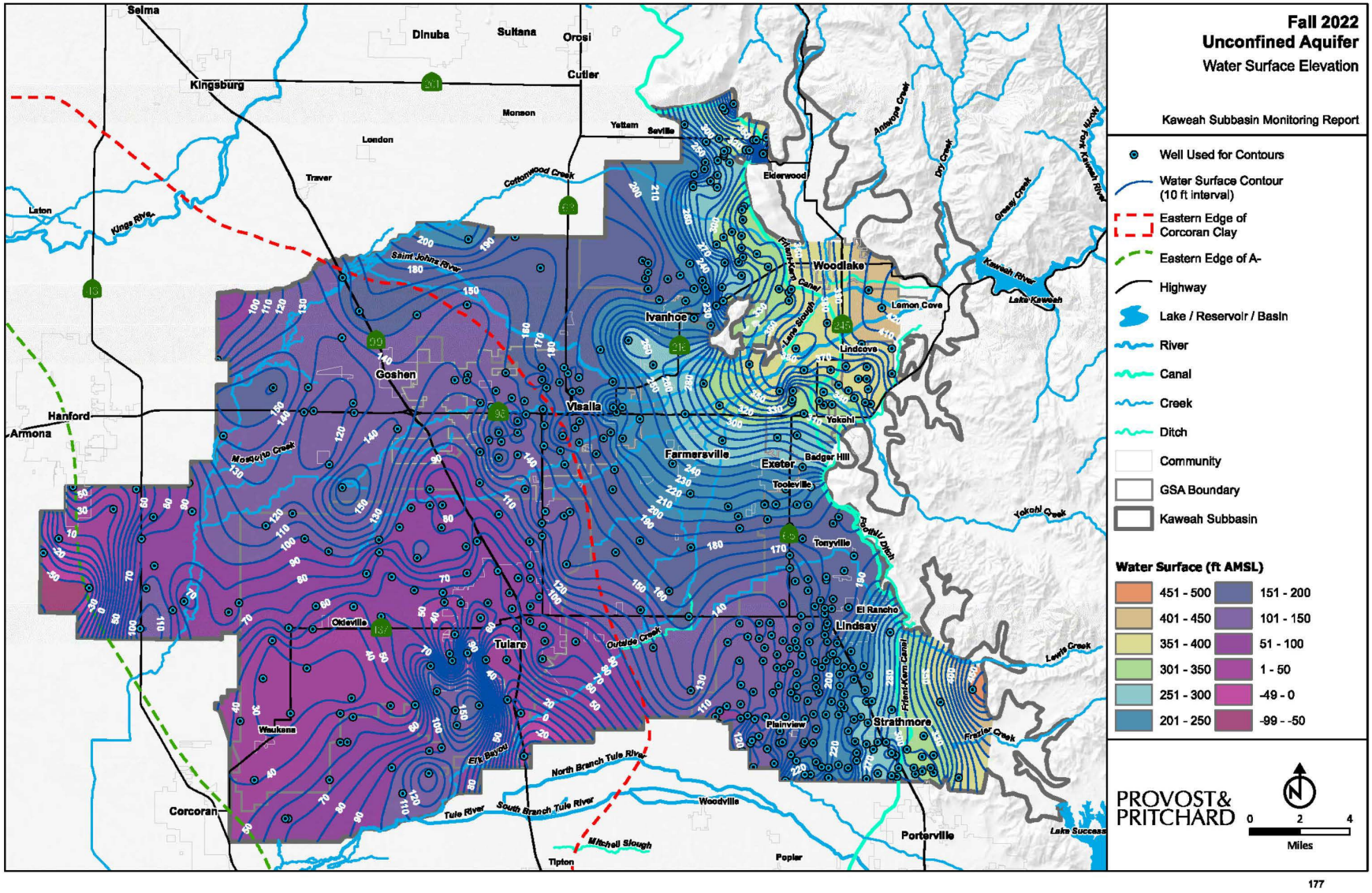
Figure 3-9a: Spring 1981 Groundwater Elevation Contours
Excerpt from the Kaweah Coordination Agreement



Draft Staff Report Kaweah Subbasin
May 2024

Figure 3-9b: Fall 2022 Unconfined Aquifer Water Surface Elevation

Excerpt from the Kaweah 2022 Annual Report



Draft Staff Report Kaweah Subbasin

May 2024

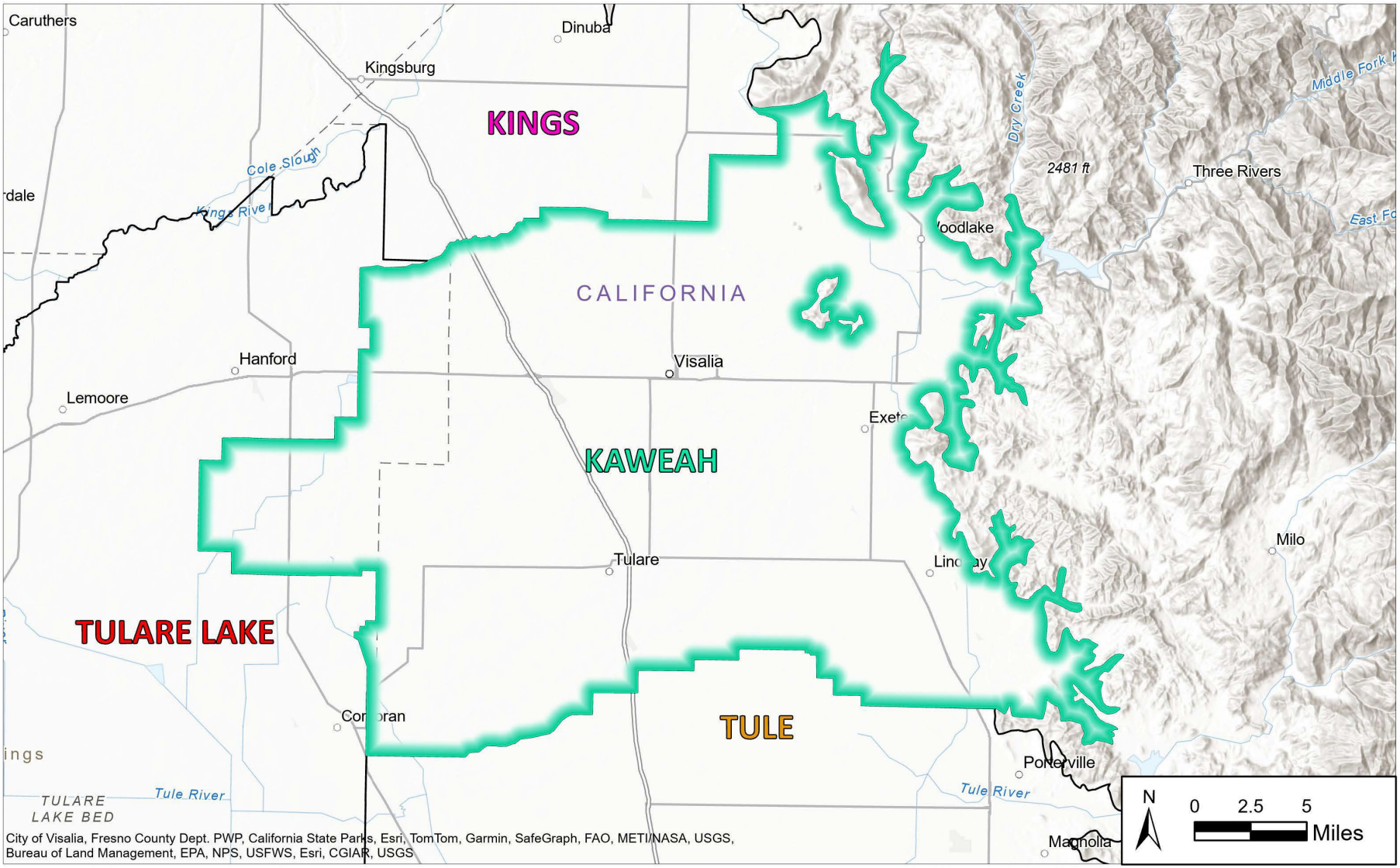


Figure 3-10

Subbasins Adjacent to Kaweah Subbasin

Draft Staff Report Kaweah Subbasin
May 2024

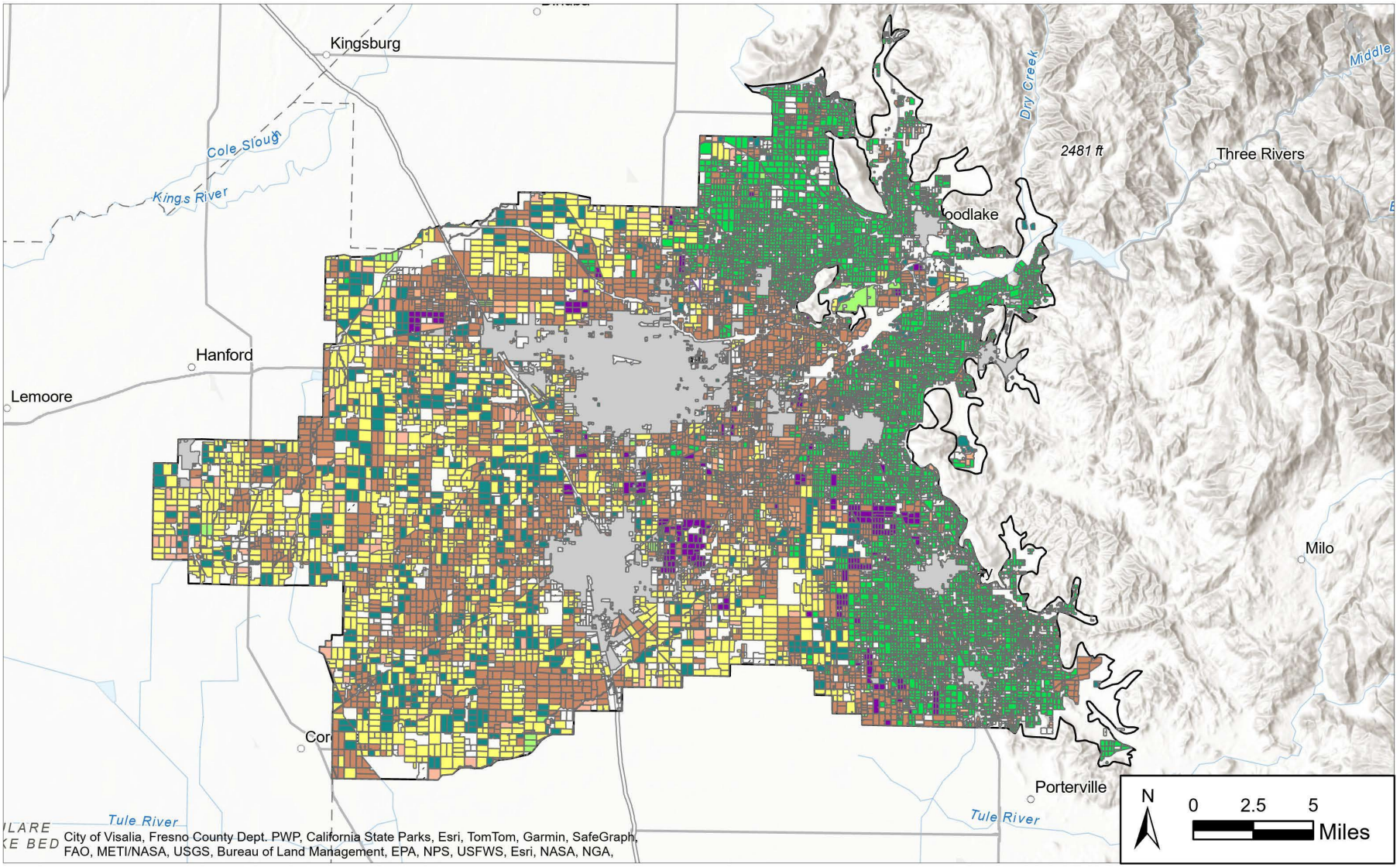


Figure 3-11

Land Use Classification in the Kaweah Subbasin (2021)

Draft Staff Report Kaweah Subbasin May 2024

Data Source:
DWR Provisional 2021 Statewide Land Use data -Accessed December 2023

https://data.cnra.ca.gov/dataset/statewide-crop-mapping/resource/eebd40ab-35a3-4e62-a625-0275b2849531

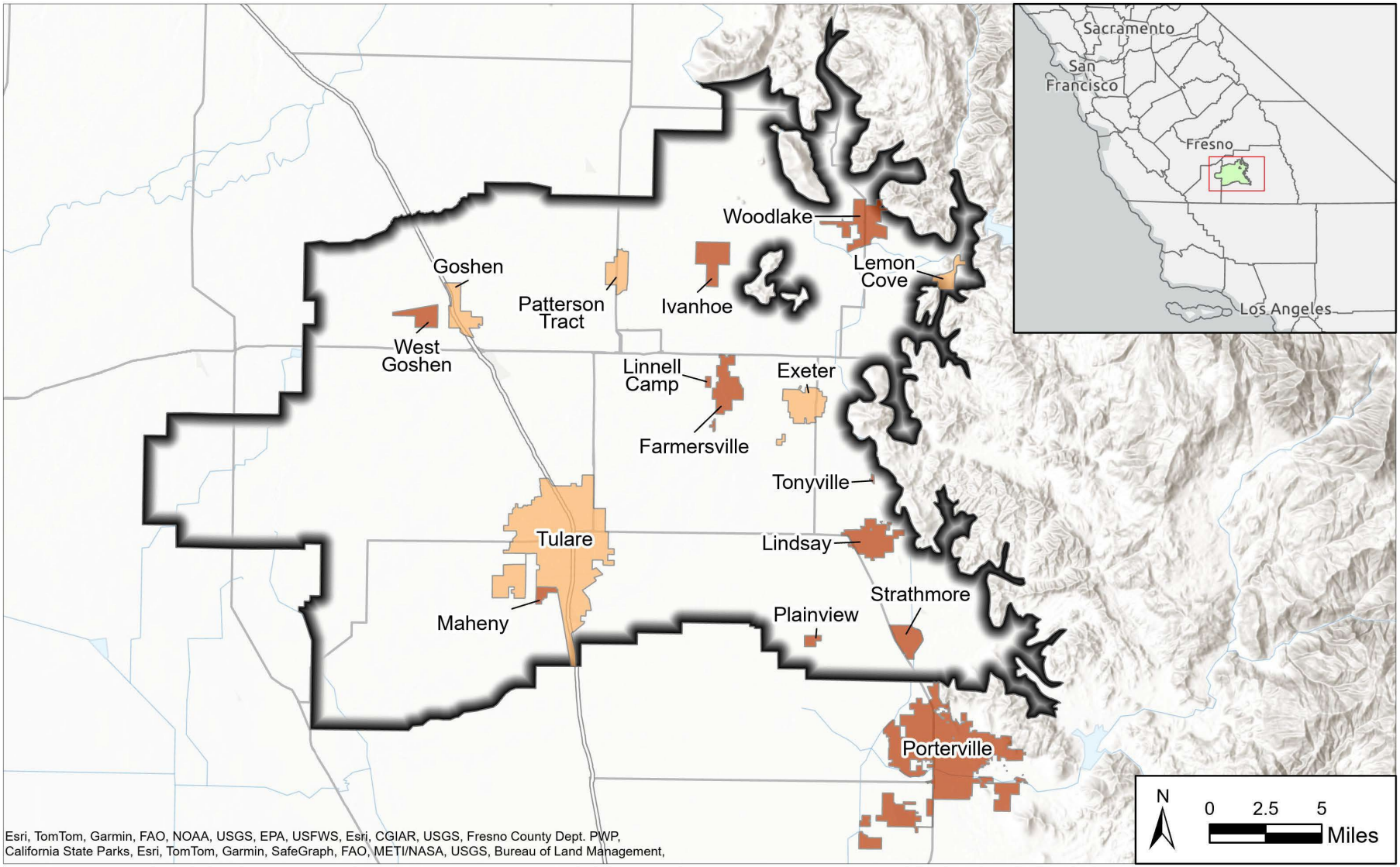


Figure 3-12

Disadvantaged Communities in the Kaweah Subbasin

Draft Staff Report Kaweah Subbasin May 2024

Kaweah Subbasin

Median Household Income

Disadvantaged Communities ($47,203 - $62,938)

Severely Disadvantaged Communities (<$47,203)

Data Source:
Department of Water Resources DAC Mapping Tool
-Accessed October 2023

https://gis.water.ca.gov/app/dacs/

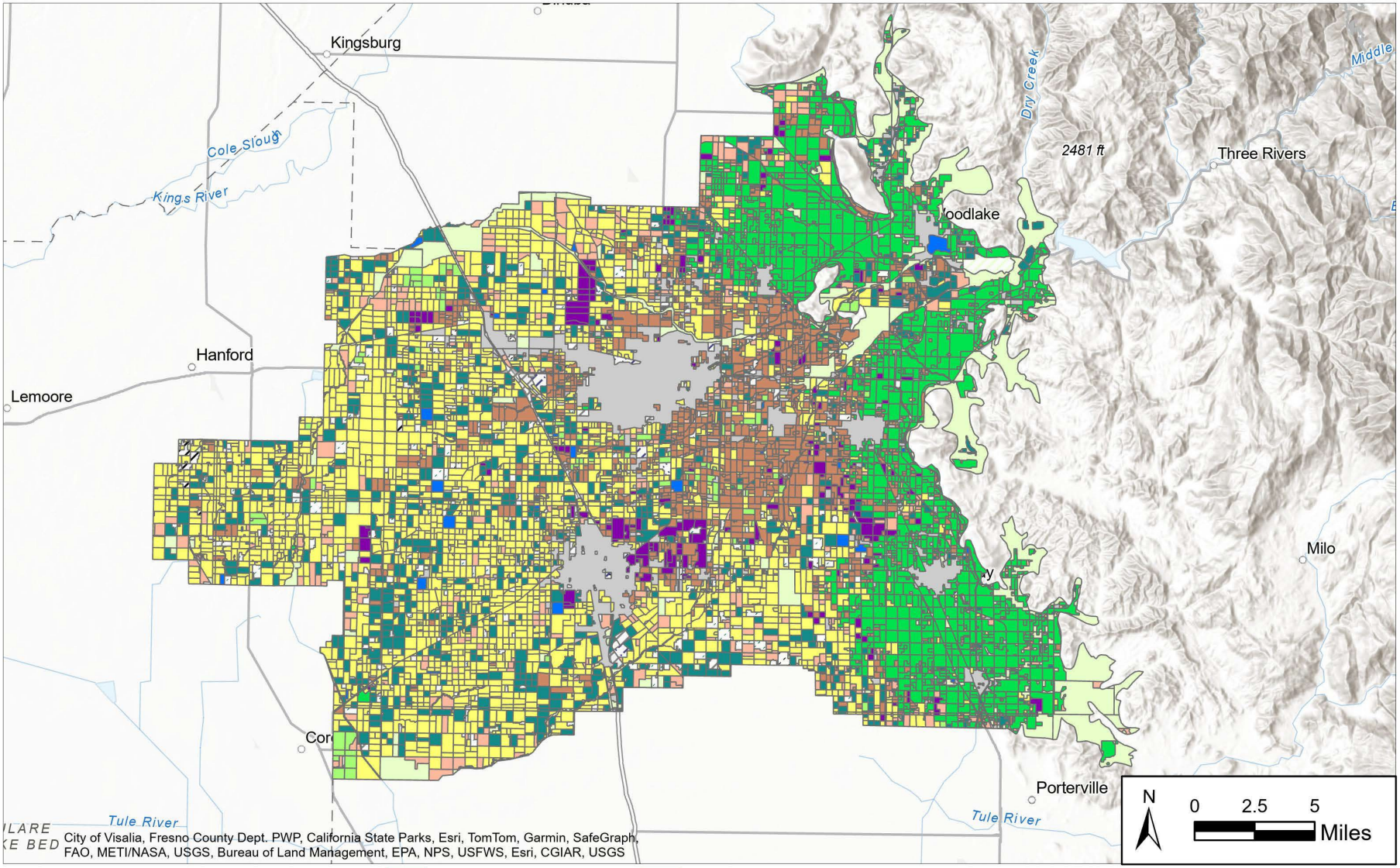


Figure 3-13

Land Use Classification in the Kaweah Subbasin (1993 and 1996)

Draft Staff Report Kaweah Subbasin
May 2024

Data Source:
DWR County Land Use Surveys
(1993 Tulare County)
(1996 Kings County)
-Accessed December 2023

https://data.cnra.ca.gov/dataset/county-land-use-surveys

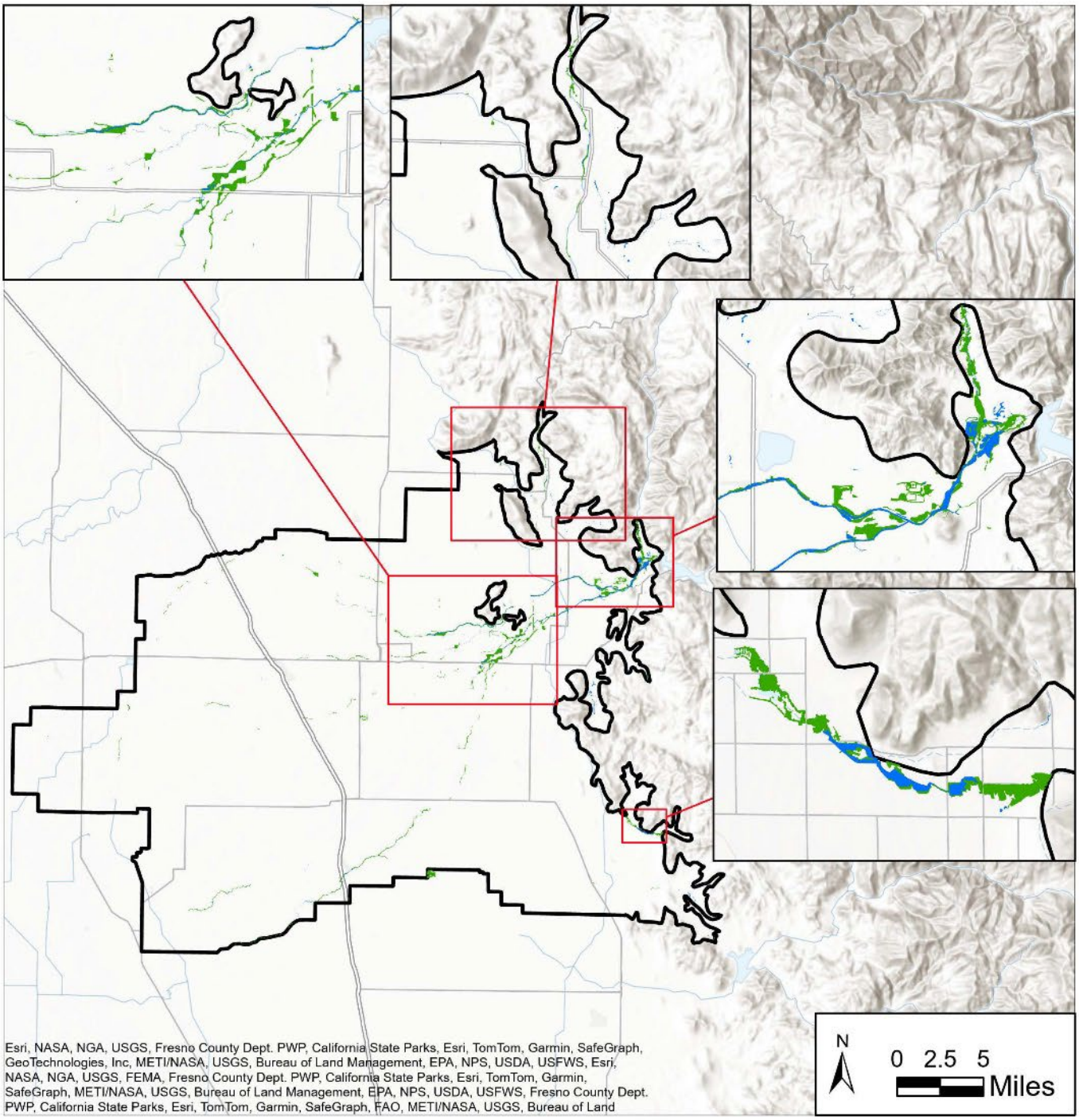


Figure 3-14a

Groundwater Dependent Ecosystems in the Kaweah Subbasin

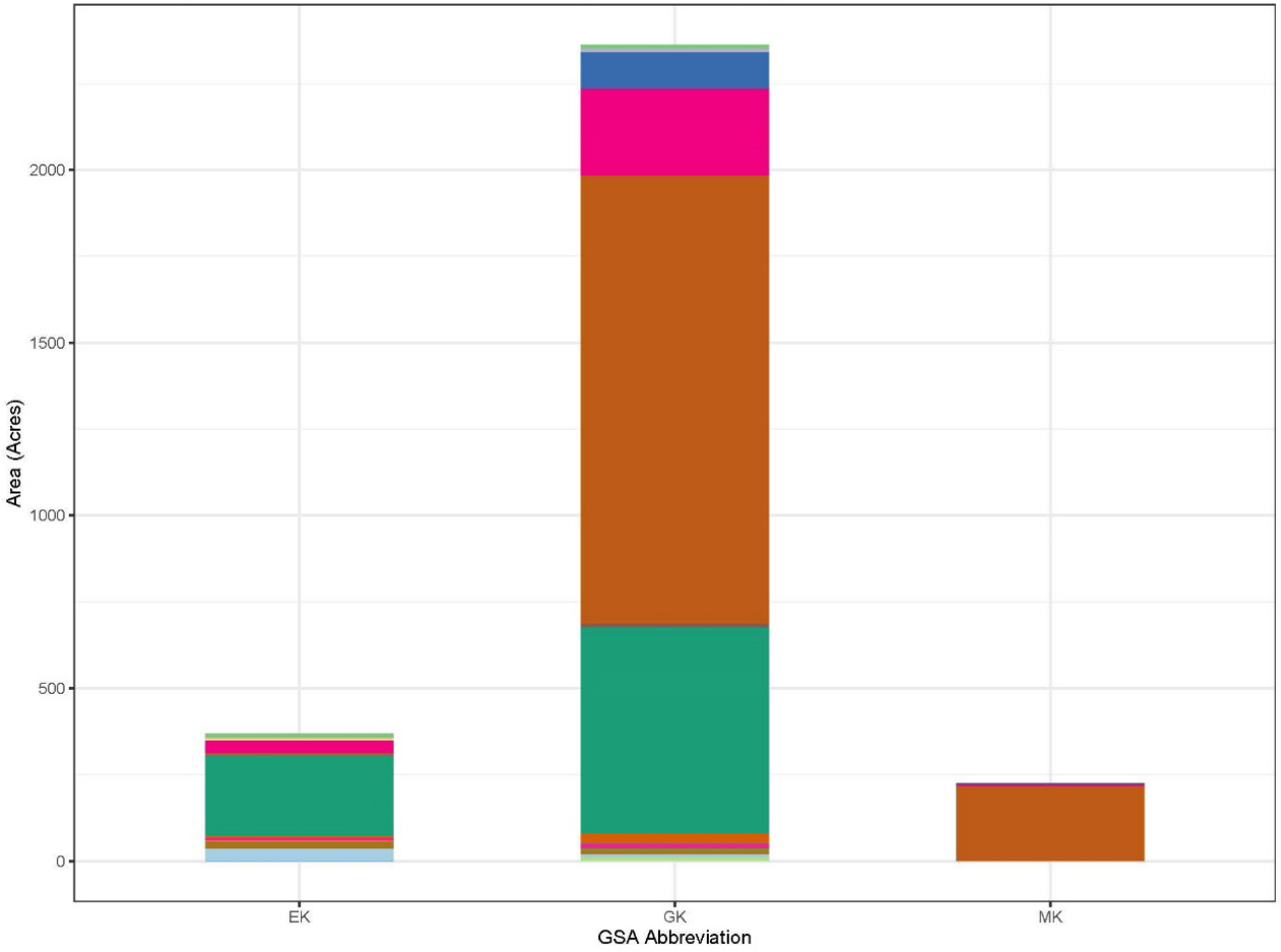
Wetlands
Vegetation
Kaweah Subbasin

Data Source:
Natural Communities Commonly Associated with Groundwater dataset
-Accessed November 2023

https://gis.water.ca.gov/app/NCDatasetViewer/#

Draft Staff Report Kaweah Subbasin
May 2024

Figure 3−14b Vegetatitive Groundwater Dependent Ecosystems Area By Type Per GSA



Abrev	GSA Name	Largest Combined GDE Type (Acres)
EK	East Kaweah GSA	*Quercus lobata (1296.7)*
GK	Greater Kaweah GSA	*Quercus lobata (215.4)*
MK	Mid−Kaweah GSA	*Salix gooddingii (236.4)*

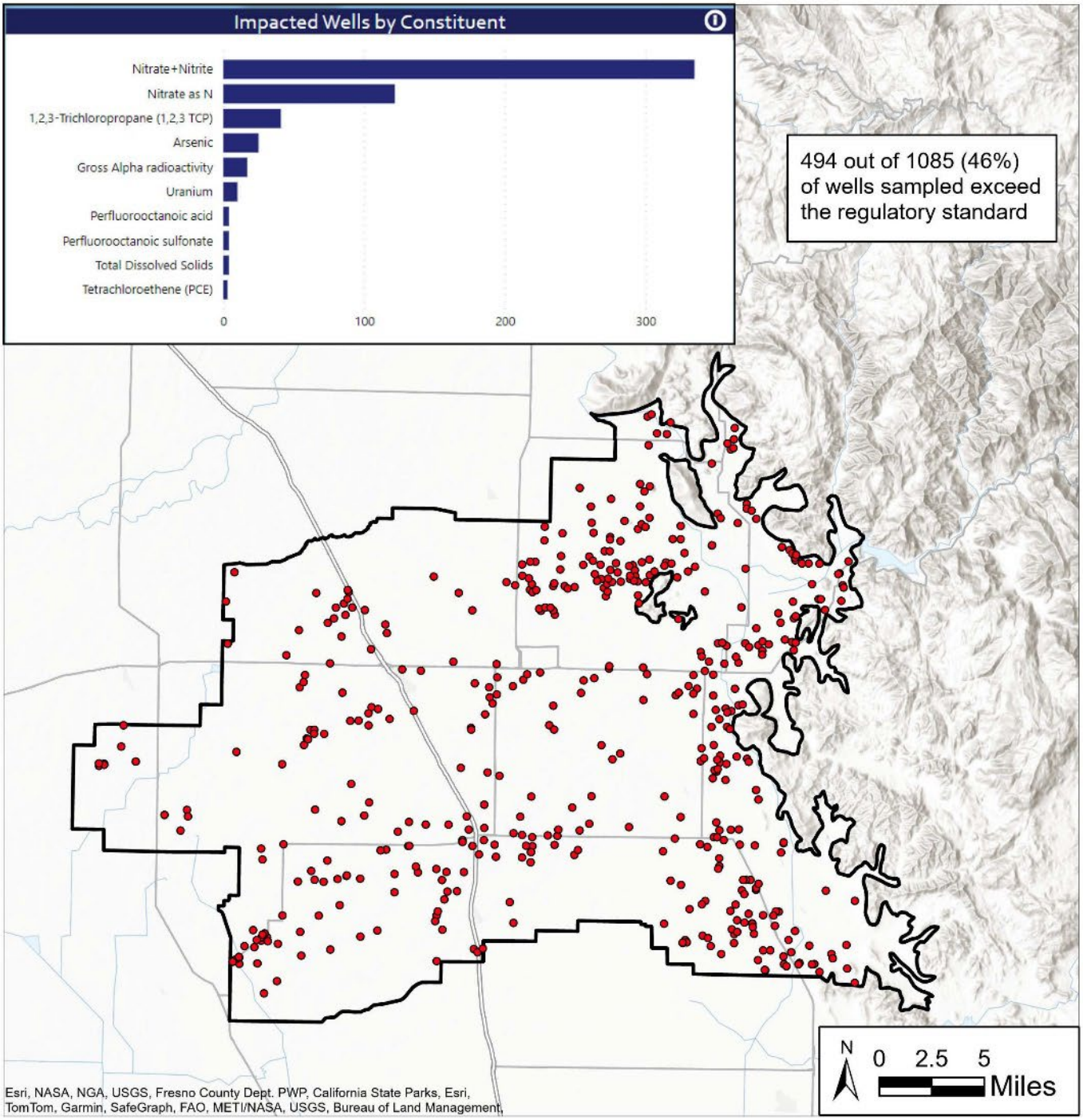


Figure 3-15

Wells with Constituent Detections Greater than the Comparable Concentration Value

Kaweah Subbasin

Wells with Detections Greater than the Comparable Concentration Value

Data Source:
SWRCB SGMA Groundwater Quality Visualization Tool
-Accessed November 2023

https://www.waterboards.ca.gov/water_issues/programs/sgma/water-quality-visualization-tool.html

Draft Staff Report Kaweah Subbasin
May 2024

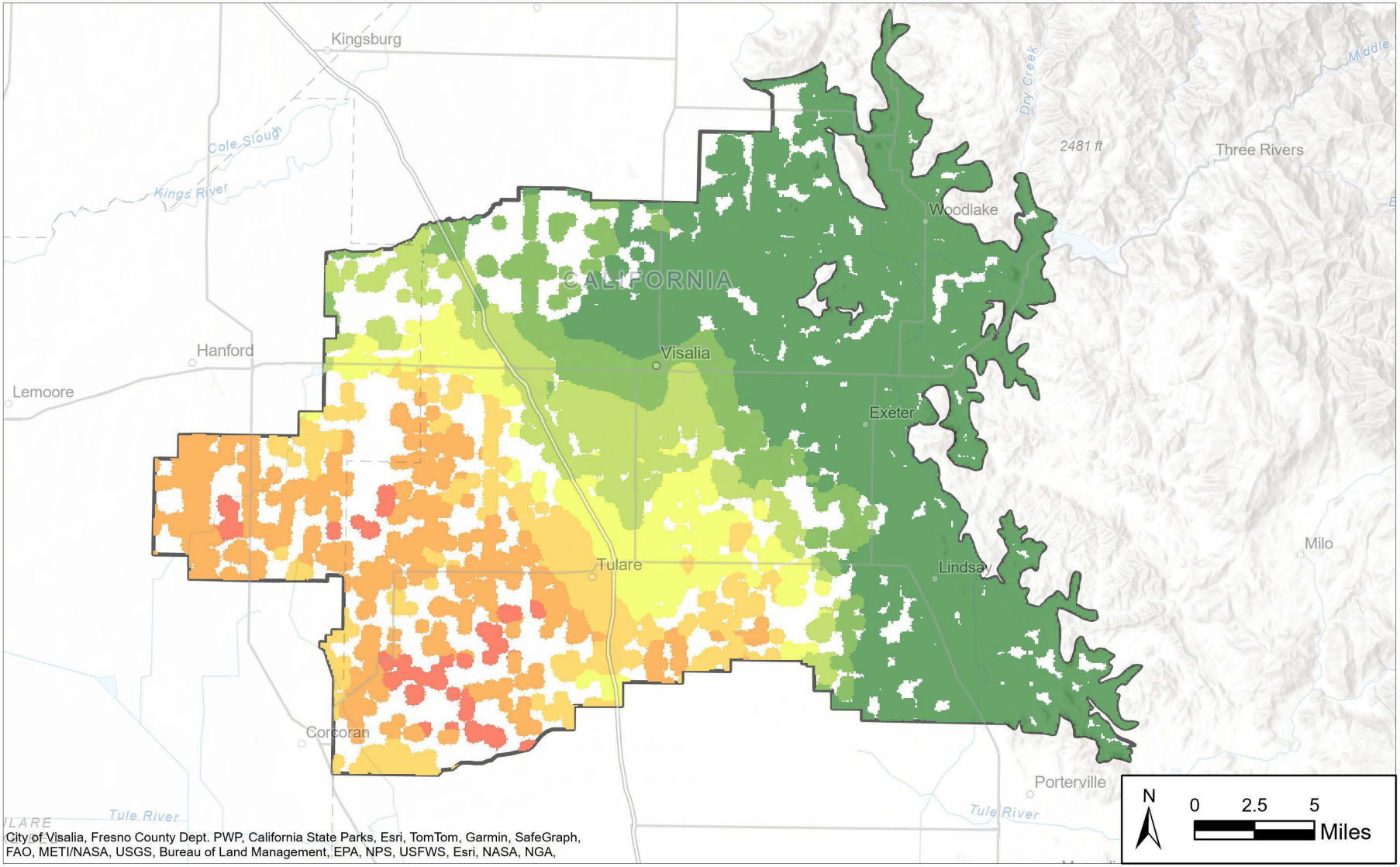


Figure 3-16

Feet of Subsidence in the Kaweah Subbasin (June 2015 - January 2024)

Draft Staff Report Kaweah Subbasin
May 2024

Data Source:
California Department of Water Resources TRE ALTAMIRA database
- Accessed January 2024

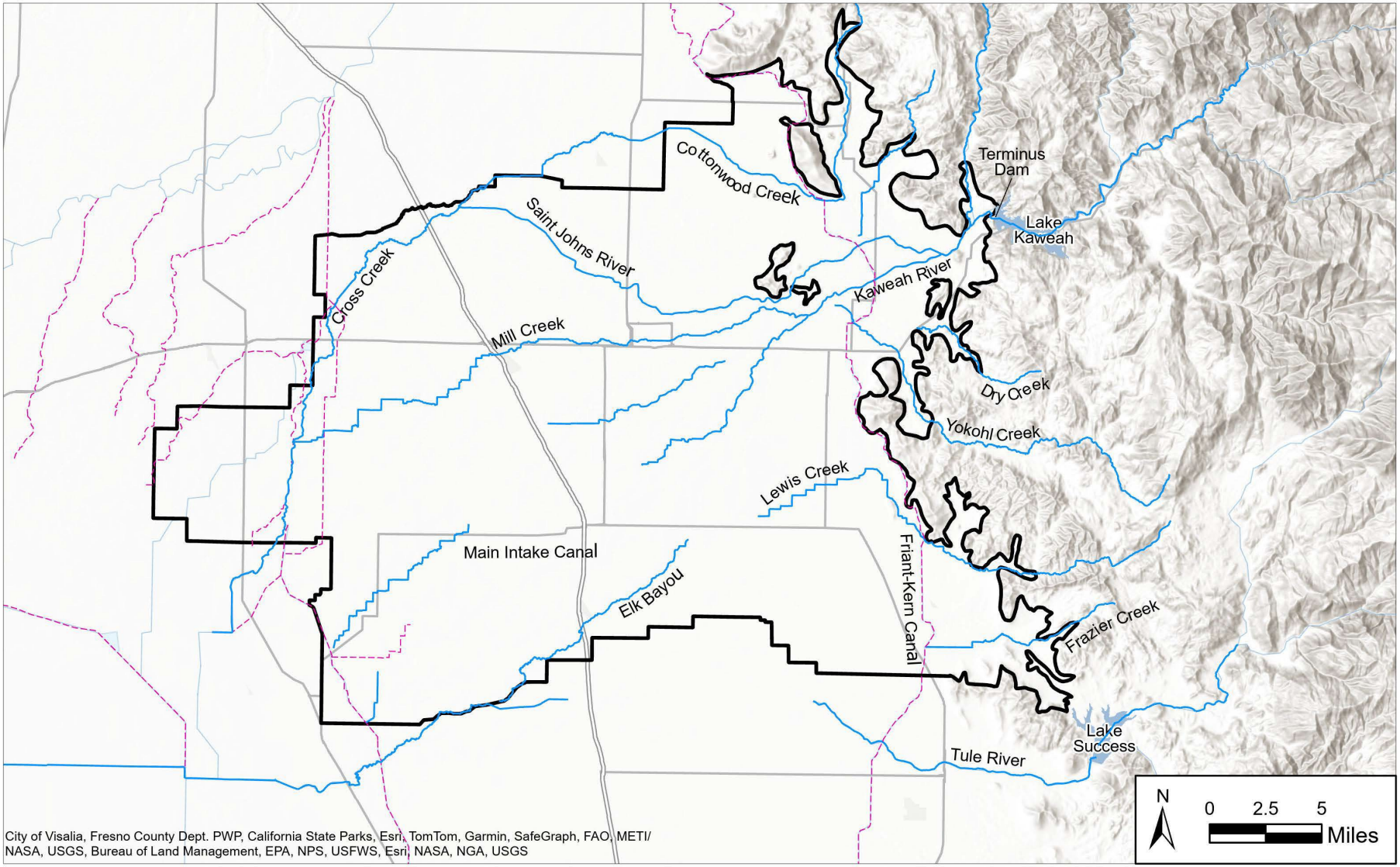


Figure 3-17

Surface Water Bodies and Canals in the Kaweah Subbasin

Draft Staff Report Kaweah Subbasin
May 2024

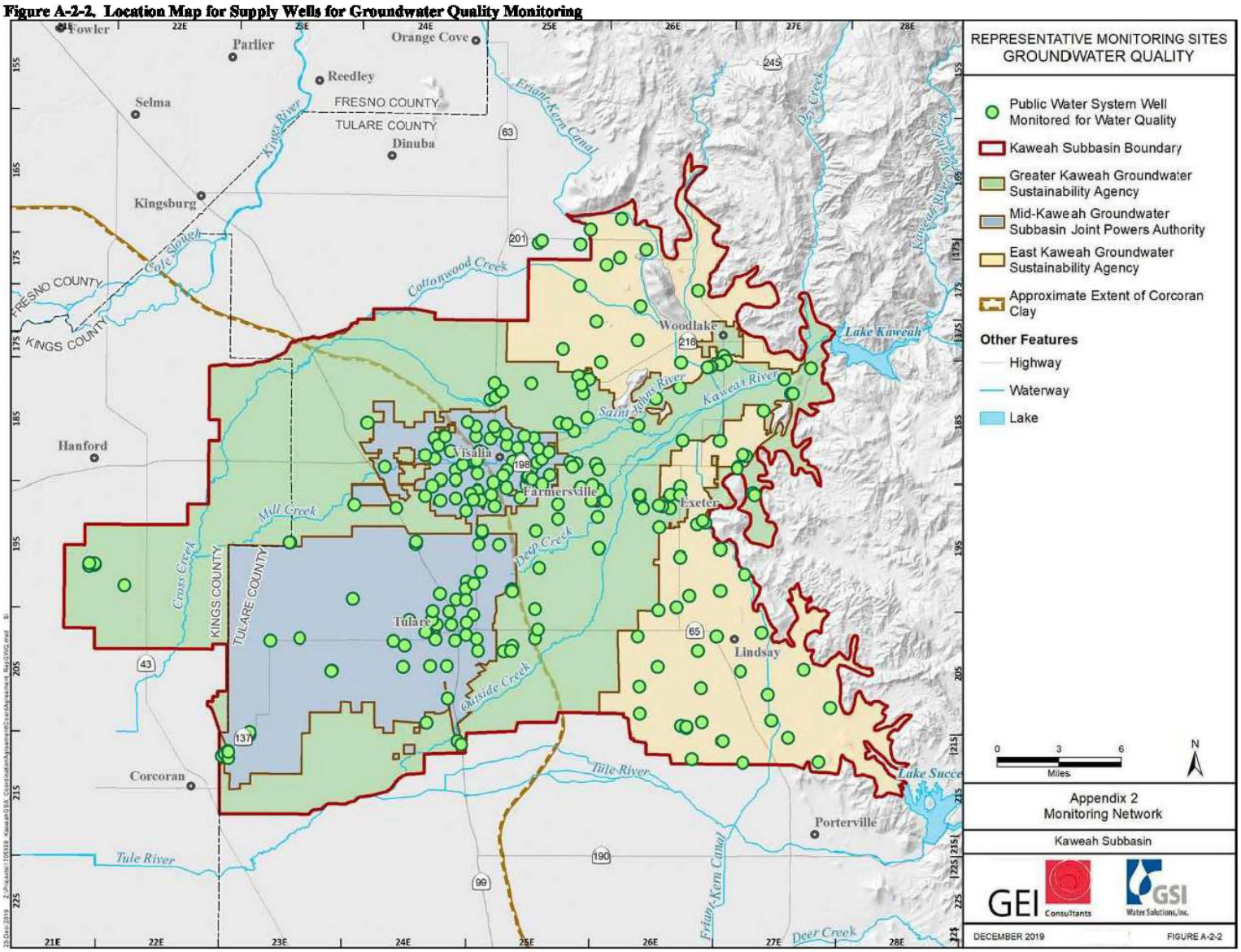
- Rivers and Creeks
- Lakes and Reservoirs
- Canals and Aqueducts
- Kaweah Subbasin

Data Source:
Department of Water Resources SGMA Data Viewer (Accessed November 2023)
- Major Rivers and Creeks (NHD)
- Local Canals and Aqueducts
- Federal Canals and Aqueducts

https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#currentconditions

Figure 4-1: Groundwater Quality Monitoring Network in the Kaweah Subbasin

Excerpt from the Kaweah Coordination Agreement



Draft Staff Report Kaweah Subbasin

May 2024