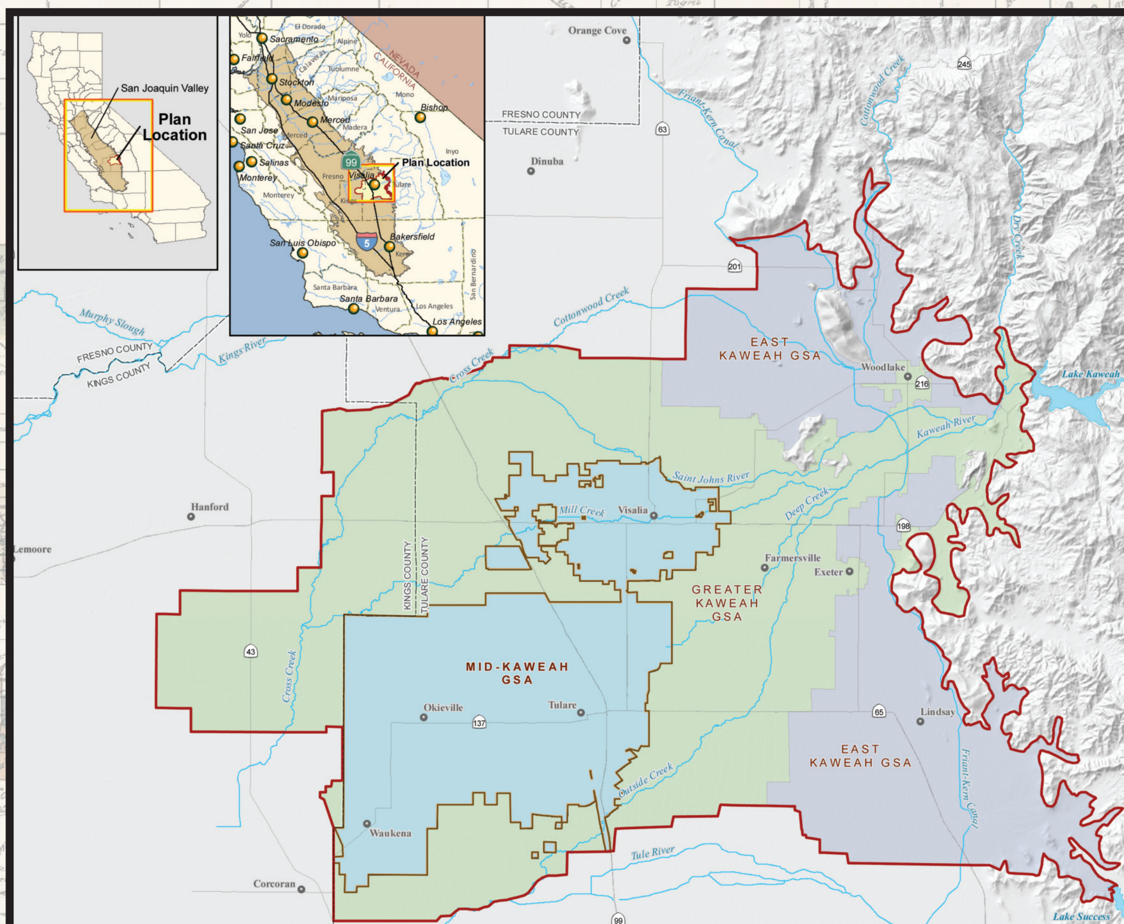
Mid-Kaweah GSA



2022 First Amended Groundwater Sustainability Plan

MID-KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

July 27, 2022

Prepared under the Kaweah Subbasin Coordination Agreement with Greater Kaweah GSA and East Kaweah GSA

2022 First Amended Groundwater Sustainability Plan

July 27, 2022

Submitted to:
Mid-Kaweah Groundwater Sustainability Agency

2022 First Amended Groundwater Sustainability Plan

Revisions prepared by:

MONTGOMERY & ASSOCIATES
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In association with:

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

2020 Groundwater Sustainability Plan

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Appendices correspond with GSP Section. Note that there is no Appendix to Sections 6, 8, or 9.

Acronyms and Abbreviations

AEM .... Airborne Electromagnetic Surveying
AF .... acre-feet
APPS .... Automatic Precise Positioning Service
ASO .... NASA's Airborne Snow Observatory
BMP .... Best Management Practice
Board .... State Water Resources Control Board
C&E........................... Communications and Engagement
CalOES .... California Office of Emergency Services
CASGEM .... California Statewide Groundwater Elevation Monitoring
CCR .... California Code of Regulations
CEQA........................ California Environmental Quality Act
CIMIS .... California Irrigation Management Information System
CIT .... California Institute of Technology
CORS........................ continuously operating reference station
CVP........................... Central Valley Project
CVPIA .... Central Valley Project Improvement Act
CWSC .... California Water Service Company
DGPS........................ Differential GPS
DMS .... Data Management System
DWR .... California Department of Water Resources
FEMA .... Federal Emergency Management Agency
gpcd .... gallons per capita per day
GEI............................ GEI Consultants, Inc.
GIPSY-OASIS........... Inferred Positioning System and Orbital Analysis Simulation Software
GNSS........................ Global Navigation Satellite System
GRAT .... Groundwater Recharge Assessment Tool
GSA .... Groundwater Sustainability Agency
GSP or Plan .... Groundwater Sustainability Plan
HCM.......................... Hydrogeologic Conceptual Model
ID .... Irrigation District
IM .... Interim milestone

InSAR........................ Interferometric Synthetic Aperture Radar

ITRC.......................... Irrigation Training & Research Center

JPA .... Joint Powers Authority

JPL............................ Jet Propulsion Laboratory

KDWCD .... Kaweah Delta Water Conservation District

KSHM........................ Kaweah Subbasin Hydrologic Model

KSJRA .... Kaweah and St. Johns River Association

MA............................ Management Area

MAF .... Million Acre Feet

MCL .... Maximum Contaminant Level

MKGSA..................... Mid-Kaweah Groundwater Sustainability Agency

MO .... Measurable Objective

MSL........................... Mean Sea Level

MT............................. Minimum Threshold

NASA .... National Aeronautics and Space Administration

NAVD88.................... North American Vertical Datum of 1988

NDVI .... Normalized Difference Vegetation Index

NEPA .... National Environmental Policy Act

NGO.......................... Non-Governmental Agency

OPUS........................ Online Positioning User Service

PPP........................... Precise point positioning

RO............................. Reverse Osmosis

RP............................. Reference Point

SCADA...................... Supervisory Control and Data Acquisition

SGMA .... Sustainable Groundwater Management Act

SJRRP .... San Joaquin River Restoration Project

SMARA .... Surface Mining and Reclamation Act

SMC .... Sustainable Management Criteria

SOP .... Standard Operating Procedure

SOR .... System Optimization Review

SWRCB..................... State Water Resources Control Board

TAF .... Thousand acre-feet

TDS........................... Total Dissolved Solids

TID .... Tulare Irrigation District
UWMPs..................... Urban Water Management Plans
USBR......................... U.S. Bureau of Reclamation
USGS......................... U.S. Geological Survey
WWTP....................... wastewater treatment plant

Definitions

The following definitions are an assemblage of those provided in the SGMA legislation (CWC §10721), the GSP Regulations (23 CCR §351), and those provided by GSA management to clarify terms used in the Kaweah Subbasin GSPs. These definitions apply to this GSP document but may also be found in the Appendices or other attachments to the Mid Kaweah Groundwater Sustainability Agency's Groundwater Sustainability Plan.

Adjudication action	An action filed in the superior or federal district court to determine the rights to extract groundwater from a basin or store water within a basin, including, but not limited to, actions to quiet title respecting rights to extract or store groundwater or an action brought to impose a physical solution on a basin.
Agency	A groundwater sustainability agency as defined in the Act.
Agricultural water management plan	A plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.
Alternative	An alternative to a Plan described in Water Code Section 10733.6.
Annual report	The report required by Water Code Section 10728.
Areal Electro Magnetics – SKYTEM	The collection of subsurface information on the relative conductivity of subsurface material from ground surface to an approximate depth of 1,000 feet. This information is collected from a helicopter equipped with equipment to both transmit and receive information.
Baseline or baseline conditions	Historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.
Basin	A groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

Basin setting	The information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.
Best available science	The use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.
Best management practice	A practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.
Bulletin 118	DWR's report entitled California's Groundwater: Bulletin 118 updated in 2003, as it may be subsequently updated or revised in accordance with Section 12924.
CASGEM	California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 et seq., or as amended.
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 to this part.
Current Water Budget	For MKGSA, "current water budget" refers to the period between water years 1997 and 2017. For the Kaweah basin the was the period over which the best data and information were available to calculating a water budget. Because this period has the lowest degree of uncertainty in terms of quantification of each water budget component, it was this period that was used for calibrating and verifying the numerical groundwater budget during the development of the 2020 GSP. This period is distinguished from the Historical Water Budget (1981-2017) and the projected future water budget (2017-2070).

Data gap	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.
De minimis extractor	A person who extracts, for domestic purposes, two acre- feet or less per year.
Governing body	The legislative body of a groundwater sustainability agency.
GPS Monitoring Station	For this purpose of the MKGSA GSP, this term refers to survey benchmarks measured periodically using GPS technology for the purpose of measuring changing in elevation overtime.
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.
Groundwater dependent ecosystem	Ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.
Groundwater extraction facility	A device or method for extracting groundwater from within a basin.
Groundwater flow	The volume and direction of groundwater movement into, out of, or throughout a basin.
Groundwater recharge or recharge	The augmentation of groundwater, by natural or artificial means.
Groundwater sustainability agency	One or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (commencing with Section 10730) or taking action to enforce a groundwater sustainability plan, groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.
Groundwater sustainability plan or plan	A plan of a groundwater sustainability agency proposed or adopted pursuant to this part.

Groundwater sustainability program	A coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.
Historical Water Budget	Also known as a "base period," the MKGSA "historical water budget" was selected to be between the years of 1981 and 2017. Fulfills DWR's regulatory requirement that, "a quantitative assessment of the historical water budget (be prepared) starting with the most recently available information (2017 in the case of Kaweah and extending a minimum of 10 years, or as sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon."
In-lieu use	The use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.
Interconnected surface water	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.
Interested parties	Persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.
Interim milestone	A target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.
Key Well	Approximately 118 wells preliminarily selected for the Kaweah Subbasin to establish a consistent, long-term source of data to monitor water levels in various aquifers over the long-term.
Land Surface Subsidence	The inelastic compaction that typically occurs in the fine-grained beds of the aquifers and in the aquitards due to the one-time release of water from the inelastic specific storage of clay layers caused by groundwater pumping.

Local agency	A local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.
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.
Measurable objectives	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.
Minimum threshold	A numeric value for each sustainability indicator used to define undesirable results.
Model Calibration	Adjustment of model input parameter such as hydraulic conductivity of aquifer storativity to improve the match between simulated and empirical data. During the development of the Kaweah GSPs only limited calibration us performed including adjusting only hydraulic conductivity of all three model layers between verifications runs in order to improve the match of simulated and empirical data. Calibration can be very time consuming and expensive, so the consulting team was only able to complete limited calibration give the time and budget constraints that existing during development of the 2020 GSPs. Calibration recommendations have been provided completion in the future as funding becomes available.
Model Verification	Groundwater model runs performed for the purpose of checking or verifying how well the model generated heads match empirical values at key wells.
NAD83	The North American Datum of 1983 computed by the National Geodetic Survey, or as modified.
NAVD88	The North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

Operator	A person operating a groundwater extraction facility. The owner of a groundwater extraction facility shall be conclusively presumed to be the operator unless a satisfactory showing is made to the governing body of the groundwater sustainability agency that the groundwater extraction facility actually is operated by some other person.
Owner	A person owning a groundwater extraction facility or an interest in a groundwater extraction facility other than a lien to secure the payment of a debt or other obligation.
Personal information	Personal information has the same meaning as defined in Section 1798.3 of the Civil Code.
Plain language	Language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.
Plan	A groundwater sustainability plan as defined in the Act.
Plan implementation	An Agency's exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.
Plan manager	An employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.
Planning and implementation horizon	A 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.
Principal aquifers	Aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

Projected Water Budget	For the Kaweah basin, "projected water budget" refers to the period between water years 2017 and 2070, fulfilling the DWR regulatory requirement that the GSP utilize 50 years of hydrology, and consider the impact of climate change on precipitation, evapotranspiration, streamflow.
Public water system	Public water system has the same meaning as defined in Section 116275 of the Health and Safety Code.
Recharge area	The area that supplies water to an aquifer in a groundwater basin.
Reference point	A permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.
Representative monitoring	A monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.
Seasonal high	The highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.
Seasonal low	The lowest annual static groundwater elevation that is typically measured in the Summer or Fall and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.
Seawater intrusion	The advancement of seawater into a groundwater supply that results in degradation of water quality in the basin and includes seawater from any source.
Statutory deadline	The date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.
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.

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(x).
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.
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.
Uncertainty	A lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.
Undesirable result	One or more of the following effects caused by groundwater conditions occurring throughout the basin: • 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. • Significant and unreasonable reduction of groundwater storage. • Significant and unreasonable seawater intrusion. • Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

	• Significant and unreasonable land subsidence that substantially interferes with surface land uses. • Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.
Urban water management plan	A plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.
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.
Watermaster	A watermaster appointed by a court or pursuant to other law.
Water Accounting Framework	The agreed-upon methodology to account for various components of the water budget consistent with commonly accepted rules regarding surface water and groundwater rights. This framework is reflected in the Subbasin Coordination Agreement.
Water source type	The source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.
Water use sector	Categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.
Water year	The period from October 1 through the following September 30, inclusive.
Water year type	The classification provided by the Department to assess the amount of annual precipitation in a basin.
Wellhead protection area	The surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

Executive Summary

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

The purpose of this Executive Summary is to provide a concise but complete overview of the content and primary messages in the Mid-Kaweah Groundwater Sustainability Plan (GSP or Plan), making clear the pathway to sustainability in the Mid-Kaweah Groundwater Sustainability Agency (MKGSA). This summary also provides the basis, supporting rationale, and limitations associated with the plan for achieving sustainability. The Executive Summary is organized by GSP section.

The Mid-Kaweah Groundwater Sustainability Agency (MKGSA or Agency) has prepared this Groundwater Sustainability Plan (GSP) to comply with the Sustainable Groundwater Management Act of 2014 (SGMA) for a portion of the Kaweah Subbasin. The remainder of the subbasin will be addressed by GSPs for the East Kaweah GSA and the Greater Kaweah GSA. Figure ES- 1 shows the location of these GSAs in the Kaweah Subbasin and GSAs in the adjacent subbasins. One or more GSP is required by SGMA for medium- and high-priority subbasins, including management criteria, to achieve the sustainable use of the groundwater resource. The Kaweah Subbasin is classified as high-priority, according to California Water Code § 10933 (b), and has been designated in critical overdraft by the California Department of Water Resources (DWR). This latter designation requires the submittal of the GSP to DWR by January 31, 2020.

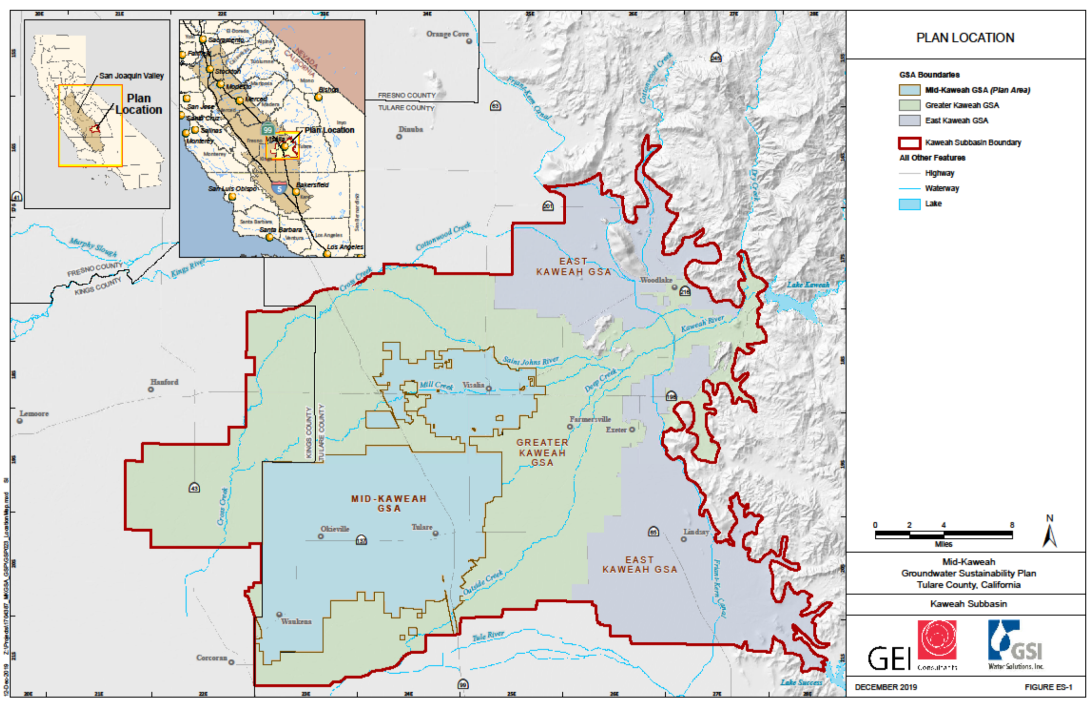

Figure ES- 1: MKGSA Plan Location Map

Full-size figure provided at the end of this Section.

Section 1 Introduction

Section 1 provides introductory information about the MKGSA and its jurisdictional area, including land use, water use, wells, and other characteristics, outreach to stakeholders, and the organization of the GSP.

The Kaweah Subbasin (No. 5-22.11 per DWR Bulletin 118, 2003, 2016) covers 696 square miles within the larger San Joaquin Valley Basin and is situated primarily within Tulare County with a small portion in eastern Kings County. The region is a prime agricultural area in the Central Valley and home to numerous small towns and communities, as well as the larger cities of Tulare and Visalia. Surface water supplies consist of the local Kaweah River system, as well as the Friant Unit of the Central Valley Project (CVP). Most urban communities rely exclusively on groundwater, and agricultural lands possess a mix of surface supplies as well as groundwater depending on location. Conjunctive-use recharge operations have utilized these water supply sources for several decades.

The MKGSA was formed September 14, 2015, through execution of a joint powers agreement between the City of Tulare, City of Visalia, and Tulare Irrigation District to establish the Mid-Kaweah Groundwater Subbasin Joint Powers Authority. Figure ES- 2 shows the location of these agencies as well as other related agencies. Pursuant to Water Code §10723.8, these Members notified DWR on September 16, 2015, of the Agency's formation and its intent to develop a GSP. The decision-making structure of the MKGSA Board of Directors is supported through a hierarchical structure that includes the GSA's Manager, a Management Committee comprised of key staff from each member agency, and a Technical Advisory Sub-Committee. To provide for a venue for consultation with community members, the agency formed an 11-member Advisory Committee. Advisory Committee meetings are held monthly, or otherwise announced, and publicly noticed consistent with the Brown Act.

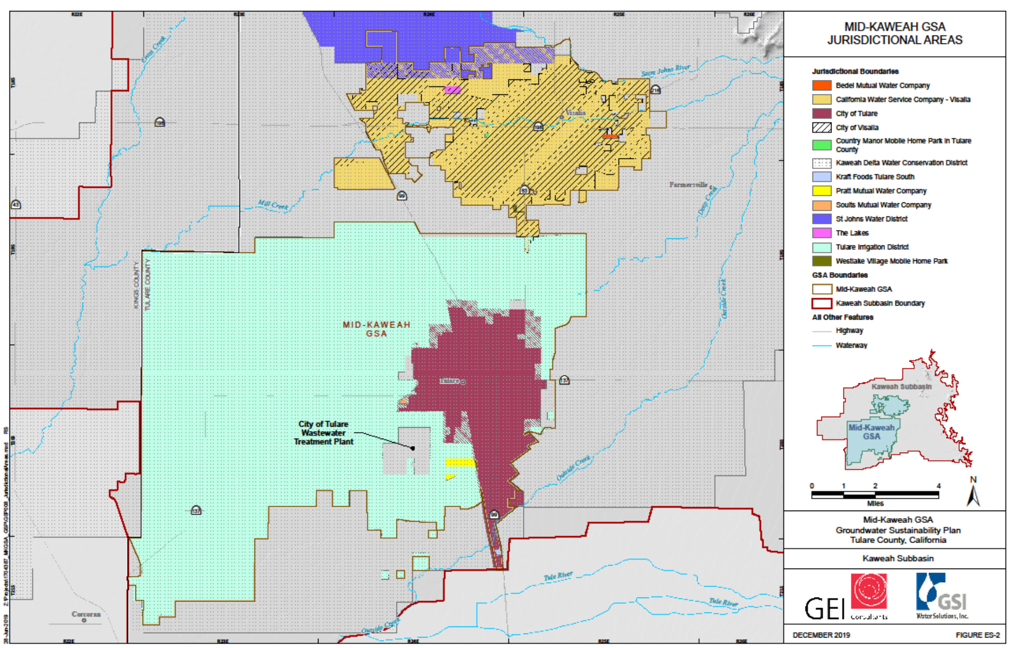

Figure ES- 2: Jurisdictional Areas

Full-size figure provided at the end of this Section.

The MKGSA jurisdictional area is approximately 163 square miles (25% of the Subbasin). Figure ES- 1 shows the Mid-Kaweah GSA area is located within the central to western side of the Subbasin and is surrounded by GKGSA, except for a portion of its western boundary.

Well density data available from DWR and obtained in 2019 indicate that, within the MKGSA, there are a total of 2,147 wells of which 1,274 wells are clearly within the MKGSA boundary, but the other 873 are along the boundary with bordering GSAs and may not all lie with MKGSA. These wells are used to meet the water supply needs of agriculture, small and large public water systems, and rural dwellings (domestic use).

General plans have been prepared by Tulare County and by the cities of Tulare and Visalia. These plans promote the conservation of water and the protection of the quantity and quality of groundwater in their respective areas.

Beneficial users of groundwater were identified and engaged by MKGSA based on the place-based and interest-based categories described in SGMA and codified in Water Code §10723.2. Beneficial users of groundwater in MKGSA include agricultural users, domestic well owners, municipal well operators, public water systems, local land use planning agencies, California Native American Tribes, disadvantaged communities, and entities engaged in monitoring and reporting groundwater elevations. Land surface uses that may be impacted by subsidence are those that rely on a stable land surface to function properly. In the MKGSA area, these include infrastructure such as water conveyance infrastructure (including canals, ditches, and flood control waterways), supply wells, roads, bridges, electrical power lines, gas and water pipelines, sanitary sewers, and railroad tracks.

Section 2 Basin Setting

The three GSAs in the Kaweah Subbasin have coordinated and jointly prepared a comprehensive Basin Setting which is included as **Appendix 2A** of this Plan. Much of the GSA is underlain by the Corcoran Clay, which creates an upper and lower aquifer system. A single aquifer system is present beneath the eastern half of Visalia in the northeastern GSA. The thickness of the fresh groundwater system varies from about 900 feet on the northeastern corner of MKGSA to about 1,600 feet near the southwestern corner. In general, groundwater flows across the MKGSA in a southwesterly direction and to local cones of depression during the irrigation season.

Groundwater quality is generally good, but available data are primarily located in the northern and eastern portions of the MKGSA. Several constituents of concern have been identified due to concentrations near Maximum Contaminant Levels (MCLs) or due to increasing trends, including arsenic, nitrate, certain volatile organics, and 1,2,3-trichloropropane.

Subsidence has occurred throughout the MKGSA area during the last 90 years. The largest amounts of subsidence occurred along the western and southern boundaries of the MKGSA area. According to DWR, subsidence between 1949 and 2005 has varied from as much as 5 feet in the Visalia area to as much as 10 feet in the Tulare area to as much as 15 feet along the southwestern corner of the MKGSA area based on land survey technology. As much as 20 feet of subsidence has occurred to the west of the MKGSA area and this area is tangential to the MKGSA area.

Key sustainability outcomes discussed in the Basin Setting document is an overall basin Safe Yield of 720 TAF. Using this information to facilitate numerous public and advisory committee meetings, the three GSAs in the basin have agreed to a sustainable yield of 660 TAF. This will be achieved in part by limiting pumping to the sustainable yield of the Kaweah Subbasin which has been determined to be 660 TAF per year on average by 2040. The sustainable yield of the Subbasin is further discussed in Appendix 3 to the Subbasin Coordination Agreement.

Section 3 Sustainability Goal

Section 3 provides the Sustainability Goal for the Kaweah Subbasin. The broadly stated sustainability goal for the Kaweah Subbasin as agreed to by the three GSAs therein is for each GSA to manage groundwater resources to preserve the quality of life through maintaining the viability of existing enterprises of the region, both agricultural and urban. The goal will also strive to fulfill the water needs of existing enterprises as well as existing and amended county and city general plans that commit to continued economic and population growth within Tulare County.

These overarching definitions were developed by the three GSAs and are fundamental to the Coordination Agreement between the GSAs in their sustainable management of their groundwater resources. Four sustainability indicators were clearly applicable to the Kaweah Subbasin, including chronic lowering of groundwater levels, reduction in groundwater storage, degraded water quality, and land subsidence. Seawater intrusion is clearly not applicable to the Kaweah Subbasin because the Pacific Ocean is located over 80 miles to the west on the opposite side of the coast range. Interconnected surface water was not considered to be a likely sustainability indicator due to groundwater depths exceeding 50 feet throughout most of the Subbasin but will be studied further during the initial portion of the implementation period.

Section 4 Monitoring Network

Section 4 provides information on the monitoring network for groundwater levels, groundwater quality, and land subsidence for the MKGSA area. The network includes 43 representative wells for groundwater levels, 117 public water supply wells for groundwater quality, and 11 land subsidence stations.

Section 5 Sustainable Management Criteria

Section 5 provides sustainable management criteria (SMC) for the MKGSA area, including numeric values for minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IM) at the various monitoring locations of groundwater levels, storage, groundwater quality, and land subsidence. As discussed above, SMCs are not developed for seawater intrusion due to the vast distance from the Pacific Ocean or for interconnected surface water.

For the chronic lowering of groundwater levels SMC, minimum thresholds are set at elevations intended to both protect at least 90% of all wells and not allow a faster rate of decline than experienced between 2006 and 2016. Protective elevations are determined in individual analysis zones to reflect differences in well type and construction across the area Section 7 describes a Drinking Water Well Mitigation Program to assist well owners impacted by lowered levels during the GSP implementation period. Measurable objectives are set at elevations higher than MTs that allow for operational flexibility of at least 5-years of drought storage. An undesirable result occurs if one-third of groundwater levels across the Kaweah Subbasin exceed MTs.

SMCs for groundwater storage are set for the entire MKGSA based on calculated storage volumes above the minimum threshold groundwater levels for 2017 and 2030 (projected) and 2040 (projected). The volume difference between the average 2017 groundwater level in relation to MTs is 1.52 MAF and the volume in storage at the MO in 2040 is 0.64 MAF.

For groundwater quality SMCs, the MCL or the agricultural water quality objective (WQO) was the basis for the MTs for 10 primary constituents, including arsenic, chromium-VI, sodium, chloride, nitrate, perchlorate, total dissolved solids, tetrachloroethene, dibromochloropropane, and 1,2,3-TCP. The choice of the MCL or the WQO will be based on the primary use of the groundwater. The Mos were set at 75% of the MCL or WQO. MKGSA will track these constituents at the public supply wells and alert the well owners if a result exceeds the respective MO and will factor the circumstance into its periodic evaluation of overall groundwater conditions. However, MKGSA does not believe it is responsible to address such an exceedance given the pre-existing water quality issues within the Subbasin unless the exceedance can be shown to be related to SGMA implementation of projects or management actions.

For the subsidence SMC, minimum thresholds are set to protect impacts to infrastructure. In particular, minimum thresholds are set to protect wells from collapsing and canals from losing more than 10% of their capacity. Minimum thresholds are defined by both a rate of acceptable subsidence and a maximum extent of subsidence. The maximum subsidence rate is based on historical data and is set at 0.67 feet per year. The maximum subsidence extent varies across the MKGSA area, but never exceeds 9 feet of total subsidence over the entire planning and implementation period. Exceeding either the rate or extent of subsidence violates the minimum threshold. Measurable objectives are set to a rate of zero subsidence. MKGSA understands that this measurable objective is potentially physically impossible to achieve, based on the existing residual subsidence. However, this goal emphasizes MKGSA's commitment to minimizing impacts from subsidence. An undesirable result occurs if one-third of groundwater levels across the Kaweah Subbasin exceed MTs.

Section 6 Water Supply Accounting

Section 6 provides an accounting of various types of groundwater budget components within the Kaweah Subbasin for the three GSAs. The total volume of water was 660 TAF and was comprised of three primary types, including native water at 364 TAF, foreign water at 73 TAF, and salvaged water at 223 TAF. The MKGSA was apportioned 35% of the total volume, including 24% of the native water, 63% of the foreign water, and 44% of the salvaged water for a total of 230 TAF.

Section 7 Projects and Management Actions

Section 7 provides a description of 18 projects and 9 management actions to enable the MKGSA to succeed at the sustainable management of its groundwater resources. Projects and management actions described in this Plan include groundwater recharge projects and programs, surface reservoir projects, leveraged surface water exchange programs, a groundwater extraction measurement implementation program, a conceptual groundwater marketing program, future urban and agricultural conservation, a groundwater allocation mechanism among well owners and operators, and other projects and management actions. The estimated total capital cost is estimated at $50,000,000 for the projects described in Section 7. Annual O&M is estimated at $70,000. Annual GSA management, administration reporting is estimated at $565,000. The cost of the 5-year GSP Assessment and Update is estimated at $250,000.

Section 8 DWR Reporting

Section 8 describes the effort to produce an annual report for submittal to DWR and for the periodic 5-year assessment of the GSP. Each annual report is due on April 1st for the preceding water year, which starts on October 1st and ends the following September 30th. For example, the 2020 annual report will be submitted by April 1, 2010, for the period between October 1, 2019, to September 30, 2020.

Section 9 References

This section includes a detailed listing of all the reference information used in developing the GSP for MKGSA.

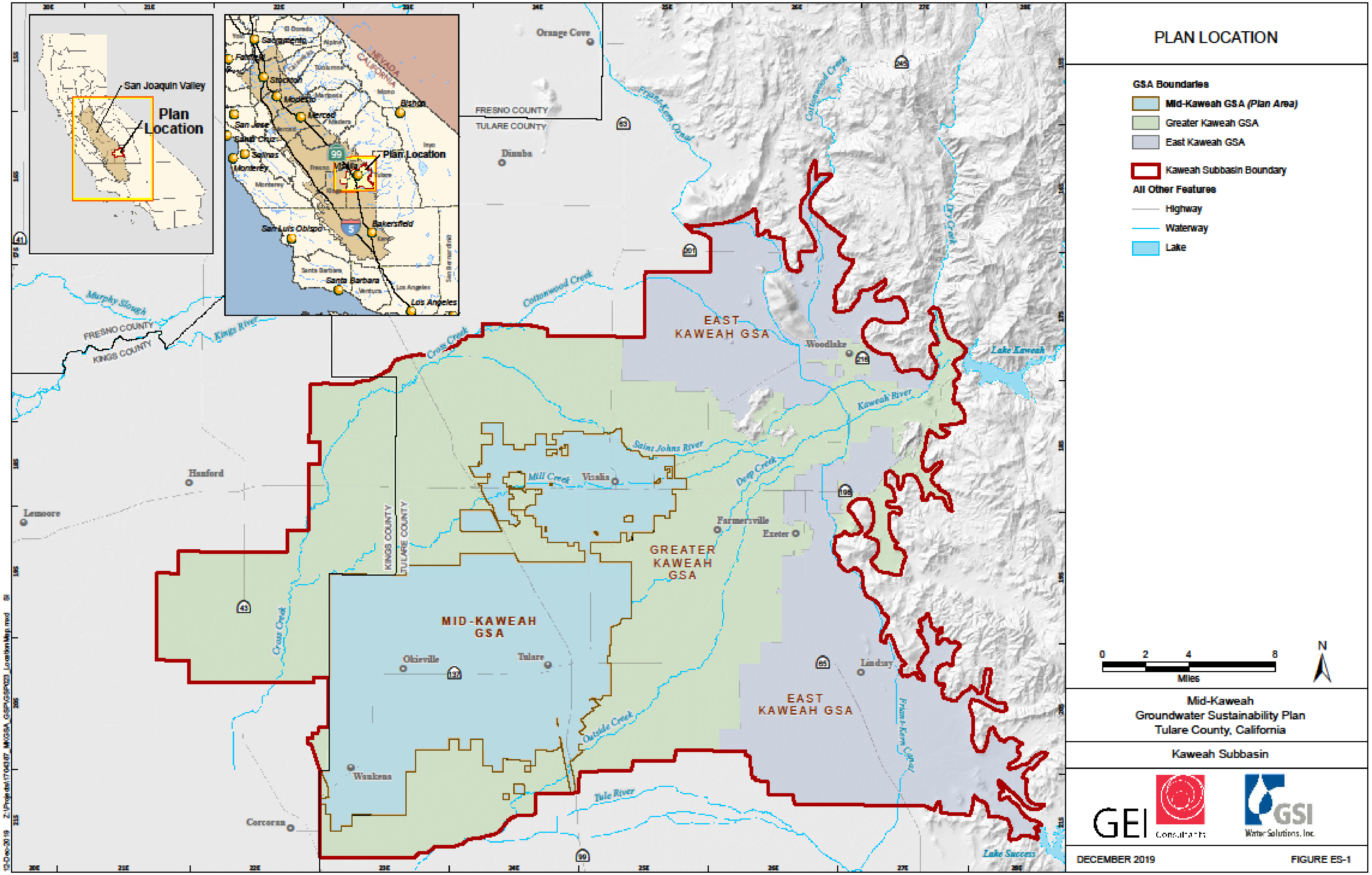

Figure ES-1: MKGSA Plan Location Map

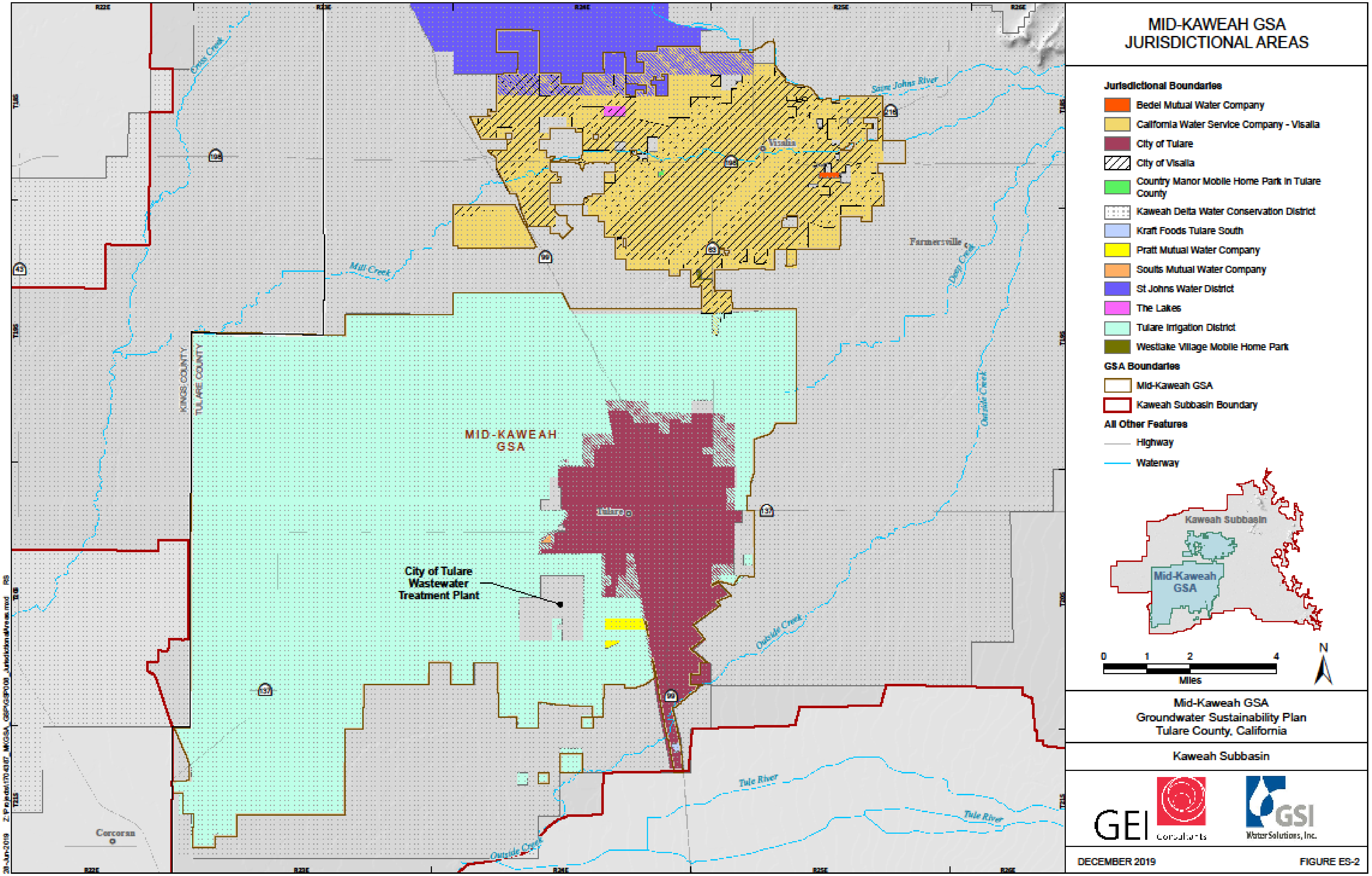

Figure ES-2: Jurisdictional Areas

1. Introduction

1.1 General Information

This section is comprised of a purpose statement, Mid-Kaweah Groundwater Sustainability Agency (MKGSA) information, information regarding the cost of implementing this Groundwater Sustainability Plan (GSP or Plan), and a general description of the plan area. Many of the figures in this GSP are 11x17 fold outs and are provided at the end of each section. Where possible we have included the locations of small, disadvantaged community water systems on these figures. In some cases the density of subject information being presented precluded us from also showing these small community water systems.

1.1.1 *Purpose of GSP*

To comply with the requirements of the Sustainable Groundwater Management Act (SGMA), the MKGSA has contracted with GEI Consultants, Inc. (GEI) for the preparation of this GSP. Revisions to the GSP completed in early 2022 were added by Montgomery and Associates and Provost and Pritchard. The GSP serves to do the following:

- Define and describe the geographic and geologic features of the MKGSA
- Identify and describe the sustainability goal for the Kaweah Subbasin and the MKGSA jurisdictional area
- Identify and describe the six undesirable results set forth in SGMA, as they pertain to the Kaweah Subbasin and the MKGSA jurisdictional area
- Establish a monitoring network sufficient to collect data characterizing groundwater and related surface water conditions that occur during Plan implementation
- Identify and describe the specific minimum thresholds and measurable objectives required for the MKGSA to achieve the sustainability goal
- Define and identify projects and management actions proposed by MKGSA to achieve, in coordination with the other Subbasin Groundwater Sustainability Agencies (GSAs), the sustainability goal and ensure that the Subbasin is ultimately operated within the sustainable yield

This Section 1 addresses all aspects of DWR's GSP Emergency Regulations (Regulations) in §354.2 through §354.10 thereof.

1.1.2 *Overview*

The Kaweah Subbasin [#5-22.11 per Department of Water Resources (DWR) Bulletin 118] (DWR, 2003, 2016), occupying some 700 sq. miles within the larger San Joaquin Valley Basin, is situated primarily within Tulare County. It is one of the prime agricultural regions in the Central Valley and home to numerous small towns and communities, as well as the larger cities of Tulare and Visalia.

The region's surface water supplies consist of the local Kaweah River system, as well as the Friant Unit of the Central Valley Project (CVP). Conjunctive-use recharge operations utilizing these sources has long been practiced.

Most urban communities rely exclusively on groundwater, and agricultural lands possess a mix of surface supplies as well as groundwater, depending on location. The Subbasin is considered to be in critical overdraft, estimated to average 78,000 acre-feet (AF) per year. Water quality concerns, related primarily to small-system and domestic wells, are localized throughout the Subbasin and stem from legacy fertilizer applications in agricultural areas and contaminant plumes from other land uses and possible degraded individual septic systems as the result of age, poor maintenance, and/or lack of routine service.

This Plan addresses SGMA compliance aspects for the MKGSA in a coordinated fashion with the two other Subbasin GSAs (East Kaweah and Greater Kaweah). Section 1.6 delineates the eight sections of this Plan, which in general, are designed to describe the basin setting, Subbasin goals, future monitoring, thresholds and objectives leading to sustainability, and efforts to achieve those objectives.

An initial apportionment of the Subbasin water budget has been undertaken and is detailed in Sections 2 and 6 of this Plan. These sections identify both the hydrogeologic budget, denoting the area's water balance, as well as the legal/appropriator budget, denoting an initial segregation of native groundwater from other groundwater associated with water agencies and purveyors. The Plan lists and describes 18 projects and 9 management actions in Section 7 to address MKGSA's responsibilities to eliminate the Subbasin overdraft and occurrence of other undesirable results. Measurable objectives to be reached in 2040, as well as interim milestone targets over time are laid out in Section 5. Monitoring to gauge the effectiveness of projects and management actions and adherence to interim milestones are described in Section 4.

1.1.3 *References*

A list of references and technical studies relied upon by the Agency in developing the Plan is provided as Section 9.

1.2 Agency Information

Agency's Name:	Mid-Kaweah GSA (MKGSA)
Agency's Address:	6826 Ave 240 Tulare, CA 93274
Agency's Phone Number:	(559) 686-3425
Agency's Website:	midkaweah.org
Contact Person:	Aaron Fukuda
Contact Person's Title:	Interim General Manager

Letter of Intent to Form GSAs: See **Appendix 1A**

The MKGSA, formed in September 2015, was one of the first GSAs in the state. Its Members consist of the City of Tulare, the City of Visalia, and the Tulare Irrigation District. These agencies desire to expand upon several water management agreements in a collective effort to comply with SGMA. These agreements are listed following:

- Tulare-TID Assessment Agreement – circa 1954
- Tulare-TID Recharge Agreement – circa 2008
- Tulare-TID Joint Recharge Facilities Construction – circa 2007
- Visalia-TID Channel Use Agreements – circa 2001
- Visalia-TID Tertiary-Treated Water Exchange Agreement – circa 2013

Each of the above-listed agreements operates in furtherance of groundwater management and preservation within the region.

1.2.1 *Legal Authority of Agency*

On September 14, 2015, the City of Visalia, the City of Tulare, and the Tulare Irrigation District (TID) entered into a Joint Powers Authority (JPA) Agreement to form the MKGSA. Under this JPA Agreement, the MKGSA was granted the authority to do all acts necessary for the exercise of all the powers authorized under SGMA as necessary to satisfy the requirements of SGMA while allowing the Members of the GSA to maintain control and autonomy over the surface and groundwater assets to which they are currently legally entitled. This original JPA Agreement and Amendment 1 are included as **Appendix 1B**.

1.3 GSP Implementation Costs

The MKGSA, on behalf of its Members, will incur costs to implement its GSP and maintain the Plan via 5-year updates. These costs and sources of funding are described below.

1.3.1 *Costs Generated by GSP Implementation*

Table 1-1 presents a description and an estimate of the costs associated with the implementation of the MKGSA GSP and measures associated with SGMA compliance.

Table 1-1: Estimated Costs for GSP Implementation

Item	Description	Estimated Cost
Annual Monitoring	Equipment, vehicles, SCADA, software	$65,000
Capital Costs Projects	Includes Projects with estimated costs per Sec. 7	$50,000,000
Annual Operations & Maintenance (O&M)	Project Operations and Maintenance	$70,000
GSA Management	Enforcement, others TBD	$100,000
Administration of GSA	Administration, legal, data management, monitoring, measurement	$400,000
Annual Report	Compilation per DWR Regulations	$25,000
5-Year GSP Update and Report	Compilation per DWR Regulations, assessment report	$250,000

1.3.2 *GSP Implementation Funding*

A joint operating fund was established for the Members to contribute to the operation and administration of the MKGSA as detailed in the JPA Agreement (**Appendix 1B**). Member contributions to the fund may be in equal proportions or, in the case of planned projects and management actions, as a function of management area water budget deficits. The MKGSA is granted the authority to pursue alternative funding sources, such as state and federal grants or loans. Unless otherwise specified by the MKGSA Board, all funding contributions obtained from alternative sources shall be equally allocated to each Member.

If the MKGSA experiences an unanticipated need to pay for extraordinary costs, and to the extent that these costs cannot be funded through use of reserves on hand or through other revenue sources authorized by the JPA Agreement (e.g., fees), the MKGSA Board may allocate additional costs to the MKGSA Members.

1.4 Description of Plan Area

The MKGSA is located entirely within the Kaweah Subbasin, as defined in DWR Bulletin 118, in the Tulare Lake Hydrologic Region of the San Joaquin Valley Groundwater Basin. The Kaweah Subbasin is bounded by the Kings River Subbasin to the north, the Tulare Lake Subbasin to the west, the Tule River Subbasin to the south, and the Sierra Nevada Mountains to the east. The MKGSA is roughly bisected by California State Highway 99. The section below describes the area covered by the MKGSA's GSP.

1.4.1 *Geographic Areas Covered*

As shown in Figure 1-2, the MKGSA's jurisdictional area (163 square miles) represents approximately 23% of the area within the Kaweah Subbasin (696 square miles). Also depicted on that figure are the three management areas within the GSA as further described in Section 2.

The MKGSA is adjacent to the Tule River Subbasin to the south and the Greater Kaweah GSA and Tulare Lake Subbasin to the west, with the Greater Kaweah GSA to the north and east. Both Disadvantaged Communities (DAC) and Severely Disadvantaged Communities (SDAC) exist in the MKGSA and are shown on Figure 1-3. Adjudicated Areas have not been established within the MKGSA or the Kaweah Subbasin. If there were Adjudicated Areas, those areas would also be shown in Figure 1-3.

The St. Johns River runs along the northern boundary of MKGSA and the City of Visalia, while the Lower Kaweah River becomes Mill Creek east of the City of Visalia, before entering the MKGSA jurisdictional area. Mill Creek roughly bisects the City of Visalia as it drains to the southwest, toward Cross Creek and the Tulare Lake Subbasin. Several other creeks and seasonal streams reach their terminus within the boundaries of MKGSA, including Packwood Creek and Cameron Creek. Elk Bayou drains along the eastern boundary of MKGSA near the City of Tulare and through the southwestern portion of Greater Kaweah GSA, until it reaches the Tule River at the boundary of the Kaweah Subbasin.

Two incorporated cities are located completely within MKGSA's jurisdictional area, including the City of Tulare and the City of Visalia, as shown on Figure 1-4.

In addition to the cities, the Tulare Irrigation District (TID) also has jurisdiction within the MKGSA area. Numerous *de minimis* domestic water users and multi-parcel water systems are located within the MKGSA, which will be covered by this GSP.

1.4.2 *Plan Area Setting*

Land use within the MKGSA consists mainly of urban and agricultural, as shown in Figure 1-5, which also depicts land-use types within the entire Subbasin. Agricultural use in MKGSA can be described as mostly seasonal field crops and grain and hay crops, interspersed with deciduous fruits and nuts and pasture. Urban land use is located within the limits of the cities of Tulare and Visalia and the surrounding unincorporated areas within the sphere of influence for the cities. Land use maps included in the most recent General Plans for the City of Tulare (2014), City of Visalia (2014) and Tulare County (2012) are included as **Appendix 1C**

The MKGSA area has used local surface water for agriculture since the late 1800s. The Tulare Irrigation District was formed in 1889. The area experiences fairly regular cycles of drought and flood, but the groundwater recovery during flood periods does not completely offset the groundwater drops in the drought years. Long-term groundwater level declines in the western part of the Subbasin on the order of 2-3 feet per year. Subsidence has been a historical issue in the area; a product of local geology and wells being drilled to deeper zones when they are replaced. Local subsidence issues have been accommodated for many years prior to the enactment of SGMA, but subsidence rates have significantly increased since 2007.

It is important to monitor water levels throughout the plan area. There are several water resource monitoring [1]program, which tracks groundwater elevation trends throughout numerous

[1] https://www.casgem.water.ca.gov/OSS/(S(pjww1s3s4mocqq0rft2t2g1n))/GIS/PopViewMap.aspx?Public=Y

groundwater basins. This system is managed by DWR with local agencies, counties, and associations providing groundwater level data.

Within the Kaweah Subbasin, numerous programs exist for monitoring and management of groundwater. These programs are described in detail in Section 2.3 of the Kaweah Subbasin Basin Setting report included as **Appendix 2A** of this Plan. The monitoring and management programs within the MKGSA are presented and described in Section 4 of this GSP. Section 4 also details the agencies and activities associated with monitoring and management of surface water inflow, weather and precipitation, and land surface subsidence.

Figure 1-6 provides information on water use sector and water source type within the MKGSA. This figure shows land use areas occupied by wetlands, recharge basins, commercial/industrial including confined animal facilities, urban areas, and agricultural areas. It also shows areas receiving a mix of groundwater and surface water, the approximate locations for municipal supply wells in the cities of Visalia and Tulare, which are both supplied by 100% groundwater, and the locations of water recycling facilities which treat wastewater for use in agricultural irrigation. A detailed water budget accounting for the entire Kaweah Subbasin is provided in the comprehensive Basin Setting (**Appendix 2A**). Section 2 of this GSP presents a water budget accounting for the MKGSA.

Figure 1-7, Figure 1-8**,** and Figure 1-9 are well-density maps which show the general distribution of domestic, production, and public supply wells within the MKGSA and are based on information from the DWR's website for the Well Completion Report Map Application[2] The SGMA regulation [§ 354.8(a)(5)] requires the mapping of agricultural, industrial, and domestic wells based on DWR data, and these figures are provided for that requirement. The DWR data appears to have combined agricultural and industrial wells into the production well category although the vast majority of production wells in the MKGSA are likely agricultural wells. The figures show 221 "square-mile" sections to address the MKGSA areas, including 131 sections wholly located within the MKGSA, 37 sections mostly located within the MKGSA, and 21 sections partially within in the MKGSA, plus 32 sections that are tangential to the MKGSA. This latter group was included because the shapefiles for the GSA boundaries and the sections overlap slightly and the application includes these sections. This GSP was not intended to produce any finer resolution than provided by the DWR map application.

Table 1-2 summarizes the well density information for domestic, production, and public wells and is subdivided into the three types of well locations: wholly within, mostly within, and partially within the MKGSA. Overall, a total of 2,147 wells were identified for the MKGSA areas, including 1,274 wells within the MKGSA area and 873 wells along the complex boundary of the MKGSA (581 wells for sections mostly in the area and 292 wells for sections with smaller portions). The total number of domestic wells is slightly higher (1,088) than production wells (937) and the number of public supply wells is relatively small (121). Note that these counts represent all wells on record within the DWR map application and do not necessarily represent current usable wells. Usability is a factor that is discussed in Section 4 regarding identification of well sites to include in the representative monitoring network.

[2] https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

The maximum total well density was nearly 40 wells per nominal square mile for the three location categories of area. The higher density sections are generally located in the northeastern portions of MKGSA, in the Visalia area or north of Tulare. Lesser well densities are generally found in the southwestern portion of MKGSA. Only one section (20S-24E-21) was devoid of any documented well and is located about 3 miles southwest of Tulare.

Table 1-2: Summary of Well Information

	Location	Total	Domestic	Production	Public
Number of Wells	Within MKGSA	1,274	594	598	82
	Mostly in MKGSA	581	351	204	25
	Partially within MKGSA	292	143	135	14
	Total number of wells	**2,147**	**1088**	**937**	**121**
Maximum Well Density	Within MKGSA	39	30	19	6
	Mostly in MKGSA	38	32	12	4
	Partially within MKGSA	39	30	11	3
Median Well Density	Within MKGSA	8	3	4	1
	Mostly in MKGSA	17	9	5	1
	Partially within MKGSA	11	5	6	1
Sections without Wells	Within MKGSA	1	16	3	78
	Mostly in MKGSA	0	3	0	19
	Partially within MKGSA	0	1	0	12

Well density units: Wells per section or nominal square mile

All the communities in the MKGSA are groundwater dependent (Figure 1-10). These include the two incorporated cities and the state small systems owned and operated by California Water Services Company (Cal Water), and one private mutual water company (Okieville). Two other private mutual water companies have recently been connected to the City of Tulare's water supply system (Soults Tract and Matheny Tract). The *de minimis* domestic water users and multi-parcel water systems located within the MKGSA are also groundwater dependent. The locations of these water users can be approximated with the maps presented as Figure 1-6 to Figure 1-8.

1.4.3 *General Plans in Plan Area*

The SGMA regulation [§ 10726.9] requires a GSP to consider the most recent planning assumptions stated in local general plans of jurisdictions overlying the basin. Each of the two incorporated cities in MKGSA's area have adopted General Plans. For the areas not within the limits of the incorporated cities, the Tulare County General Plan applies. The General Plans for the cities and the General Plan for the county each have land use elements which address water usage. These plans promote the conservation of water and the protection of the quantity and quality of groundwater in their respective areas and were considered in this GSP.

GEI reviewed the 2015 Urban Water Management Plans for the cities of Visalia (Cal Water, 2016) and the Tulare (City of Tulare, 2015) and California Department of Finance population projections (California Department of Finance, 2017). Information in these documents were useful in understanding both current and projected future water supplies and demands.

1.4.3.1 County of Tulare General Plan

The 2030 General Plan Update for the County of Tulare, adopted on August 28, 2018, does not have a specific update to address water usage and supply. However, the Tulare County 2012 General Plan has a Water Resources Element that requires the County to adopt ordinances and measures to:

- Regulate the permanent extraction and exportation of groundwater from the County
- Assure that all watershed planning is done on a complete regional and watershed basis, and that such planning considers a balance between urban and agricultural demands
- Where feasible, the county shall participate in coordinated local, regional, and statewide groundwater monitoring and planning programs
- Encourage active participation by local stakeholders and develop groundwater monitoring partnerships with local groundwater users and developers
- Avoid the destruction of established recharge sites
- Work with federal, state, local, and regional agencies to improve local groundwater pollution detection and monitoring
- Encourage responsible agencies and organizations to install and monitor additional groundwater monitoring wells in areas where data gaps exist
- Research the development of an education program to inform homeowners in the valley and mountain areas regarding water quality concerns
- Incorporate provisions, including evaluating incentives, for the use of reclaimed wastewater, water-conserving appliances, drought-tolerant landscaping, and other water conservation techniques into the county's building zoning
- Identify and evaluate conditions within established watersheds which are causing deterioration of the water quality, water supply, or declining water yields
- Develop an education program to inform residents of water conservation techniques and the importance of water quality and adequate water supplies

- Protect groundwater recharge areas
- Amend county ordinances to include development standards which protect groundwater basins and surface water drainage areas and provide incentives for use of conservation techniques
- Establish development or design standards for the protection of groundwater recharge areas
- Work with other local/regional agencies, water purveyors, and interest groups to seek funding sources to implement a variety of surface and groundwater restoration activities

The Tulare County General Plan includes both policies and implementation measures that address water supply, wastewater treatment, adequate infrastructure, plans, programs, and funding in the following elements:

Planning Framework (Chapter 2),

Agriculture (Chapter 3),

Land Use (Chapter 4),

Economic Development (Chapter 5),

Housing (Chapter 6),

Environmental Resources Management (Chapter 8),

Health and Safety (Chapter 10),

Water Resources Chapter 11),

Public Facilities and Services Chapter 14),

Gen Plan Water Resources Element Policies Include:

Water Supply WR-1.1

Groundwater Withdrawal, WR-1.3

Water Export Outside County, WR-1.4

Conversion of Agricultural Water Resources, WR-1.5

Expand Use of Reclaimed Wastewater, WR-1.6

Expand Use of Reclaimed Water, WR 1.7

Collection of Additional Groundwater Information, WR-1.8

Groundwater Basin Management, WR-1.9

Collection of additional Surface Water Information, WR-1.10

Channel Modification, WR-3.1

Develop Additional Water Sources, WR-3.2

Develop an Integrated Regional Water Master Plan, WR-3.3

Adequate Water Availability, WR-3.4

Water Resource Planning, WR-3.5

Use of Native and Drought Tolerant Landscaping, WR-3.6

Agricultural Irrigation Efficiency, WR 3.7

Emergency Water Conservation Plan, WR-3.8

Educational Programs, WR-3.9

Establish Critical Water Supply Areas WR-3.10

Diversion of Surface Water, WR-3.11

Policy Impacts to Water Resources, WR-3.12

Joint Water Projects with Neighboring Counties, WR-3.13

Coordination of Watershed Management on Public Land PFS-2.1

Water Supply, PFS-2.2

Adequate Systems, PFS-2.3

Well Testing, PFS-2.5

New Systems or Individual Wells, Water Quality, WR-1.2

Groundwater Monitoring, WR 1.7

Collection of Additional Groundwater Information, WR-1.8

Groundwater Basin Management, WR-2.1

Protect Water Quality, WR-2.2

NPDES Enforcement, WR-2.3

Best Management Practices, WR-2.4

Construction site Sediment, WR-2.5

Major Drainage Management, WR-2.6

Degraded Water Resources, WR-2.7

Industrial and Agricultural Sources, WR-2.8

Point Source Control, WR-2.9

Private Wells, PFS-2.1

Water Supply, PFS-2.5

In addition to the county's ongoing efforts to address these objectives in the Water Resources Element of the General Plan, the MKGSA will address these issues with the adoption and implementation of its GSP, pursuant to California Water Code § 10726.9. This GSA, as well as others within Tulare County, meet on a monthly basis to coordinate relevant county data sets, ordinances, and related needs of the GSAs regarding new wells and enforcement measures.

1.4.3.2 City of Visalia General Plan

The 2030 General Plan Update for the City of Visalia, adopted on October 14, 2014, has several objectives related to water resources in general and groundwater, in particular. These objectives can be found in the Open Space and Conservation Element of the Plan in Chapter 6.

One of the objectives is to: "work with the county and other organizations to protect prime farmland and farmland of statewide importance outside the city's Urban Development Boundary for agricultural production, and to preserve areas for groundwater recharge."

Two policies are listed to further this objective:

1. Open Space Policy #1: "Conduct an annual review of cancelled Williamson Act contracts and development proposals on agricultural land within the Planning Area Boundary to foresee opportunities for acquisition, dedication, easements or other techniques to preserve agricultural open space or for groundwater recharge."
2. Open Space Policy #6: "Continue cooperative efforts with the Kaweah Delta Water Conservation District, Integrated Regional Water Management Planning group, and others to partner on pursuing grant funding and development of water resource, recharge, and conservation projects and programs."

The Water Resources section of the city's General Plan Open Space and Conservation Element includes a description of both surface water resources and groundwater resources. The objectives of the Water Resources section are:

1. Protect water resources vital to the health of the community's residents and important to the Planning Area's ecological and economic stability
2. Preserve and enhance Planning Area waterways and adjacent corridors as valuable community resources which serve as plant and wildlife habitats, as groundwater recharge facilities, as flood control and irrigation components, and as connections between open space areas
3. Continue to participate in a waterway program involving the Tulare Irrigation District, irrigation companies, private water companies, and state agencies

Among the policies listed in the General Plan to meet these objectives, the City of Visalia included:

1. Protect, restore and enhance a continuous corridor of native riparian vegetation along Planning Area waterways, including the St. Johns River; Mill, Packwood, and Cameron Creeks; and segments of other creeks and ditches where feasible, in conformance with the Parks and Open Space diagram of this General Plan
2. Establish design and development standards for new projects in waterway corridors to preserve and enhance irrigation capabilities, if provided, and the natural riparian environment along these corridors. In certain locations or where conditions require it, alternative designs may be appropriate (e.g., terraced seating or a planted wall system)

3. Place special emphasis on the protection and enhancement of the St. Johns River Corridor by establishing extensive open space land along both sides
4. Where no urban development exists, maintain a minimum riparian habitat development setback from the discernible top of the bank: 50 feet for both sides of the Mill, Packwood, and Cameron Creek corridors and 25 feet for both sides of Modoc, Persian, and Mill Creek ditches. Where riparian trees are located within 100 feet of the discernible top of the banks of the creek corridors and 50 feet from the banks for the ditches, the setback shall be wide enough to include five feet outside the drip line of such trees. Restore and enhance the area within the setback with native vegetation as follows:
    a. Where existing development or land committed to development prohibits the 50-foot setback on Mill, Packwood, and Cameron Creek corridors, provide the maximum amount of land available for a development setback
    b. Where existing development or land committed to development prohibits the 25-foot setback along Modoc, Persian, and Mill Creek ditches, provide the maximum amount of land available for a development setback

These objectives and policies are addressed in the projects and management actions portion of this GSP, particularly with respect to groundwater recharge facilities and use of riparian habitat corridors for groundwater recharge (City of Visalia, 2014).

1.4.3.3 City of Tulare General Plan

The 2035 General Plan Update for the City of Tulare, adopted on October 7, 2014, addresses water supply and usage in several of its elements (City of Tulare, 2014). Under its Land Use Element, the Tulare General Plan addresses existing water supply by requiring that, "water supply systems be adequate to serve the size and configuration of land developments. Standards as set forth in the subdivision ordinance shall be maintained and improved as necessary." To address future water supply, the General Plan calls for "all new development, prior to the approval of any subdivision applications, the developers shall assure that there is sufficient available water supply to meet projected buildout."

The Plan Implementation Measures adopted in the General Plan, with respect to water supply, include the following:

> *"The City shall update its water master plan to address future water supply treatment, and distribution system. The water master plan shall explore:*
>
> *a. Water supply alternatives*
>
> *b. Treatment alternatives, including wellhead and centralized treatment*
>
> *c. Alternatives for reuse of grey water*
>
> *d. Water conservation program"*

While the General Plan does not have specific actions to meet these objectives, it refers to maintaining and improving infrastructure to support these objectives. The adoption of the MKGSA GSP will address these measures, particularly with respect to promotion of water supply alternatives and water conservation.

The Conservation and Open Space Element of the Tulare General Plan also addresses the issue of water resources for the City. One of the element's objectives is to "ensure a reliable, adequate water supply to sustain a high quality of life, while protecting and enhancing the environment."

The Water Resources Section of the Conservation and Open Space Element states that the City's Goal is "to preserve and enhance surface waterways and aquifers." This section of the plan includes the following policies, pertaining to groundwater and water conservation:

- **Regional Groundwater Protection**. The City shall work with Tulare County and special districts to help protect groundwater resources from overdraft by promoting water conservation and groundwater recharge efforts.
- **Groundwater Recharge Area Protection**. When considering new development, the City shall protect existing open spaces, natural habitat, floodplains, and wetland areas that serve as groundwater recharge areas.
- **Continued Recharge of Groundwater Basin**. In known or identified groundwater recharge areas, the predominant land use and resource activities should be designed to promote recharge of the groundwater basin and protection of groundwater quality at a level superior to standard development practices. When appropriate to the land use designation, clustered development should be encouraged to promote open space and continue infiltration.
- **Groundwater Wells**. The City shall protect and monitor its groundwater wells to ensure a sufficient groundwater supply.
- **Water Source**. The city shall cooperate with other jurisdictions to jointly study the potential for using surface water sources to help protect the groundwater supply.
- **Water Conservation**. The City shall promote efficient water use and reduced water demand by:
    - Requiring water-conserving design and equipment in new construction
    - Encouraging water-conserving landscaping and other conservation measures
    - Encouraging retrofitting of existing development with water-conserving devices
    - Providing public education programs
    - Distributing outdoor lawn watering guidelines
    - Promoting water audit and leak detection programs
    - Enforcing water conservation programs

These City and County policies are complimentary to the MKGSA GSP or are addressed indirectly as a result of the GSP implementation. The outreach and education policies and actions are addressed in the Communication & Engagement (C&E) Plan, developed by Stantec for MKGSA and adopted on August 14, 2018 and included as **Appendix 1D**.

1.4.4 *Well Permitting Process*

Well permits are required by Tulare County pursuant to various sections (4-13) of Tulare County Code Part IV, Chapter 13, Article 1. The ordinance is administered by the County Environmental Health Division and regulates the location, construction, reconstruction, destruction, and inactivation of all wells to ensure each well will produce high-quality water and to protect the quality of the groundwater. The ordinance incorporates the various DWR bulletins related to well standards (74-81 and 74-90). The City of Visalia has a well permit application for the construction or destruction of wells within its jurisdiction. The county has updated and revised their well permit application in collaboration with GSAs with jurisdiction in the County. The revised permit application is intended to meet the needs of the County in permitting new wells and to meet the needs of the GSAs in implementing their authorities in accordance with SGMA. The County's has revised the well permit application to include more robust data collection, providing the MKGSA with a better understanding of how groundwater is used in the Subbasin. The County has also implemented, in cooperation with local GSAs, a well permit notification and comment process. GSAs are notified when a well permit is submitted, along with receiving the well permit request. GSAs are allowed to review and comment on the well permit prior to issuance. Upon issuance of a well permit, the County notifies the GSA of the issuance.

More information on Tulare County's well permitting process is available athttps://tularecountyeh.org/eh/our-services/water-wells/and include the following information as of June 2022:

- Water Well Guidance
- Water Well Forms
- Water Well Contractors
- Voluntary Water Well Testing Program

1.4.5 *Existing Monitoring and Management Programs*

Existing monitoring and measurement programs are presented and described in the Basin Setting Report (**Appendix 2A**) and Section 4 of this document.

1.5 Notice and Communication

SGMA and subsequent Emergency Regulations developed by the DWR in May 2016 identified a number of requirements for public notice and communication related to GSA formation and GSP development. California Code of Regulations §354.10 identifies the requirements for notice and communication information in a GSP:

> *"Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:*
>
> *(a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.*
>
> *(b) A list of public meetings at which the Plan was discussed or considered by the Agency.*
>
> *I Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.*
>
> *(d) A communication section of the Plan that includes the following:*
>
> 1. *An explanation of the Agency's decision-making process.*
> 2. *Identification of opportunities for public engagement and a discussion of how public input and response will be used.*
> 3. *A description of how the Agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin.*
> 4. *The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions."*

Pursuant to these requirements, MKGSA conducted several activities to engage beneficial users of groundwater, interested parties, and the general public in the development of the GSP. MKGSA was responsible for conducting outreach and engagement related to SGMA and conducted a series of coordinated activities aimed at engaging stakeholders within its service area. This section describes the coordinated tools, methods, and activities the MKGSA used to inform and engage stakeholders in development of the GSP.

1.5.1 *Participating Agencies*

> **§354.10 (d) A communication section of the Plan that includes the following:**
> **(1) An explanation of the Agency's decision-making process.**

The MKGSA was formed September 14, 2015, through execution of a joint powers agreement between the City of Tulare, City of Visalia, and Tulare Irrigation District to establish the Mid-Kaweah Groundwater Subbasin Joint Powers Authority. Pursuant to Water Code §10723.8, these members notified DWR on September 16, 2015, of the agency's formation and its intent to develop a GSP. The decision-making structure of the MKGSA Board of Directors (Figure 1-1) is supported through hierarchical structure that includes the GSA's Manager, a Management Committee comprised of key staff from each member agency, and a Technical Advisory Sub-Committee. To provide for a venue for consultation with community members, the agency formed an 11-member

Advisory Committee. Committee meetings are held monthly, or otherwise announced, and publicly noticed consistent to the Brown Act.

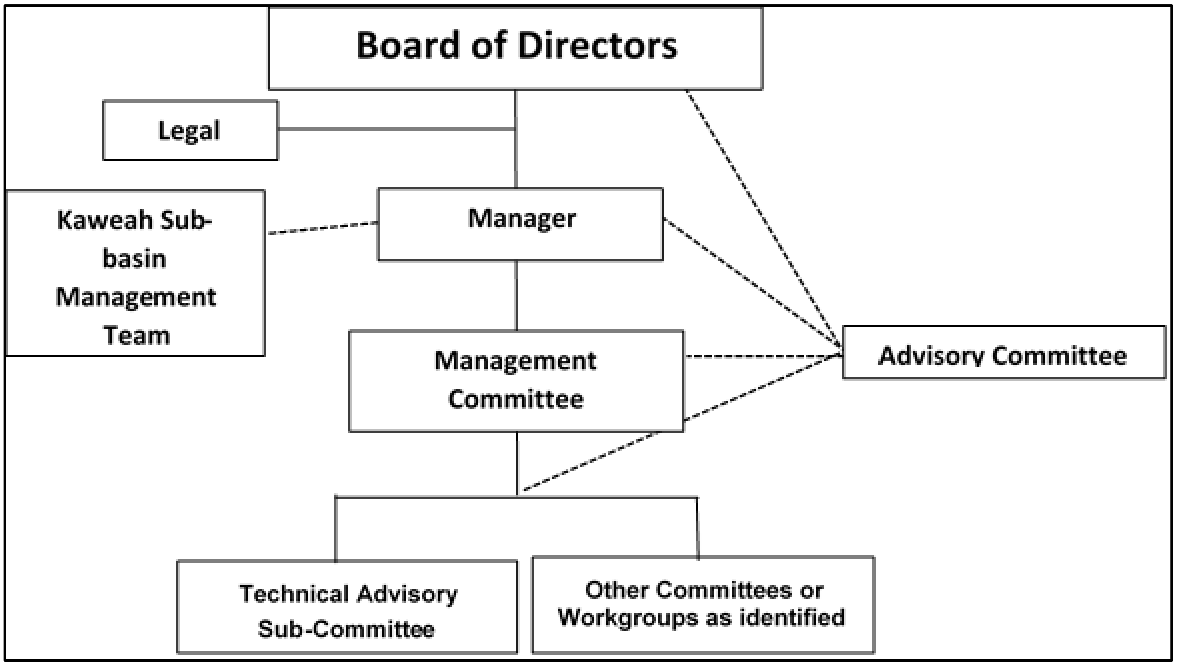

Figure 1-1: Mid-Kaweah Groundwater Sustainability Agency Decision-Making Structure

The governing body of the JPA consists of a six-member Board of Directors that includes two representatives from each of the founding JPA members. Members eligible to sit on the Board of Directors are the elected officials of each member agency, with the City of Tulare able to appoint a member of the Tulare Board of Public Utilities to serve on its behalf. Members may also appoint up to two members to serve as an alternate in the event of an absence. All decisions require a majority vote of the present and voting Board of Directors, except the following found in Table 1-3.

Table 1-3: MKGSA Voting Thresholds

Key Authority	Threshold
Adoption of initial budget	Unanimous vote by entire Board (which may include alternates)
Adoption or modification of the annual budget	Modified majority of the Board(*) (which may include alternates)
Contracts over $25,000 and for terms in excess of two (2) years	Modified majority of the Board(*) (which may include alternates)
Admissions of additional members	Modified majority of the Board(*) (which may include alternates)
Appointment, employment, or dismissal of an employee, including any independent contractor who functions as an employee	Modified majority of the Board(*) (which may include alternates)

Key Authority	Threshold
Setting the amounts of any contributions or fees to be made or paid to the Authority from any Member	Modified majority of the Board(*) (which may include alternates)
Compromise or payment of any claim against the Authority	Modified majority of the Board(*) (which may include alternates)
Acquisition by grant, purchase, lease, gift, devise, contact, construction, or otherwise, and hold, use, enjoy, sell, let, and dispose of, real and personal property of every kind, including lands, water rights, structures, buildings, rights-of-way, easements, and privileges, and construct, maintain, alter, and operate any and all works or improvements, within or outside the agency, necessary or proper to carry out any of the purposes of the Authority	Modified majority of the Board(*) (which may include alternates)
Adoption and imposition of any fees pursuant to Water Code §§ 10730-10731	Modified majority of the Board(*) (which may include alternates)
Replacement of the annual special audit required by Government Code § 6505 with an audit covering a two-year period	Unanimous vote by entire Board (which may include alternates); A Tulare County reqt.
Approval of a GSP for the portions of the Subbasin identified by the GSA boundaries.	Modified majority of the Board(*) (which may include alternates)
(*) Modified majority is defined in the amended JPA to mean four affirmative votes, with at least one from each Member.	

1.5.2 *Beneficial Uses and Users*

1.5.2.1 Legal Requirements

§354.10 Each plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.

Beneficial uses of groundwater within MKGSA primarily include agricultural water supply, industrial process supply, and municipal and domestic water supply. MKGSA serves as GSA for the area comprising the collective jurisdictional area of its members, which is approximately one-quarter of the Kaweah Subbasin, or about 170 square miles of the 700 square-mile Subbasin. Beneficial users of groundwater were identified and engaged by MKGSA based on the place-based and interest-based categories described in SGMA and codified in Water Code §10723.2:

- Citizens Groups
- General Public

- Disadvantaged Communities[3]
- Agricultural Well Owners
- Domestic Well Owners
- Commercial and Industrial Self-Supplied
- Private and Public Water Purveyors
- Surface Water Users[4]
- Governmental and Land Use Agencies
- Tribal Governments and Communities
- Environmental and Ecosystem Interests
- Remediation and Groundwater Cleanup

Beneficial users of groundwater in MKGSA include agricultural users, domestic well owners, municipal well operators, public water systems, local land use planning agencies, California Native American Tribes, disadvantaged communities, and entities engaged in monitoring and reporting groundwater elevations. Beneficial users and types of parties representing these users are further described below.

1.5.2.2 Citizens Groups and General Public

Citizens groups and members of the general public were considered beneficial water users and were invited to engage in the Advisory Committee and participate in public meetings. Outreach was conducted to civic organizations of Visalia, City of Tulare and the Tulare Irrigation District by requesting to present at pre-existing organizational meetings or to disseminate SGMA and GSP development information to their members.

1.5.2.3 Disadvantaged Communities

The MKGSA region includes five areas identified as a Census Designated Place or Census Designated Tract by the 2016 U.S. Census Bureau as disadvantaged or severely disadvantaged communities. Census Designated Places within the GSA include the City of Tulare, and the unincorporated communities of Matheny Tract and Waukena. The City of Tulare has been identified as a Disadvantaged Community, while Matheny Tract and Waukena have been identified as Severely Disadvantaged Communities. The unincorporated communities of Okieville/Highland Acres, Lone Oak Tract, and Soults Tract have been identified as severely disadvantaged Census Designated Tracts. The Stakeholders in these communities have had the opportunity to consult on the plan during the agency's Board of Directors meetings, Advisory Committee meetings, and during review of this Plan.

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[3] Includes those served by private domestic wells or small community water systems (Water Code §10723.2(i)
[4] If there is a hydrologic connection between surface and groundwater bodies (Water Code §10723.2(g))

1.5.2.4 Agricultural Users

Agriculture and rangeland cover a broad area of the Kaweah Subbasin and account for about 50 percent of the land area within the MKGSA. Representatives from the agricultural community serve on MKGSA's Board of Directors and the Advisory Committee, and agricultural interests are represented in GSP development by landowners and water users within the Tulare Irrigation District service area. Other types of parties representing agricultural users include Tulare County Farm Bureau, agricultural-based interest organizations, farmworkers, individual growers, and ranchers. Consultation with these parties included periodic briefings led by Tulare Irrigation District, and through information discussed during meetings of the agency's Board of Directors and Advisory Committee and during development and review of this Plan.

1.5.2.5 Private Domestic Well Owners

Private domestic well operators within the MKGSA primarily include rural residents interspersed with active farmlands; the communities of Waukena and Oakieville/Highland acres; and rural schools including Waukena Joint Union Elementary, Buena Vista Elementary, Buena Vista School, Oak Valley Union School, Liberty School, and Packwood School. They are located in the unincorporated area of Tulare County and are represented on the MKGSA Board of Directors by Tulare Irrigation District. Stakeholders have the opportunity to consult on the Plan during the agency's Board of Directors and Advisory Committee meetings, and during review of this Plan.

1.5.2.6 Municipal and Industrial Well Operators

Municipal and industrial water supplies within the MKGSA are provided by the City of Tulare and California Water Service, a private water company regulated by the California Public Utilities Commission. Some food and industrial manufactures maintain deep wells as back-up supplies in the event of service interruption by municipal and industrial well operators. The City of Tulare and the City of Visalia account for 12.7 and 21.7 percent of the land area within the MKGSA, respectively. Consultation with the City of Tulare consists of information dissemination and coordination with the Tulare Board of Public Utilities and through the city's participation as MKGSA member agency. California Water Service consulted during development of this Plan as members to the agency's Advisory Committee and Technical Advisory Subcommittee.

1.5.2.7 Surface Water Users

Surface water users within the MKGSA include farm, ranch, and dairy operations that purchase runoff from the Kaweah River and San Joaquin River watersheds from Tulare Irrigation District. San Joaquin River supplies are delivered by Friant Water Authority, which provides operation and maintenance of the Friant Division of the Central Valley Project. Kaweah supplies are managed by Kaweah Delta Water Conservation District. Members of this agricultural community attend meetings and serve on the MKGSA Advisory Committee and Board of Directors.

1.5.2.8 Governmental and Land Use Planning Agencies

Governmental and land use planning agencies in the MKGSA include the planning commissions of the County of Tulare, City of Tulare, and City of Visalia, and the Tulare County Local Agency Formation Commission. Consultation with these planning commissions included briefings and requests to comment on the public draft GSP.

1.5.2.9 California Native American Tribes

As part of the MKGSA's 2015 formation notification to DWR, the agency preliminarily identified two California Native American Tribes for potential engagement in the planning process as beneficial water users: the Santa Rosa Rancheria Tachi-Yokut Tribe of Lemoore, California, and the Waksache Tribe. No details were available for the later tribe and the Santa Rosa Rancheria Tachi-Yokut Tribe's reservation is located in the Tulare Lake Subbasin.

1.5.2.10 Environmental and Ecosystem Interests

Environmental and ecosystem interests in MKGSA include representatives of the Tulare Basin Wildlife Partners, Sierra Club Mineral King Group, and Sequoia Riverlands Trust.

1.5.2.11 Groundwater Elevation Monitoring and Reporting Entities

Groundwater elevation monitoring and reporting in the MKGSA is primarily led by the Tulare Irrigation District and Kaweah Delta Water Conservation District. The Tulare Irrigation District updated its Groundwater Management Plan in 2012. The Kaweah Delta Water Conservation District leads development of an Integrated Regional Water Management Plan and manages a series of wells registered in the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Tulare Irrigation District is a member agency of MKGSA and representatives of Kaweah Delta Water Conservation District regularly attend meetings of the Board of Directors and Advisory Committee.

1.5.2.12 Land Surface Users Potentially Impacted by Land Subsidence Caused by Groundwater Extraction

Land surface uses and users that may be impacted by subsidence are described in Section 5.6.2.

1.5.3 *Stakeholder Communications and Engagement Plan*

§354.10 (d): A communication section of the Plan that includes the following:

> **(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.**

Notification and communication activities for development of this Plan were guided by the MKGSA C&E Plan (August 2018). The C&E Plan serves to identify notification and communication activities that would meet or exceed the requirements and intent of the State legislature in passage of SGMA.

The nature of the consultation to beneficial users of groundwater and other interested parties was approached by segmenting stakeholders into one of three "groups," based on a stakeholder's level of interest in, or contribution to, GSP development. These groupings are as follows:

> **Group 1:** *Collaborated (Inform + Consult + Collaborate*) – This group has been closely connected during the planning process through direct engagements aimed to exchange information through active two-way communication. As a proactive and reactive activity, these engagements gather information, and develop solutions to existing and emerging issues.
>
> **Group 2:** *Consulted (Inform + Consult*) – This group has been connected during planning through written informational materials and scheduled presentations. This engagement is a proactive activity that seeks to gather stakeholder opinions to information presented by MKGSA.
>
> **Group 3:** *Connected (Inform*) – This group has been connected during planning through distribution of written informational materials and prepared informational presentations. Presentations would be held in response to stakeholder requests.

These groupings framed the approach MKGSA implemented to engage interested parties and stakeholder groups to participate in development of the GSP. Individuals and organizations were initially assigned one of the three groups by the MKGSA's Advisory Committee, with the anticipation that each stakeholder's involvement would change based on consultation with stakeholder and GSP content needs. All outreach efforts and engagement activities were tracked in a Community Engagement and Activities Database (CE & AD) that was continuously monitored and updated, consistent with DWR Emergency Regulations §354.10 (b) and §354.10 (d).

To encourage active participation during Plan development by the diverse social, cultural, and economic interests in the region, the agency in coordination with its Kaweah Subbasin sister agencies – East Kaweah GSA and Greater Kaweah GSA – established the Kaweah Groundwater Communication Portal (GCP). Established pursuant to Water Code §10723.4, the Kaweah GCP is a shared database of interested parties in the Kaweah Subbasin and provides for distribution of notices and announcements by email. In addition to the Kaweah GCP, the platform supports self-enrollment to an email database of the GSA or GSAs of the stakeholder's choice.

Additional tools to support public and stakeholder engagement included the MKGSA website (www.midkaweah.org), the primary location for stakeholders within the GSA's boundaries to review information related to SGMA and implementation of this Plan. Information provided on the website includes: an overview of SGMA, MKGSA member agencies, Board of Directors, Board meeting notices and summaries, public outreach and timeline information, frequently asked questions, news, links and a contact list. Past and upcoming workshops and public meetings are also on the site. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the MKGSA Board, the Advisory Committee, and the Kaweah Subbasin Management Team (See Section 1.5.5. Intra-Basin and Inter-Basin Coordination). The site is cross-linked to the Greater Kaweah GSA and the East Kaweah GSA websites, the DWR SGMA information portal, and other related sites.

1.5.4 *Public Meetings*

§354.10 (d): A communication section of the Plan that includes the following:
(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.

To encourage active involvement in the diverse social, cultural, and economic communities in the development of this Plan, MKGSA staff and Advisory Committee members coordinated several types of targeted stakeholder outreach meetings and presentations. Initial outreach activities focused on raising awareness of SGMA and establishment of MKGSA as the local public agency responsible for complying with the new law. These later matured to technically-oriented presentations during regularly scheduled public meetings of the MKGSA Advisory Committee and other venues, as appropriate. These meetings are described as follows:

1.5.4.1 Kaweah Subbasin Presentations:

The MKGSA reached out to more than 40 community organizations, stakeholder groups and agencies as part of a Speaker's Bureau Program to raise awareness of the agency and encourage participation development of this Plan at Board and Advisory Committee meetings. The Speaker's Bureau Program sought to present information about the agency and status of Plan development during meetings hosted by the identified group. While the focus of the Speaker's Bureau Program is to secure placement on the agenda of meetings where members of a community gather, it is also a method to raise awareness in a stakeholder community by sharing information to individuals active in the community. Overall, the Speaker's Bureau resulted in 15 presentations and the distribution of MKGSA information to an additional 27 organizations. Table 1-4 includes the list of presentations provided during development of this Plan. Table 1-5 provides the list of organizations that received information from MKGSA representatives through the Speaker's Bureau Program.

Table 1-4: Speaker's Bureau Program Presentations

Presentation	Organization Name	Organization Type	Point of Contact	Email
Jun. 14, 2019	Tulare Noon Rotary	Citizens Groups	Kathy Mederos	
May 16, 2019	Sycamore Valley Academy	Domestic Well Users, Rural School	Ruth Dutton	
May 14, 2019	Almond Board: "Navigating the Waters"	Agriculture	J.P. Cativiela	Jp.cativiela@padillaco.com
May 8, 2019	Buena Vista School	Domestic Well Users, Rural School	Carole Mederos	cmederos@buenavistaeagles.org
May 1, 2019	Tulare Sunrise Rotary	Citizens Groups	Brett Schroder	
Apr. 21, 2019	Leadership Tulare – Tulare Chamber of Commerce	Citizens Groups	Darcy Phillips	
Apr. 16, 2019	Tulare County League of Women Voters	Citizens Groups	Maile Melkonian	maile@melkonian.org
Apr. 15, 2019	Leadership Visalia – Visalia Chamber of Commerce	Agriculture	Dante Rosh	
Apr. 8, 2019	210 Connect (Visalia Times-Delta & first Presbyterian Church)	Citizens Groups	Teresa Douglas	
Mar. 26, 2019	Visalia County Center Rotary Club	Citizens Groups	Sam Logan	sam-logan@ml.com
Mar. 25, 2019	Visalia Planning Commission, Parks and Recreation Department, Environmental Committee	Government and Land Use Planning Agency	Paul Bernal	paul.bernal@visalia.city
Mar. 19, 2019	Downtown Visalia Kiwanis Club	Citizens Groups	Olivia Velasquez	oliviaspost@yahoo.com, kiwanisvisalia@gmail.com
Mar. 6, 2019	Sequoia-Visalia Kiwanis Club	Citizens Groups	Jeff Sweeney	info@sequoia-visaliakiwanis.org
Mar. 3, 2019	Visalia Host Lions Club	Citizens Groups	Ruth McKee	rmckee.2@netzero.net
Feb. 20, 2019	Tulare International Kiwanis Club	Citizens Groups	Kenneth Hood,	kenneth.hood@usw.salvationarmy.org

Table 1-5: Speakers Bureau Program Information Dissemination

Organization Name	WC 10723.2	Point of Contact
Rotary Club of Visalia Breakfast	Citizens Group	Daniel Evans
Rotary Club of Visalia	Citizens Group	Paul Hurley
Tulare Host Lions Club	Citizens Group	Ruth McKee
Tulare Morning Kiwanis	Citizens Group	Kent Jensen, Neva Stevenson
Visalia Breakfast Lions Club	Citizens Group	Karen McVeigh
Visalia Economic Development Corporation	Citizens Group	Nancy Lockwood
Visalia Latino Rotary	Citizens Groups	Lina Contreras
Visalia Masonic Lodge	Citizens Groups	Linda Godsave
Visalia Sequoia Lions Club	Citizens Groups	Steve Gerard
Visalia Sunset Rotary	Citizens Group	Barbara Hood
West Visalia Kiwanis Club	Citizens Group	Buz Southard
Building Industry Association	Commercial & Industrial Self-Supplied	Brian Todd
Kraft Foods	Commercial & Industrial Self-Supplied	Laura Burns Manager
Land O Lakes	Commercial & Industrial Self-Supplied	Pete Garboni
Saputo Dairy Foods USA	Commercial & Industrial Self-Supplied	Michael "Buck" Buchanan
County Manor Mobile Home Community	Disadvantaged Community	George or Carolyn
Mooney Grove Manor Mobile Home Park	Disadvantaged Community	Neil Pilegard
Mountain View Mobile Home Park	Disadvantaged Community	Lonny Fulton
Royal Oaks Mobile Home Park	Disadvantaged Community	Laura Fierro
Westlake Village Mobile Home Park	Disadvantaged Community	Richard Popkins
Willow Glen Mobile Estates	Disadvantaged Community	Linda McCuin
Liberty School	Domestic Well Owner, Rural School	Keri Montoya
Oak Valley School	Domestic Well Owner, Rural School	Fernie Marroquin
Palo Verde School	Domestic Well Owner, Rural School	Phil Anderson
Sundale School District	Domestic Well Owner, Rural School	Terri Rufert
Waukena Joint Union School District	Domestic Well Owner, Rural School	Superintendent Terri Lancaster
City of Tulare, Planning Department	Governmental and Land Use Agencies	Josh McDonnell

1.5.4.2 Board of Directors Meetings

Meetings of the Board of Directors served, in part, as a venue for planning staff to receive direction for major technical and policy issues. Comments on these topics from the public, Advisory Committee members and other stakeholders were welcomed during scheduled public comment sessions. Comments received during these sessions were responded to by Board members or staff, as appropriate. These meetings also served as key opportunities for the public and stakeholders to engage and consult in development of the GSP and to track its progress. Information and notification of Board meetings were publicly provided in accordance with the Brown Act. Meeting agendas and summaries were additionally posted on the agency website and distributed to stakeholders that registered as an interested party on the Kaweah GCP.

The MKGSA Board of Directors meet monthly, unless otherwise publicly noticed in accordance with the Brown Act. Since September 14, 2015, the Board has held 27 meetings, with one meeting held at the City of Visalia Administration Building, 220 N. Santa Fe St. Visalia, CA. The balance of the Board sessions were held at the Tulare Public Library and Council Chambers, 491 North M. Street Tulare, CA. The list of meetings is available at the agency website. The meetings represented opportunities for the public and stakeholders to participate in Plan development and exchange ideas and concerns with Board members and agency staff. Standard agenda items at each Board meeting included a public comment session, an update on intra-basin coordination activities, and a report of activities of the Advisory Committee and Technical Advisory Committee.

1.5.4.3 Advisory Committee Meetings

The publicly noticed Advisory Committee meetings are important venues for development of recommendations to the Board of Directors to key technical and policy issues. The public was encouraged to engage and consult in these discussions and assist Advisory Committee members in their consideration of a preferred approach. These recommendations were later provided to the Board of Directors for their consideration. Written notification of each meeting was posted on the MKGSA website and by email to all parties that subscribed to the Kaweah CCP. Notifications were additionally posted for public review at the meeting location, as required by the Brown Act.

The MKGSA advisory Committee holds monthly meetings, unless otherwise publicly noticed. It has held 16 meetings since the committee's May 9, 2016 formation. The majority of the meetings were held at the City of Visalia Wastewater Treatment Plant, 7579 Ave. 288, Visalia, CA. Two meeting were held at the City of Visalia's City Clerk's office, 220 N. Santa Fe St. Visalia, CA, and one at the Tulare City Hall, 411 East Kern Ave. Tulare, CA. Common agenda topics include a public comment session, status and planning of outreach activities, committee reports and updates, and technical presentation. Another frequent agenda topic included brief presentations focused on water resource supplies and supply reliability applicable to the Mid-Kaweah region. These educational briefings were provided by staff of member agencies of the MKGSA and other parties. For a full schedule of the Advisory Committee meetings, meeting materials, agendas and meeting summaries, visit the MKGSA website.

1.5.5 *Comments Received*

> **§354.10 I:** Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.

The MKGSA held a public comment period on the Draft GSP from July 31 to September 16, 2019. The Draft GSP was posted on the MKGSA website, as well made available for review at multiple public locations. Written comments on the Draft GSP could be submitted electronically via email or hard copy via mail or hand delivery. The MKGSA received 13 comment letters on the Draft GSP during the public comment period. From the 13 letters, a total of 197 individual comments were identified. MKGSA staff and consultants reviewed and categorized each comment. Every comment was provided a response, which was recorded in a comment matrix tool. The GSP was revised to address any comments that raised credible technical or policy issues. **Appendix 1G** Public Comment Summary further describes the MKGSA's process to solicit, review, and address comments on the Draft GSP. This summary further describes external peer review processes that were led by Member agencies of the MKGSA Joint Powers Authority. Copies of comments received on the Draft GSP are provided as Attachment B to **Appendix 1G**.

Pursuant to California Water Code § 10728.4, the MKGSA also provided notice of the MKGSA's intent to adopt the GSP to cities and counties within the plan area. This notification included a letter sent to the cities of Tulare and Visalia and the county of Tulare on August 13, 2019, provided as Attachment A to **Appendix 1G** as a courtesy, the MKGSA also provided notice to California Water Service, which serves as the water purveyor for the City of Visalia. Cities and counties within the GSP area were provided 30 days from receipt of the notice to request consultation on the Draft GSP. The MKGSA did not receive any requests for consultation during this time. Cities and counties within the GSP area will be notified of any future amendments to the GSP and GSP implementation activities.

1.5.6 *Inter-Basin Coordination*

Development of this Plan was supported through a series of intra-basin and inter-basin coordination activities. The key intra-basin coordination activity was the Kaweah Subbasin Management Team (KSMT), a committee comprised of representatives from each of the three Kaweah Subbasin GSAs: East Kaweah, Greater Kaweah, and Mid-Kaweah. As members of the KSMT are appointed by their respective Board of Directors, all meetings of this group were publicly noticed consistent with the Brown Act. These meetings focused on development and evaluation of key policy and technical issues mutually shared by Kaweah Subbasin GSAs. Members of the public that attended these meetings were invited to provide comments to these topics. The schedule of KSMT, and other intra-basin activities, is provided in Table 1-6**.**

Inter-basin coordination activities included participation in events scheduled by other organizations, or events led by Kaweah Subbasin GSAs. These inter-basin activities focused GSAs within the groundwater subbasins that comprise the Tulare Lake Basin, and provided opportunities for GSA managers, technical consultants, and the public to collaborate on topics of mutual concern. The schedule of these meetings is provided in Table 1-6.

Table 1-6: Inter-Basin, Intra-Basin Coordination Meetings

Date	Type	Event Name	Location	Participating GSAs or Subbasin	Key Agenda Topics
Jun. 19, 2019	Intra-basin	Management Team Committee Meeting	City of Visalia Wastewater Treatment Plan, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement, consultant presentation and recommendations
May. 15, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	Public comment, GSA updates and progress, coordination agreement status, consultant and SkyTEM presentations
Apr. 23, 2019	Inter-basin	Farmer-Rancher Meeting	International Agri - Center, Tulare, CA	Tulare Lake Subbasin	SGMA and GSP development
Apr. 17, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement status, consultant presentation
Mar. 20, 2019	Intra-basin	Management Team Committee Meeting	Exeter Museum, Exeter, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement status, consultant presentation
Jan. 16, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, next steps and future activities
Dec. 18, 2018	Inter-basin	South Valley SGMA Practitioners Roundtable IV	Tulare County Agricultural Commissioner's Office, Tulare, CA	Tulare Lake Subbasin	SGMA updates, inter-basin coordination, basin boundary flows and minimum thresholds, mapping aquifers and hydrogeologic frameworks near Tulare, SkyTEM, DACs and groundwater marketing
Dec. 14, 2018	Inter-basin	South Valley Technical Group Meeting	Greater Kaweah GSA, Farmersville, CA	Tulare Lake Subbasin	Technical GSP development and coordination
Sep. 19, 2018	Intra-basin	Management Team Committee Meeting	Kaweah Delta Water Conservation District, Farmersville, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, next steps and future activities

Date	Type	Event Name	Location	Participating GSAs or Subbasin	Key Agenda Topics
May 16, 2018	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, memorandum of understanding amendment, coordination agreement elements, next steps and future activities (**Appendix 1D**)
Apr. 18, 2018	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, GSA coordination, management teamwork plan, next steps and future activities
Apr. 10, 2018	Inter-basin	The Community Water Center: Drinking Water Vulnerability Assessment Web Tool Kick-Off Meeting	Resources Legacy Fund Sacramento, CA	Tulare Lake Subbasin	Development of an accessible, interactive and publicly available drinking water vulnerability assessment web tool, groundwater management needs of SDACs for GSPs
Mar. 2, 2018	Inter-basin	Technical Group Meeting	Kaweah Delta WCD Office, Farmersville, CA	Tulare Lake Subbasin	SkyTEM proposal, technical memorandum discussing accounting framework, water budgets
Feb. 16, 2018	Inter-basin	South Valley Technical Group Meeting	Technical Three-hour Webinar	Tulare Lake Subbasin	SGMA overview, DWR inter-basin relationships regulations, subbasin perspectives, hydrogeologists/modelers subbasin concerns, hydrogeologic conceptual model development, subbasin numerical surface water and groundwater modeling efforts, adjacent subbasins, next steps
Jan. 30, 2018	Intra-basin	Management Team Committee Meeting	Kaweah Delta Water Conservation District, Farmersville, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, subbasin Memorandum of Understanding, management team administration, consultant presentation, subbasin water budget apportionment, management teamwork outlook
Oct. 20, 2017	Inter-basin	South Valley SGMA Practitioners Roundtable III	International Agri-Center Heritage Complex, Tulare, CA	Tulare Lake Subbasin	Subbasin updates, DWRs SGMA technical assistance, SkyTem in the South Valley, headwaters coordination

Date	Type	Event Name	Location	Participating GSAs or Subbasin	Key Agenda Topics
Mar. 17, 2017	Inter-basin	South Valley SGMA Practitioners Roundtable II	International Agri-Center Heritage Complex, Tulare, CA	Tulare Lake Subbasin	Inter-basin coordination, objectives and best practices, groundwater flows between subbasins, next steps
Jul. 22, 2016	Inter-basin	South Valley SGMA Practitioners Roundtable I	Southern California Edison, Ag Technology Application Center, Tulare, CA	Tulare Lake Subbasin	Perspective from a functioning GSA, coordinating the uncoordinated, SGMA fees, and SGMA implementation in the South Valley updates.

1.5.7 *GSP Implementation*

> *§ 354.10(b)(4):* The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.

Following GSP adoption, the MKGSA will continue to inform beneficial users and interested parties through continuation of activities implemented to develop this Plan. Key activities for the public to follow and engage in GSP implementation include attendance at regularly scheduled meetings of the MKGSA Board of Directors, the MKGSA Advisory Committee, and the Kaweah Subbasin Management Team. The agency intends to continue to notify the public of these meetings by email, public postings of agendas, and social media. The agency anticipates civic and non-profit organizations contacted during the planning phase may request follow-up presentations. The agency will support these requests as resources allow. The agency will continue to provide new and updated information on GSP implementation on its agency website, including the Kaweah Subbasin Annual Report (GSP Emergency Regulations §356.2). The website will also assist implementation of projects subject to the California Environmental Quality Act and Assembly Bill 52, as applicable.

1.6 GSP Organization

This GSP, developed in compliance with SGMA, consists of the following Sections:

- Section 1 – Introduction
- Section 2 – Basin Setting
- Section 3 – Sustainability Goal e
- Section 4 – Monitoring Networks
- Section 5 – Sustainable Management Criteria
- Section 6 – Water Supply Accounting
- Section 7 – Projects and Management Actions

- Section 8 – DWR Reporting
- Section 9 – References

Section 1 – Introduction

The development of this MKGSA Introduction Section was informed by DWR's GSP Annotated Outline Guidance Document and Stakeholder Communication and Engagement Guidance Document. These documents are provided in **Appendix 1F**.

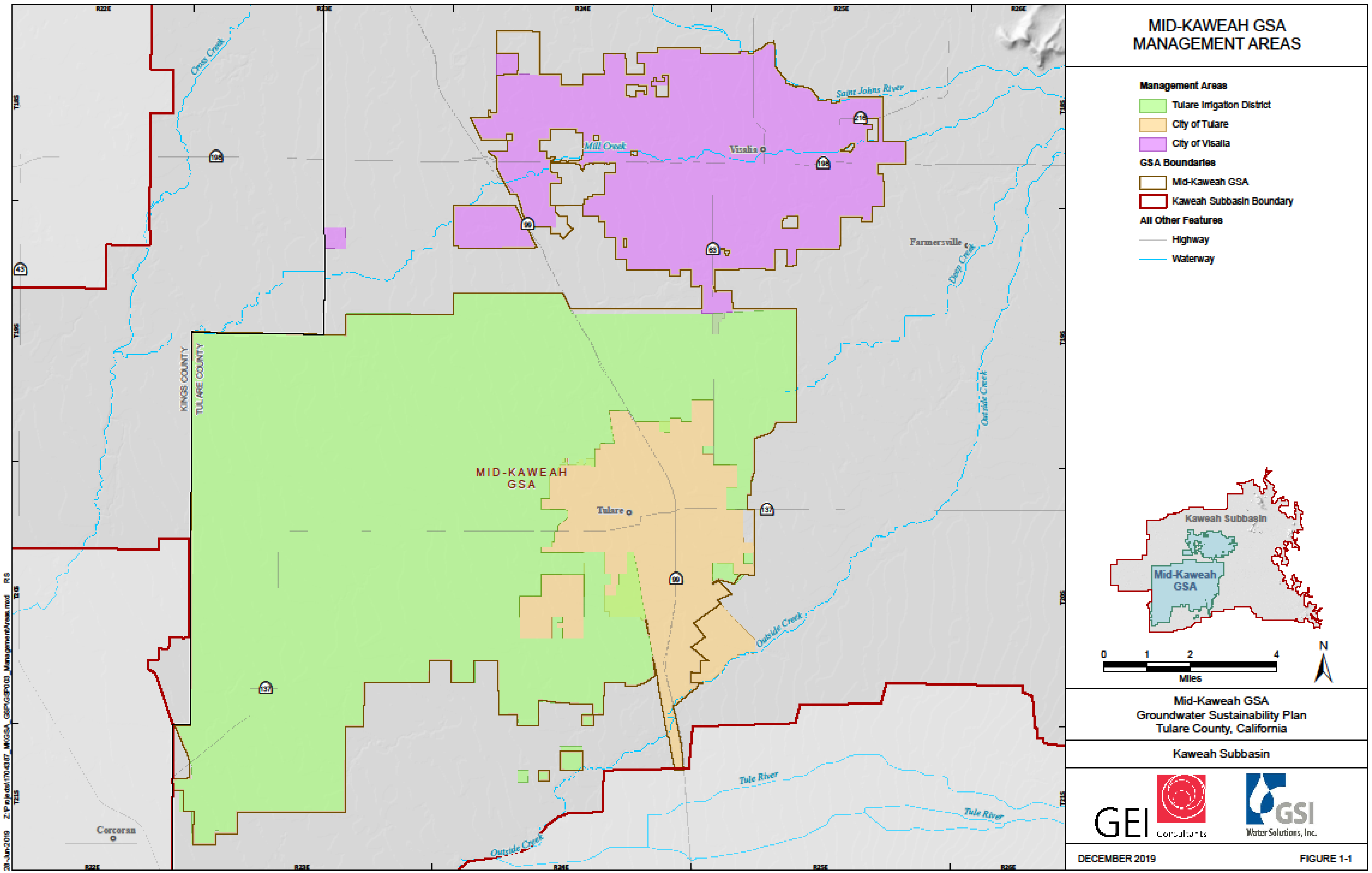

Figure 1-2: Management Areas

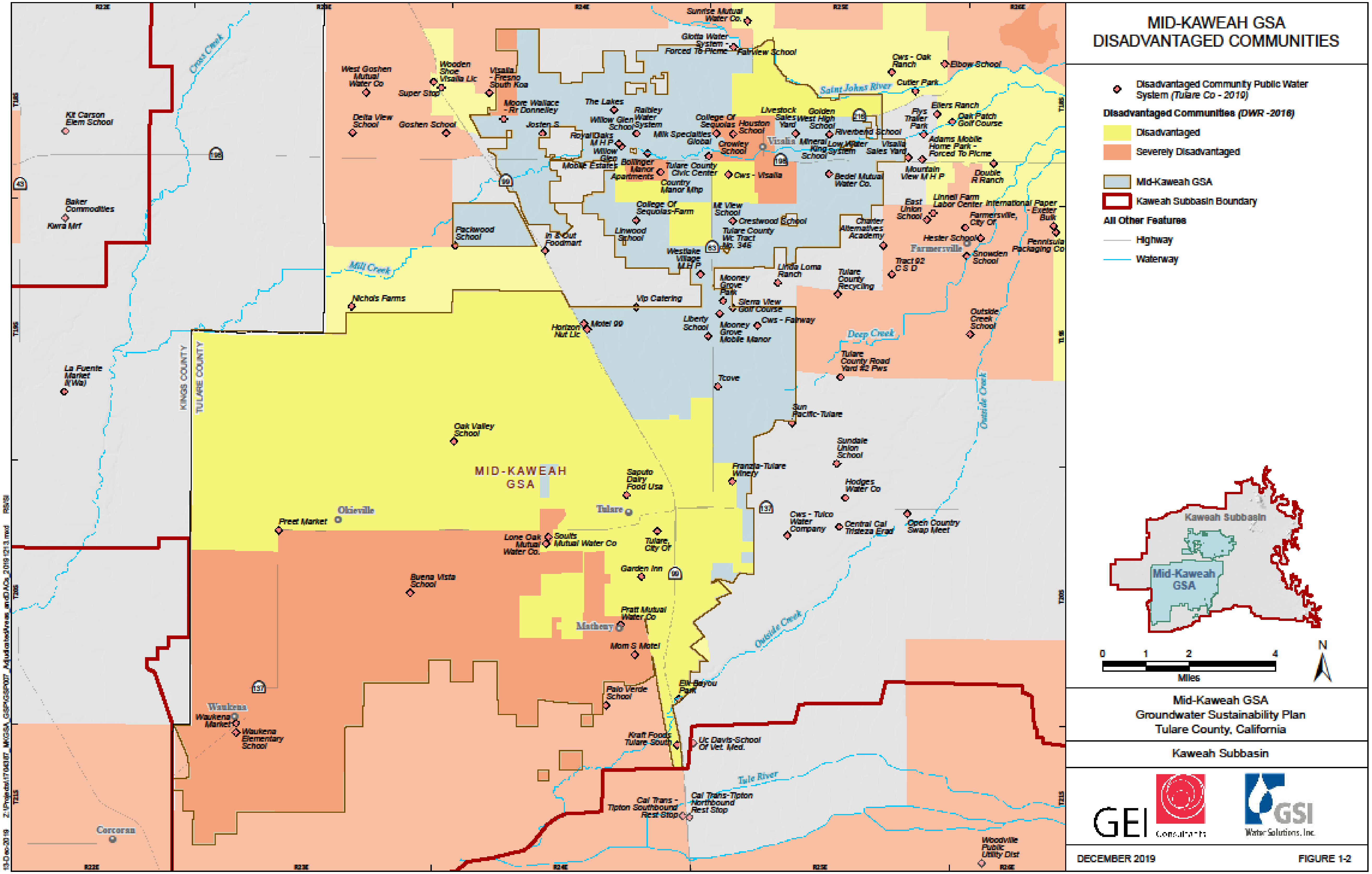

Figure 1-3: Adjudicated Areas and Disadvantaged Communities

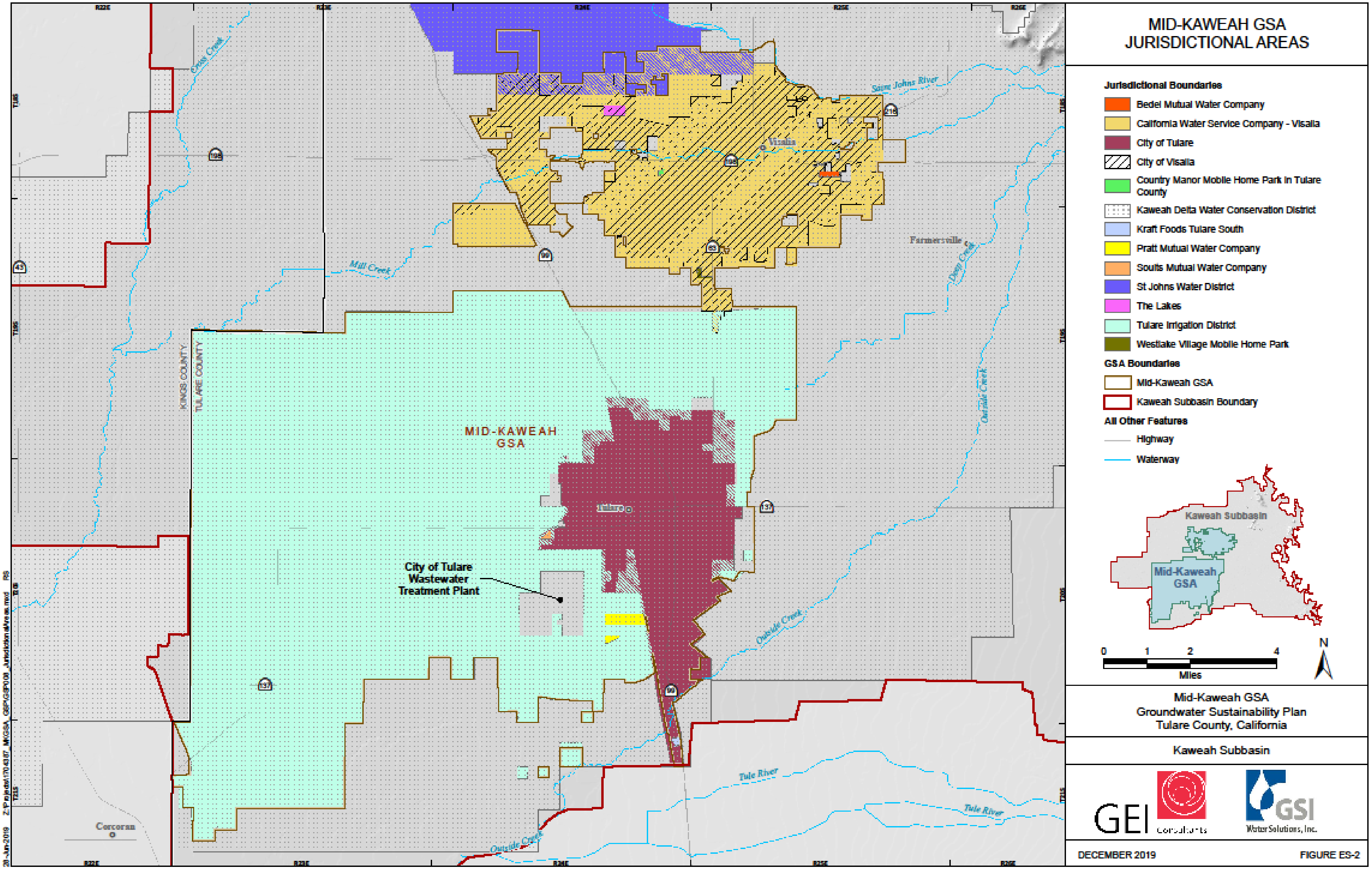

Figure 1-4: MKGSA Jurisdictional Boundaries

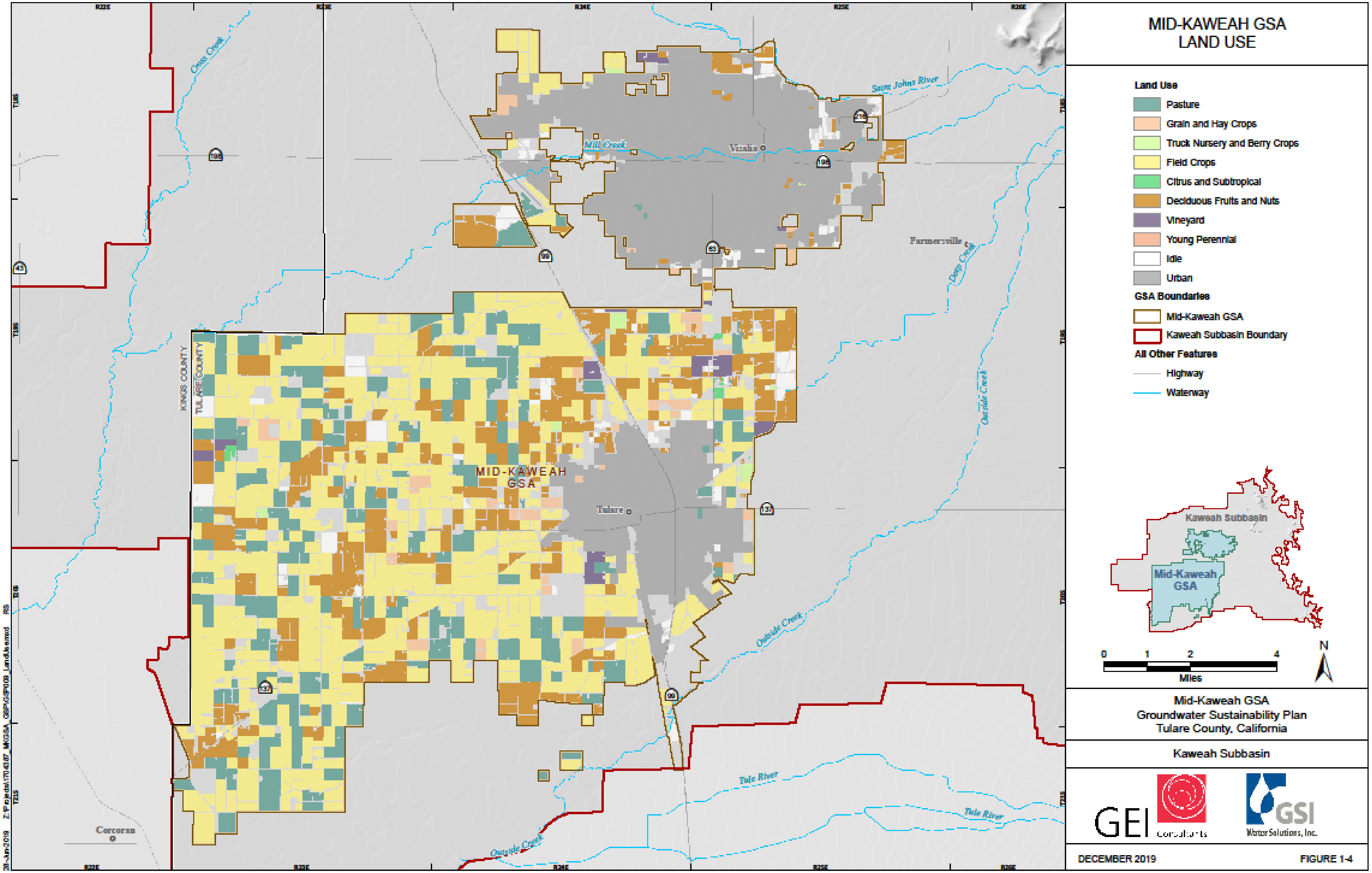

Figure 1-5: MKGSA Land Use

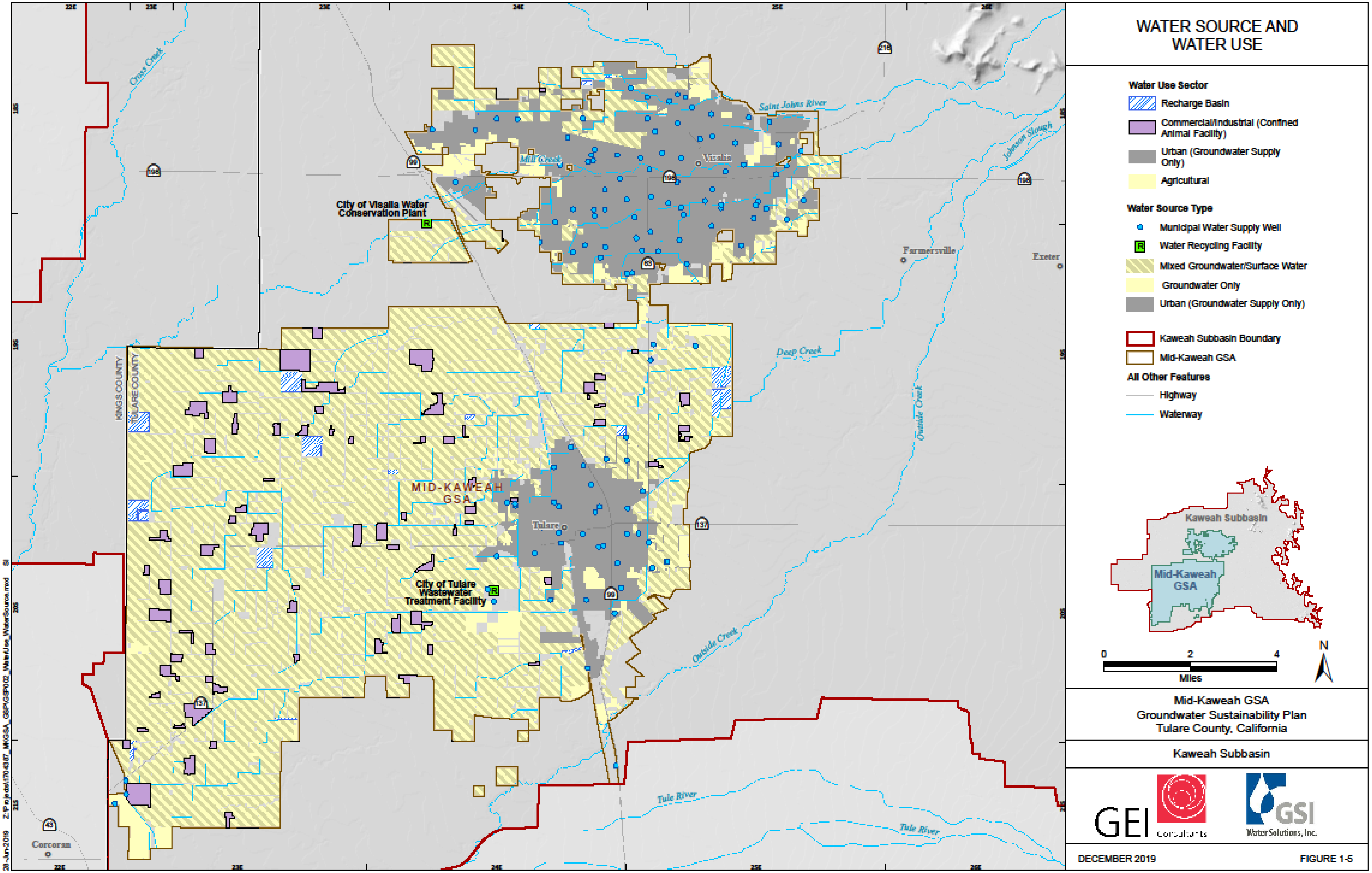

Figure 1-6: Water Source and Water Use

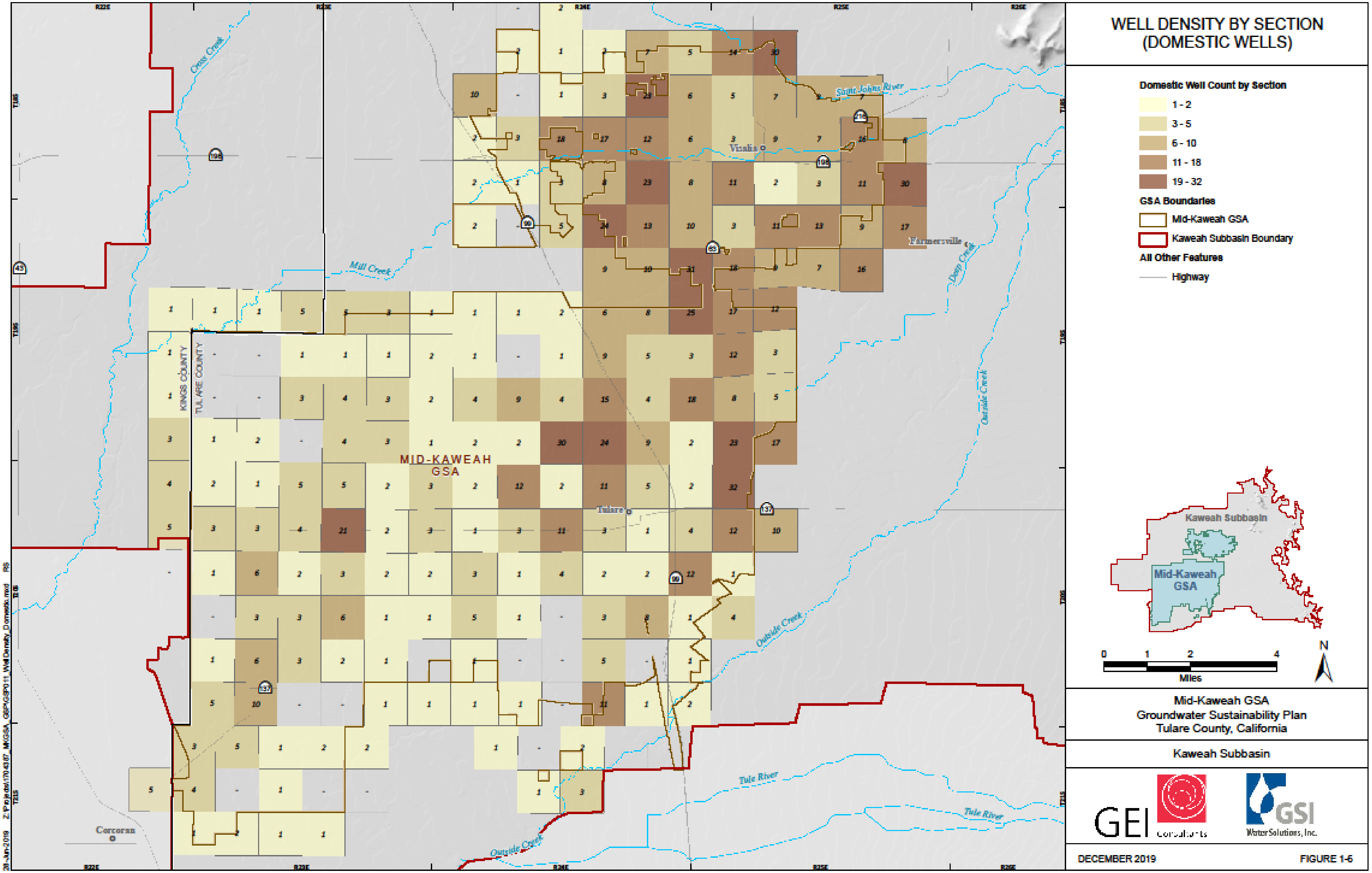

Figure 1-7: Density of Wells – Domestic

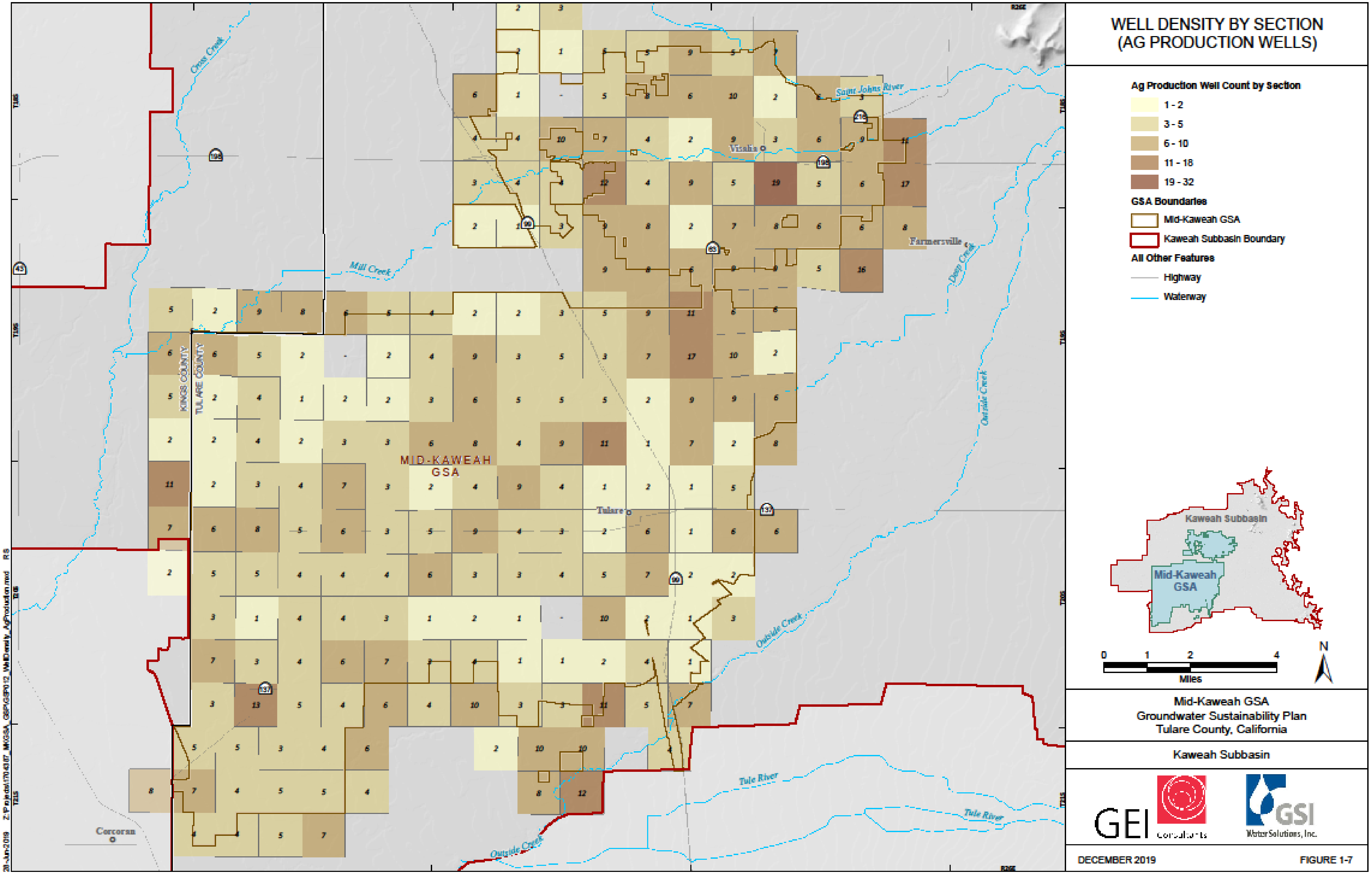

Figure 1-8: Density of Wells – Production

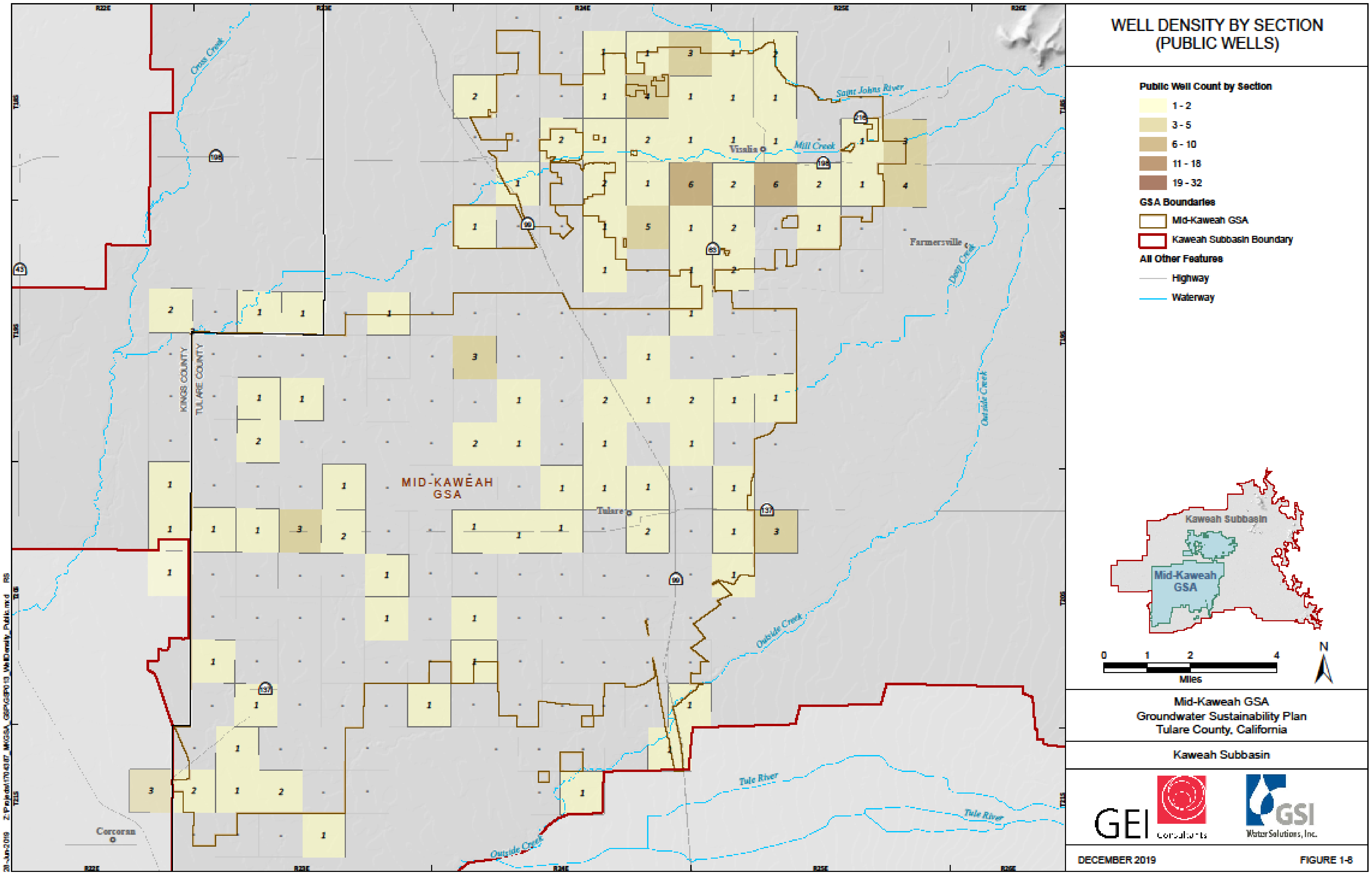

Figure 1-9: Density of Wells – Public

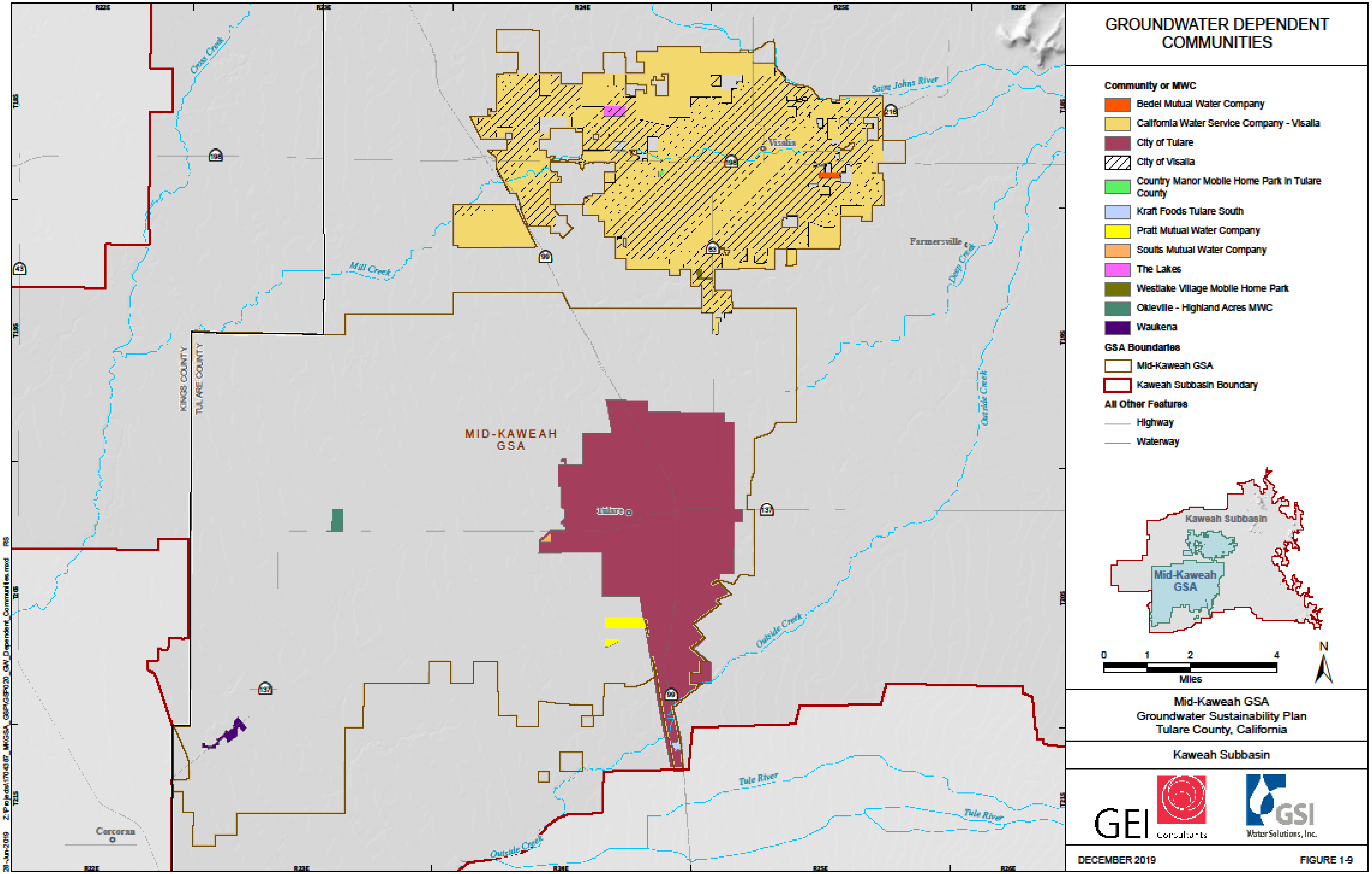

Figure 1-10: Groundwater Dependent Communities

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2. Basin Setting

2.1 Overview

The three GSAs in the Kaweah Subbasin have coordinated and jointly prepared a comprehensive Basin Setting which is included as **Appendix 2A** of this Plan. The process and work effort to prepare this document are in accordance with the "MOU for Cooperation and Coordination of the Kaweah Subbasin" executed by the GSAs in 2017 for the purposes of (a) retaining consultants to conduct the necessary technical work sufficient to support a Coordination Agreement and (b) to establish a committee structure and associated public vetting process leading to an acceptable Hydrogeologic Conceptual Model (HCM), which describes and depicts the groundwater conditions and water budgets within the Subbasin.

Key sustainability outcomes discussed in the Basin Setting document is an overall basin Safe Yield of 720 TAF. Using this information to facilitate numerous public and advisory committee meetings, the three GSAs in the basin have agreed to a sustainable yield of 660 TAF. **Appendix 2A** fully addresses §354.14, §354.16, and §354.18 of the GSP Regulations. The following sections highlight information for the MKGSA from **Appendix 2A**, but we strongly encourage the reader to review **Appendix 2A** to understand the hydrogeologic and groundwater conditions in the MKGSA within the context of the entire Subbasin.

The Kaweah Subbasin's safe yield is estimated to be about 720,000 AF, which includes net sub-surface inflow. As defined in SGMA, however, the Subbasin's sustainable yield may additionally be impacted when considering undesirable results other than reductions in groundwater storage. The Parties therefore have preliminarily determined that the sustainable yield may be something less and have agreed that the total groundwater inflow of 660,000 AF, which does not include net subsurface inflow (other than mountain front recharge) and was agreed to be most protective of both the Kaweah and adjacent subbasins. This estimated sustainable yield will continue to be revised pursuant to the monitoring of sustainability indicators and avoidance of undesirable results.

Building on the Kaweah Subbasin Basin Setting document provided in Appendix **2A,** this section provides an overview of the basin setting followed by more detail on elements unique to the MKGSA, including:

- GSA Groundwater Level Trends
- GSA Water Budget for Current Period
- GSA Disconnection between Surface and Groundwater

A description of management areas is also provided in this section.

2.2 GSA Basin Setting Features

The MKGSA is located within the central to southwestern side of the Kaweah Subbasin, midway between the mountain front and the center of the San Joaquin Valley. Much of the GSA is underlain by the Corcoran Clay, which creates an upper and lower aquifer system, as shown by Sections B-B' and E-E' of **Appendix 2A**. A single aquifer system is present beneath the eastern half of Visalia in the northeastern GSA. The thickness of the fresh groundwater system varies from about 900 feet on the northeastern corner of MKGSA to about 1,600 feet near the southwestern corner. In general, groundwater flows across the MKGSA in a southwesterly direction and to local cones of depression during the irrigation season. The vertical flow gradient is from shallow to deep conditions.

Groundwater quality is generally good, but available data are primarily located in the northern and eastern portions of the MKGSA. Several constituents of concern have been identified due to concentrations near Maximum Contaminant Levels (MCLs) or due to increasing trends, including arsenic, nitrate, certain volatile organics, and 1,2,3-trichloropropane.

Subsidence has occurred throughout the MKGSA area during the last 90 years. The largest amounts of subsidence occurred along the western and southern boundaries of the MKGSA area. Greater amounts of subsidence have occurred beyond the Kaweah Subbasin to the west and south. According to DWR, subsidence between 1949 and 2005 has varied from as much as 5 feet in the Visalia area to as much as 10 feet in the Tulare area to as much as 15 feet along the southwestern corner of the MKGSA area based on land survey technology. As much as 20 feet of subsidence has occurred to the west of the MKGSA area and this area is tangential to the MKGSA area. More recently, radar technology has been used to identify subsidence for various time periods (January 2007 to March 2011, May 2015 to April 2017). Up to 0.5 feet (total) of recent subsidence is documented for the northeastern corner of the MKGSA area (northeast of Visalia) while near the southwestern corner, recent subsidence totals nearly 4 feet, excluding any potential subsidence between the measurement periods.

The following data gaps were identified for the MKGSA:

- Accurate count of wells in the MKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned)
- Construction details of wells, especially production/screen interval(s). This was a significant data gap that prevented a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay
- Groundwater production records from direct measurement and locally generated estimates of groundwater use in rural areas of the MKGSA. This information will improve the water budget.
- Lithologic composition of aquifer, including geophysical logs at strategic locations

- Hydraulic parameters of principal aquifers such as transmissivity, storativity and porosity based on pumping tests preferably. This information could then help with the interpretation of Aerial Electro-Magnetic (AEM) data recently collected.
- Water quality data for small rural community, domestic (rural residential homeowners) and agricultural irrigation wells
- Understanding of groundwater quality trends with depth (i.e. between upper and lower principal aquifers and vertical changes within each principal aquifer). With this information, an improved understanding is possible regarding depth of base of freshwater throughout the MKGSA as well as the Kaweah subbasin as a whole.
- Measurements of subsidence within the MKGSA. The historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth. Correlation between subsidence and release of arsenic from clay mineralogy represents a data gap that needs to be filled through improved sampling and subsidence monitoring.
- Expanded monitoring of groundwater levels and groundwater quality in small rural communities and disadvantaged communities

The data gaps will be addressed as MKGSA implements the management actions designed to close such gaps, as described in Section 7.4.

2.3 GSA Groundwater Level Trends

Current and historic groundwater level trends for the entire basin are presented in Section 2.4.1 and Appendix B of the Basin Setting document included as **Appendix 2A** to this GSP. This section provides more detail on these trends throughout the MKGSA. These trends are observable on Figure 2-2 which include 10 long-term hydrographs across the MKGSA with records beginning in the 1950s or 1960s and extending to the present. Groundwater levels are lowest in the southwest region of the GSA where groundwater levels in the range up to 300 feet or more below ground surface as shown on the hydrographs for KSB-889 and KSB-922 provided in Figure 2-2. The highest groundwater levels in the GSA are observed in the northeast region of the GSA near the St. Johns River where depth to groundwater is in the range of 100 to 150 below ground surface as shown on KSB-1977 and KSB-1696 on Figure 2-2.

2.4 GSA Water Budget

Water budget information was compiled for the three GSAs within the Subbasin to evaluate the historic availability and reliability of past surface water supply deliveries and the aquifer response to water supply and demand trends relative to water year type (or hydrologic condition). All readily available data were collected, and a water budget was compiled in accordance with a coordination agreement between the three GSAs "to ensure that the three plans are developed and implemented utilizing the same data and methodologies, and that the elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting." (§354.4 (a))

Within the Kaweah Subbasin, the historical water budget period (base period) was selected to be between water years 1981 and 2017. The current water budget period was between water years 1997 and 2017. The projected of future water budget extends to 2070 accounting for climate change impacts on both supply and demand. Each of these are described in detail in the Kaweah Subbasin Basin Setting Document in **Appendix 2A**. Of these three water budgets, the current water budget is the most accurate because better data, records, and estimating methods were available. Table 32 of **Appendix 2A** presents the annual tabulation of the current (1997-2017) water budget for the Subbasin. The basin current water budget was used in the numerical groundwater model and the future water budget was used to run model simulation to estimate future groundwater levels under a number of different scenarios. The model was a helpful tool in setting measurable objectives for this GSP. For more information on the details of groundwater modeling for use in the development of the GSP, please review the groundwater modeling report included as an appendix to the Coordination Agreement.

Based on the jurisdictional areas of each Subbasin GSA and the water budget components physically located within each area, a MKGSA water budget is presented in Table 2-1. This localized water budget represents the estimated physical movement of water in and out of the MKGSA area on an annual basis and provides an average for the 21-year period. A brief description of each of the inflow and outflow components is provided in this section, but more detailed descriptions of methods are provided in the Current Water Budget section of the **Appendix 2A**.

2.4.1 *Inflows to the MKGSA*

The inflow components to the MKGSA groundwater system include the following:

- Subsurface inflow
- Percolation of wastewater
- Streambed percolation in the natural and man-made channels
- Artificial recharge
- Percolation of irrigation water
- Percolation of precipitation

Each of these components and the method used for each calculation is presented in this section.

Subsurface Inflow

Subsurface flow into the MKGSA was calculated using the Darcy equation Q = PiA, where 'P' is the coefficient of aquifer permeability (horizontal hydraulic conductivity), 'i' is the average hydraulic gradient, and 'A' is the cross-sectional area of the saturated aquifer. Permeability data for the aquifers in the Kaweah Subbasin, including the MKGSA, were discussed in Section 2.2.5.2 of **Appendix 2A**, which were used in the numerical groundwater model. Hydraulic gradient data, derived from annual water level contour maps developed for this Basin Setting were analyzed on an annual basis over the base period. The cross-sectional areas of the aquifer at each groundwater flux line representing the boundaries of the MKGSA were estimated using GIS analysis. From these, annual magnitudes of subsurface flow were tallied. These initial calculations were refined using the numerical groundwater model which was run to generate subsurface inflows and outflows over the current water budget period. The average annual subsurface inflow to MKGSA from 1997 to 2017 was 111.3 TAF.

Wastewater Inflow

Several municipal WWTPs are operated within the Kaweah Subbasin, the principal ones of which are the cities of Visalia and Tulare, located entirely within the MKGSA. Treated wastewater is discharged to holding ponds for percolation, evaporation, or agricultural reuse. Both WWTPs are regulated by Waste Discharge Requirements (WDRs) and Monitoring and Reporting Programs by the RWQCB (Fugro West, 2007). The managers of the two treatment plants were contacted by GSI, and Annual Use Monitoring Reports for the City of Tulare were consulted during this analysis. Based on this research, on average, approximately 80 percent of the Visalia WWTP effluent percolates to groundwater while the other 20 percent is applied to adjacent crops. At the city of Tulare's WWTP, on average, 30 percent of the WWTP effluent percolates to groundwater while the other 70 percent is applied to nearby crops. The annual sums of wastewater that percolate to groundwater within MKGSA are presented in ***Table 26*** of **Appendix 2A**. For the MKGSA, the average annual percolation of wastewater is 13.9 TAF from 1997 to 2017.

Streambed Percolation and Conveyance Losses

Streambed losses from natural streambed channels was estimated using available stream gauge data. Percolation in these natural channels was estimated based on the number of days that water flowed in each reach and the difference between an adjusted reach loss and any known riparian diversion within the reach (Fugro West, 2007; Fugro Consultants, 2016). Ditch losses were calculated by subtracting total water demand (estimated by Davids Engineering) from total surface water delivered and then correcting for area (total ditch area divided by total irrigable acreage). For the MKGSA, the average annual percolation from streambeds and conveyance ditches was 53 TAF from 1997 to 2017.

Percolation of Recharge Basins

Artificial recharge basins receive surface water, which percolates directly to groundwater, the volumes of which were estimated for the MKGSA. The method of estimating these volumes was developed as part of the WRIs for KDWCD, which involved multiplying the number of days each recharge basin received water by the basin's known percolation rate. The basin recharge factors were refined for the entire period of the WRI (Fugro Consultants, 2016) and were utilized for this analysis for the entire base period. For the MKGSA, the average annual percolation from artificial recharge basins was 32.1 TAF from 1997 to 2017.

Percolation of Irrigation Return Water

Similar to the method used to quantify conveyance losses, percolation of irrigation return water was calculated by subtracting total water demand (estimated by Davids Engineering) from total surface water delivered and then correcting for area (total crop area divided by total irrigable acreage). A detailed description of this methodology as applied to the entire subbasin is provided in **Appendix 2A**. For the MKGSA, the average annual percolation irrigation return water was 48.4 TAF from 1997 to 2017.

Percolation of Precipitation

The amount of rainfall that percolates deeply into the groundwater system depends on many factors including the type and structure of the soil, density of the vegetation, the quantity, intensity and duration of rainfall, the vertical permeability of the soil, the relative saturation of the soil during rainfall episodes, and local topography. Deep percolation of rainfall does not occur until the initial soil moisture deficiency is exceeded. In most years, rainfall events do not produce sufficient quantities and timing of rainfall to penetrate beyond the root zone of native vegetation. However, in irrigated soils, because of the artificial application of water, the initial fall and winter moisture content is greater, and less annual rainfall is required to meet and exceed the soil moisture deficiency. Once the soil moisture deficiency within the root zone has been satisfied, continued precipitation (occurring prior to evapotranspiration) will percolate downward and eventually reach the groundwater reservoir.

Estimation of the deep percolation of precipitation was performed for the earlier period (prior to 2000) using an established method that incorporates the distribution of known crop types, rainfall distribution, reference evapotransporation (ET) data from the CIMIS, and soil data. From these data, the percolation of precipitation was calculated with the development of a monthly moisture model spreadsheet that accounted for immediate evaporation, effective rainfall, percolation of infiltrated rainfall, and percolation of rainfall runoff (Fugro West, 2007).

Since 2000, estimates of the percolation of precipitation were made by a different method, based on a combination of remote sensing (satellite) images and computer simulations, which relied on a daily root zone water balance model and crop ET. The method utilizes Davids Engineering's "Normalized Difference Vegetation Index" (NDVI) analysis methods, which were applied to the area of the KDWCD (Davids Engineering, 2013) and the entire Subbasin (Davids Engineering, 2018[*Appendix C of Appendix 2A*]).

For the MKGSA, the average annual percolation of precipitation was 25.4 TAF from 1997 to 2017.

2.4.2 *Outflows from the MKGSA*

Outflow from the groundwater system occurs through the following components:

- Municipal and industrial pumping
- Agricultural pumping
- Extraction by phreatophytes
- Evaporative Losses
- Subsurface outflow

Each of these components and the method used for each calculation is presented in this section

Municipal and industrial pumping

The categories of water users included in this component include:

- Urban
- Small public water system
- Golf course
- Dairy
- Nursery
- Rural domestic

The total M&I groundwater pumping estimate within the MKGSA is the sum of the individual groundwater pumping estimates each of these water uses. Data used in the M&I groundwater pumping estimate were collected from a variety of sources, including metered municipal groundwater pumping records, estimates based on service connections and categories of facilities, population and dwelling unit density estimates, interviews with various industrial facility managers (nursery, food processing, and packing plants, etc.), and information provided by the County Agricultural Commissioner's Office and the Dairy Advisor. **Appendix 2A** provides more detail on M&I pumping estimates. For the MKGSA, the average annual estimate of M&I pumping was 54.4 TAF from 1997 to 2017.

Agricultural Pumping

To determine distributions of groundwater pumping in the MKGSA for irrigated agriculture, the surface water volumes distributed among the known-irrigated fields within each service area were subtracted from the spatially precise NDVI crop water demand dataset using the following equation:

$$AP = CD - SWc$$

where: AP = Agricultural Pumping

CD = Agricultural Crop Demand

SWc = Surface Water Crop Delivery

Agricultural pumping is the largest groundwater outflow component in the MKGSA with an average annual estimate of 137.9 TAF from 1997 to 2017.

Evaporative Losses

Evaporation of surface water features (ditches, streams, groundwater recharge basins, etc.) represent a very small fraction of total water outflow from the basin at 0.17%.

Riparian Extractions

Riparian vegetation occurs in a few areas throughout the MKGSA adjacent to surface water features such as natural streams, ditches and irrigation channels. The abundance of surface water in these features occasionally supports natural vegetation due to the proximity of these plants to available surface water. Table 2-1 shows that these loses are small at 0.02%.

Subsurface Outflow

Subsurface outflow of groundwater at depth is that fraction of groundwater passing beyond the downgradient boundary of the MKGSA. The same methodology described above to calculate subsurface inflow was used to calculate subsurface outflow. For the MKGSA, the average annual estimate of subsurface outflow was 103.8 TAF from 1997 to 2017.

MKGSA Water Budget Summary

During the current water budget period of 1997 to 2017, groundwater outflow exceeded groundwater inflow in 12 of the 21 years. During this period, the average groundwater storage depletions were 12.6 thousand acre-feet (TAF) per year due to a combination of water management activities within the GSA as well as influences from neighboring GSAs both in the Kaweah Subbasin and in neighboring subbasins.

To apportion responsibilities for the development of projects and management actions (extraction reductions), Section 6 of this GSP segregates groundwater inflows based on a legal construct of native, foreign, and salvaged components. These components are proportionately assigned to each of the three Subbasin GSAs. This construct and apportionment were designed so as not to impact surface water or groundwater rights, were considered and accepted by each GSA, and represent a preliminary water accounting framework to be further discussed and refined during the first five-year assessment of this GSP.

2.5 GSA Disconnection between Surface and Groundwater

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. Figure 2-3 shows the depth to groundwater in the upper principal aquifer for the Spring of 2017 condition which is both a recent and very wet year. Depth to water in the upper principal aquifer is at least (60-80 feet) north and northeast of the City of Visalia near the St. Johns river. Depth to groundwater is greatest in the southwest area of the GSA (200 ft). Figure 2-3 **(new figure)** appeared as Figure 2 in The Nature Conservancy's report entitled "Identifying GDEs (Groundwater Dependent Ecosystems) under SGMA**.**

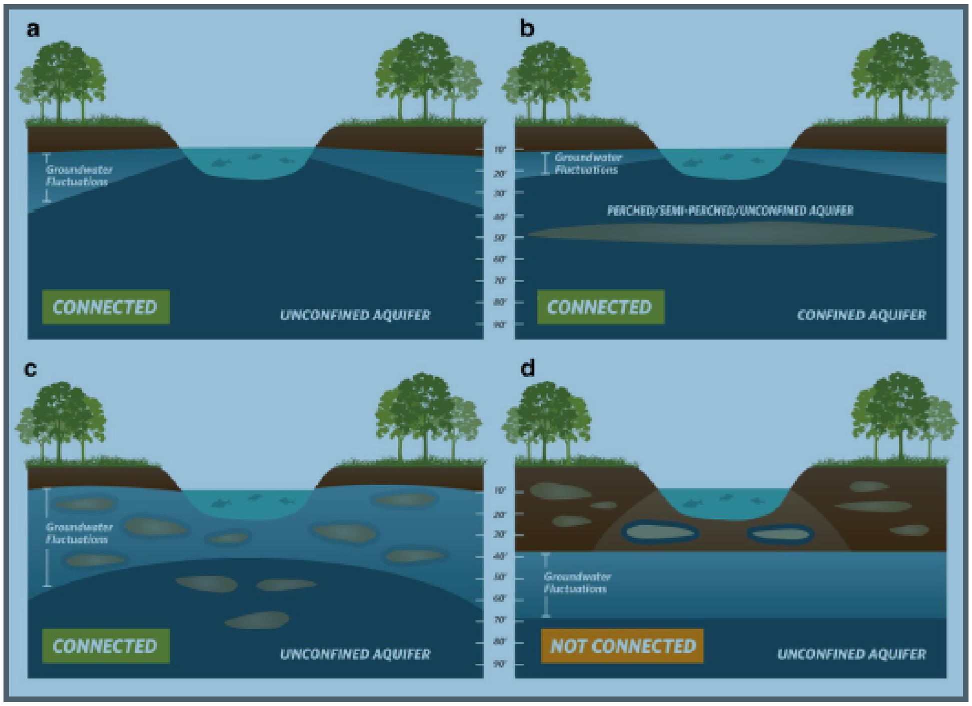


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(b)** Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. **Bottom: (c)** Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. **(d)** Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

Figure 2-1: Connected and Disconnected Surface and Groundwater Conditions

(Source: TNC, July 2019)

Based on the recent past (pre SGMA) and current depth-to-groundwater conditions in the MKGSA as shown on the groundwater level hydrographs provided in Figure 2-2 and the depth to groundwater map Figure 2-3 described above, groundwater is disconnected from surface water. Figure 2-1 caption (d) best matches the conditions in the MKGSA and water in the unsaturated zone above the upper principal aquifer is due to recharge from precipitation and indirect recharge under streams and irrigation ditches in the MKGSA. Therefore, any species present along the surface water features in MKGSA do not require access to groundwater for survival, but instead are accessing surface water for their survival.

MKGSA reviewed the "Natural Community Dataset Viewer" maps for the Kaweah Subbasin to evaluate the possibility of whether groundwater-dependent ecosystems could exist in the MKGSA management area. The mapping system identifies stream reaches supporting habitat that *may* rely on groundwater. Collections of Valley Oak and Cottonwood populate some reaches of the St. Johns River, which traverse along the northern boundary of the City of Visalia. The same habitat species reside along reaches of Mill Creek and Packwood Creek, which traverse through Visalia and to the southwest into Tulare ID in the case of Packwood. Certain reaches of the St. Johns River are indicated to be wetlands of the type "Palustrine, Scrub-Shrub, Seasonally Flooded." However, this river (the northern fork of the Kaweah River) carries water primarily during releases from Terminus Dam at Lake Kaweah, and flows occur on an average of four to five months annually within this river channel as well as Mill and Packwood creeks fed by the same releases from the dam.

The water table lies some 60 to 150 feet below the invert of all three of these channels reaches, which is generally 40 to 130 feet below the root zone of the Valley Oak, which represent the deepest root zone of the native trees in the MKGSA, this being an alluvial environment. Valley Oaks have a rooting depth that has been measured to as much as 80 feet below ground surface in a fractured-rock environment. However, the MKGSA is underlain by alluvial deposits rather than fractured rock (Lewis and Burgy, 1964; Braatne, et.al., 1996). Because the water table is not connected to the systems and the root zones do not reach the groundwater elevations, the aforementioned habitat species depend on bank seepage and not groundwater.

Table 2-1: Mid-Kaweah Water Budget

Mid-Kaweah Estimated Deep Percolation, Extractions and Change in Storage - Current Period

Values in 1,000s af

Water Year	Rainfall		Components of Inflow						Components of Outflow								Total Inflow	Total Outflow	Change in Storage	Cumulative Change in Storage
									Groundwater Pumpage											
	Inches	% of Average	Subsurface Inflow	Wastewater Inflow	Steambed Percolation and Conveyance Losses	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	M & I	Gross Applied Irrigation Water (Crop Water Demand)	Delivered Surface Water	GW Pumping for Irrigated Agriculture	Total Net Extraction	Extraction by Riparian Vegetation	Evaporative Losses	Subsurface Outflow			Inventory Method	Inventory Method
1997	12.5	128%	82.0	11.9	86.4	50.7	51.6	33.9	46.2	216.6	106.0	110.6	156.8	0.1	0.5	**-15.9**	316.5	141.5	175.0	175.0
1998	22.8	234%	87.6	12.2	103.7	67.9	39.2	73.9	40.1	164.9	147.5	34.9	75.0	0.1	0.5	**-26.3**	384.6	49.3	335.2	510.2
1999	9.6	99%	107.1	12.7	53.4	28.0	50.3	21.7	46.2	208.4	115.5	104.4	150.5	0.1	0.5	103.6	273.2	254.7	18.5	528.7
2000	11.4	117%	107.1	13.3	55.9	21.9	49.8	24.6	46.7	217.8	116.4	106.9	153.6	0.1	0.5	101.9	272.5	256.1	16.4	545.1
2001	10.1	103%	102.2	13.6	25.3	7.7	44.8	21.6	50.8	215.2	54.6	160.7	211.5	0.1	0.5	106.8	215.2	318.9	-103.7	441.4
2002	10.4	107%	101.0	13.3	32.9	8.2	48.3	22.0	53.5	230.8	65.8	165.9	219.5	0.1	0.5	108.5	225.7	328.5	-102.9	338.6
2003	8.7	90%	107.0	13.9	55.6	21.8	49.9	19.1	55.0	231.8	98.6	133.1	188.2	0.1	0.5	111.1	267.3	299.8	-32.5	306.0
2004	8.0	82%	102.6	14.3	26.0	11.2	47.3	16.1	58.7	235.3	48.2	188.0	246.6	0.1	0.5	109.6	217.6	356.8	-139.2	166.8
2005	12.2	125%	121.2	14.4	102.8	66.7	44.9	31.7	57.3	206.9	155.9	68.0	125.3	0.1	0.5	115.9	381.8	241.8	140.0	306.8
2006	15.4	159%	127.3	14.8	93.2	49.1	49.4	39.6	57.5	212.3	149.9	70.4	127.9	0.1	0.5	113.2	373.4	241.7	131.7	438.5
2007	3.8	39%	107.8	14.7	17.6	15.7	51.6	10.5	61.6	239.0	33.6	211.5	273.1	0.0	0.5	120.3	218.0	393.9	-175.9	262.6
2008	5.0	52%	104.1	14.8	32.9	10.6	48.6	16.7	62.4	237.2	60.5	176.7	239.1	0.0	0.5	138.9	227.7	378.5	-150.8	111.8
2009	6.4	66%	106.1	14.6	40.4	13.8	48.0	13.6	61.8	246.5	77.8	168.8	230.5	0.0	0.5	145.3	236.5	376.4	-139.9	-28.1
2010	11.1	114%	121.8	14.7	71.8	63.9	44.7	22.9	58.6	215.6	153.5	73.6	132.2	0.1	0.5	141.2	339.8	274.0	65.8	37.6
2011	13.7	140%	155.9	14.7	78.8	81.9	53.2	47.9	56.8	219.6	171.5	58.0	114.9	0.1	0.5	131.9	432.3	247.4	185.0	222.6
2012	4.4	45%	136.9	14.5	26.4	14.8	50.9	16.7	58.2	236.2	40.5	195.8	253.9	0.0	0.5	121.9	260.2	376.4	-116.2	106.4
2013	4.4	45%	116.6	14.3	15.9	5.4	51.1	11.8	60.5	235.1	6.9	228.6	289.0	0.0	0.5	122.0	215.2	411.5	-196.4	-90.0
2014	4.7	48%	108.1	14.2	3.8	0.0	52.2	9.5	56.1	241.3	4.6	236.8	292.8	0.0	0.5	109.6	187.9	403.0	-215.1	-305.1
2015	6.2	63%	99.6	13.4	1.2	0.0	48.1	16.9	49.9	217.1	3.3	213.8	263.7	0.0	0.5	97.2	179.3	361.5	-182.2	-487.3
2016	9.8	100%	99.7	13.2	35.0	14.7	44.2	25.4	51.0	202.8	54.5	149.3	200.3	0.1	0.5	100.6	232.1	301.5	-69.4	-556.6
2017	14.0	143%	136.1	13.7	154.5	119.6	48.2	37.5	52.8	200.6	190.2	39.9	92.7	0.1	0.5	123.4	509.7	216.7	293.0	-263.7
Maximum	22.8	234%	155.9	14.8	154.5	119.6	53.2	73.9	62.4	246.5	190.2	236.8	292.8	0.1	0.5	145.3	509.7	411.5	335.2	
Minimum	3.8	39%	82.0	11.9	1.2	0.0	39.2	9.5	40.1	164.9	3.3	34.9	75.0	0.0	0.5	-26.3	179.3	49.3	-215.1	
Average	**9.7**	**100%**	**111.3**	**13.9**	**53.0**	**32.1**	**48.4**	**25.4**	**54.4**	**220.5**	**88.3**	**137.9**	**192.2**	**0.1**	**0.5**	**103.8**	**284.1**	**296.7**	**-12.6**	
% of Total			39%	5%	19%	11%	17%	9%	18%			46%		0.02%	0.17%	35%				
			100%						100%											

Italic = Calculation
= Component of Inflow
= Component of Outflow

2.6 Management Areas

MKGSA has established three management areas (MAs) within the GSAs boundaries. The three Mas consist of the respective jurisdictional areas of MKGSA's three Members, i.e., the City of Visalia, City of Tulare, and the Tulare Irrigation District, and are depicted on Figure 1-2. Below addresses §354.20(b) and (c) of the GSP Regulations for Mas.

The reasons for the creation of the three aforementioned Management Areas are:

- Each Member of the MKGSA is a separate public agency. The two incorporated municipalities are charter cities with the ability to enact laws distinct from those adopted by the State. The agricultural area is administered by an independent special district.
- As distinct public agencies, the GSA Members have differing means of raising funds to comply with SGMA and abilities to implement the projects and management actions described in Section 7 of this GSP.
- Water sources vary among Members – Visalia and Tulare rely exclusively on groundwater, whereas TID has local and imported surface water to supplement groundwater uses of its landowners. TID also diverts its surface water supplies for groundwater recharge purposes, particularly in wet years. Furthermore, Visalia's water supply system is owned and operated by the California Water Service Company (CWSC), while Tulare's water supply system is under City ownership and operation.
- Financial contributions by each Member towards projects may depend on an evaluation of existing water management agreements among them and on the water accounting framework (Section 6) which will define the water budget components of each Member. These contributions may not be equal and would therefore vary depending on the management area.
- Management actions by each Member may differ due to varying water supply sources, participation in projects, and other available resources.
- Tulare and Visalia have exclusively urban demands including municipal, industrial, commercial, and residential uses, while TID serves exclusively irrigated agricultural demands and related uses. Small-system and domestic wells also exist within the TID service area, but these types of wells are not prevalent within the confines of the cities.
- Each Member has maintained an existing groundwater monitoring program for differing purposes and time periods. While these programs may be incorporated into a common platform for DWR annual reporting purposes, these programs will continue and will be somewhat distinct.
- The Corcoran Clay is present beneath both Tulare and TID, and unconfined groundwater is present above the clay while semiconfined/confined groundwater is present beneath the clay. The Corcoran Clay is present beneath the western half of Visalia but not the eastern half, so groundwater occurs under unconfined/confined

conditions as well as only unconfined conditions, respectively. In addition, Visalia benefits from percolation from the St. Johns River branch of the Kaweah River flanking its northerly boundary, whereas Tulare and TID do not receive direct percolation from the larger natural water courses in the Subbasin.

The minimum thresholds and measurable objectives for each management area are identified in Section 5 of this Plan and the monitoring and associated data evaluation are described in Section 4.

Each MA's minimum thresholds have been established to protect at least the 90th percentile well depths within analysis zones, as explained in Section 5 and detailed in **Appendix 5A**. This approach provides assurances that the minimum thresholds are compatible based on historical well hydrograph trends for selected well monitoring sites. Measurable objectives for groundwater storage have been chosen on a monolithic basis, embracing all three management areas, and by application of the Subbasin numerical model for water levels.

CWSC wells serving Visalia are generally tapping the unconfined aquifer system east of the Corcoran Clay whereas Tulare's well field overlies this clay layer and pumps from the confined aquifer. Newer wells serving recently annexed portions of Visalia along its westerly boundary do produce from semi-confined/confined zones. Both systems pump on a year-round basis and static water-level conditions are rarely if ever reached in these areas.

A historic cone of depression exists under Tulare due to steady-state pumping; however, this is not expected to create undesirable results in the future. The numerical model results under implementation of the chosen measurable objectives do not indicate any adverse impacts as among the management areas leading to undesirable results. Action triggers, as described in Section 5, will avoid any significant deviation from these measurable objectives in any one management area.

The selected management areas in two instances contain DACs, the presence of which may dictate unique management actions to address localized undesirable results. These two management areas are the Tulare ID and the City of Tulare, which is itself considered by the state as a DAC. A description of DACs and SDACs within the GSA is provided in Section 1.5.2.3. Should DAC's sustainability needs within Tulare ID dictate a more focused management effort, consideration may be given to designating additional management areas therein if warranted.

Section 2 – Basin Setting

The development of this MKGSA Basin Setting Section was informed by DWR's Water Budget Best Management Practices (BMP), Hydrogeologic Conceptual Model BMP, and Guidance for Climate Change Data Use During Sustainability Plan Development. These documents are provided in **Appendix 2B**.

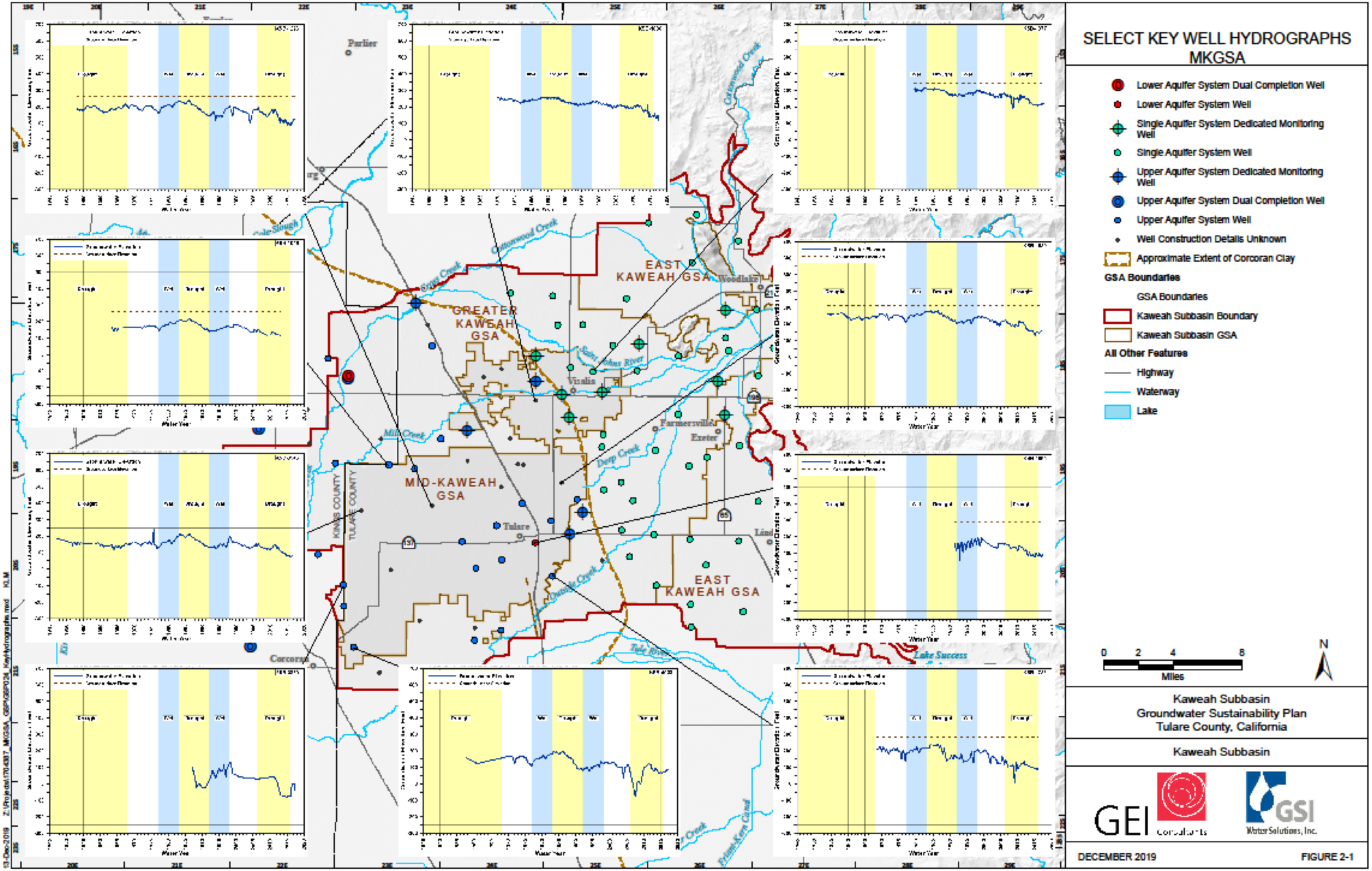


Figure 2-2: Long Term Groundwater Level Trends in the MKGSA Plan Area

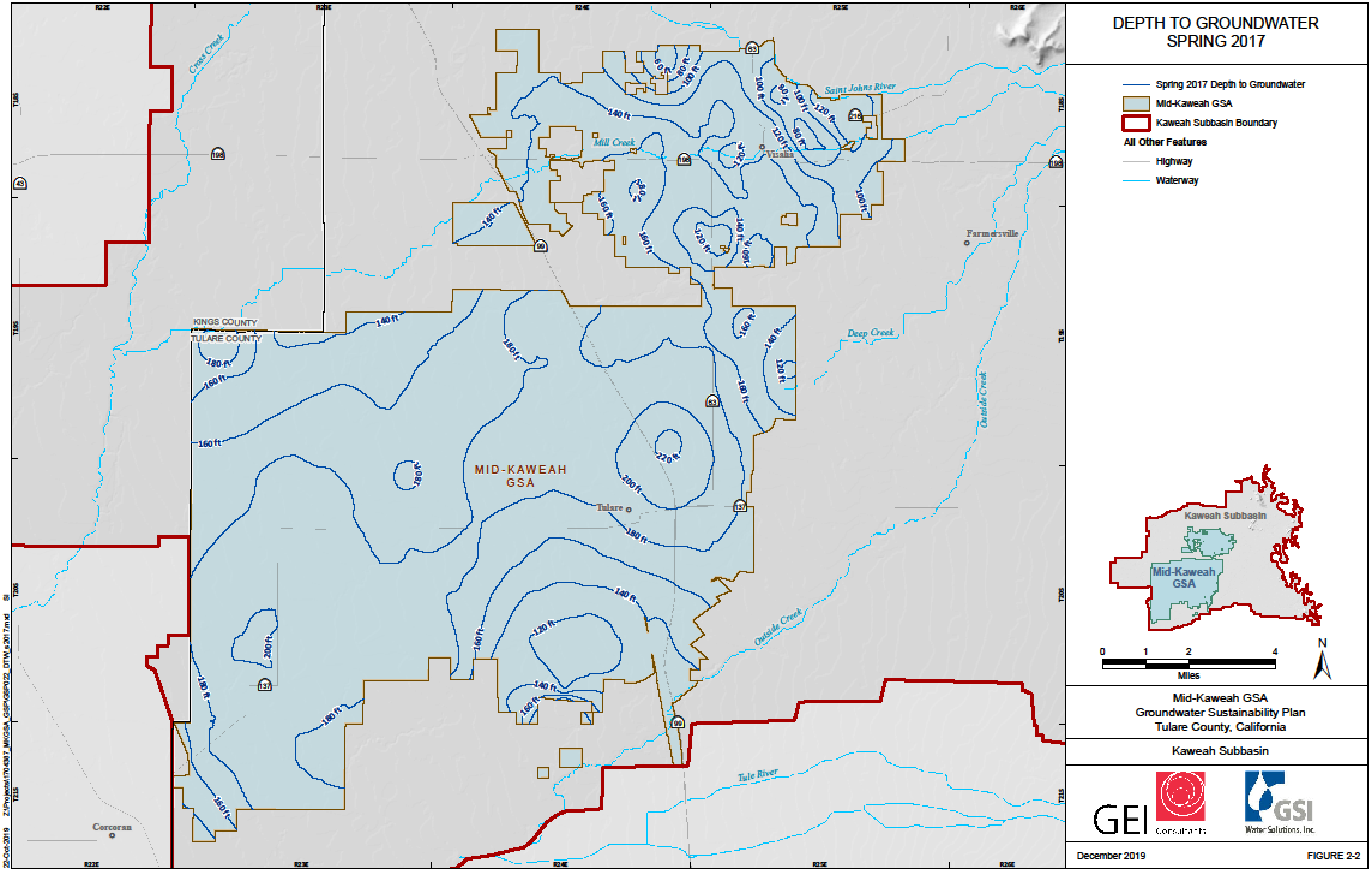


Figure 2-3: Depth to Groundwater in the MKGSA Area, Spring 2017

3. Sustainability Goal

The Sustainability Goal in this section reflects goals agreed-upon by the three Kaweah Subbasin GSAs as documented in the Coordination Agreement and basinwide Kaweah Basin Setting Report. How the Undesirable Results apply specifically in the MKGSA is discussed in Section 5 alongside the discussion of Minimum Thresholds. Note that the Undesirable Results are viewed as a starting point which will be further refined as uncertainty is reduced and data gaps are filled throughout GSP implementation.

The broadly stated Sustainability Goal for the Kaweah Subbasin is for each GSA to manage groundwater resources to preserve the viability of existing agricultural enterprises of the region and the smaller communities that provide much of their job base in the Sub-basin, including the school districts serving these communities. The Goal will also strive to fulfill the water needs of existing and amended county and city general plans that commit to continued economic and population growth within Tulare County. This goal statement complies with §354.24 of the Regulations.

These goals will be achieved by:

- The implementation of the EKGSA, GKGSA and MKGSA GSPs, each designed to identify phased implementation of measures (projects and management actions) targeted to ensure that the Kaweah Subbasin is managed to avoid undesirable results by 2040 or as may be otherwise extended by DWR. This will be achieved in part by limiting pumping to the sustainable yield of the Kaweah Subbasin which has been determined to be 660 TAF per year on average by 2040.
- Collaboration with other agencies and entities to arrest chronic water-level and groundwater storage declines, reduce or eliminate land subsidence where significant and unreasonable, decelerate ongoing water quality degradation where feasible, and protect beneficial uses.
- Application of the Kaweah Subbasin Hydrologic Model (KSHM) – incorporating the initial selection of projects and management actions by the Subbasin GSAs – and its simulation output is summarized in the Subbasin Coordination Agreement to help explain how the sustainability goal is to be achieved within 20 years of GSP implementation.
- Assessments at each interim milestone of implemented projects and management actions and their achievements towards avoiding undesirable results as defined herein.
- Continuance of projects and management action implementation by the three GSAs as appropriate through the planning and implementation horizon to maintain this sustainability goal.

In furtherance of this Subbasin goal, MKGSA advances the following objectives:

- Pursuit of projects to sustain and maximize the delivery of local and imported water supplies into the Subbasin for beneficial use, including groundwater recharge via sinking basins, incentivized on-farm programs, and natural and man-made water conveyance systems. MKGSA recognizes that maximizing deliveries of Sierra watershed surface supplies into the Subbasin will provide inherent water quality improvements for all beneficial uses including benefits to plant and animal communities. MKGSA further recognizes the importance of the Kaweah/St. Johns river system and its connected streams and creeks as a key source of groundwater recharge and role in achieving sustainability.

- Where necessary, imposition of management actions to ensure that the rate of groundwater hydrostatic pressure/water-level decline in semiconfined zones and rate of groundwater-level decline in the unconfined zone reaches zero on a rolling 10-year average basis in GSAs and Management Areas as identified in Subbasin Plans by 2040 or as otherwise extended by DWR. Management actions may include land fallowing or other land-use conversion alternatives and will incorporate a demand reduction program.

- When necessary, implement Emergency Ordinances to enact management actions in furtherance of achieving groundwater sustainability.

- Implementation of water conservation measures consistent with state mandates and as reflected in urban water management plans.

- Where feasible, installations and modifications and upgrades of wastewater treatment facilities, both public and private, where effluent discharges reach the underlying aquifer, all as approved and authorized by the owner/operator of such facilities.

- Placement of recharge projects and management of pumping regimes in each GSA/Management Area such that acceleration of contaminant plume migration that impairs domestic and municipal supply well production as induced by GSP projects and management actions is avoided. Where technologically and economically feasible as determined by the GSA, consideration will be given to those projects and management actions (e.g., pumping regimes) that could result in key water quality constituent improvements leading to a deceleration of ongoing water quality degradation for potable uses. Any improvements would be consistent with MCLs or other constituents of concern as established by applicable regulatory agencies. Projects and management actions affording such improvements would be undertaken in partnership with other agencies charged with enforcing MCLs or otherwise engaged in water quality regulation.

- Placement of recharge projects and management of pumping regimes and adherence to minimum thresholds in each GSA/Management Area such that newly induced subsidence is not causing significant and unreasonable harm to surface and sub-surface infrastructure, including water conveyance systems, or contributing to significant and unreasonable sub-surface water quality degradation.

- Continued use of the Subbasin groundwater simulation model and monitoring network data to assist with projecting achievement of the sustainability goal.

Section 3 – Sustainability Goal

The development of this MKGSA Sustainability Goal and Undesirable Results Section was informed by DWR's Sustainable Management Criteria BMP, which is provided in **Appendix 3B**.

4. Monitoring Networks

The following chapter describes both the existing groundwater monitoring within the MKGSA area, and the representative monitoring required by SGMA. In areas where existing monitoring does not meet the SGMA requirements, this chapter identifies data gaps and proposed measures to address these data gaps during the SGMA implementation period, so the representative monitoring improves over time. Plan updates will reflect new information regarding improvements to representative monitoring. This Section 4 includes all information in compliance with §354.32 through §354.40 of the Regulations.

4.1 Existing Monitoring Networks and Programs

Within the MKGSA boundaries, there are local, regional, state, and federal programs to monitor groundwater levels, groundwater and surface water quality, surface water inflow, weather and precipitation, and land subsidence. A brief description of these programs and their applicability to groundwater management are provided below.

4.1.1 *Existing Groundwater Level Monitoring*

Groundwater elevations are monitored by local agencies (e.g., water districts) and regional agencies. Table 4-1 presents a summary of the groundwater monitoring in the MKGSA. The data collected by these agencies and historical trends are described in the Kaweah Subbasin Basin Setting Report (**Appendix 2A**).

Table 4-1: Existing Groundwater Level Monitoring Summary

Agency	Frequency of Monitoring	Period of Record for Monitoring	Types of Wells Monitored	Number of Wells (Approx.)	Known Completion of Wells Monitored	Number of Dual Completion Wells
Bureau of Reclamation	Monthly to bi-annually	1924 – 2008	Unknown	118	15	Unknown
Cal Water (City of Visalia)	Monthly	1971 – 2018	Municipal	104	None	Unknown
City of Tulare	Monthly to bi-annually	1992 – 2018	Municipal	30	11	None
Dept of Water Resources	Bi-annually	1930 – 2016	Various	182	7	Unknown
KDWCD	Monthly to bi-Annually	1919 – 2018	Agricultural	425	30	4
Kings County Water District	Bi-annually	2011 – 2018	Agricultural	6	3	Unknown
Lakeside ID	Bi-annually	2012 – 2017	Agricultural	33	2	Unknown
Tulare ID	Bi-annually	1945 – 2018	Agricultural	128	5	4

In addition to the local agency monitoring, the Kaweah Delta Water Conservation District (KDWCD) and TID participate in the CASGEM program. CASGEM was established by DWR in 2009 and is used to track seasonal and long-term groundwater elevation trends in groundwater basins statewide in collaboration with local monitoring entities.

4.1.2 *Existing Groundwater Quality Monitoring*

Groundwater quality monitoring and reporting is currently conducted through numerous public agencies and programs which are summarized in Table 4-2. These programs are further described in the Kaweah Subbasin Basin Setting Report (**Appendix 2A**).

Table 4-2: Existing Groundwater Quality Monitoring Programs

Water Quality Monitoring Program	Participating Agencies	Parameters	Frequency
AB 3030 & SB 1938	KDWCD, Lakeside ID, Tulare ID	Ag suitability analysis (Selected constituents from general minerals suite)	Annually to Every 3 Years
State of California – Drinking Water Program for Large Public Community Water Systems	City of Tulare, City of Visalia	All Title 22 regulated constituents	Title 22 General Minerals & Metals, every 3 years. Nitrates, annually (quarterly if ≥ 5 ppm). VOCs and SOCs, every 3 years. Uranium, dependent on historical sampling and varies between every 3 years when ≥ 10 pCi/L, 6 years when < 10 pCi/L or 9 years when not detected.
State of California – Drinking Water Program for Public Non-Community Water Systems And State Small Water Systems	Non-Community Water Systems such as gas stations, food processing facilities, schools, and motels	Subset of Title 22, varies by system, but typically include frequent analyses of coliform and nitrate.	Frequency could not be determined and will be updated in the annual reports and 5-year update as information becomes available.
CV-SALTS		Most constituents sampled monthly, quarterly General Minerals from source water and annual General Minerals from waste discharge. Kaweah is a Priority 1 Basin, meaning that management strategies will be initiated in 2019.	
Department of Pesticide Regulation (DPR)	City of Exeter, City of Farmersville, Ivanhoe Public Utility District, City of Woodlake	Pesticides	Annual

Water Quality Monitoring Program	Participating Agencies	Parameters	Frequency
Groundwater Ambient Monitoring and Assessment (GAMA)	State Water Resources Control Board (SWRCB), Central Valley Regional Water Quality Control Board (RWQCB), DWR DPR, National Water Information System, Lawrence Livermore National Laboratory	Constituents vary by Program Objectives. U.S. Geological Survey (USGS) is typically the technical lead in conducting the studies and reporting data	Priority Basin Project performed baseline and trend assessments, sampling 2,900 public and domestic wells statewide. Domestic Well Project sampled over 180 wells in Tulare County (29 wells were in the Kaweah Subbasin).
Geotracker and Envirostor Databases	SWRCB, Central Valley RWQCB	Many contaminants of concern, organic and inorganic	Dependent on program or conditions of permits (monthly, quarterly, semiannually, annually, etc.)
Irrigated Lands Regulatory Program (IRLP)	Kaweah Basin Water Quality Association	Temperature, pH, electrical conductance, nitrate as nitrogen, dissolved oxygen, General Minerals suite	Annually for the five constituents, every 5 years for General Minerals (First sampling occurred during fall 2018)
USGS California Water Science Center	USGS	Multiple Groundwater Quality studies in Kaweah Subbasin	Studies used for Basin Setting: Groundwater Quality in the Shallow Aquifer (2017) Status and Understanding (2012) Groundwater Quality in Southeast San Joaquin Valley (SESJ) (2012) Groundwater Quality Data in the SESJ (2008) Environmental Setting (1998)

4.1.3 *Existing Surface Water Inflow Monitoring in the Basin and MKGSA*

Section 2.3.4 of the Basin Setting document provided as **Appendix 2A** describes all the surface water flow monitoring in the Kaweah Subbasin and Figure 21 of that document shows the locations of flow monitoring stations. TID's main sources of surface water come from the San Joaquin and the Kaweah rivers. Surface water is provided from the San Joaquin River through a U.S. Bureau of Reclamation (USBR) contract which delivers water to TID from the Friant Dam via the Friant-Kern Canal. Kaweah River water is delivered to TID and is administered by the Kaweah & St. Johns River Association (KSJRA). TID can also obtain surface water from several small surface streams which pass through TID's service area. Figure 4-1 (at the end of this Section) shows the surface water monitoring stations upstream and within MKGSA. Water from the Kaweah River is delivered via Pre-1914 water rights and administered by the KSJRA. Seasonal streams originating in the eastern portion of the Kaweah Subbasin that flow through the EKGSA and GKGSA also contribute to the surface water inflow to MKGSA but are not currently measured.

4.1.4 *Existing Weather and Precipitation Monitoring*

For the Kaweah Subbasin, several weather stations are used for the measurement of precipitation. These stations, which are part of the state's CIMIS network, are listed in Table **4-3** below.

Table 4-3: CIMIS Stations in Kaweah Subbasin

Station Number	Station Name
43747	Hanford *
42012	Corcoran *
49367	Visalia *
44957	Lindsay
44890	Lemon Cove
48917	Three Rivers Edison
* Located in close proximity to the MKGSA jurisdictional area	

4.1.5 *Existing Land Subsidence Monitoring*

As described in Section 2.3.3 of the Basin Setting Report (**Appendix 2A**), land subsidence monitoring includes both the monitoring of land elevation changes and groundwater level changes. Land elevation survey monitoring includes National Geodetic Survey benchmark repeat level surveys, remote sensing by InSAR, and in-situ compaction monitoring by an extensometer south of the Kaweah Subbasin. The existing groundwater level monitoring network is described in Sections 4.1.1 and 2.3.1 of **Appendix 2A**. Table **4-4** below is a summary of historic and recent land subsidence monitoring programs in the MKGSA and the Kaweah Subbasin, at large.

The Tulare Irrigation District has created a Subsidence Monitoring Network consisting of 24 survey markers on key structures throughout the irrigation district where potential subsidence may be occurring. TID intends to use in-house survey-grade equipment to annually monitor the survey markers for potential subsidence impacts to infrastructure, notably irrigation district distribution facilities.

Table 4-4: Historical and Recent Subsidence Monitoring

Category	Monitoring Entity (Entities)	Period of Record
Historical Monitoring	National Geodetic Survey of benchmarks (repeat level surveys)	1926 – 1970
Recent Monitoring	National Geodetic Survey of benchmarks (repeat level surveys). Installation and measurement of Deer Creek extensometer (8.5 miles south of Kaweah Subbasin, in the Tule Subbasin)	1970 to present
	KDWCD Land Surface Elevation Monitoring (local benchmark monitoring network)	2016 to present
	UNAVCO and CVSRN CGPS stations: P056, P566, CRCN, LEMA, and RAPT	2006 to present (depending on station)
	NASA JPL and USGS and others (InSAR and UAVSAR programs)	2007 – 2010 2015 – 2018
	TID Subsidence Monitoring Benchmarks	2022 to present

4.2 Monitoring Network Objectives

According to GSP Regulations § 354.34(b), each GSA is required to develop a monitoring network that, when implemented, shall accomplish the following objectives:

1. Demonstrate progress toward achieving interim milestones and measurable objectives described in the Plan
2. Monitor impacts to the beneficial uses or users of groundwater
3. Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds
4. Quantify annual changes in water budget components
5. Monitor changes for the following pertinent sustainability indicators

The minimum thresholds and measurable objectives for the Kaweah Subbasin account for the following sustainability indicators: groundwater levels, groundwater storage, groundwater quality, and land subsidence. While they are listed in SGMA, seawater intrusion and interconnected streams are not considered in this Plan because they do not apply to the MKGSA area. As described in the Subbasin Basin Setting Report (**Appendix 2A**), the location of the Kaweah Subbasin precludes the possibility of seawater intrusion and historic groundwater depletion has also caused enough separation between surface water and groundwater to eliminate interconnected streams from consideration for the MKGSA.

4.2.1 *Monitoring Objectives*

The monitoring networks will maintain data quality to meet the measurable objectives of this GSP. As described in the 2016 DWR Best Management Practice (BMP) document for monitoring

(*Groundwater Monitoring Protocols, Standards, and Sites BMP*), the processes for maintaining quality control and quality assurance are iterative and will be evaluated every five years for effectiveness. The monitoring networks implemented with this GSP are adequate to obtain acceptable data required to monitor the Sustainability Indicator levels against minimum thresholds and interim milestones. Where necessary, revisions will be made every five years.

4.2.2 *Temporal Monitoring*

The monitoring network will be capable of collecting sufficient data to demonstrate seasonal, short-term (1 to 5 years), and long-term (5 to 10 years) trends in groundwater and related surface conditions, in addition to providing information about groundwater conditions necessary to evaluate the effectiveness of this Plan in achieving the sustainability goal. The frequency at which data will be collected for each network is described in the following sections.

4.2.3 *Representative Monitoring*

As referenced in Regulations §354.36, representative monitoring sites may be designated where site results reflect the general conditions in the area, and where quantitative values for minimum thresholds and interim milestones are defined.

Representative monitoring will also include the use of groundwater elevations as proxy measurements for other sustainability indicators such as groundwater storage and land subsidence. The USGS and DWR have utilized changes in groundwater elevations to estimate changes in storage and have demonstrated a correlation between groundwater elevation and subsidence. A reasonable margin of operational flexibility with groundwater elevations will be taken to avoid undesirable results for the other sustainability indicators.

The Kaweah Subbasin Basin Setting (**Appendix 2A**) presents spatial distribution of groundwater quality, groundwater levels, and land subsidence data. Representative monitoring sites for each Management Area are described in their respective section.

4.3 Monitoring Rationales

As discussed in the Basin Setting Report (**Appendix 2A**), the overall trend for groundwater levels is declining basinwide, including MKGSA, for the hydrologic base period and groundwater storage is commensurately less. Inelastic subsidence also tends to trend with declining groundwater levels in areas interbedded with clay layers or with significant a confining layer(s). Seawater intrusion, due to the Subbasin's distance from the Pacific Ocean, is not under consideration as a Sustainability Indicator (Chapter 3: sustainability goal and undesirable results). Due to its location within the central to westerly side of the Kaweah Subbasin, depletion of interconnected streams is also not under consideration in this Plan.

Groundwater level monitoring is the key parameter that will inform progress made by the MKGSA in meeting the interim milestones and measurable objectives set in this Plan. The other Sustainability Indicators will also be monitored using the existing monitoring systems and programs and can be evaluated concurrently with groundwater levels. Data collected from the monitoring networks will be used to refine water budget components for future planning and subbasin modeling. Additional stream flow data will also enhance the water budget for an updated Subbasin model. The following sections (4.4 through 4.9) describe how MKGSA will monitor each sustainability indicator.

4.4 Groundwater Level Monitoring Network

4.4.1 *Management Areas for Groundwater Level Monitoring*

A Management Area (MA) is an area within the subbasin or GSA for which a GSP has identified different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on unique local conditions for water use, water source, geology, aquifer characteristics, or other factors. The Mas will preserve groundwater management practices and implement additional requirements set forth in this GSP.

The MKGSA portion of the Kaweah Subbasin can be characterized with zones or regimes in which water quality, groundwater levels, and land subsidence characteristics are similar. The MAs are based on the jurisdictional boundaries of the MKGSA member agencies: Tulare Irrigation District, the City of Tulare, and the City of Visalia. The rationale for these MAs is explained in Section 2.

4.4.2 *Groundwater Level Monitoring Frequency*

At a minimum, groundwater level monitoring will occur in the spring and fall each year. TID collects groundwater level measurements in January and October each year. The cities collect water level data much more frequently (monthly or continuously). This frequency of monitoring is more than sufficient to demonstrate seasonal, short-term (1 to 5 years), and long-term (5 to 10 years) trends in groundwater and related surface conditions and yield representative information about groundwater conditions.

4.4.3 *Groundwater Level Monitoring Spatial Density*

Figure 4-2 (at the end of this Section) provides the current distribution of wells throughout the entire Subbasin with available data through CASGEM, local and regional agencies, and Management Areas. Figure 4-3(at the end of this Section) shows the current groundwater level monitoring wells in the MKGSA only, with aquifer designations if known. Based on the BMP for monitoring networks, the well density goal is 4 to 10 wells per 100 square miles. The MKGSA area is 170 square miles. Based on the BMP, the MKGSA monitoring network will require a minimum of 6 to 16 monitoring wells.

4.4.4 *Maps of Grid for Each Aquifer/Management Area*

Figure 4-4 (at the end of this Section) presents the representative groundwater level monitoring program wells for the MKGSA. The 43 key wells will be used for the representative monitoring wells relative to their respective sustainable management criteria. Criteria considered in selecting wells for the representative groundwater level monitoring program included the following:

- Long record of historical data
- Current data
- Well accessibility
- Well construction information
- Total well depth
- Uniform geographical distribution

Table 4-5 summarizes known well construction information and, unfortunately for many of these wells, construction information was not available (noted as NA in the Table 4-5) during the development of this initial GSP. Table 4-5 also lists the monitoring entity and the frequency at which water level data is collected.

Table 4-5: Groundwater Level Monitoring Network

Well Construction Information					
Well Summary Well ID	Monitoring Entity	Total Depth (ft. bgs)	Top of Screen (ft. bgs)	Bottom of Screen (ft. bgs)	Monitoring Frequency
KSB-0922	Tulare Irrigation District	428	322	420	semi-annual (oct, feb)
KSB-0946	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, feb)
KSB-0948	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, may)
KSB-0976	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, feb)
KSB-0994	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, feb)
KSB-1071	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, feb)
KSB-1129	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, feb)
KSB-1168	Tulare Irrigation District	331	178	190	semi-annual (oct, jan)
KSB-1206	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1226	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1320s	Tulare Irrigation District	540	80	250	semi-annual (oct, jan)
KSB-1320d	Tulare Irrigation District	540	330	540	semi-annual (oct, jan)
KSB-1384	Kaweah Delta Water Conservation District	121	91	121	semi-annual (oct, jan)
KSB-1408s	Tulare Irrigation District	490	80	200	semi-annual (oct, jan)
KSB-1408d	Tulare Irrigation District	490	230	490	semi-annual (oct, jan)
KSB 1427	Kaweah Delta Water Conservation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1431	Tulare Irrigation District	229	170	210	semi-annual (oct, jan)
KSB-1447	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1477	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1506	Tulare Irrigation District	720	300	720	semi-annual (oct, jan)
KSB-1526	Kaweah Delta Water Conservation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1536s	Tulare Irrigation District	500	80	250	semi-annual (oct, jan)
KSB-1536d	Tulare Irrigation District	500	350-420	500-540	semi-annual (oct, jan)
KSB-1538	Tulare Irrigation District	NA	157	357	semi-annual (oct, jan)
KSB-1545s	Tulare Irrigation District	450	80	255	semi-annual (oct, jan)
KSB-1545d	Tulare Irrigation District	450	340	450	semi-annual (oct, jan)
KSB-1628	Tulare Irrigation District	720	320	720	semi-annual (oct, jan)
KSB-1689	City of Tulare	110	70	110	Monthly
KSB-1690	Kaweah Delta Water Conservation District	123	83	123	semi-annual (oct, jan)
KSB-1695	City of Tulare	774	348	756	Monthly
KSB-1696	City of Visalia (Cal Water)	NA	NA	NA	semi-annual (oct, jan)
KSB -1699	City of Visalia (Cal Water)	NA	NA	NA	Monthly
KSB-1706	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1709	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1770	City of Tulare	715	300	700	Monthly
KSB-1819	Kaweah Delta Water Conservation District	123	83	123	semi-annual (oct, jan)
KSB-1862	Kaweah Delta Water Conservation District	124	84	124	semi-annual (oct, jan)
KSB-1884	City of Visalia (Cal Water)	NA	NA	NA	Monthly
KSB-1903	City of Tulare	620	320	620	Monthly
KSB-1905	Tulare Irrigation District	NA	NA	NA	semi-annual (oct, jan)
KSB-1977	City of Visalia (Cal Water)	NA	NA	NA	Monthly
KSB-2014	Kaweah Delta Water Conservation District	100	60	100	semi-annual (oct, jan)

Access agreements to collect and report groundwater level monitoring data are pending at the time of publication of this public review draft, and these agreements, as well as a Standard Operating Procedure (SOP) for data collection will be prepared per DWR's BMP "*Monitoring Protocols, Standards, and Sites*."

In addition to the wells shown on Figure 4-4, the City of Visalia also measures groundwater levels in 52 municipal production wells each month. Groundwater levels are collected under both static and pumping conditions. City of Tulare measures groundwater levels monthly in 28 municipal production wells. Although these wells are not included in the representative monitoring program, groundwater level data collected will be reviewed in preparing potentiometric surface maps for the annual reports. The City of Visalia also administers a groundwater monitoring program at their WWTP located in the southwest area of the City. A detailed groundwater monitoring report for the City of Visalia, showing the well locations, well construction details, groundwater levels, and groundwater quality results is provided as **Appendix 4A.**

4.4.5 *Groundwater Level Monitoring Protocols*

As referenced in § 352.4 of the GSP Regulations, "monitoring protocols shall be developed according to best management practices. Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan and modified as necessary."

Per the DWR's Monitoring Protocol BMP:

- All groundwater levels in a basin will be collected within as short a time as possible, preferably within a 1- to 2-week period.
- Depth to groundwater will be measured at an established Reference Point (RP) on the well casing. The RP will be identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention, in open casing monitoring wells, the RP is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.
- The sampler will remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is evident, the measurement will be delayed for a short period of time to allow the water level to equilibrate.
- Measurements of depth to groundwater and land surface will be measured and reported in feet to an accuracy of at least 0.1 feet relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement will be noted on the record (e.g. electric sounder, steel tape, transducer, acoustic sounder, or airline).
- The water level probe should be cleaned after measuring each well.
- To assure that the same well is being measured each time, the monitoring entity will create a Well Identification Sheet, which will be used to track the monitoring at each well site. The following information will be recorded on the Well Identification Sheet: well

number, date of survey, latitude and longitude, RP elevation and description, location description and map, well type and use, well completion type, and, if available, total depth, screened intervals, and well completion report number.

- The sampler will replace any well caps or plugs and lock any well buildings or covers.
- All data will be entered into the MKGSA data management system (DMS) as soon as possible. Care will be taken to avoid data entry mistakes and the entries will be checked by a second person for accuracy.

TID follows a monitoring plan in collecting groundwater elevation data for local groundwater management and for reporting to DWR as required by the CASGEM program. A copy of TID's groundwater level monitoring plan is attached as **Appendix 4B**.

4.4.5.1 Pressure Transducers

Per the DWR *Monitoring Protocols* BMP, groundwater levels may be measured using pressure transducers installed in monitoring wells and recorded by data loggers, along with calculated groundwater elevations. When relying on pressure transducers and data loggers, manual measurements of groundwater levels will be taken during installation to synchronize the transducer system and, periodically (quarterly), to ensure monitoring equipment does not allow a "drift" in the actual values.

The following protocols will be followed when installing a pressure transducer in a monitoring well:

- The sampler will use an electronic sounder or chalked steel tape to measure the depth to groundwater level from the RP. The groundwater elevation will be calculated by subtracting the depth to groundwater from the RP elevation. These values will be used as references to synchronize the transducer system in the monitoring well.
- The sampler will record the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and other pertinent information in the log.
- The sampler will record whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented cables are acceptable if the transducer data are properly corrected for natural fluctuations in barometric pressure, which requires commensurate logging of barometric pressures.
- Transducers will be able to record groundwater levels with an accuracy of at least 0.1 feet. Various factors will be considered in the selection of the transducer system, including battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers.
- Follow manufacturer specifications for installation, calibration, battery life, correction procedure (for non-vented cables), and anticipated life expectancy to ensure optimal use of the equipment.

- Secure the cable to the wellhead with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker to allow estimates of future cable slippage.
- The transducer data will be checked periodically against hand-measured groundwater levels to monitor electronic drift or cable movement. This check will not occur during routine site visits, but at least annually.
- The data will be downloaded regularly to ensure data are not lost and entered the DMS following the QA/QC program established for the GSP. Data from non-vented cables will be corrected for atmospheric barometric pressure changes, as appropriate. After ensuring the transducer data have been downloaded and stored in the data management system (DMS), the data will be deleted from the data logger to ensure that adequate data logger memory remains for future measurements.

4.5 Groundwater Storage Monitoring Network

Change in groundwater storage is correlated with the change in groundwater levels. Therefore, the MKGSA will use groundwater levels as a proxy for the change in groundwater storage. Groundwater storage changes will be calculated by evaluating the volumetric difference between changes in groundwater surfaces created based on groundwater level data collected in the spring of each year.

Because groundwater levels will be used as a proxy for groundwater storage changes, the sub-level discussions such as management areas, monitoring frequency, spatial density, etc., are not deemed necessary, since this information is provided for groundwater level data collection above.

4.6 Land Subsidence Monitoring Network

4.6.1 *Management Areas for Land Subsidence Monitoring*

For the purposes of this Plan, the MKGSA will not have management areas for the purposes of evaluating subsidence, and subsidence will be evaluated during the first five years of SGMA implementation to determine the necessity for management areas specific for monitoring subsidence.

4.6.2 *Land Subsidence Monitoring Frequency*

The monitoring network of subsidence survey stations will be capable of collecting sufficient data to demonstrate short-term (1 to 5 years) and long-term (5 to 10 years) trends in subsidence and yield representative information about land surface elevation changes to evaluate Plan implementation. These station elevations are and will continue to be monitored annually for the purpose of measuring subsidence rates. This data will be used in conjunction with, and supplemented with, NASA InSAR imagery and TID survey benchmark data. NASA's InSAR data is generally precise to within an inch (Farr, 2015 and 2016). In general, land surface elevation monitoring data will be collected annually within an assigned 15-day period.

4.6.3 *Land Subsidence Monitoring Spatial Density*

Figure 4-5 provides the current distribution of monitoring stations with available data through local and regional agencies. The Kaweah Delta Water Conservation District (KDWCD) Land Surface Elevation monitoring network consists of 31 monitoring stations throughout the Kaweah Subbasin and in the neighboring subbasins. Vertical measurement accuracy is within +/- 0.01 feet. A total of nine stations are located within the MKGSA area and four stations are located just beyond the MKGSA boundary (< 0.5 mile). In addition, two continuous GPS stations are located on either side of the MKGSA area, including one on the east side within 0.5 miles of the boundary and one near the southwestern corner within 2 miles. Moreover, these two GPS stations are located in proximity to two KDWCD stations (~1 mile or less). Another subsidence station is located at the office of TID and is being monitored by KDWCD and CALTRANS and information from this station will be incorporated into MKGSAs annual reporting and 5-year plan updates.

4.6.4 *Land Subsidence Monitoring Protocols*

According to the KDWCD Land Surface Elevation Monitoring Plan, the following protocols will be used for data collection and processing.

4.6.4.1 Static Occupation

The protocols listed below will be followed for collection of the land surface elevation data:

- Static occupation strategies may necessarily vary by point but will in every case remain consistent with NGS recommendations. The observer will use a dual-frequency (L1/L2) survey grade GPS receiver to continuously occupy each station for no fewer than 2.0 hours per measurement period. Lower root-mean square error (RMSE) correlates directly with longer duration of observation. Commensurately, dilution of precision (DOP) and combined error also tend to be more favorable.

- The preferred outcome at each station is to acquire one 4.0+ hour autonomous dataset from one (1) setup. The average of two 2.0+ hour autonomous datasets from two independent setups separated by not more than 24 hours is an acceptable alternative. Occasionally, one 2.0+ hour autonomous dataset may meet the Vertical RMSE (VRMSE) standard.

- Although L-band receivers are 24-hour, all-weather capable, operations will be limited to daylight hours. Modern receivers are resistant to moisture infiltration but will not be exposed to heavy or sustained precipitation. Fog, haze, overcast, clouds, light rain, and dust should not be problematic. High wind and blowing debris will be avoided. In cases where environmental elements or man-made conditions threaten observer safety, equipment functionality, or data integrity operations will cease, recommencing only when practicable for at least two hours.

- Prior to initiating each collection period, at 30-minute intervals during each period, and at cessation, observers will complete a schedule of system checks in the station field notes. Logging will be enabled during instrument configuration; however, observers shall remain aware and engaged throughout each collection period, ready to take appropriate action.

4.6.4.2 Data Processing

After the land surface elevation data are collected, the protocols listed below will be followed in the processing of the data:

- All original datasets will be preserved in a permanent stand-alone database. Copies of the datasets will be examined for coherence and continuity. Errors and deficiencies will be corrected additively or proportionally wherever possible. Unusable datasets will be set aside, and stations with inadequate data will be occupied again. Further data will not be eliminated unless irreparable defects are revealed by subsequent analysis. Station coordinates will be computed from the quality-checked copies with rigorous relative and absolute adjustment strategies.
- Relative coordinate solutions will be computed by the Online Positioning User Service (OPUS), an NGS differential GPS (DGPS) internet application. OPUS solutions are the primary program deliverables. Primary solutions are given in terms of the computational reference frame on the observation epoch date, and of the standard datum on the current standard epoch date.
- Absolute coordinate solutions will be computed by the Automatic Precise Positioning Service (APPS), a National Aeronautics and Space Administration (NASA) – Jet Propulsion Laboratory (JPL) – California Institute of Technology (CIT) precise point positioning (PPP) internet application. APPS solutions are secondary program deliverables. Secondary solutions are rendered in terms of the computational reference frame on the observation epoch date and may be transformed to the standard datum adjusted to the current standard epoch date.
- Uncertainty is associated with every observation. Every measurement contains some degree of error. GPS coordinates are characteristically less accurate in the vertical than in the horizontal. NGS and NASA employ sophisticated strategies to detect and correct systematic error. While many conventions are observed, no single comprehensive adjustment computation protocol exists.
- Corrections can be performed in-office, differentially with local instrument software and continuously operating reference station (CORS) data obtained online from NGS, or absolutely with archived ephemerides and the Global Navigation Satellite System (GNSS)- Inferred Positioning System and Orbital Analysis Simulation Software (GIPSY-OASIS) site package. These options should be considered if OPUS and APPS become problematic.

4.7 Seawater Intrusion Monitoring Network

As stated previously, the Kaweah Subbasin is not located near the Pacific Ocean which precludes the consideration of seawater intrusion as a sustainability indicator. Therefore, a monitoring network and monitoring is not required for the Subbasin and GSAs therein.

4.8 Depletions of Interconnected Surface Water Monitoring Network

As stated previously, the interconnection of surface water and groundwater was disrupted many decades ago in the MKGSA. Therefore, a monitoring network and monitoring is not required for this GSA.

4.9 Groundwater Quality Monitoring Network

Figure 4-6 (at the end of this Section) shows the location of current public drinking water system wells dedicated agricultural monitoring wells currently used to monitor groundwater quality, sorted by aquifer where information is available. Please refer to Figure 1-3 for the small water system identifiers. Table 4-6 provides a listing of wells, the public water system associated with the well, location, construction information, principal aquifer monitored and type (public water system or agricultural monitoring well). As the largest public water systems in the MKGSA, the City of Visalia and City of Tulare monitor groundwater quality for compliance with Title 22 for municipal and industrial uses. Both Visalia and Tulare have protocols that they follow for the collection, handling, transport and analysis of groundwater samples. These protocols are included as **Appendix 4C**. Figure 4-6 includes four multi-level piezometers located within the TID services area. These wells will be monitored annually during the SGMA implementation period of 2020 to 2040 and these data will be reported to DWR in the MKGSAs annual report. Samples collected annually from these wells will be analyzed for the agricultural suitability suite of constituents including:

- pH
- Ec (Conductivity)
- TDS (Total Dissolved Solids)
- Boron
- SAR (Sodium Adsorption Ratio)
- Cations
    - Calcium
    - Magnesium
    - Sodium
    - Potassium
- Anions
    - Bicarbonate (HCO_3)

- Chloride
- Nitrate as N
- Sulfate-Sulfur

MKGSA will plot trends to show how these constituents may be changing over time during the SGMA implementation period and these time series plots will be provided to DWR in the annual reports required by the GSP Regulations.

Table 4-6: Mid-Kaweah GSA Water Quality Monitoring Network

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System	Type of Threshold	
									Public Drinking Water	Agricultural
5400679-001	Public Drinking Water	99 Palms Inn and Suites	WELL 01	36.2709	-119.36636	175	300	Both	X	
5400538-001	Public Drinking Water	Accelerated Charter High School	WELL 01	36.25236	-119.30941	168	320	Both	X	
5400816-002	Public Drinking Water	Bedel Mutual Water Co	WELL 02	36.32347	-119.26517	NA	NA	Single	X	
5400816-003	Public Drinking Water	Bedel Mutual Water Co	WELL 03	36.32349	-119.26528	NA	NA	Single	X	
5400919-001	Public Drinking Water	Buena Vista School	WELL 01	36.18212	-119.43825	240	350	Both	X	
5400919-002	Public Drinking Water	Buena Vista School	WELL 02	36.18167	-119.43857	NA	NA	Unknown	X	
1610004-003	Public Drinking Water	Corcoran, City Of	WELL 03A	36.12465	-119.52906	250	470	Both	X	
1610004-015	Public Drinking Water	Corcoran, City Of	WELL 06A	36.11987	-119.5287	590	1130	Lower	X	
1610004-016	Public Drinking Water	Corcoran, City Of	WELL 07A	36.12425	-119.52878	515	1000	Lower	X	
5410016-010	Public Drinking Water	CWS – Visalia	WELL 07-01	36.32889	-119.28169	175	270	Single	X	
5410016-014	Public Drinking Water	CWS – Visalia	WELL 11-02	36.32281	-119.28684	310	440	Single	X	
5410016-015	Public Drinking Water	CWS – Visalia	WELL 12-01	36.34049	-119.28692	186	246	Single	X	
5410016-016	Public Drinking Water	CWS – Visalia	WELL 13-01	36.32044	-119.31236	214	265	Upper	X	
5410016-017	Public Drinking Water	CWS – Visalia	WELL 14-01	36.335	-119.30782	222	280	Single	X	
5410016-018	Public Drinking Water	CWS – Visalia	WELL 15-01	36.32802	-119.26052	280	334	Single	X	
5410016-023	Public Drinking Water	CWS – Visalia	WELL 19-01	36.31061	-119.28716	192	225	Single	X	
5410016-024	Public Drinking Water	CWS – Visalia	WELL 20-01	36.34502	-119.30138	245	257	Single	X	
5410016-026	Public Drinking Water	CWS – Visalia	WELL 22-01	36.33086	-119.25627	78	300	Single	X	
5410016-027	Public Drinking Water	CWS – Visalia	WELL 23-01	36.30859	-119.31249	196	304	Both	X	
5410016-028	Public Drinking Water	CWS – Visalia	WELL 24-01	36.33842	-119.27757	198	275	Single	X	
5410016-029	Public Drinking Water	CWS – Visalia	WELL 25-01	36.32263	-119.33147	274	282	Upper	X	
5410016-030	Public Drinking Water	CWS – Visalia	WELL 26-01	36.32649	-119.32533	269	373	Both	X	
5410016-031	Public Drinking Water	CWS – Visalia	WELL 27-01	36.31444	-119.29889	175	328	Both	X	
5410016-035	Public Drinking Water	CWS – Visalia	WELL 30-01	36.33112	-119.27397	130	330	Single	X	

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System	Type of Threshold: Public Drinking Water	Type of Threshold: Agricultural
5410016-036	Public Drinking Water	CWS – Visalia	WELL 31-01	36.30212	-119.30928	208	245	Upper	X	
5410016-037	Public Drinking Water	CWS – Visalia	WELL 32-01	36.30652	-119.31853	119	257	Upper	X	
5410016-040	Public Drinking Water	CWS – Visalia	WELL 34-01	36.29796	-119.29742	120	250	Upper	X	
5410016-043	Public Drinking Water	CWS – Visalia	WELL 36-01	36.35028	-119.29544	120	282	Single	X	
5410016-044	Public Drinking Water	CWS – Visalia	WELL 37-01	36.33424	-119.32651	150	290	Upper	X	
5410016-045	Public Drinking Water	CWS – Visalia	WELL 38-01	36.33076	-119.35002	175	295	Both	X	
5410016-046	Public Drinking Water	CWS – Visalia	WELL 39-01	36.31612	-119.34474	190	310	Both	X	
5410016-047	Public Drinking Water	CWS – Visalia	WELL 40-01	36.31607	-119.33142	96	192	Upper	X	
5410016-048	Public Drinking Water	CWS – Visalia	WELL 41-01	36.30235	-119.31605	148	296	Both	X	
5410016-053	Public Drinking Water	CWS – Visalia	WELL 45-01	36.30588	-119.3006	150	280	Upper	X	
5410016-054	Public Drinking Water	CWS – Visalia	WELL 46-01	36.33605	-119.33569	170	300	Both	X	
5410016-055	Public Drinking Water	CWS – Visalia	WELL 47-01	36.30344	-119.33124	168	292	Upper	X	
5410016-056	Public Drinking Water	CWS – Visalia	WELL 48-01	36.34657	-119.31396	200	330	Single	X	
5410016-057	Public Drinking Water	CWS – Visalia	WELL 49-01	36.31316	-119.26975	160	290	Single	X	
5410016-058	Public Drinking Water	CWS – Visalia	WELL 50-01	36.3455	-119.26326	150	270	Single	X	
5410016-059	Public Drinking Water	CWS – Visalia	WELL 51-01	36.31173	-119.35196	160	286	Upper	X	
5410016-060	Public Drinking Water	CWS – Visalia	WELL 52-01	36.27095	-119.31122	180	300	Both	X	
5410016-061	Public Drinking Water	CWS – Visalia	WELL 53-01	36.34706	-119.27199	190	300	Single	X	
5410016-064	Public Drinking Water	CWS – Visalia	WELL 56-01	36.34804	-119.28745	280	420	Single	X	
5410016-065	Public Drinking Water	CWS – Visalia	WELL 57-01	36.31764	-119.26898	292	350	Single	X	
5410016-066	Public Drinking Water	CWS – Visalia	WELL 57-02	36.31771	-119.26898	252	265	Single	X	
5410016-067	Public Drinking Water	CWS – Visalia	WELL 58-01	36.31889	-119.26785	272	290	Single	X	
5410016-069	Public Drinking Water	CWS – Visalia	WELL 61-01	36.30172	-119.34474	220	440	Both	X	
5410016-070	Public Drinking Water	CWS – Visalia	WELL 62-01	36.31654	-119.26465	200	460	Single	X	
5410016-080	Public Drinking Water	CWS – Visalia	WELL 70-01	36.33315	-119.35828	220	400	Both	X	
5410016-081	Public Drinking Water	CWS – Visalia	WELL 64-01	36.34004	-119.34695	190	400	Both	X	

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System	Type of Threshold	
									Public Drinking Water	Agricultural
5410016-087	Public Drinking Water	CWS – Visalia	WELL 77-01	36.32501	-119.39351	175	355	Both	X	
5410016-089	Public Drinking Water	CWS – Visalia	WELL 72-01	36.33809	-119.25954	280	450	Single	X	
5410016-090	Public Drinking Water	CWS – Visalia	WELL 78-01	36.31296	-119.256	220	250	Single	X	
5410016-091	Public Drinking Water	CWS – Visalia	WELL 79-01	36.35366	-119.31398	180	290	Single	X	
5410016-092	Public Drinking Water	CWS – Visalia	WELL 80-01	36.30502	-119.35831	290	555	Lower	X	
5410016-093	Public Drinking Water	CWS – Visalia	WELL 81-01	36.31938	-119.24915	245	620	Single	X	
5410016-094	Public Drinking Water	CWS – Visalia	WELL 82-01	36.31902	-119.29002	280	450	Single	X	
5410016-098	Public Drinking Water	CWS – Visalia	WELL 91-01	36.35365	-119.2982	180	390	Single	X	
5410016-154	Public Drinking Water	CWS – Visalia	WELL 16-02	36.32956	-119.31309	260	480	Both	X	
5410016-156	Public Drinking Water	CWS – Visalia	WELL 83-01	36.30411	-119.27493	370	680	Single	X	
5410016-158	Public Drinking Water	CWS – Visalia	WELL 93-01	36.34649	-119.34068	NA	NA	Unknown	X	
5410016-159	Public Drinking Water	CWS – Visalia	WELL 60-01	36.27059	-119.2937	NA	NA	Unknown	X	
5410016-166	Public Drinking Water	CWS – Visalia	WELL 55-02	36.29472	-119.32229	196	570	Both	X	
5410016-167	Public Drinking Water	CWS – Visalia	WELL 94-01	36.3567	-119.32098	230	590	Single	X	
5410016-185	Public Drinking Water	CWS – Visalia	WELL 97-01	36.33575	-119.24997	NA	NA	Single	X	
5401033-001	Public Drinking Water	Horizon Nut LLC	WELL 01	36.27279	-119.36578	NA	NA	Unknown	X	
5403074-002	Public Drinking Water	Kraft Heinz Foods Co	WELL 01	36.13242	-119.32923	360	700	Lower	X	
5403074-004	Public Drinking Water	Kraft Heinz Foods Co	WELL 01	36.13016	-119.32604	NA	NA	Unknown	X	
5403146-001	Public Drinking Water	Liberty Elementary School	WELL 01	36.24517	-119.3216	NA	NA	Unknown	X	
5402050-001	Public Drinking Water	Milk Specialties Global	WELL 01	36.33601	-119.31067	NA	NA	Single	X	
5402050-002	Public Drinking Water	Milk Specialties Global	WELL 01	36.33594	-119.31071	NA	NA	Single	X	
5400951-003	Public Drinking Water	Mooney Grove Park	WELL 01	36.27932	-119.30842	NA	NA	Unknown	X	
5400951-004	Public Drinking Water	Mooney Grove Park	WELL 01	36.28044	-119.30818	NA	NA	Unknown	X	
5400713-001	Public Drinking Water	Oak Valley School	WELL 01	36.23272	-119.4201	610	660	Lower	X	
5403217-001	Public Drinking Water	Okieville Highland Acres Mwc	WELL 01	36.2047	-119.4666	NA	NA	Unknown	X	
5402031-001	Public Drinking Water	Preet Market	WELL 01	36.20295	-119.49257	260	300	Both	X	

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System	Type of Threshold	
									Public Drinking Water	Agricultural
5403118-001	Public Drinking Water	Saputo Dairy Food USA	WELL 01	36.21476	-119.34787	240	440	Both	X	
5403208-002	Public Drinking Water	Soults Pump & Equipment Co	WELL 02	36.20312	-119.38544	NA	NA	Unknown	X	
5400880-001	Public Drinking Water	The Lakes Association	WELL 01	36.34482	-119.35018	180	360	Both	X	
5400880-002	Public Drinking Water	The Lakes Association	WELL 02 – South	36.34543	-119.35014	NA	NA	Unknown	X	
5401039-001	Public Drinking Water	Tulare County Civic Center	WELL 01 – AG Bldg.	36.3289	-119.3206	NA	NA	Unknown	X	
5401039-002	Public Drinking Water	Tulare County Civic Center	WELL 02 – Motorpool	36.32847	-119.31827	NA	NA	Unknown	X	
5401039-003	Public Drinking Water	Tulare County Civic Center	WELL 03 – Courthouse	36.32887	-119.31528	NA	NA	Unknown	X	
5410015-001	Public Drinking Water	Tulare, City Of	WELL 01	36.20966	-119.35737	382	520	Lower	X	
5410015-011	Public Drinking Water	Tulare, City Of	WELL 11	36.20363	-119.33155	348	756	Lower	X	
5410015-012	Public Drinking Water	Tulare, City Of	WELL 12	36.21816	-119.35218	312	708	Lower	X	
5410015-013	Public Drinking Water	Tulare, City Of	WELL 13	36.2077	-119.32192	300	700	Lower	X	
5410015-014	Public Drinking Water	Tulare, City Of	WELL 14	36.16261	-119.33796	300	700	Lower	X	
5410015-015	Public Drinking Water	Tulare, City Of	WELL 15	36.22191	-119.31546	300	700	Lower	X	
5410015-017	Public Drinking Water	Tulare, City Of	WELL 17	36.18549	-119.33858	300	396	Lower	X	
5410015-021	Public Drinking Water	Tulare, City Of	WELL 22	36.22403	-119.33683	300	702	Lower	X	
5410015-025	Public Drinking Water	Tulare, City Of	WELL 26	36.21799	-119.37162	300	720	Lower	X	
5410015-026	Public Drinking Water	Tulare, City Of	WELL 27	36.23654	-119.34513	320	720	Lower	X	
5410015-033	Public Drinking Water	Tulare, City Of	WELL 31	36.23258	-119.33051	400	700	Lower	X	
5410015-047	Public Drinking Water	Tulare, City Of	WELL 33	36.20002	-119.37576	321	764	Lower	X	
5410015-048	Public Drinking Water	Tulare, City Of	WELL 34	36.21494	-119.33492	450	663	Lower	X	
5410015-051	Public Drinking Water	Tulare, City Of	WELL 35	36.19635	-119.31145	390	760	Lower	X	
5410015-052	Public Drinking Water	Tulare, City Of	WELL 36	36.24002	-119.32245	320	600	Lower	X	
5410015-055	Public Drinking Water	Tulare, City Of	WELL 37	36.2047	-119.31274	320	680	Lower	X	
5410015-056	Public Drinking Water	Tulare, City Of	WELL 38	36.21622	-119.32173	280	620	Lower	X	
5410015-057	Public Drinking Water	Tulare, City Of	WELL 39	36.23227	-119.32199	320	590	Lower	X	

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System	Type of Threshold	
									Public Drinking Water	Agricultural
5410015-061	Public Drinking Water	Tulare, City Of	WELL 40	36.18542	-119.35347	380	725	Lower	X	
5410015-065	Public Drinking Water	Tulare, City Of	WELL 42	36.18491	-119.3769	310	690	Lower	X	
5410015-073	Public Drinking Water	Tulare, City Of	WELL 45	36.20433	-119.34884	NA	NA	Unknown	X	
5410015-075	Public Drinking Water	Tulare, City Of	WELL 46	36.22436	-119.35128	NA	NA	Unknown	X	
5410015-077	Public Drinking Water	Tulare, City Of	WELL 47	36.24399	-119.31532	NA	NA	Unknown	X	
5400795-001	Public Drinking Water	Waukena Elementary School	WELL 01	36.13611	-119.5104	NA	NA	Unknown	X	
5402030-002	Public Drinking Water	Waukena Market	WELL 02	36.13826	-119.51044	NA	NA	Unknown	X	
NA	Monitoring	Tulare Irrigation District	KSB-1408s[1]	36.26165	-119.39435	80	200	Upper		X
NA	Monitoring	Tulare Irrigation District	KSB-1408d[2]	36.26165	-119.39435	230	490	Lower		X
NA	Monitoring	Tulare Irrigation District	KSB-1545s[1]	36.26204	-119.36237	80	255	Upper		X
NA	Monitoring	Tulare Irrigation District	KSB-1545d[2]	36.26204	-119.36237	340	450	Lower		X
NA	Monitoring	Tulare Irrigation District	KSB-1536s[1]	36.23973	-119.36606	80	250	Upper		X
NA	Monitoring	Tulare Irrigation District	KSB-1536d[2]	36.23973	-119.36606	350-420	500-540	Lower		X
NA	Monitoring	Tulare Irrigation District	KSB-1320s[1]	36.21066	-119.41640	80	250	Upper		X
NA	Monitoring	Tulare Irrigation District	KSB-1320d[2]	36.21066	-119.41640	330	540	Lower		X

NOTES:
[1] "s" designates shallow meaning this monitoring wells is screened above the Corcoran clay
[2] "d" designates deep meaning this well is screened below the Corcoran clay

4.10 Monitoring Network Improvement Plan

4.10.1 *Data Gaps*

The following section describes data gaps for groundwater elevations and storage, groundwater quality, and land subsidence.

4.10.1.1 Groundwater Elevation and Storage Data Gaps

As referenced in Regulation §352.4, "If an Agency relies on wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a Plan, the Agency shall describe a schedule for acquiring monitoring wells with the necessary information or demonstrate to the Department that such information is not necessary to understand and manage groundwater in the basin."

Well types and construction details will need to be determined to improve the monitoring network. Downhole well surveys and desktop surveys will be utilized for existing wells to fill in the well construction details gap. New dedicated monitoring wells and converted production wells will be utilized to fill in the monitoring network spatial extent and density. Improvement will occur during the initial few years of the implementation period, prior to the first five-year update.

4.10.1.2 Groundwater Quality Data Gaps

Groundwater quality information is currently collected for public water systems, primarily Visalia and Tulare. The groundwater quality new dedicated monitoring wells and converted production wells will be utilized to fill in the monitoring network spatial extent and density. Improvement will occur during the initial few years of the implementation period, prior to the first 5-year update. DWR will be constructing new multilevel monitoring wells at the locations shown on Figure 4-7(at the end of this Section) as part of their Technical Support Services program. These wells will be used for both groundwater level and quality monitoring.

4.10.1.3 Land Subsidence Data Gaps

For the preparation of this initial plan, MKGSA lacked sufficient data to effectively correlate changes in groundwater levels within the MKGSA with historical land surface subsidence. This was problematic in developing accurate projections of potential future subsidence that may occur during the implementation period. Additionally, there was not sufficient data to find a good correlation between pumping and land surface subsidence.

Most subsidence occurs below the Corcoran Clay. Impacts due to subsidence have been difficult to observe due to regular maintenance of infrastructure that can address the impacts of subsidence incrementally. This includes not tracking well collapse due to subsidence, because it is not included in the well permitting process. Also well collapse due to subsidence is often not identified as it may only be one of many well casing related issues.

The implementation of KDWCD's Land Surface Elevation Monitoring Plan along with the Tulare Irrigation District Subsidence Monitoring Survey Marker Monitoring Program will provide additional data for future subsidence monitoring and evaluation of Sustainability Indicators. The MKGSA will explore other options for a secondary data source, especially where surface infrastructure in the southwestern portion of the subbasin could be affected. Ongoing discussions and surveys of the overlying beneficial uses and users will be conducted to further understand subsidence impacts in the MKGSA. The Kaweah Subbasin GSAs are working with Stanford University and NASA to elevate the understanding of the interconnected nature of geophysics and subsidence including an updated Kaweah Subbasin Model that incorporates newly acquired geophysical data to create a hydrogeologic model with a subsidence model.

Section 4 – Monitoring Networks

The development of this MKGSA Monitoring Networks Section was informed by DWR's Monitoring Protocols Standards and Sites BMP and Monitoring Networks and Identification of Data Gaps BMP. These documents are provided in **Appendix 4D**.

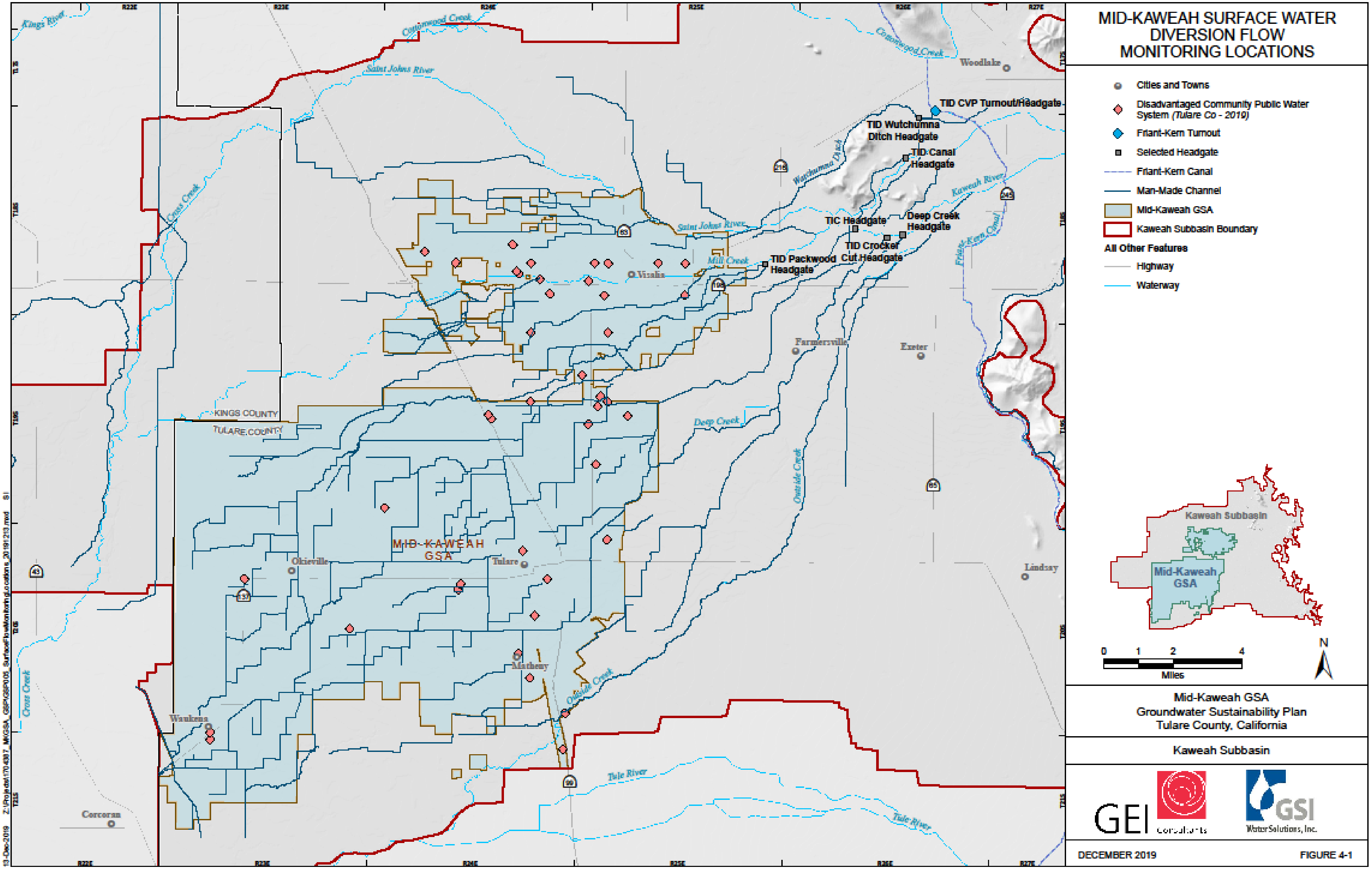


Figure 4-1: Surface Water Diversion Flow Monitoring Locations

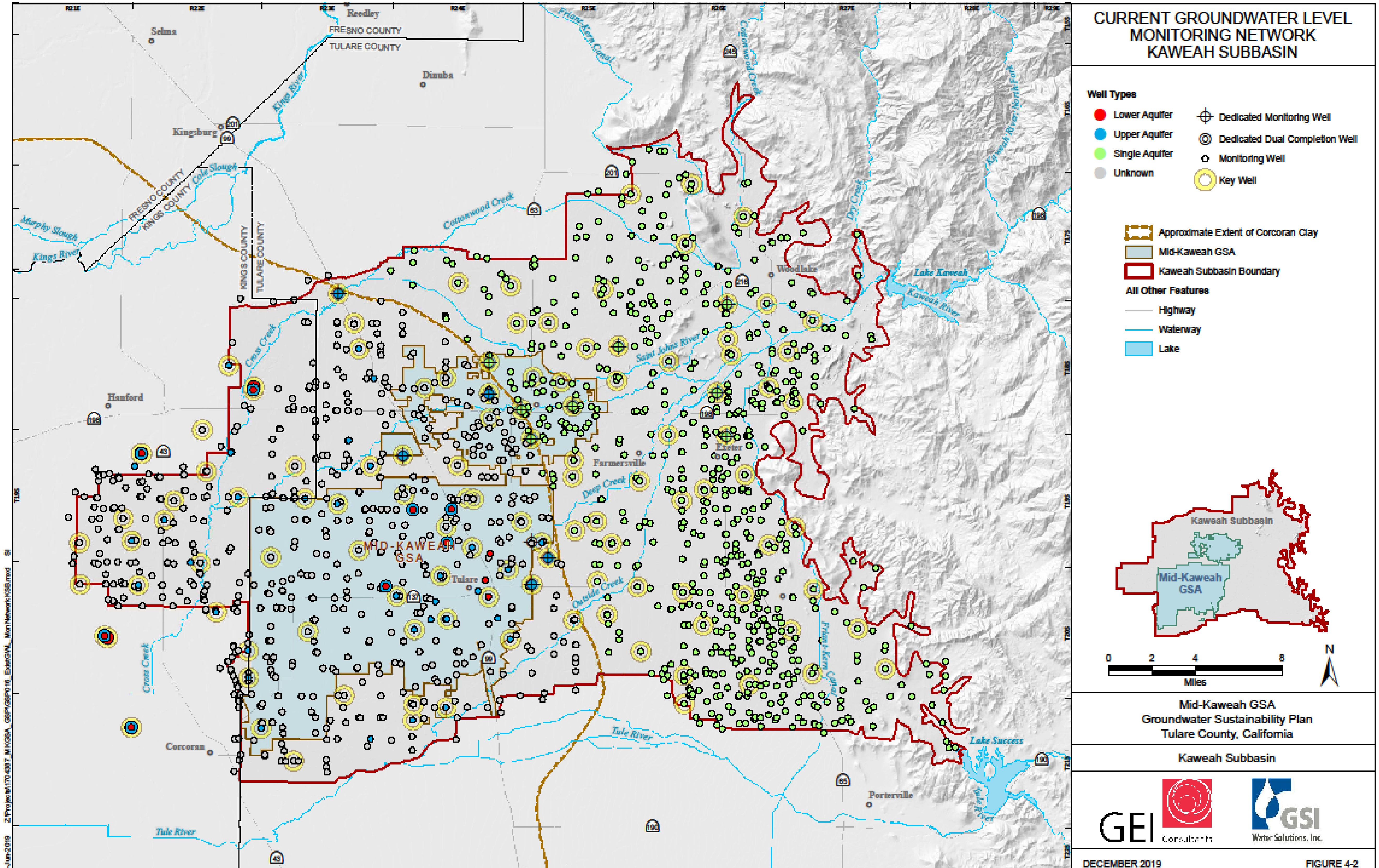


Figure 4-2: Current Groundwater Level monitoring network for Kaweah Subbasin

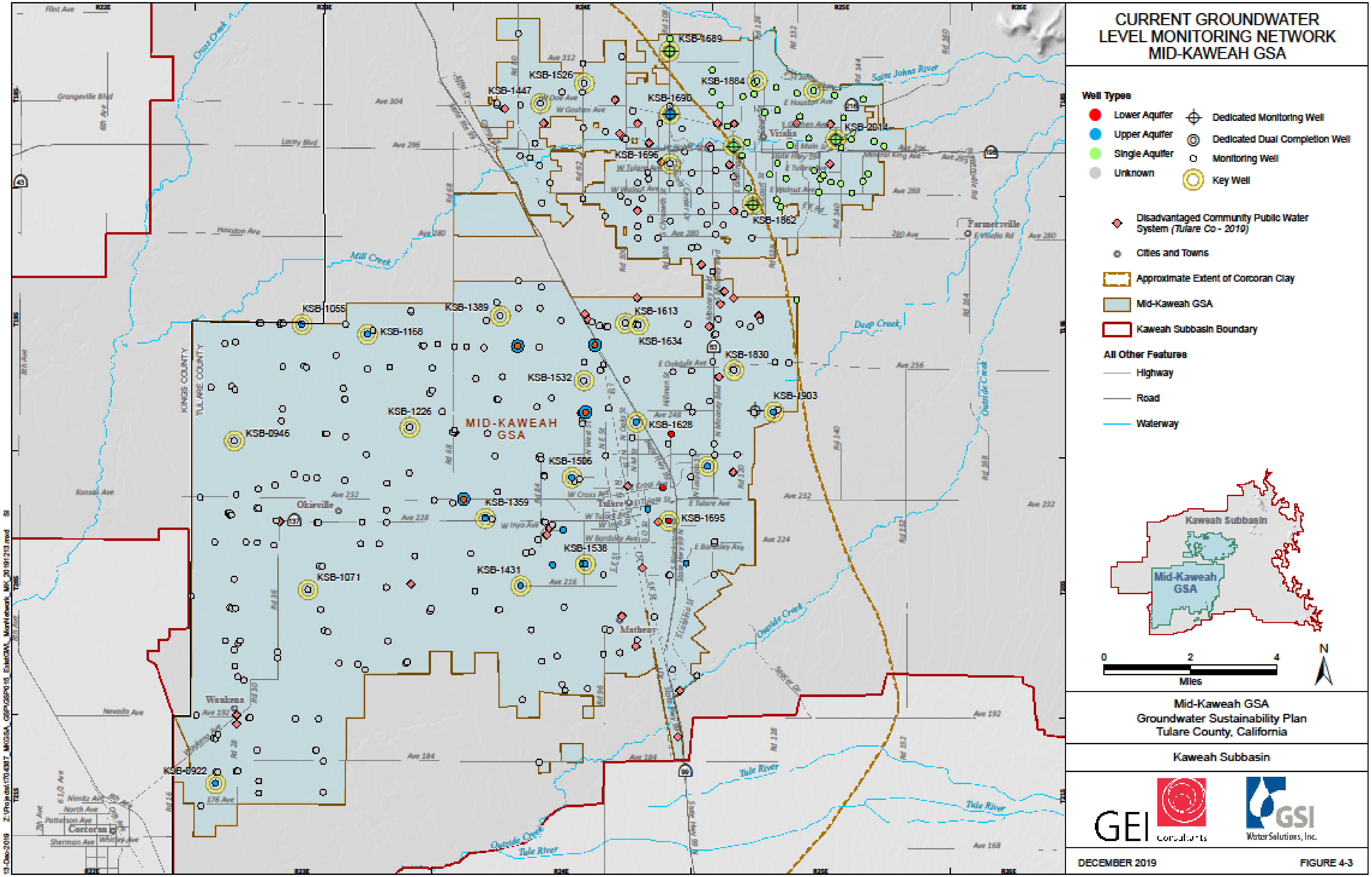


Figure 4-3: Current Groundwater Level monitoring network for MKGSA

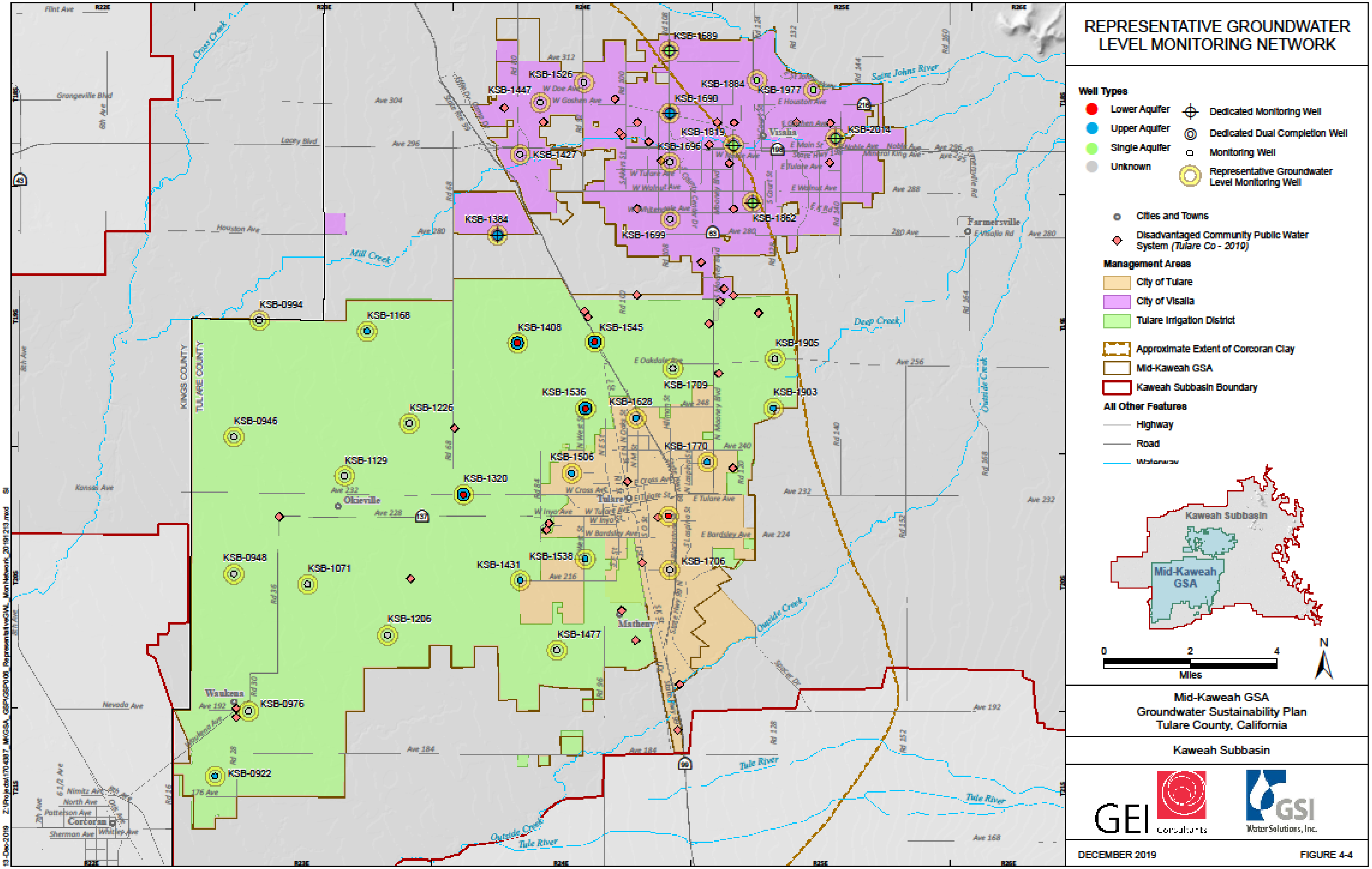


Figure 4-4: Representative Groundwater Level monitoring network

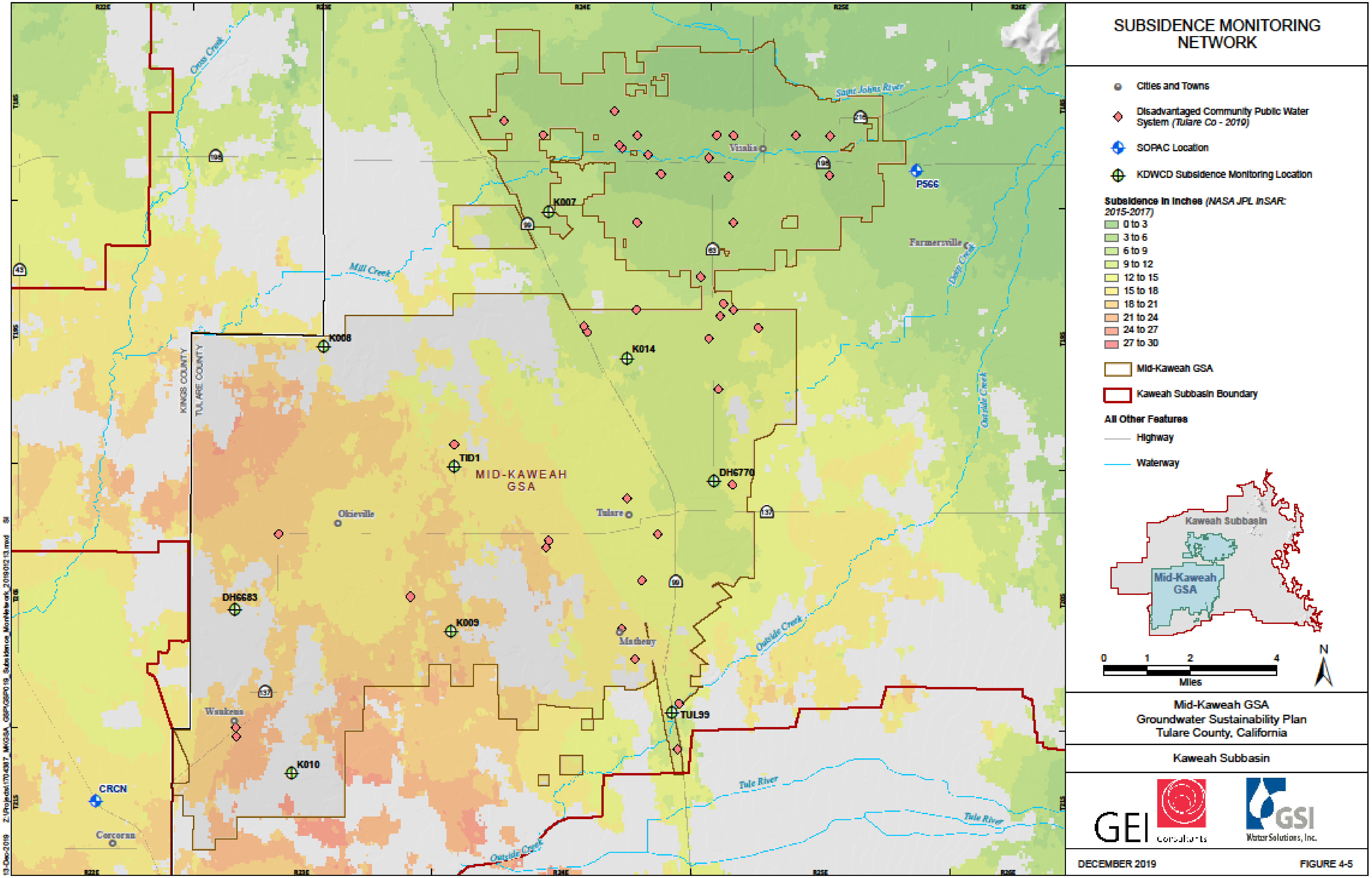


Figure 4-5: Subsidence monitoring network

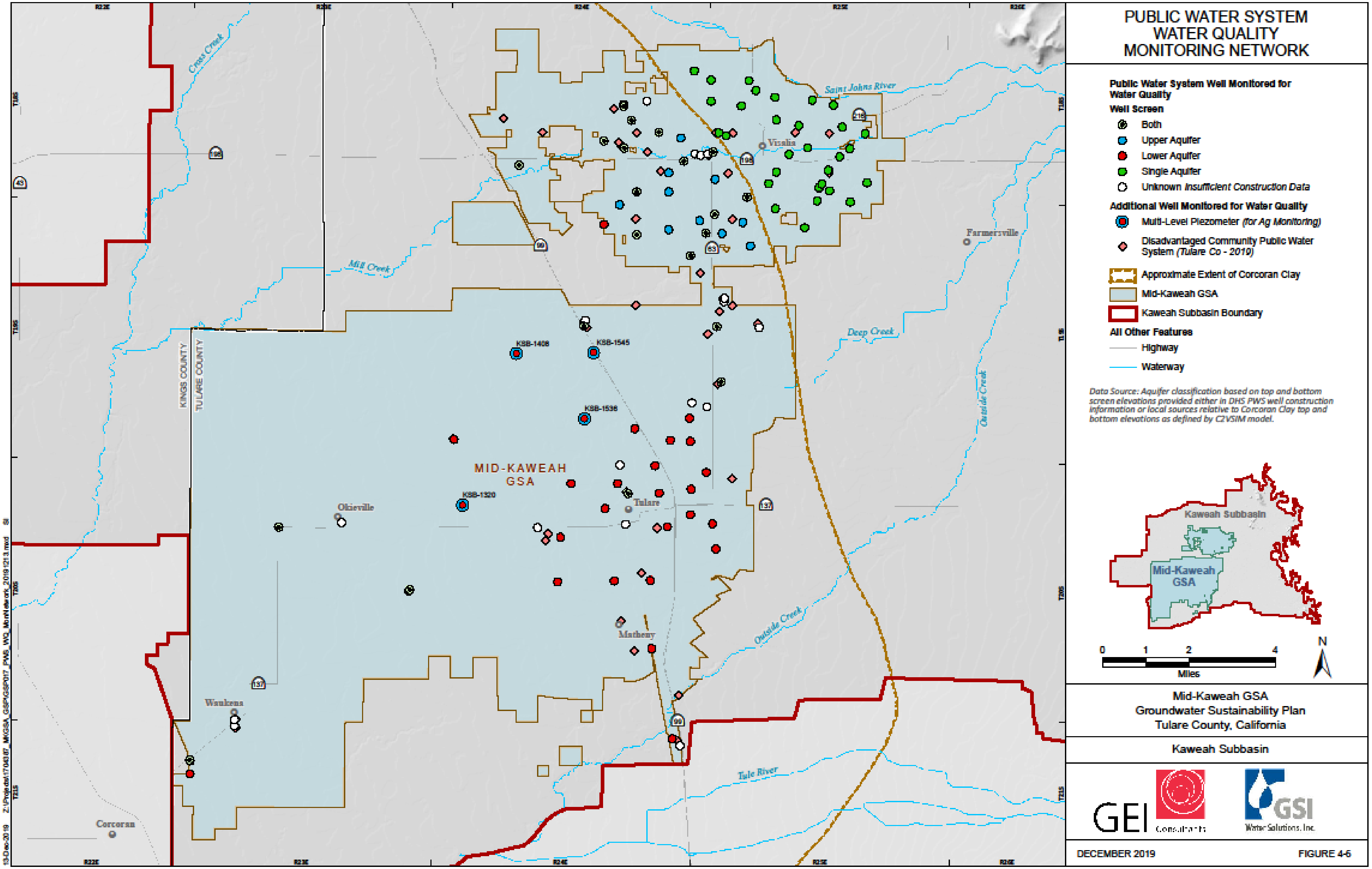


Figure 4-6: Public Water System (Representative) Water Quality monitoring network

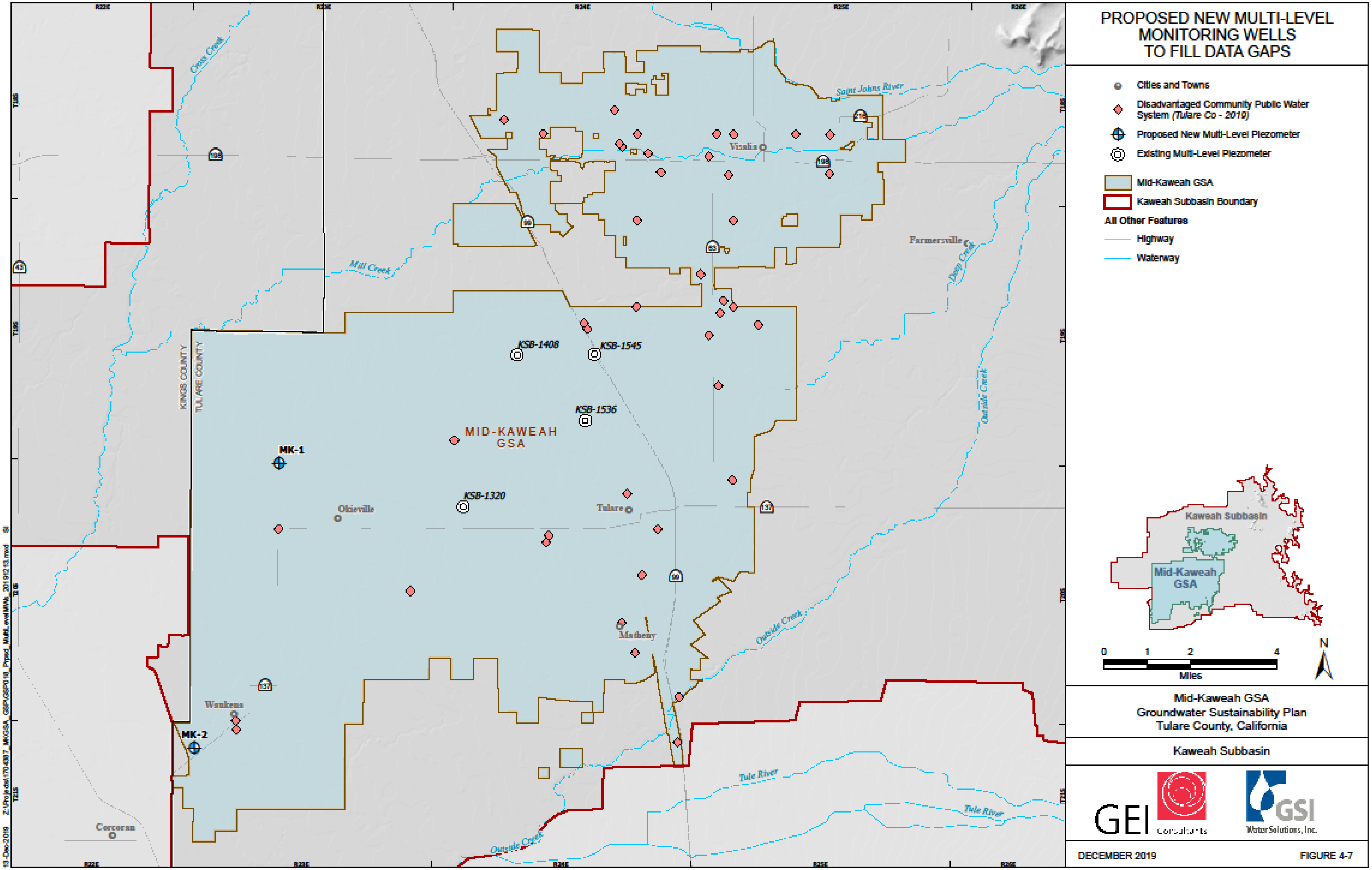


Figure 4-7: Proposed New Multilevel Monitoring Wells to Fill Data Gaps

5. Sustainable Management Criteria

5.1 Introduction

Section 5 discusses the general approach for setting GSA-specific sustainable management criteria (SMC), establishes minimum thresholds, undesirable results, and measurable objectives with interim milestones, and describes mutual influences between neighboring GSAs during GSP implementation. This section builds upon the Subbasin-scale Sustainability Goal described in Section 3

The metrics and approaches to be employed by MKGSA for the six sustainability indicators are shown in Table 5-1.

Table 5-1 Sustainable Management Criteria by Sustainability Indicator

SMC Summary for MKGSA		
Sustainability Indicators	**Minimum Threshold**	**Measurable Objective**
Chronic Lowering of Groundwater Levels	Protect the approximate 90th percentile of all beneficial uses/user types and do not allow a greater than historical rate of decline [1]	Provide at least 5 years of drought storage above the MT
Reduction in Storage	Calculated based on groundwater levels [2]	Calculated based on groundwater levels [2]
Land Surface Subsidence	Total subsidence of no more than 9-feet, and a subsidence rate of no more than 0.67 feet/year at Benchmark Survey Points	Zero subsidence rate
Water Quality	Ref. other regulators [3]	Ref. other regulators [3]
Seawater Intrusion	Not applicable	Not applicable
Interconnected Surface Waters	Not applicable	Not applicable

1 Determined by representative monitoring sites in analysis zones
2 Storage volume changes and associated SMC determined as function of groundwater level changes
3 e.g., SWRCB Division of Drinking Water requirements for public supply wells, RWQCB Irrigated Lands Regulatory Program

5.2 General Process for Establishing Sustainable Management Criteria

To ensure Subbasin wide consistency, the SMC presented in this chapter were developed for the Subbasin as a whole using publicly available information, feedback gathered during public meetings, hydrogeologic analysis, GSA Advisory Committees, and meetings with the three GSA Managers, staff, consultants, technical advisors, and legal counsels. The general process included:

- Weekly technical meetings with GSA Managers, staff, consultants, technical advisors, and legal counsel.

- Presentations to the MKGSA Board on the SMC requirements, implications, and development.
- Presentations to the three GSA Managers and their Advisory Committees outlining the approach to developing SMC and discussing initial SMC ideas. The GSA Managers and Advisory Committees provided feedback and suggestions for the development of initial SMC.
- Discussions with GSA staff and various Board Members.
- Modifying minimum thresholds and measurable objectives based on input from GSA staff and Board Members.

All meetings with the GSA Board and Advisory Committees were conducted under public participation with full participation by the public. This general process resulted in the SMC presented in this section.

5.3 Chronic Lowering of Groundwater Levels Sustainable Management Criteria

5.3.1 *General Approach and Beneficial Users*

Chronic lowering of groundwater levels SMC are developed to protect relevant and applicable beneficial uses and users of groundwater in the Subbasin. Beneficial users of groundwater are identified as domestic pumpers, disadvantaged communities, small water systems (2 to 14 connections), municipal water systems (>14 connections), agricultural pumpers, California Native American Tribes, environmental users, and entities engaged in monitoring and reporting groundwater elevations. These users are described in Section 1.5.2. Understanding the types of users and their access to groundwater is the first step taken to inform what the GSAs and their stakeholder groups consider significant and unreasonable impacts to those users.

Since wells are how users access groundwater, the approach used to develop SMC is based on water supply well depths. The depth of wells across the Subbasin varies by depth to groundwater and beneficial user type. Because of well depth variability, the Subbasin is subdivided into analysis zones based on GSP management area boundaries, clusters of beneficial user types, aquifers, and completed well depths. Completed well depth statistics inform significant and unreasonable groundwater levels, with the SMC being based on protecting at least 90% of all water supply wells in the Subbasin.

5.3.2 *Data Sources Used to Establish Minimum Thresholds and Measurable Objectives*

Information used for establishing the chronic lowering of groundwater levels SMC include:

- Completed depths, screen depths, and locations of wells installed since January 1, 2002, and included in DWR's Well Completion Report (WCR) dataset (see Figure 2 of Appendix 5A). Only 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 elevations. Data were downloaded on March 1, 2022 and represent an update of the data presented in Section 2.

- Historical groundwater elevation data from DWR's California Statewide Groundwater Elevation Monitoring Program, SGMA Portal Monitoring Network Module, and individual water agencies.
- Maps of current and historical groundwater elevation contours.

The WCR dataset does not contain a complete accurate dataset, however, it is the best public source of data available. Approximately one-third of the wells drilled since 2002 did not have well completion depth data in the WCR and could not be used in the analysis. For purposes of well depth analyses, MKGSA assumed the available wells with depth information are typical of depths in the Subbasin.

Well logs were reviewed for wells with completion depths less than 100 feet. This review generally found that either 1) the planned well use field was incorrectly classified as a water supply well when it was supposed to be a destroyed or remediation well, or 2) the completed well depth field was the depth of the conductor casing (often 50 feet) and not the bottom of the completed well. These inaccuracies were corrected. Furthermore, where coordinates of wells are unavailable, DWR locates the well in the middle of the Public Land Survey System section.

5.3.3 *Significant and Unreasonable Chronic Lowering of Groundwater Levels*

Significant and unreasonable conditions were determined based on public meetings (board meeting, workshops, committee meetings, etc.) and discussions with managers, staff, and technical advisory groups Significant and unreasonable groundwater elevation in the Subbasin are those that:

- Are not able to recover in periods of average/above average precipitation following multi-year droughts
- Dewater a subset of active wells
- Cause substantial increased costs for pumping groundwater, well development, well construction, etc. that impact the economic viability of the area
- Cause increased (or new) subsidence impacts related to lowered groundwater levels
- Cause adverse effects on health and safety
- Interfere with other sustainability indicators

5.3.4 *Chronic Lowering of Groundwater Levels Minimum Thresholds*

5.3.4.1 Process Used to Establish Minimum Thresholds

Minimum thresholds (MTs) represent elevations below which significant and unreasonable groundwater levels would occur. The GSAs agreed that MTs must represent groundwater elevations that protect at least 90% of all water supply wells, and that do not result in a future rate of decline greater than observed from 2006 to 2016. Groundwater elevations representing MTs are set at representative monitoring sites identified in the Monitoring Network section of the GSP.

The process for developing MTs involved multiple steps and methodologies described more fully in **Appendix 5A**. Generally, the process compares MTs derived from:

1. Calculating the 90th percentile well completion depth for water supply wells within 39 analysis zones, then applying the analysis zone specific 90% protective depth to representative monitoring sites within corresponding analysis zones (MT methodology 1)

2. Projecting 2006-2016 base period groundwater level trends to 2040 for each representative monitoring site (MT methodology 2)

The most protective elevation of the 2 methodologies is selected as the initial MT. The initial MTs are contoured to determine if the MT surface is relatively smooth and realistic. If there are anomalous MTs, those MTs are excluded as control points and the MTs are recontoured. The anomalous MTs are given elevations interpolated from the recontoured MTs. This interpolation method is the third MT methodology used in the process.

By grouping wells into 39 analysis zones based on similar conditions such as groundwater elevations, base of aquifer, aquifer type, beneficial user type, land use, and completed well depths, the depths protective of 90% of all water supply wells (methodology 1) are localized to the area the representative monitoring site is located in.

The GSAs' decision to use a protective groundwater depth shallower than 90% of all water supply wells (MT methodology 1) recognizes that it is impractical to manage groundwater to protect the shallowest wells. More importantly, the GSAs wanted to set elevations based on well records of active wells, and not wells that may be destroyed or replaced. Because there is no active well registry to provide more accurate records, there is uncertainty regarding which wells are active. For example, the 2012-2016 drought was a period when approximately 480 wells in the Subbasin were reported dry according to the DWR's Dry Well Reporting System and a record number of wells were drilled in the Subbasin (refer to **Appendix 5A** for supporting information). Wells replaced by new deeper wells during this time are those that are presumed part of the shallowest 10% of wells in the dataset used to determine protective elevations. In consideration of the abovementioned factors, the GSAs selected 90% so that the dataset used to establish minimum thresholds contained well records reflective of current active wells.

5.3.4.2 Minimum Thresholds

SGMA requires the minimum threshold for groundwater levels be set by using measured groundwater elevations at representative monitoring sites. Minimum thresholds have been established for each monitoring well included in the representative groundwater level monitoring program, presented in Section 4 of the GSP. **Appendix 5B** provides hydrographs with minimum thresholds, measurable objectives, and interim milestones for MKGSA representative monitoring sites.

Table 5-2 summarizes minimum thresholds for wells in the representative groundwater level monitoring network. The minimum thresholds allow MKGSA to implement projects and management actions in a phased approach to allow for SGMA's 20-year time period within which to reach sustainable yield and avoid the occurrence of undesirable results in terms of further chronic lowering of groundwater levels. Accomplishment of projects as gauged by water budget supplementation are identified in Section 7 of this Plan.

There are four multi-level representative monitoring wells for which minimum thresholds could not be established because the wells are new and empirical groundwater level data was not available for the period 2006 to 2016. Because these wells are within MKGSA's representative monitoring program, MKGSA will establish minimum thresholds and measurable objectives at these wells for the 2025 GSP assessment report informed by groundwater level observations at these wells during the first five years of GSP implementation.

Table 5-2: Summary of Groundwater Level Sustainable Management Criteria for MKGSA

Unique Well ID	Local Well ID	Aquifer System	Minimum Threshold	Measurable Objective	Interim Milestones 2025	Interim Milestones 2030	Interim Milestones 2035
			Groundwater Elevation (feet above sea level)				
025-01	KSB-1696	Upper	138	163	124	150	159
036-01	KSB-1884	Single	79	115	136	122	118
047-01	KSB-1699	Upper	157	167	178	171	169
053-01	KSB-1977	Single	56	121	167	137	127
075-01	KSB-1447	Upper	81	109	79	99	106
077-01	KSB-1427	Upper	81	100	107	103	101
18S24E13N001M	KSB-1689	Single	75	130	208	156	139
18S24E22E001M	KSB-1526	Upper	103	171	26	123	155
18S24E25D001M	KSB-1690	Upper	161	176	184	179	177
18S25E28R001M	KSB-2014	Single	69	141	173	152	145
18S25E30Q001M	KSB-1819	Single	75	101	219	141	115
19S23E20C001M	KSB-0994	Lower	71	93	102	96	94
19S23E22H001M	KSB-1168	Upper	30	72	91	79	75
19S23E31R001M	KSB-0946	Upper	-27	-6	62	17	2
19S23E35H001M	KSB-1226	Upper	3	49	26	42	47
19S24E08D002M	KSB-1384	Upper	47	89	179	119	99
19S24E20F001M	KSB-1408	Upper	*	*	*	*	*
19S24E22E001M	KSB-1545	Upper	*	*	*	*	*
19S24E25D001M	KSB-1709	Upper	88	117	92	109	115
19S24E34D001M	KSB-1536	Upper	*	*	*	*	*
19S24E35E001M	KSB-1628	Lower	-92	-21	22	-7	-17
19S24E36C002M	KSB-1903	Lower	-43	17	43	26	20
19S25E06A001M	KSB-1862	Single	76	103	230	146	118
19S25E20P001M	KSB-1905	Upper	90	136	159	144	139
20S23E03L001M	KSB-1129	Upper	-9	34	9	26	32
20S23E18R001M	KSB-0948	Upper	-66	-27	-35	-30	-28
20S23E21B001M	KSB-1071	Upper	-66	-33	4	-21	-29
20S23E26C001M	KSB-1206	Upper	-20	21	45	29	24
20S24E01H002M	KSB-1770	Lower	-150	-117	-102	-112	-116
20S24E04K001M	KSB-1506	Lower	-39	9	47	22	14
20S24E07C001M	KSB-1320	Upper	*	*	*	*	*
20S24E11J002M	KSB-1695	Lower	-119	-40	16	-22	-34
20S24E16H001M	KSB-1538	Lower	62	83	74	80	82
20S24E17P001M	KSB-1431	Upper	88	110	113	111	111
20S24E28L001M	KSB-1477	Upper	60	96	114	102	98
21S23E05A002M	KSB-0976	Upper	-84	-49	-12	-37	-45
21S23E07J001M	KSB-0922	Upper	-22	19	-27	4	14
361856N1193313W001	KSB-1706	Lower	-136	-87	22	-51	-75

* Recent multi-level well. SMC to be set in 2025 GSP Update for these wells

A Drinking Water Well Mitigation Program (Mitigation Program) is described in Section 7.4 of this Plan, which will aid stakeholders as the GSA implements measures over time to achieve the sustainability goal by 2040. The Mitigation Program is intended to accommodate those drinking water wells that may see impacts from chronic lowering of groundwater and subsidence, and provide mitigation efforts to offset impacts. Stakeholders have been apprised of the threshold-setting process through the GSA's outreach program as articulated in Section 1.5.2 of this Plan, and input to the design of these criteria has been obtained through regular meetings of this GSA's Advisory Committee and the Kaweah Subbasin Management Team Committee.

Importantly, MKGSA will not be managing to these minimum thresholds but, rather, to the measurable objectives established in Section 5.3.5.

5.3.4.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Section 354.28 of the GSP Regulations requires that the description of minimum thresholds include a discussion about the relationship between the minimum thresholds for each sustainability indicator. In the SMC BMP (DWR, 2017), DWR has clarified this requirement. First, the GSP must describe the relationship between each sustainability indicator's minimum threshold (e.g., describe why or how a groundwater level minimum threshold set at a particular representative monitoring site is similar to or different from groundwater level thresholds in nearby representative monitoring sites). Second, the GSP must describe the relationship between the selected minimum threshold and minimum thresholds for other sustainability indicators (e.g., describe how a groundwater level minimum threshold would not trigger an undesirable result for land subsidence).

The groundwater elevation minimum thresholds are plotted to check that they have a relatively smooth distribution across the Subbasin (Figure 5-1 and Figure 5-2). Because the underlying groundwater elevation contours are a reasonably achievable condition, the individual minimum thresholds at representative monitoring sites do not conflict with each other. Groundwater elevation minimum thresholds may influence other sustainability indicators, as described below.

- **Reduction in groundwater storage.** Chronic lowering of groundwater levels minimum thresholds are used to derive groundwater storage minimum thresholds. Thus, the groundwater level minimum thresholds will not result in an undesirable loss of groundwater in storage.

- **Degraded water quality.** The chronic lowering of groundwater levels minimum thresholds may affect groundwater quality through two potential processes:
    - Changes in groundwater elevation could change groundwater gradients, which may cause poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. These groundwater gradients, however, are only dependent on differences between groundwater elevations, not on the groundwater elevations themselves. Minimum threshold groundwater elevations do not directly lead to significant and unreasonable degradation of groundwater quality

in supply wells because there are no large differences in minimum thresholds between wells that would cause increased gradients.

  - Lowered groundwater levels can mobilize contaminants that may occur at depth, such as arsenic or draw down contaminants that are found closer to the ground surface such as nitrate. Since the chronic lowering of groundwater levels minimum thresholds are lower than historical levels, new depth dependent contaminants could potentially be mobilized and impact beneficial uses and users.

- **Land subsidence.** The chronic lowering of groundwater levels minimum threshold allows for some additional groundwater level declines while the MKGSA implements the GSP. Additional land subsidence is expected to occur in parts of the MKGSA if groundwater levels decline to the minimum thresholds. Impacts to beneficial groundwater users and land uses will be mitigated by the MKGSA, should they occur, through implementation of the Mitigation Program. In general, limiting groundwater level decline will help the MKGSA avoid getting close to the groundwater level and land subsidence minimum thresholds.

- **Depletion of interconnected surface water.** Surface water in the MKGSA area is not connected to groundwater because groundwater levels are deeper than 60 feet below ground surface. Minimum thresholds for chronic lowering of groundwater levels will therefore not change the existing condition.

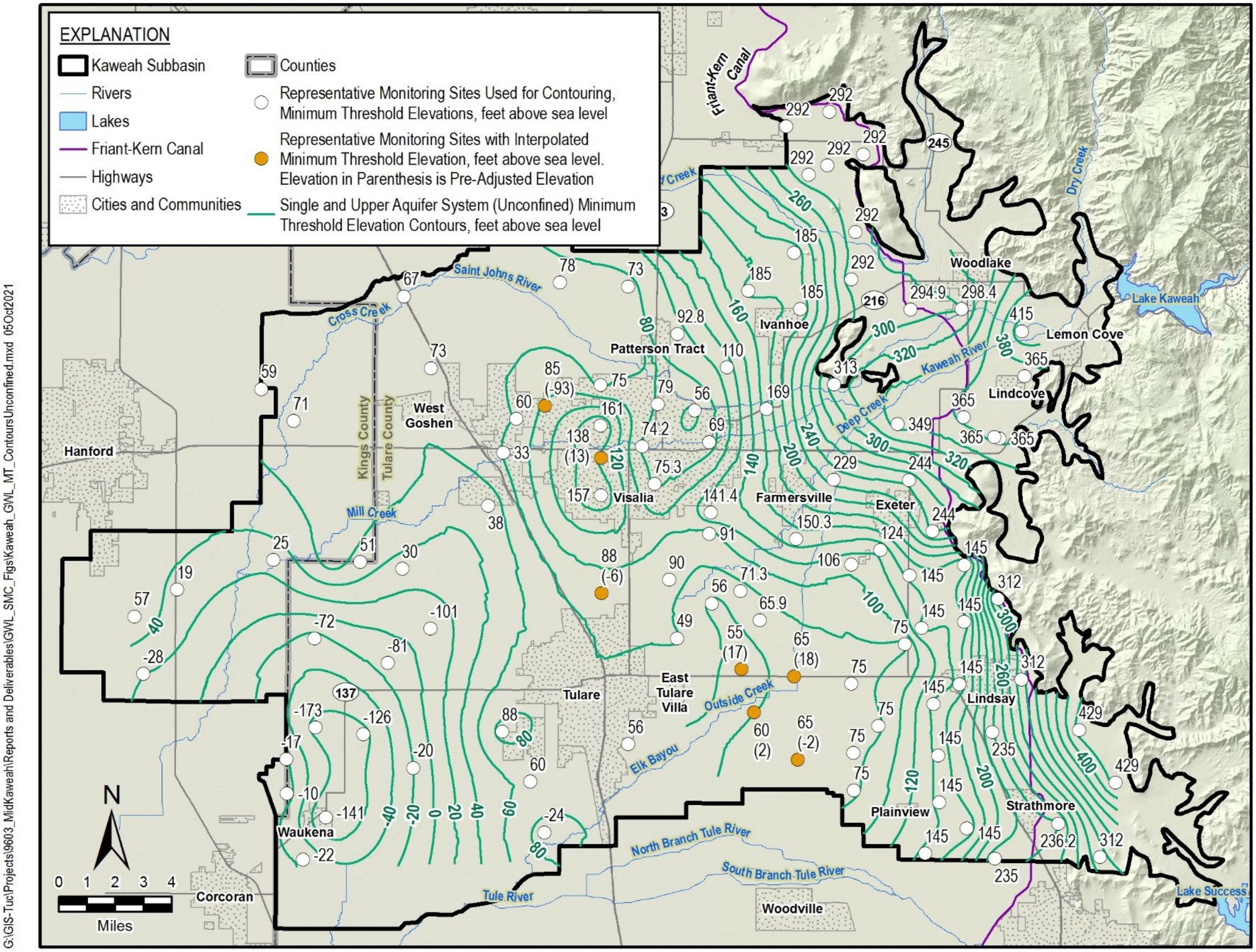


Figure 5-1: Unconfined Groundwater Elevation Minimum Threshold Contour Map

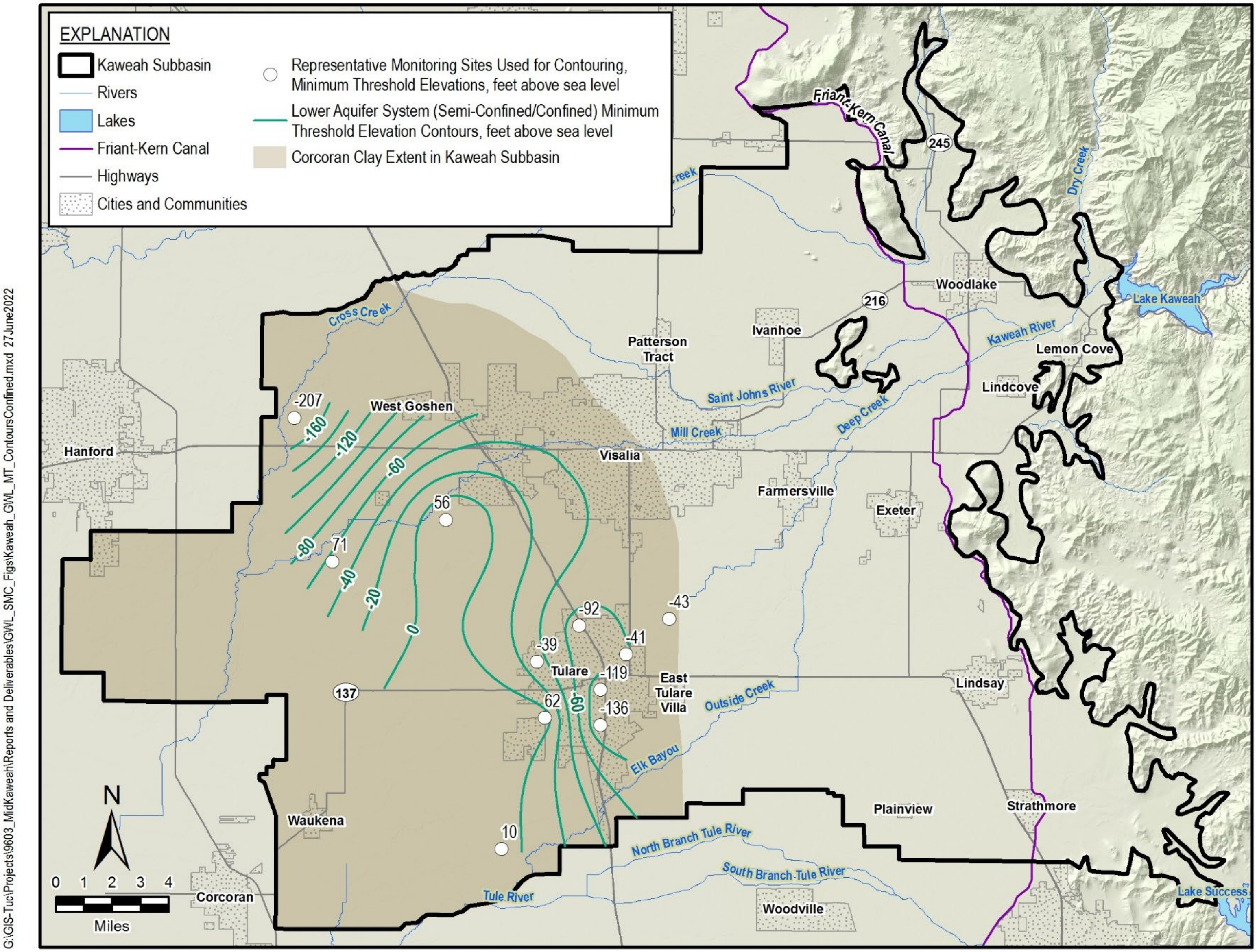


Figure 5-2: Confined Groundwater Elevation Minimum Threshold Contour Map

5.3.4.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The MKGSA jurisdictional area is entirely within the Kaweah Subbasin, in the San Joaquin Valley Groundwater Basin.

The MKGSA is one of three GSAs preparing a GSP for the Kaweah Subbasin. The other two GSPs are being prepared by the following GSAs:

- Greater Kaweah GSA, to the north, east, and south
- East Kaweah GSA, to the east

Three other subbasins of the San Joaquin Valley Basin neighbor the Kaweah Subbasin:

- Kings River Subbasin, to the north
- Tule Subbasin, to the south
- Tulare Lake Subbasin, to the west

Neighboring subbasins all received incomplete GSP determinations from DWR and due to the restrictive timelines to make revisions, the MKGSA was unable to initially determine how other adjacent subbasins proposed minimum threshold setting. The MKGSA will be reaching out to adjacent subbasins to coordinate upon submission of the GSP revisions on July 27, 2022.

All three GSAs in the Kaweah Subbasin used identical approaches to establish chronic lowering of groundwater levels minimum thresholds. Because the same approach is used, MKGSA minimum thresholds will have no negative effects on neighboring GSAs within the Subbasin. Figure 15 of **Appendix 5A** shows a Subbasin contour map of Single and Upper Aquifer System (unconfined) minimum thresholds as being relatively smooth with similar gradients to groundwater levels. In general, neighboring subbasins used similar approaches to establish their minimum thresholds; therefore, maintaining groundwater levels above minimum thresholds should not prevent the neighboring subbasins from achieving sustainability and vice versa. The MKGSA will continue to coordinate closely with other GSAs in the region during GSP implementation to ensure that minimum thresholds have no significant effects on neighboring GSAs ability to achieve sustainability.

5.3.4.5 Affects on Beneficial Users and Land Uses

Stakeholder input has indicated that the largest impact of declining groundwater levels historically is the dewatering of some wells, forcing homeowners, businesses, farmers, and other groundwater well owners to drill new replacement wells. Some impacts, such as declining groundwater levels causing increases in pumping costs, were deemed to be insignificant as they were viewed by the Committee as typical for public water systems and rural residential homes during drought periods and a nominal increase in the business costs for agriculture.

Section 2 in **Appendix 5A** describes how minimum thresholds are set at elevations that will not protect all water supply wells because of the challenges associated with managing groundwater based on the shallowest wells. The description of how minimum threshold's affect specific users and uses below does acknowledge that some shallow wells will go dry.

Agricultural land uses and users. The groundwater elevation minimum thresholds allow some lowering of groundwater levels in the Subbasin. This could affect various beneficial users and land uses:

- Changes to crop types from annual crops to permanent crops is based on market value. Permanent crops provide less flexibility for irrigation during potential future droughts as the opportunity to fallow in dry periods does not exist. The groundwater elevation minimum threshold allows for groundwater irrigation within a reasonable operational range for current land use to help protect the permanent crops that are already planted.
- Some shallow agricultural wells may go dry, however, deepening of agricultural wells in the region has been occurring for decades. Maintaining groundwater elevations above minimum thresholds will ensure that significant and unreasonable numbers of agricultural wells do not go dry and stay within the normal range of costs associated with the frequency and depth of groundwater well replacements.

Urban land uses and users. The groundwater elevation minimum thresholds may result in some shallow public supply wells going dry. However, deepening of public supply wells in the region has been occurring for decades and these wells are covered in the Mitigation Program. Maintaining groundwater elevations above minimum thresholds will ensure that significant and unreasonable numbers of public supply wells do not go dry. Declining groundwater levels may lead to higher costs to pump groundwater and maintain deeper wells.

Domestic land uses and users including DACs. The groundwater elevation minimum thresholds may affect shallow domestic wells, specifically in drought years when more pumping from agricultural wells is anticipated. Shallow domestic wells may become dry, requiring owners to drill deeper wells. The Mitigation Program is being developed to help shallow domestic well owners affected by declining groundwater levels. The Mitigation Program is also being developed and coordinated at the Kaweah Subbasin level via a Kaweah Subbasin Well Mitigation Workplan to ensure that drinking water wells in the Kaweah Subbasin have access to mitigation of declining groundwater levels if they are to reach minimum thresholds.

Small water systems including DACs. The groundwater elevation minimum thresholds may affect shallow small water system wells, specifically in drought years when more pumping from agricultural wells is anticipated. Shallow supply wells may become dry, requiring deepening. The Mitigation Program is being developed to help small water systems affected by declining groundwater levels. The Mitigation Program is also being developed and coordinated at the Kaweah Subbasin level via a Kaweah Subbasin Well Mitigation Workplan to ensure that drinking water wells in the Kaweah Subbasin have access to mitigation of declining groundwater levels if they are to reach minimum thresholds.

5.3.4.6 Relevant Federal, State, or Local Standards

There are no federal, state, or local regulations related to chronic lowering of groundwater levels.

5.3.4.7 Method for Quantitative Measurement of Minimum Thresholds

Groundwater elevation data for the MKGSA will be collected from the Groundwater Level Monitoring Network in accordance with Section 4.4. As outlined in Section 4.4.2, the MKGSA will monitor groundwater elevations seasonally, with a goal to take measurements in the spring (seasonal high before summer irrigation demands) and the fall (seasonal low after the summer irrigation demands). The spring and fall groundwater elevation are both compared annually to the minimum threshold.

5.3.5 *Chronic Lowering of Groundwater Levels Measurable Objectives and Interim Milestones*

5.3.5.1 Process for Setting Measurable Objectives

Measurable objectives (MOs) are established at groundwater elevations higher than MTs to provide operational flexibility and reflect the GSAs' desired groundwater conditions in 2040. The margin of operational flexibility accounts for droughts, climate change, conjunctive use operations, groundwater supply projects, other groundwater management activities, and data uncertainty. Projects, management actions, and implementation of the MKGSA GSP are all being carried out to achieve the MO groundwater level by 2040.

The MOs are based on one of two methods, depending on which methodology was used to set MTs. Figure 5-3 graphically shows the relationship between the different MT and MO methodologies.

MO Method 1, Groundwater Level Trend Projection to 2030:

- For representative monitoring sites with MTs derived from the groundwater level trend projection, the MO is the 2006-2016 groundwater elevation projected to 2030.
- For representative monitoring sites where the MT is set using the protective elevation, and the difference between the MT and groundwater elevation trend projected to 2030 is 20 feet or more, the MO is the 2006-2016 groundwater elevation projected to 2030.

MO Method 2: 5-Year Drought Storage Based on 2006-2016 Trend

- For representative monitoring sites where the MT is set using the protective elevation, and the difference between the MT and groundwater elevation trend projected to 2030 is less than 20 feet, the MO is set at an elevation that provides for 5 years of drought storage above the MT. Five years of drought storage is determined as the groundwater level change occurring over 5 years using the 2006-2016 groundwater level trend. The groundwater level change is added to the MT elevation to establish the MO elevation.

- For representative monitoring sites where anomalously low MTs are adjusted by interpolating from MT contours, the MO is set at an elevation that provides for 5 years of drought storage above the adjusted MT

Details of the methods used to set Mos are described in **Appendix 5A**.

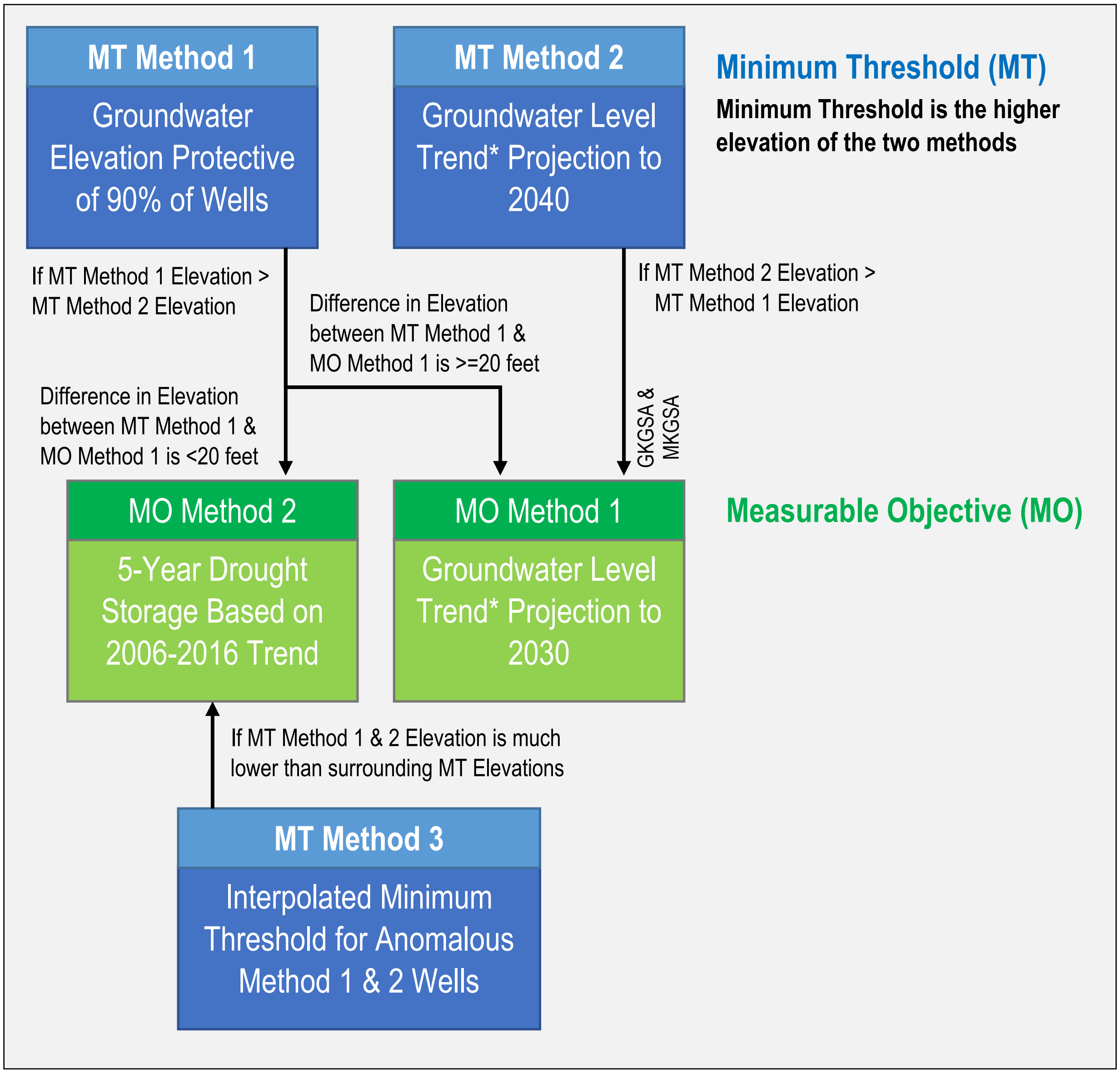


Figure 5-3. Relationship Between Minimum Threshold and Measurable Objective Methodologies

5.3.5.2 Measurable Objectives

Measurable objectives for each representative monitoring site in the MKGSA area are provided in Table 5-2**.**

Measurable objectives reflect the path to sustainability that MKGSA chooses to take. MKGSA's path to sustainability is "Path A" presented by DWR in the Draft Sustainable Management Criteria BMP (DWR, 2017), shown below as Figure 5-4. Path A acknowledges the current rate of decline in the subbasin and sets a goal to slow the decline and stabilize the groundwater basin, reaching its measurable objectives by 2040. This path was discussed and agreed to by the three subbasin GSAs.

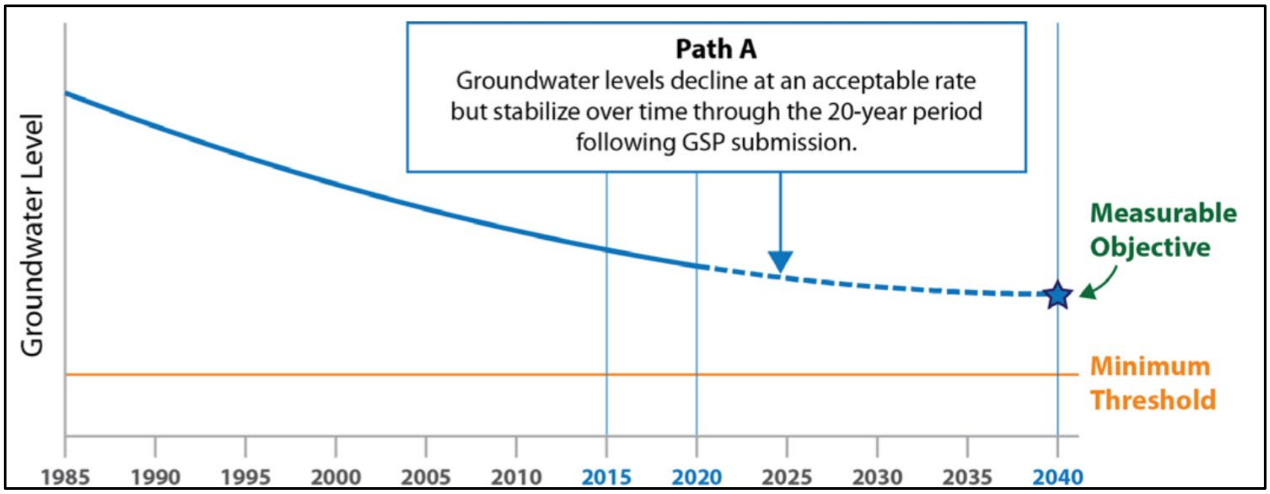


Figure 5-4: DWR's Potential Paths to Sustainability, Path A. ***(DWR, 2017)***

To check on the methodology described above, an empirical relationship was developed to relate water level responses to groundwater recharge for the MKGSA region. Tulare Irrigation District (TID) occupies the southwestern portion of the MKGSA and uses ponds and canals for managed groundwater recharge at various locations. Historical water level response is plotted against annual recharge and, when plotted using a five-year moving average, a relationship becomes evident, as shown on Figure 5-5. This delayed relationship is due to the lag time between surface infiltration and the effect on the water table or potentiometric surface. Although the relationship is somewhat scattered and produces a correlation coefficient of 0.75, it helps provide supporting evidence that measurable objectives are achievable by 2040.

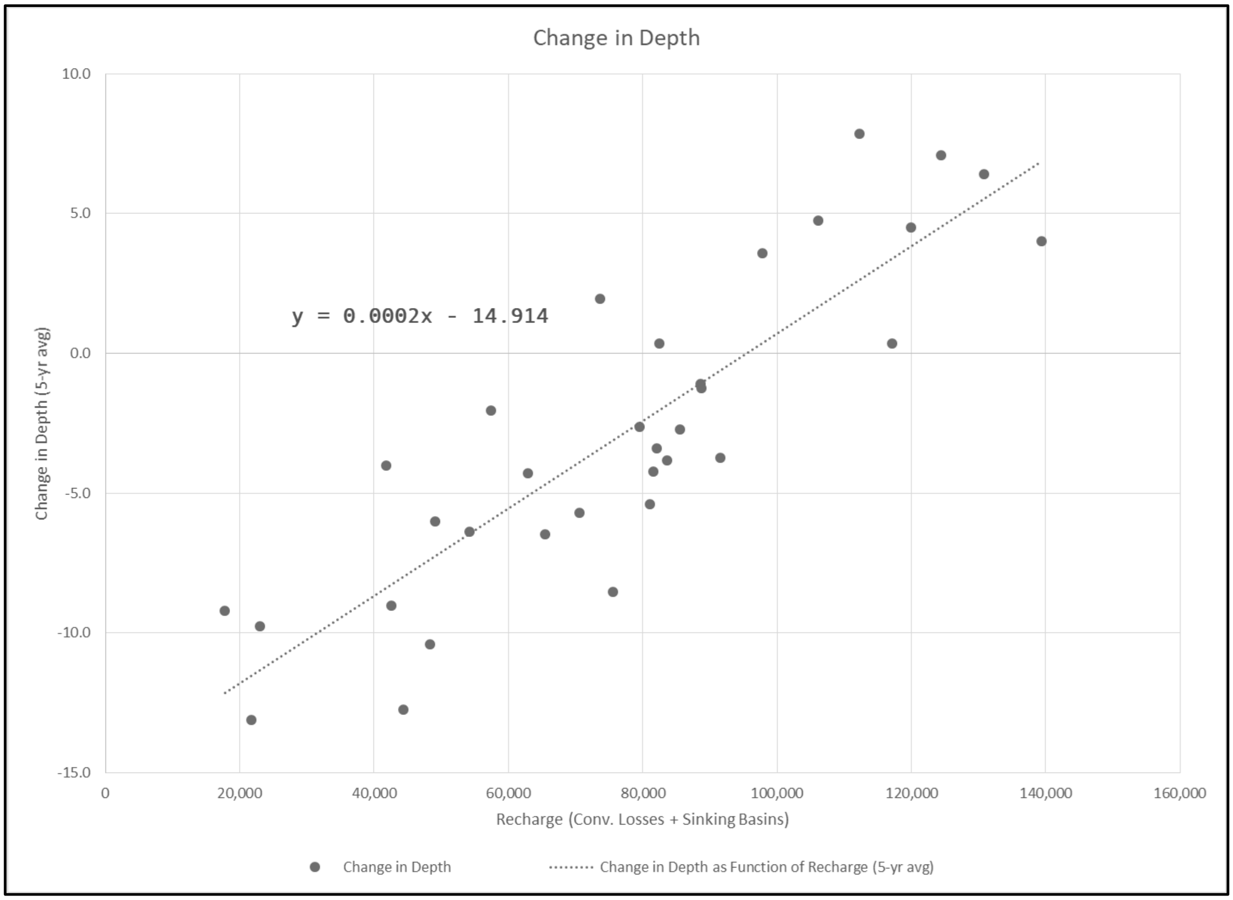


Figure 5-5: Change in Depth to Groundwater as a Function of Recharge in TID

This empirical relationship may be used to relate MKGSA's planned project accomplishments as estimated in Section 7 with water level improvements over time. This causal connection is further discussed in **Appendix 5D**.

5.3.5.3 Methodology for Setting Interim Milestones

Interim milestones for all representative monitoring sites take the form of a curve that flattens out toward 2040 when the MO is reached. The curve shape reflects the timed implementation of projects and management actions over the next 18 years.

Interim milestones for representative monitoring sites are based on incrementally decreasing groundwater level change over time based on the following:

- 2025 interim milestone– extend the 2006-2016 groundwater level trend to 2025
- 2030 interim milestone –elevation at two-thirds of the elevation difference between the 2025 interim milestone and the MO
- 2035 interim milestone - elevation at two-thirds of the elevation difference between the 2030 interim milestone and the MO

The method for setting interim milestones is illustrated on Figure 5-6.

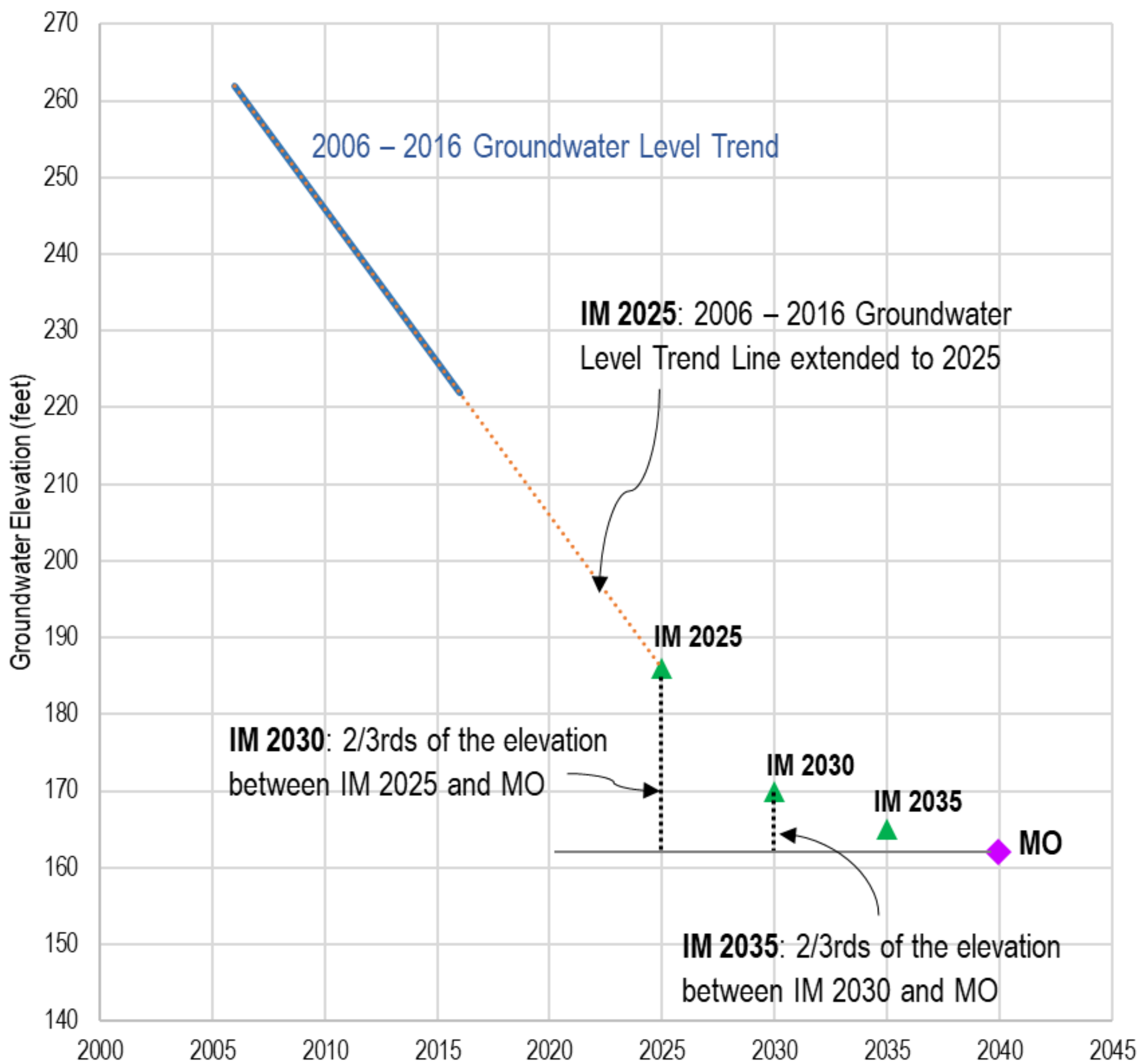


Figure 5-6. Example of Groundwater Level Interim Milestone Methodology

5.3.5.4 Interim Milestones

Interim milestones for each representative monitoring site in the MKGSA area are provided in Table 5-2.

5.3.6 *Chronic Lowering of Groundwater Levels Undesirable Results*

5.3.6.1 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

SGMA defines undesirable results for groundwater elevations as the:

> *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.*

Based on this definition, MKGSA worked with its advisory committee and stakeholders to determine which factors would locally constitute a "significant and unreasonable depletion of supply." Coordination with the stakeholder committees of the other Subbasin GSAs culminated in the following definition of undesirable results:

> *With respect to water-level declines, undesirable results occur when one-third of the representative monitoring sites in all three GSA jurisdictions combined exceed their respective minimum threshold water level elevations.*

This consensus was reached with the understanding that these undesirable results are a broad starting point due to the current high level of uncertainty associated with this initial monitoring network (in relation to well construction details, lack of information on the exact location, depth and volume of pumping relative to the well network) and will later be refined as uncertainty is reduced and data gaps are filled during GSP implementation. Data gaps and the plans to address them were presented in the Monitoring Network Improvement Plan in Chapter 4 of this GSP.

5.3.6.2 Potential Causes of Chronic Lowering of Groundwater Levels Undesirable Results

Undesirable results associated with groundwater level declines are caused by over-pumping, reduced surface water availability due to lack of snowpack in the Sierra Nevada Range, or nominal groundwater recharge operations -such that groundwater levels fall and remain below minimum thresholds. Over-pumping and lack of recharge is area specific, and some GSA Management Areas experience greater adverse impacts than others. 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. (Sustainable Management Criteria- BMP document, November 2017, page 4)

Should this occur, a determination shall be made of the then-current GSA water budgets and resulting indications of net reduction in storage. Similar determinations shall be made of adjacent GSA water budgets in neighboring subbasins to ascertain the causes for the occurrence of the undesirable result.

5.3.6.3 Effects on Beneficial Users and Land Uses

The potential effects of lowered groundwater levels, when approaching or exceeding minimum thresholds and thus becoming an undesirable result, are reduced irrigation water supplies for agriculture and for municipal systems through loss of well capacity, loss or degradation of water supplies for smaller community water systems and domestic wells due to well failures, increased energy consumption due to lowered water levels, and the adverse economic consequences of the aforementioned effects such as increased energy usage to extract groundwater from deeper levels. Economic consequences also would be felt as agricultural lands would no longer be productive without groundwater, in the absence of surface water supplies in quantities needed to meet agronomic needs, and homes and businesses without water would no longer be viable. The same effects occur with reductions in groundwater storage due to the proxy relationship with water levels.

5.4 Reduction in Storage Sustainable Management Criteria

5.4.1 *General Approach*

A SMC for reductions in groundwater storage is determined as a function of changes in groundwater levels. Groundwater levels are not serving as a proxy for this minimum threshold but, rather, as a means to calculate changes in storage using estimated hydrogeologic parameters.

5.4.2 *Data Sources Used to Establish Minimum Thresholds and Measurable Objectives*

The chronic lowering of groundwater elevation minimum thresholds, measurable objectives, and interim milestones are used to establish the reduction in storage minimum threshold, measurable objective, and interim milestones. Other data used to develop the reduction in storage SMC are sustainable yield, specific storage and Lower Aquifer System thickness.

5.4.3 *Significant and Unreasonable Reduction in Storage*

Significant and unreasonable reduction in storage is identical to the significant and unreasonable conditions for chronic lowering of groundwater levels discussed in Section 5.3.3. Significant and unreasonable reduction in storage conditions in the Subbasin may include the following:

- Are not able to recover in periods of average/above average precipitation following multi-year drought periods
- Dewater a subset of active wells

- Cause substantial increased costs for pumping groundwater, well development, well construction, etc. that impact the economic viability of the area
- Cause increased (or new) subsidence impacts related to lowered groundwater levels
- Cause adverse effects on health and safety
- Interfere with other sustainability indicators

5.4.4 *Reduction in Storage Minimum Threshold*

5.4.4.1 Methodology Used to Establish Minimum Thresholds

The MKGSA used the following methodology to develop a minimum threshold for reduction in storage:

- Prepare spring 2017 groundwater elevation maps for the combined Upper and Single Aquifer Systems, which are unconfined aquifers, and Lower Aquifer System, which is a confined aquifer, representing current conditions.
- Prepared spring 2040 groundwater elevation maps for the combined Upper and Single Aquifer Systems and Lower Aquifer System by contouring the projected groundwater level minimum thresholds for each representative monitoring site.
- Calculate the total volume between the 2017 and 2040 using the groundwater surfaces described above.
- Estimate the total groundwater storage change by multiplying the volume between the 2017 and 2040 surfaces by specific yield for the combined Upper and Single Aquifer System and by specific storage and approximate aquifer thickness for the Lower Aquifer System. The base of fresh water within the Subbasin is not definitively known, as existing wells have historically been drilled to depths well above the presumed base.
- Sum the change in groundwater storage between 2017 and 2040 in the combined Upper and Single Aquifer Systems and Lower Aquifer System.

The result of this analysis shows that, as of Spring 2017, the MKGSA had 1.52 MAF in aquifer storage above the minimum threshold groundwater levels. A single reduction in storage measurable objectives applies to the entire GSA area.

5.4.4.2 Minimum Threshold

MKGSA incorporates the use of water levels as a means to estimate the reduction in groundwater storage over time. The specific metrics to be applied for storage changes (additions or reductions) will be acre-feet per year and estimated groundwater in storage above the minimum threshold groundwater levels, or floor. Figure 5-7 shows the minimum threshold volume as zero on the vertical axis. This zero value represents a loss of 1.52 MAF of storage over the 2017 condition, well below the total storage estimate of 15-30 MAF.

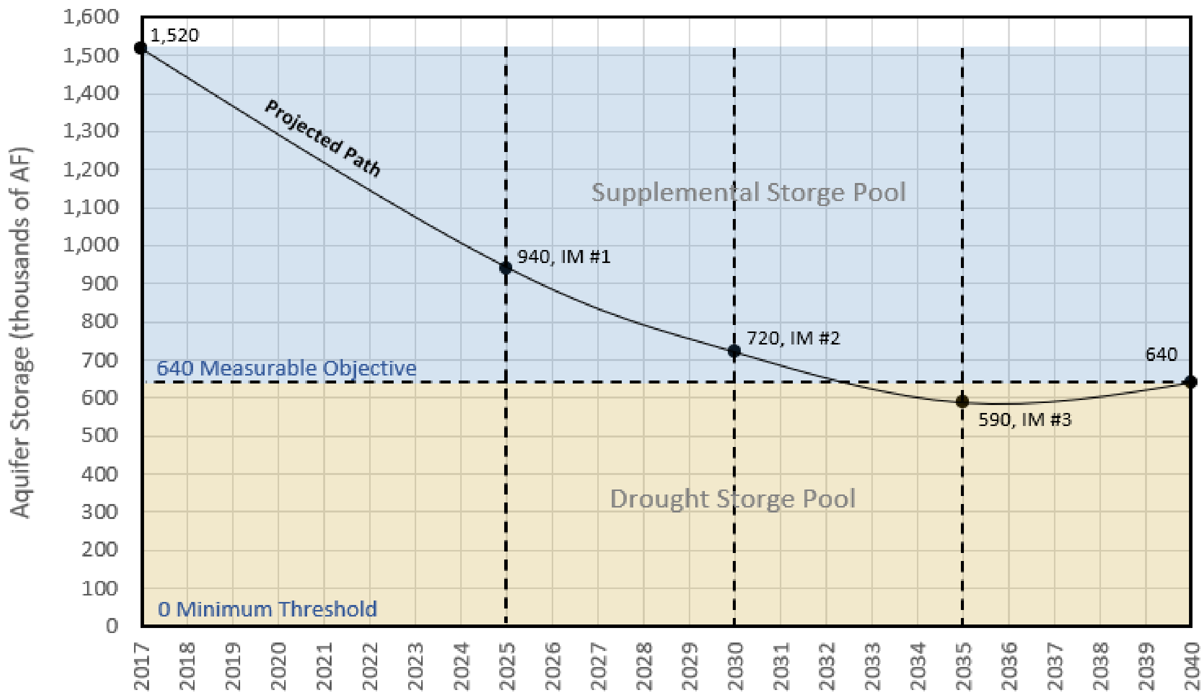


Figure 5-7: MKGSA Groundwater Storage Sustainable Management Criteria

5.4.4.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The reduction in storage minimum threshold may influence other sustainability indicators. Since the chronic lowering of groundwater elevation minimum thresholds were used to establish a reduction in groundwater storage minimum threshold, the same information applies to this section as summarized for chronic lowering of groundwater levels in Section 5.3.4.2.1.

5.4.4.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The selected minimum threshold for reduction in storage may have several effects on beneficial users and land uses in the Subbasin. Since the chronic lowering of groundwater elevation minimum thresholds were used to establish a reduction in groundwater storage minimum threshold, the same information applies to this section as summarized for chronic lowering of groundwater levels in Section 5.3.4.2.2.

5.4.4.5 Affects on Beneficial Users and Land Uses

The selected minimum threshold for reduction in storage may have several effects on beneficial users and land uses in the Subbasin. Since the chronic lowering of groundwater elevation minimum thresholds were used to establish a reduction in groundwater storage minimum threshold, the same information applies to this section as summarized for chronic lowering of groundwater levels in Section 5.3.4.2.3.

5.4.4.6 Relevant Federal, State, or Local Standards

No federal, state, or currently enforced local standards exist for reductions in groundwater storage.

5.4.4.7 Method for Quantitative Measurement of Minimum Threshold

Annual change in groundwater storage will be estimated annually to compare to the minimum threshold. The methods for calculating change in groundwater storage will be different for the combined upper and single aquifer systems, which are unconfined aquifers, and the lower aquifer system, which is a confined aquifer. Each year, storage changes for the combined upper and single aquifer systems and lower aquifer system will be calculated from changes in water levels for the representative wells within the MKGSA to compute volumetric changes between annual potentiometric surfaces.

The combined upper and single aquifer system change in volume will be multiplied by the specific yield estimates for the aquifer material to estimate change in groundwater storage. Change in storage in the confined lower aquifer system will be estimated by multiplying the change in piezometric surface by the storativity to estimate change in groundwater storage. The changes in groundwater storage from the unconfined and confined aquifers will be summed to estimate a total change in groundwater storage.

5.4.5 *Reduction in Storage Measurable Objectives and Interim Milestones*

5.4.5.1 Methodology for Setting Measurable Objectives

The approach used for setting a measurable objective for reduction in storage is identical to the approach for setting the minimum threshold, except that the chronic lowering of groundwater levels measurable objectives are used instead of the minimum thresholds to calculate groundwater potentiometric surfaces.

5.4.5.2 Measurable Objectives

The measurable objective for reduction in storage shown on Figure 5-7 is 640,000 AF above the minimum threshold. MKGSA's goal is to manage groundwater basin storage above the measurable objectives.

MKGSA is also mindful of its computed groundwater budget as discussed in Section 6 and its obligations in mitigating for reductions in groundwater storage during Plan implementation. With this in mind, MKGSA will additionally evaluate changes in storage as a function of new projects (via water recharged) and management actions (via water not extracted). This evaluation, while not established or represented as a measurable objective per se, is generally described in **Appendix 5D**.

5.4.5.3 Methodology for Setting Interim Milestones

The approach for setting interim milestones for reduction in storage is identical to the approach for setting the minimum threshold, except that the chronic lowering of groundwater levels interim milestones are used instead of the minimum thresholds to calculate groundwater potentiometric surfaces.

5.4.5.4 Interim Milestones

The interim milestones for reduction in storage are shown on Figure 5-7. The 2025 IM is 940,000 AF, 2030 IM is 720,000 AF, and 2035 IM is 590,000 AF.

5.4.6 *Reduction in Storage Undesirable Results*

5.4.6.1 Criteria for Defining Reduction in Storage Undesirable Results

SGMA defines undesirable results for groundwater storage as the:

> *"Significant and unreasonable reduction of groundwater storage."*

The Subbasin GSAs have determined that future reductions in groundwater storage by 2040 will not constitute an undesirable result. Fundamental to this conclusion are estimates made by USGS, the WRI reports of the Kaweah Delta WCD, and the Basin Setting information in Section 2 of this Plan that a volume of fresh water in storage currently exists in the range of 15 to 30 MAF within the Subbasin. At an average overdraft rate of 78 TAF per year for the water budget (current conditions) expressed in Section 2, many years of productive capacity remain, well beyond 2040 or even the full planning and implementation horizon out to 2070. It is understood that this historic trend, should it continue further in time, would result in some sustainability indicators, such as land subsidence or possibly water quality, to exhibit undesirable results. However, adherence to the measurable objectives established in Section 5.4.5 should prevent such occurrences.

Nevertheless, a minimum threshold for storage is determined herein by direct correlation to changes in water levels over time. The water-level sustainability indicator is used as the driver for calculated changes in groundwater storage. As such, when one-third of the Subbasin representative monitoring sites for water levels exceed their respective minimum thresholds, an undesirable result for storage will be deemed to occur. This metric will aid in tracking the performance of future recharge projects and effectiveness of future management actions.

5.4.6.2 Potential Causes of Reduction in Storage Undesirable Results

Undesirable results associated with groundwater storage are caused by the same factors as those contributing to groundwater level declines. Given assumed hydrogeologic parameters of the Subbasin, direct correlations exist between changes in water levels and estimated changes in groundwater storage.

5.4.6.3 Effects on Beneficial Users and Land Uses

The potential effects to beneficial uses and users of reductions in groundwater storage are essentially the same as for chronic lowering of groundwater levels. In most cases the direct correlation is with declines in levels; however, some beneficial uses may be tied more specifically to loss of groundwater in storage, such as a reduction in supply for areas not served by a surface water system.

5.5 Degraded Water Quality Sustainable Management Criteria

5.5.1 *General Approach*

SGMA does not provide the MKGSA with the regulatory tools or authority to enforce water quality violations or otherwise take abatement actions. Rather, MKGSA is charged with avoiding the degradation of water quality and the migration of contaminant plumes due to its actions or management. Groundwater quality is currently regulated by multiple state and local governmental agencies. Water quality objectives and the enforcement of these objectives is the responsibility of the State Water Resources Control Board (SWRCB), the Division of Drinking Water, and the Central Valley Regional Water Quality Control Board. The SWRCB and these supporting agencies all enforce Federal Environmental Protection Agency (EPA) water quality standards for both surface and groundwater. There are also agricultural suitability standards (Agricultural Water Quality Objectives as referenced herein) for water quality protection of agriculture that require irrigation water standards by crop type..

In order to comply with the SGMA requirements, the MKGSA supports the protection of groundwater quality by coordinating with agencies and programs such as those listed above that are already established to maintain and improve the groundwater quality in the Kaweah Subbasin. All future projects and management actions implemented by the MKGSA will be designed to avoid or mitigate for causing further groundwater quality degradation. The avoidance of groundwater quality degradation will be supported by groundwater sampling and reports demonstrating the conditions pre-SGMA and any changes in groundwater quality that occur through the period 2020 to 2040.

5.5.2 *Data Sources Used to Establish Minimum Thresholds and Measurable Objectives*

The minimum thresholds and measurable objectives are based on MCLs or Agricultural WQOs, whichever is applicable at the representative monitoring site.

5.5.3 *Significant and Unreasonable Degraded Water Quality*

Per SGMA Regulations, significant and unreasonable degraded water quality is the migration of contaminant plumes that impair water supplies. With respect to SGMA, degradation of groundwater quality only applies to groundwater quality changes due to actions implemented as part of this GSP, such as changes in regional pumping patterns or implementation of projects or management actions.

5.5.4 *Degraded Water Quality Minimum Thresholds*

5.5.4.1 Methodology Used to Establish Minimum Thresholds

The minimum thresholds are the MCLs or the Agricultural WQOs, whichever is applicable at the representative monitoring site. As summary of constituents to be monitored and tracked by the MKGSA is provided as Table 5-3**.**

The methodology used to distinguish between the applicability of either MCLs or agricultural constituents of concern is as follows:

- At each representative monitoring well, determine the dominant beneficial use for that monitoring well. If the majority of the beneficial use (greater than 50% of the pumping within a determined area) was agriculture and there were no public water systems (including schools) the minimum threshold would be a host of agricultural water quality constituents.
- The water will be monitored for drinking water standards; however if there is an exceedance of a MCL, the GSA shall inform any users in the area of the exceedance and provide technical assistance such as water quality testing and information on potential alternative water supply options (bottled water, reverse osmosis (RO) systems, connecting to a public water system, etc.).
- As a part of the technical assistance, water quality testing of residential systems could be offered, which would increase the water quality data temporally and spatially over the MKGSA.
- The GSA will also notify other responsible agencies and organizations of the MCL exceedance and coordinate activities such that the actions of the GSA do not contribute to the further exceedance of any MCL.
- The above assistance programs are as summarized in Section 7.4 of this Plan.
- If a monitoring well is located within an urban area, or near a public water system (e.g., within a mile), which includes schools, then the minimum threshold would be set at the MCL for drinking water. If an MCL is exceeded, then the public water agency responsible for the water quality in those wells shall be contacted and the GSA shall coordinate their activities such that they do not result in an exceedance of any MCL.

5.5.4.2 Minimum Thresholds

Minimum thresholds for water quality are summarized in Table 5-3**.** The groundwater quality monitoring network is provided in Section 4.4 of this Plan.

Table 5-3: MKGSA Groundwater Quality Constituent List, Minimum Thresholds and Measurable Objectives.

Type	Constituent	Minimum Threshold		Measurable Objective	
Public Drinking Water	As	10	ug/L	7.5	ug/L
	NO_3 (as N)	10	mg/L	7.5	mg/L
	Cr-VI	(10) [1]	ug/L	(7.5) [1]	ug/L
	DBCP	0.2	ug/L	0.15	ug/L
	TCP	0.005	ug/L	0.0038	ug/L
	PCE	5	ug/L	3.8	ug/L
	ClO_4	6	ug/L	4.5	ug/L
	Na	no drinking water MCL		no drinking water MCL	
	Cl	500 [2]	mg/L	375	mg/L
	TDS	1000 [2]	mg/L	750	mg/L
Agricultural [3]	pH (upper)	8.4	pH units	7.9 [4]	pH units
	pH (lower)	6.5	pH units	7.0 [4]	pH units
	Conductivity	700	uS/cm	525	uS/cm
	TDS	450	mg/L	338	mg/L
	Boron	700	ug/L	525	ug/L
	Ca	No established Ag Water Quality Goal		No established Ag Water Quality Goal	
	Mg	No established Ag Water Quality Goal		No established Ag Water Quality Goal	
	Na	69	mg/L	52	mg/L
	K	No established Ag Water Quality Goal		No established Ag Water Quality Goal	
	HCO_3	No established Ag Water Quality Goal		No established Ag Water Quality Goal	
	Cl	106	mg/L	80	mg/L
	NO_3 (as N)	No established Ag Water Quality Goal		No established Ag Water Quality Goal	
	SO_4 (as SO4)	No established Ag Water Quality Goal		No established Ag Water Quality Goal	

[1] As of the date of adoption of this document, there is no MCL for Hexavalent Chromium. The previously established MCL of 10 ug/l was invalidated (redacted) in 2017. The state water resources control board is currently working to re-establish an MCL. Once the MCL is re-established, the MCL will become the Minimum Threshold. In the meantime, Hexavalent Chromium will continue to be monitored and tracked by the Mid Kaweah GSA as data is available, but no Minimum Threshold will be enforced.

[2] Chloride and TDS are regulated under secondary MCLs in California due to aesthetics. These constituents have three ranges for the MCL: recommended, upper, and short term. The Minimum Thresholds use the upper limit of consumer acceptance MCL.

[3] Agricultural thresholds are based on the State Water Resources Control Board's Compilation of Water Quality Goals available at: https://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/

[4] Measurable Objective for pH calculated as 75% of the difference between the upper and lower Ag Water Quality goals.

5.5.4.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Preventing degradation of groundwater quality has little or no impact on minimum thresholds for other sustainability indicators, as described below:

- **Chronic lowering of groundwater levels**. The degradation of groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for recharge to maintain or raise groundwater elevations. Water used for recharge cannot exceed any groundwater quality standards.
- **Reduction in groundwater storage**. The degradation of groundwater quality minimum thresholds do not promote lower groundwater elevations. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the groundwater storage minimum threshold.
- **Land subsidence**. The degradation of groundwater quality minimum thresholds do not promote additional pumping that could cause subsidence. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the subsidence minimum threshold.
- **Depletion of interconnected surface water.** The water quality minimum threshold has no effect on depletion of interconnected surface water because surface water is not interconnected in the MKGSA area.

5.5.4.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

Coordination between all GSAs responsible for establishing minimum thresholds in the Kaweah Subbasin and neighboring subbasins occurred throughout the development of this GSP. All three GSAs in the Kaweah Subbasin used identical approaches to establish degradation of groundwater quality minimum thresholds. Because the same approach is used, MKGSA minimum thresholds will have no negative effects on neighboring GSAs within the Subbasin. In general, the neighboring subbasins used similar approaches to establish their minimum thresholds; therefore, maintaining groundwater quality above minimum thresholds or pre-SGMA baseline conditions, should not prevent the neighboring subbasins from achieving sustainability and vice versa. The MKGSA will continue to coordinate closely with other GSAs in the region during GSP implementation to ensure that minimum thresholds have no significant effects on neighboring GSAs ability to achieve sustainability.

5.5.4.5 Affects on Beneficial Users and Land Uses

In general, groundwater concentrations less than or equal to the minimum thresholds will be suitable for all beneficial use in the Subbasin. Exceedance of minimum thresholds could affect beneficial users and land uses by requiring water treatment, well replacement, or modification, or decreasing crop yields.

- **Agricultural land uses and users**. Maintaining groundwater quality concentrations at or below the minimum threshold in agricultural areas will generally support beneficial water use for irrigating the crops grown in the Subbasin. Exceedance of the minimum threshold could decrease crop yields for crops sensitive to specific water quality constituents.

- **Urban land uses and users**. Maintaining groundwater quality concentrations at or below the minimum threshold will support beneficial water use for public supply. Exceedance of the minimum threshold would affect public water supply. Depending on the constituent and concentration, exceedance of the minimum threshold could require water treatment, well modification, or replacement.
- **Domestic and small water system land uses and users, including DACs.** Maintaining groundwater quality concentrations at or below the minimum threshold will provide adequate potable water for residential and small system water users. Exceedance of the minimum threshold could limit available rural residential and small water system potable supplies. Depending on the constituent and concentration, exceedance of the minimum threshold could require water treatment, well modification, or replacement.
- **Depletion of interconnected surface water.** Minimum thresholds for water quality will have no impact on depletion of interconnected surface water because surface water in the MKGSA area is not connected to groundwater.

5.5.4.6 Relevant Federal, State, or Local Standards

The groundwater quality minimum thresholds specifically incorporate state and federal standards for drinking water and basin plan objectives.

5.5.4.7 Method for Quantitative Measurement of Minimum Thresholds

As described in Section 4.9, MKGSA will evaluate groundwater quality degradation by either directly performing groundwater sampling at representative monitoring sites and coordinating with other agencies responsible for the collection and reporting of groundwater quality through other regulatory programs. MKGSA will partner with these agencies to share data for inclusion in its GSP annual reports and five-year assessments. The relationship between groundwater levels and degradation trends, if any, is site-specific. Periodic sampling during the GSP implementation phase will assist in revealing any such relationship as water levels stay above water level minimum thresholds and within the confines of measurable objectives.

The 10-year average concentration of each constituent will be compared to the minimum threshold in GSP Annual Reports. Where MCLs are already exceeded prior to GSP implementation, this will be considered a baseline condition that MKGSA is not responsible for remediating.

5.5.5 *Degraded Water Quality Measurable Objectives and Interim Milestones*

5.5.5.1 Methodology for Setting Measurable Objectives

As explained in Section 5.5.1, the MKGSA supports the protection of groundwater quality by coordinating with other agencies and programs established to maintain and improve the groundwater quality in the Kaweah Subbasin. All future projects and management actions implemented by the MKGSA are designed to avoid causing further groundwater quality degradation.

To protect against causing a water quality degradation (exceedance of MCLs or Agricultural WQOs), the MKGSA will establish measurable objectives at 75% of the MCLs or Agricultural WQOs. This stricter objective will alert MKGSA to any constituent's concentration that is approaching the MCL or water quality objective. Using water quality data provided by other agencies, as well as data collected from the MKGSA representative groundwater quality monitoring network, MKGSA will include time-series plots of water quality constituents to demonstrate projects and management actions are operating to avoid degradation. Should the concentration of constituents of concern raise to 75% of the MCL or water quality objective as the result of a GSA project, MKGSA will immediately implement corrective measures (i.e., halting recharge operations, reducing pumping, etc.) to avoid an exceedance in the event that such concentrations be as a result of GSA actions.

MKGSA will also coordinate with the entities responsible for complying with existing groundwater quality regulatory programs. Many of these programs are still in the early stages of implementation (i.e., Irrigated Lands, Dairy Program, CV-Salts) and groundwater quality measurable objectives have yet been established. Once established, MKGSA will reflect these levels in the GSP periodic assessments outlined in Section 8 of this Plan.

5.5.5.2 Measurable Objectives

Measurable objectives for water quality are provided in Table 5-3.

5.5.5.3 Interim Milestones

As progress towards improving water quality rests largely with other regulatory agencies, interim milestones for water quality will not be explicitly applied.

5.5.6 *Degraded Water Quality Undesirable Results*

5.5.6.1 Criteria for Defining Degraded Water Quality Undesirable Results

SGMA defines undesirable results for groundwater quality as the:

> *"Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."*

The key SGMA directive is a degradation of existing water quality. MKGSA recognizes MCLs are relevant to public drinking water as a beneficial use. Since a large portion of this Plan area is in agriculture, with agricultural irrigation as the beneficial use, the MKGSA will also avoid degradation above the Agricultural Water Quality Objectives (Ag WQO) presented and described in the Basin Setting report (**Appendix 2A**).

An exceedance of any of the MCL or agricultural metrics as defined herein at any representative monitoring sites will trigger a management action within the applicable Management Area or GSA, subject to determination that the exceedance was caused by actions of the GSA. Should one-third of all Subbasin monitoring sites exhibit an exceedance, an undesirable result will be deemed to occur. Where MCLs are already exceeded prior to GSP implementation, this will be considered a baseline condition that MKGSA is not responsible for remediating. However, MKGSA will work cooperatively with water quality agencies charged with addressing these conditions.

Groundwater quality degradation will be evaluated relative to established MCLs or other agricultural constituents of concern by applicable regulatory agencies. The metrics for degraded water quality shall be measured by MCL compliance or by other constituent concentration measurements where appropriate. These metrics will include measurements for the following constituents where applicable:

- Arsenic
- Nitrate
- Chromium-6
- DBCP
- TCP
- PCE
- Sodium
- Chloride
- Perchlorate
- TDS

As explained in Section 5.5.4.1, in regions where agriculture represents the dominant use of groundwater, Agricultural Water Quality Objectives will serve as the metric as opposed to MCLs within public water supply jurisdictions. An exceedance of any of the MCL or agricultural metrics as defined herein at any representative monitoring sites will trigger a management action within the applicable Management Area or GSA, subject to determination that the exceedance was caused by actions of the GSA. MCLs and water quality objectives are listed in **Appendix 3A** and these are subject to changes as new water quality objectives are promulgated by the State of California and the Federal EPA. MKGSA will provide updates in our annual reports and GSP Updates throughout the implementation periods of 2020 to 2040.

5.5.6.2 Potential Causes of Degraded Water Quality Undesirable Results

Undesirable results associated with water quality degradation can result from pumping localities and rates, as well as other induced effects by implementation of a GSP, such that known migration plumes and contaminant concentrations are threatening production well viability are causes of Undesirable results. Well production depths too may draw out contaminated groundwater, both from naturally occurring and man-made constituents which, if MCLs are exceeded, may engender Undesirable results. Declining water levels may or may not be a cause, depending on location. In areas where shallow groundwater can threaten the health of certain agricultural crops, rising water levels may be of concern as well.

5.5.6.3 Effects on Beneficial Users and Land Uses

The beneficial uses of groundwater in the Kaweah Subbasin are described in the Water Quality Control Plan for the Tulare Lake Basin Second Edition – 1995 (State Board Water Quality Control Plan). This document also includes a description of the Water Quality Objectives for Groundwater, an Implementation Plan, Relevant Plans and Policies, and Surveillance and Monitoring. MKGSA's sustainability goal is in alignment with the State Board's Water Quality Control Plan.

The beneficial uses of groundwater in the Kaweah Subbasin include:

- Municipal, Small Community, Disadvantaged Community and Domestic Drinking Water Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PRO)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)

The water quality objectives for each of these beneficial uses, including MCLs and their associated metrics for each constituent, is provided as **Appendix 3A**. MCLs change as new rules are promulgated by the Federal EPA and SWRCB. MKGSA will provide updates including the addition of any new constituents in its five-year GSP assessments.

The potential effects of degraded water quality from migrating plumes or other induced effects of GSA actions include those upon municipal, small community, disadvantaged community and domestic well sites rendered unfit for potable supplies and associated uses, and/or the costs to treat groundwater supplies at the well head or point of use so that they are compliant with state and federal regulations. Potential effects also include those upon irrigated agricultural industries, as certain mineral constituents and salt build-up can impact field productivity and crop yields.

5.6 Land Subsidence Sustainable Management Criteria

5.6.1 *General Approach*

Land subsidence SMC are defined by the amount of total subsidence that would be significant and unreasonable based on substantial interference with land surface uses and users. SGMA Regulations (§ 354.28 (c)(5)) state, "The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results." It is the MKGSA's intention to avoid or minimize subsidence to the degree possible. This will be accomplished by

- Controlling groundwater elevations that trigger subsidence
- Developing financial incentives that reduce or control pumping

- Expanding recharge operations
- Tracking pumping through well registration and well metering
- Improving groundwater level and subsidence monitoring systems
- Mitigating impacts

These projects and management actions are further outlined in Section 7.

Land subsidence SMC are developed based on input collected during stakeholder input meetings, MKGSA Subbasin Advisory Committee meetings, and discussions with GSA staff. The land subsidence SMC methodology begins by identifying the land surface beneficial users and uses in the Subbasin that might be impacted by subsidence. Significant and unreasonable impacts to beneficial users related to land subsidence are identified and quantified. Minimum thresholds and measurable objectives are then developed based on best available data. The general process to develop SMC is shown in Figure 5-8.

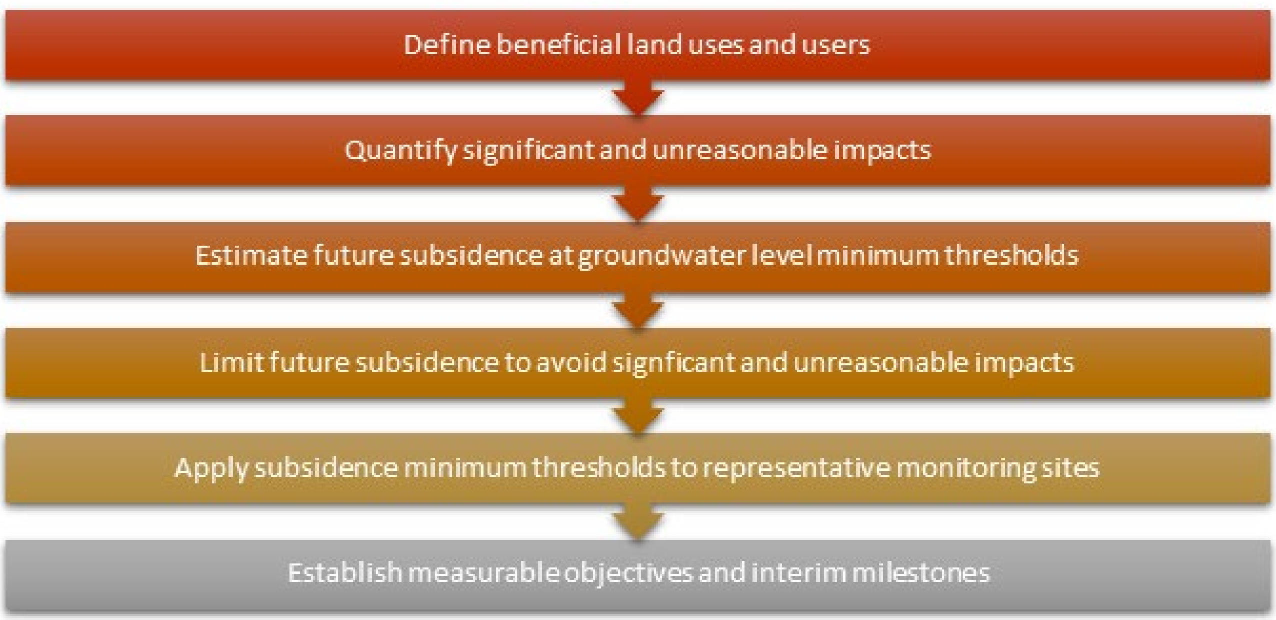


Figure 5-8: Process for Developing Land Subsidence SMC

5.6.2 *Beneficial Uses and Users*

5.6.2.1 Identifying Key Beneficial Uses and Users

Land surface uses and users that may be impacted by subsidence are those that rely on a stable land surface to function properly. In the MKGSA area, these include infrastructure such as water conveyance infrastructure (including canals, ditches, and flood control waterways), supply wells, roads, bridges, electrical power lines, gas and water pipelines, sanitary sewers, and railroad tracks.

The amount of local infrastructure is generally denser in cities and communities than in rural agricultural areas. The corridor along Highway 99 is considered an area of dense infrastructure because there is a major state highway, a gas pipeline, and a railroad along the alignment. These areas of dense infrastructure are considered in terms of their cumulative risk related to subsidence.

The GSA must establish quantifiable levels of subsidence that are significant and unreasonable to these beneficial uses and users. An initial assessment was performed to identify data that could provide quantifiable correlations between infrastructure impacts and subsidence. A review of historical subsidence impacts on infrastructure includes the following:

- Flood Channels – Subsidence has not been observed to diminish the capacity of local flood channels, but it theoretically could impact capacity under the right circumstances. Additionally, subsidence could cause a change to the amount of sediment that is moved by the system

- Local Canals – Canals are a fundamental part of the MKGSA's Management Strategies. If their capacities are significantly impacted, reduced surface water deliveries may trigger greater groundwater pumping.

- Shallow Wells – Shallow wells and wells in the single aquifer that do not significantly perforate the confined aquifer below the Corcoran Clay do not appear to be at risk of collapse from subsidence due to the lack of compaction in upper aquifer clay layers.

- Deep Wells – Wells completed in the confined aquifer below the Corcoran Clay are at risk of collapse due to subsidence. Because subsidence has been active in this area for many years, owners and well drillers have been including compression sleeves and used thicker well casings to make wells more resistant to subsidence.

- Railroads – Historical subsidence does not appear to have significantly impacted local railroads or the adjacent flood control their culverts. However, localized subsidence could be a significant issue.

- Natural Gas Pipelines – Along Highway 99 there is a significant natural gas pipeline. Over the past several years this facility has been worked on and repaired, but it appears these efforts are related to issues other than subsidence.

Based on this review, the infrastructure historically impacted by subsidence in the Subbasin is water conveyance infrastructure and deep supply wells. Although InSAR data show that up to 5-feet of subsidence has occurred in the Subbasin from 2015 to 2022, there has been no record of impacts to roads, bridges, electrical power lines, gas and water pipelines, sanitary sewers, or railroad tracks. Table 5-4 summarizes the beneficial land surface uses, along with the initial assessment of whether data exist to quantify significant and unreasonable impacts from subsidence. The MKGSA will monitor subsidence impacts on all infrastructure listed in Table 5-4 whether quantifiable data exist or not.

Table 5-4: Summary of Beneficial Uses and Users (Critical Infrastructure) Potentially Impacted by Land Subsidence

Infrastructure / Beneficial Use	Significant & Unreasonable Impact	Quantifiable Impacts?
Water Conveyance Infrastructure	Capacity loss from slope flattening and cracks	Possible based on historical impacts to beneficial users
Supply Wells	Collapse of deep wells that prevents use and requires repair or replacement	Possible based on well design. Not enough historical information to correlate collapse with subsidence
Roads and Bridges	Uneven settlement that requires repairs or replacement	Difficult to quantify based on lack of historical impacts
Electrical Power Lines	Stretch or harm	Difficult to quantify based on lack of historical impacts
Sanitary Sewers	Cracks or loss of capacity	Difficult to quantify based on lack of historical impacts
Gas and Water Pipelines	Cracks or loss of capacity	Difficult to quantify based on lack of historical impacts
Railroad Tracks	Uneven settlement that requires repairs or replacement	Difficult to quantify based on lack of historical impacts

This analysis acknowledges that the relationship between subsidence and infrastructure impacts is incomplete. Additional data will be collected to identify zones more susceptible to subsidence, potential masking of subsidence impacts due to regular maintenance, subsidence impacts on well collapse, and impacts on flood zones. TID has already installed a benchmark survey system to monitor key infrastructure and plans to survey landowners to identify subsidence impacts. As more subsidence data become available, subsidence SMC will be updated to quantify impacts on all infrastructure.

5.6.2.2 Significant and Unreasonable Impacts on Most Sensitive Beneficial Uses and Users

Input from GSA staff and the MKGSA Subbasin Advisory Committee is used to establish significant and unreasonable impacts to water conveyance infrastructure and supply wells. The following levels of significant and unreasonable are based on conversations among interested parties:

- A 10% reduction in any primary waterway's capacity is significant and unreasonable. Primary waterways in the MKGSA area include Mill Creek, Packwood Creek, the TID Main Canal, and Cameron Creek (Figure 5-9). The 10% loss of capacity applies to both water supply infrastructure and flood control infrastructure.
- Any domestic, small water system, or municipal well collapse due to subsidence is significant and unreasonable.

5.6.2.2.1 Significant and Unreasonable Impacts on Water Conveyance Infrastructure

The GSA established that a 10% reduction in any primary waterway's capacity is significant and unreasonable. A 10% reduction is chosen because of the impact on groundwater management. The canals shown on Figure 5-9 can accommodate flows up approximately 350 cubic feet per second (cfs). A 10% reduction to 35 cfs, would impact approximately 5 to 7 users and cause the users to potentially pump more groundwater.

Hydraulic analyses of each primary waterway have not been completed. The MKGSA plans to conduct hydraulic analyses to refine how much subsidence would result in a 10% loss of capacity. This analysis will include determinations of canal cross sections, high-water levels, and other canal parameters.

A preliminary estimate of significant and unreasonable impacts can be established by looking at historical impacts to canal capacities. In 2021, the Tulare Irrigation District (TID) observed an unacceptable decline in the capacity of its main canal. The TID mitigated the decline by raising the canals banks to allow more flow. The banks were raised between 10-inches and 1-foot. DWR-supplied InSAR data show the subsidence that led to the loss of capacity. These data show that this impact was from approximately 1-foot of subsidence occurring over approximately 1.5-miles of canal length (Figure 5-10). Based on these historical data, 1-foot of conveyance flattening over a 1.5-mile reach caused by differential subsidence is a significant and unreasonable condition.

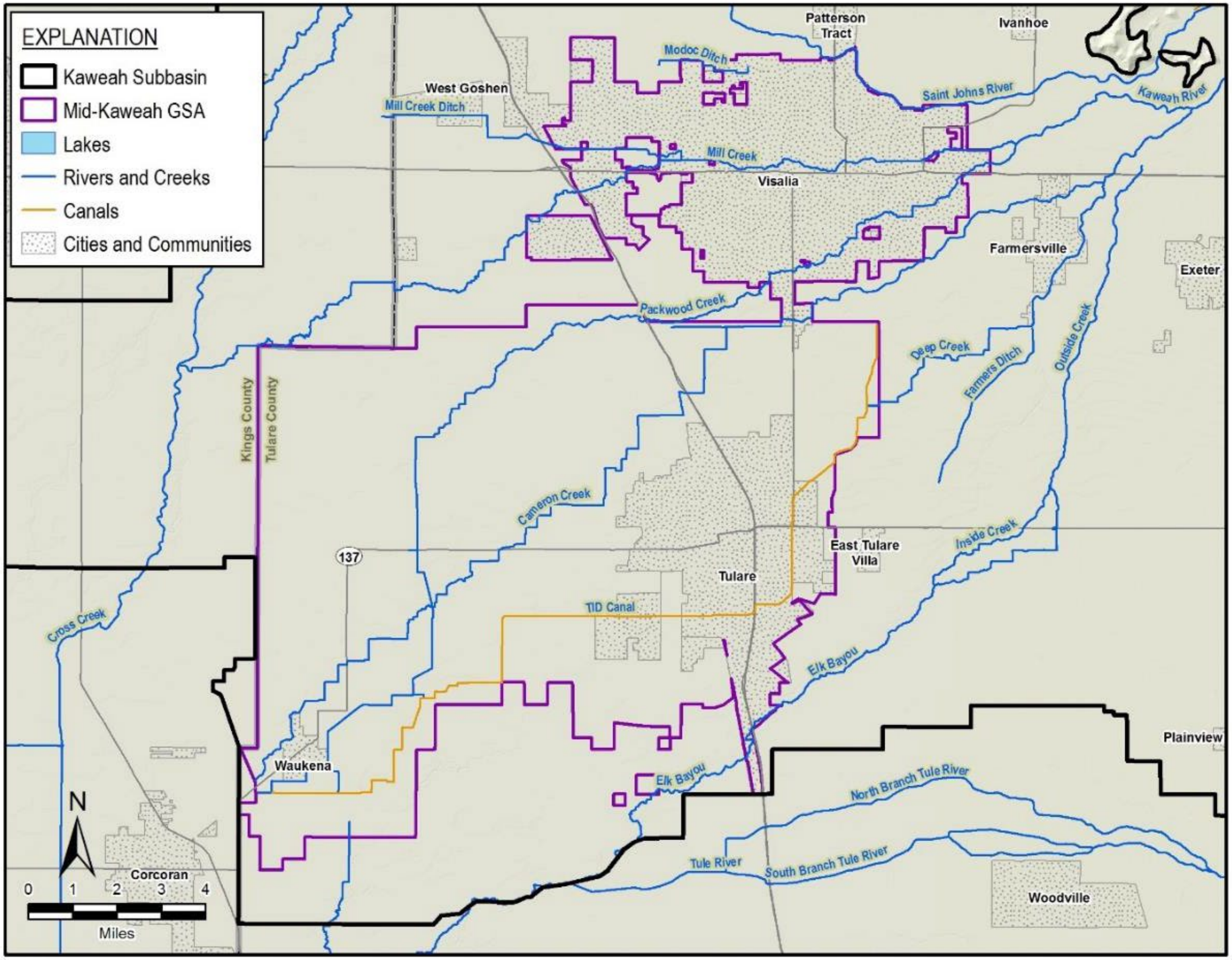


Figure 5-9: Primary Waterways in the Mid-Kaweah GSA Area

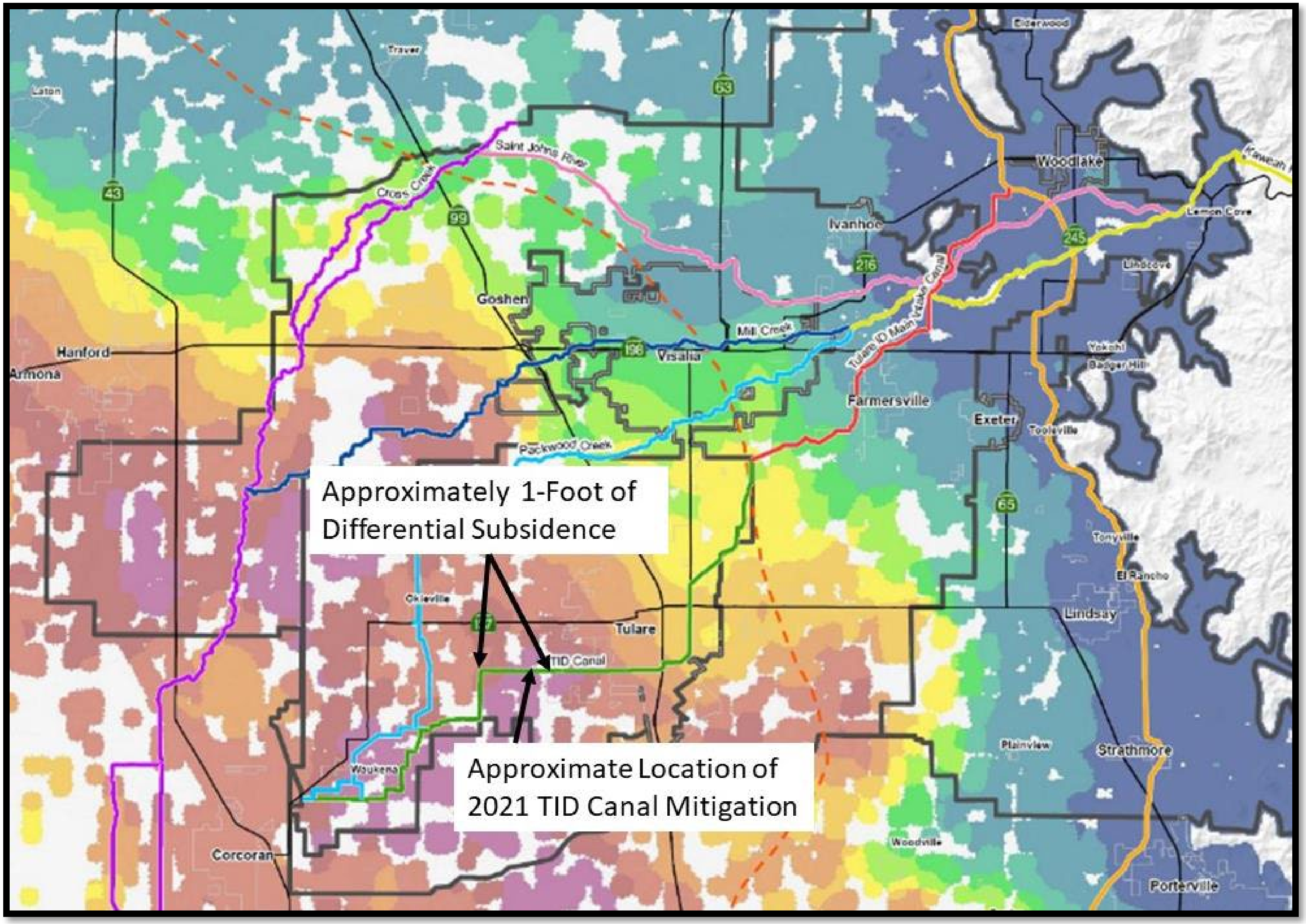


Figure 5-10: Historical Subsidence Impacts on TID Main Canal

5.6.2.2.2 Significant and Unreasonable Impacts on Water Supply Wells

Subsidence that results in irreparable damage to water supply well casing and/or surface completions is a significant and unreasonable condition. However, not enough information is available to establish a quantitative amount of subsidence that causes well damage in the MKGSA area. A paper by Borchers et al. (1998) showed that some wells were damaged in parts of the Sacramento Valley that experienced between 1-foot and 5.4-feet of subsidence. The paper did not correlate the amount of subsidence with well collapse, nor establish a subsidence threshold that causes well collapse. The relationship between subsidence and well damage is complex because each well has many unique variables that may lead to collapse such as well age, depth, materials, construction, and hydrogeology.

A preliminary estimate of significant and unreasonable impacts can be established by looking at well construction practices. Subsidence mainly occurs in the deeper aquifers, and therefore well collapse due to subsidence primarily affects deeper wells. Conversations with local well drillers and suppliers indicates that deeper wells are now commonly outfitted with compression sleeves (personal communication). These compression sleeves allow well casings to telescope in response to subsidence, preventing casing collapse (Turnbull, 2022). Each compression sleeve allows 6 feet of compression, and often wells are equipped with 1 or 2 sections (personal communication). This allows for 6 to 12 feet of subsidence without causing collapse. Based on these data, MKGSA selected 9 feet of total subsidence as a significant and unreasonable amount of subsidence that may result in well collapse.

While this is a reasonable preliminary approach to establishing quantitative levels of significance, the GSAs realize that well collapse could still occur with less than 9 feet of subsidence. This would be a significant and unreasonable outcome. To that end, the MKGSA is developing a Mitigation Program to mitigate the impacts of subsidence on drinking water supply wells during GSP implementation. Mitigation plan details are provided in Section 7.4.8.

5.6.3 *Land Subsidence Minimum Thresholds*

The minimum threshold for land subsidence is both a rate and extent of total subsidence. The horizontal extent of minimum thresholds covers the entire MKGSA area, as measured by subsidence representative monitoring site locations. The vertical extent of total subsidence is discussed below. Total subsidence is the sum of active subsidence caused by ongoing lowering of groundwater levels and any residual subsidence from previous years.

Minimum thresholds are measured at 11 representative monitoring sites in the MKGSA area shown on Figure 5-11. Each representative monitoring site is assigned both a maximum total subsidence, which is the vertical extent of subsidence, and a maximum subsidence rate. Minimum threshold subsidence values for each of the 11 representative monitoring sites are listed in Table 5-5.

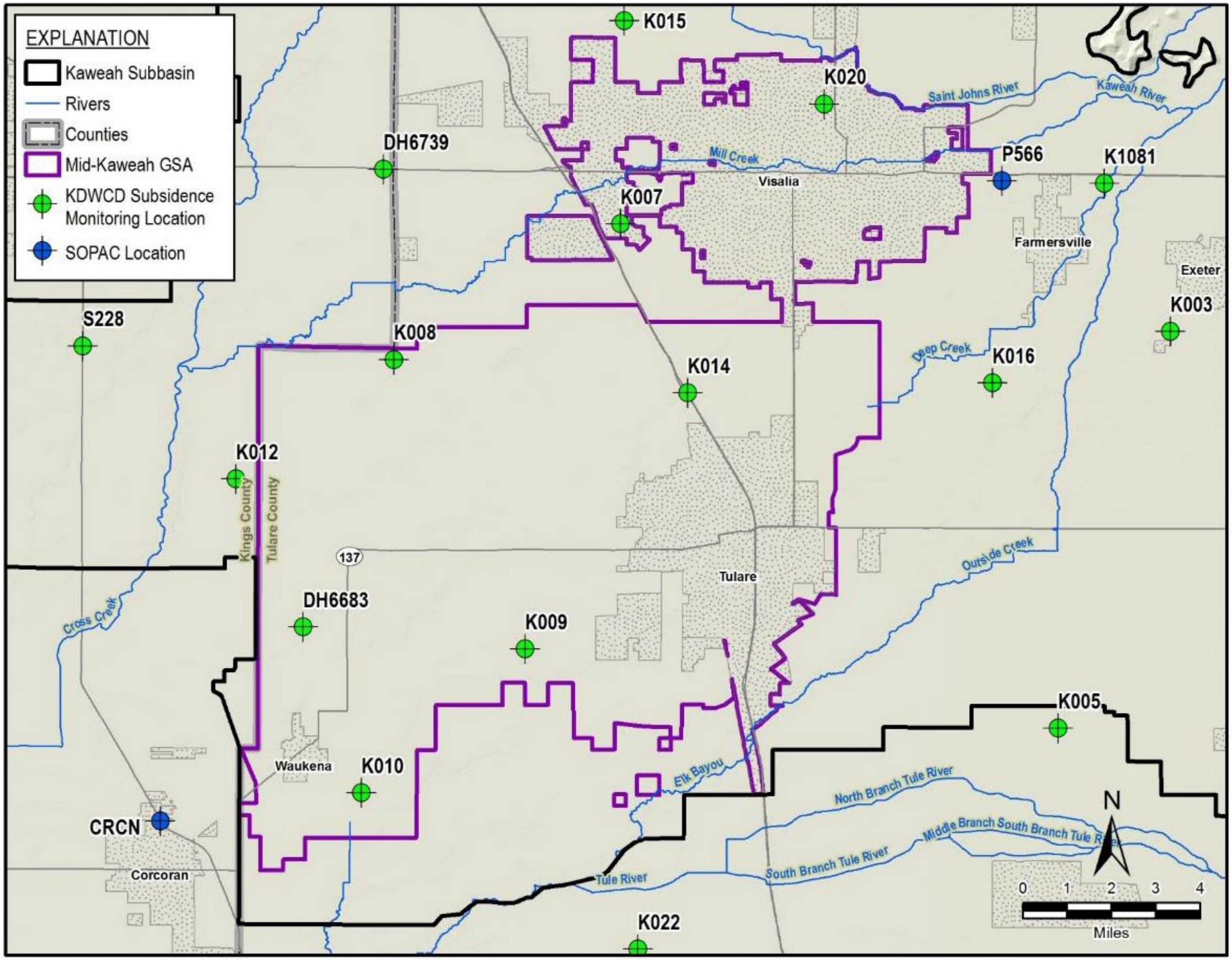


Figure 5-11: Subsidence Monitoring Locations

Table 5-5: Subsidence Minimum Thresholds and Measurable Objectives

Subsidence Monitoring Point	Minimum Threshold		Measurable Objective		Interim Milestones (inch/year)		
	Annual Subsidence (feet/year)	Total Subsidence (feet)	Annual Subsidence (feet/year)	Total Subsidence (feet)	2025	2030	2035
CRCN	0.67	9.0	0	0	0.67	0.45	0.30
K010	0.67	9.0	0	0	0.67	0. 45	0. 30
DH6683	0.67	9.0	0	0	0.67	0. 45	0. 30
K009	0.67	9.0	0	0	0.67	0. 45	0. 30
K008	0.67	9.0	0	0	0.67	0. 45	0. 30
TID1	0.67	9.0	0	0	0.67	0. 45	0. 30
TUL99	0.67	9.0	0	0	0.67	0. 45	0. 30
DH6770	0.67	9.0	0	0	0.67	0. 45	0. 30
K014	0.67	9.0	0	0	0.67	0. 45	0. 30
K007	0.67	9.0	0	0	0.67	0. 45	0. 30
P566	0.67	3.1	0	0	0.67	0. 45	0. 30

5.6.3.1 Information and Methodology Used to Establish Minimum Thresholds

The subsidence minimum threshold comprises both a rate and extent of subsidence. Figure 5-11 diagrams the process for establishing both the rate and extend of subsidence. This process is an expansion of boxes 2, 3, and 4 in Figure 5-8. This process is further described in the following sections.

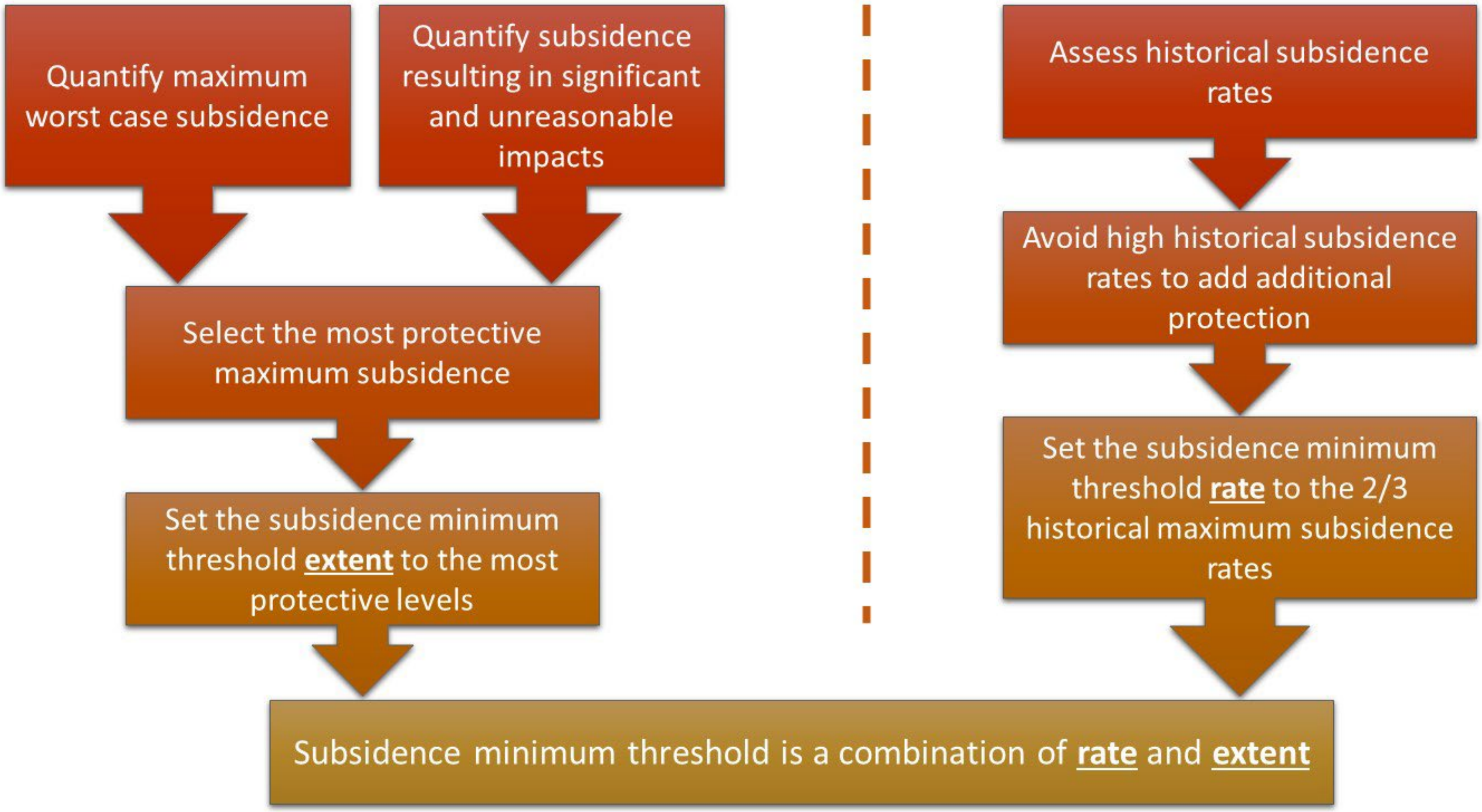


Figure 5-12: Process for Establishing Rate and Extent of Subsidence Minimum Threshold

5.6.3.1.1 Subsidence Minimum Threshold Extent

The extent portion of the subsidence minimum threshold is the maximum amount of allowable subsidence. It is set at the more protective of either the subsidence that causes significant and unreasonable impacts, or the worst-case subsidence that occurs if groundwater levels equilibrate at minimum thresholds. Subsidence minimum thresholds never exceed the significant and unreasonable levels for infrastructure discussed in Section 5.6.2.2. If the expected worst-case subsidence is less than the significant and unreasonable levels, the minimum threshold is reduced to this worst-case amount, providing greater protection.

The three-step process for developing the extent portion of the subsidence minimum thresholds is detailed below.

Step 1: Assess Maximum Worst-Case Subsidence

Appendix 5E estimates worst-case total subsidence in the Subbasin if groundwater levels are held at minimum thresholds. The total subsidence reflects all subsidence between 2020 and 2070. The worst-case subsidence in the MKGSA area from **Appendix 5E** is shown on Figure 5-13**.** This is not the expected condition, but rather the extreme condition should groundwater levels drop to minimum thresholds and remain there indefinitely.

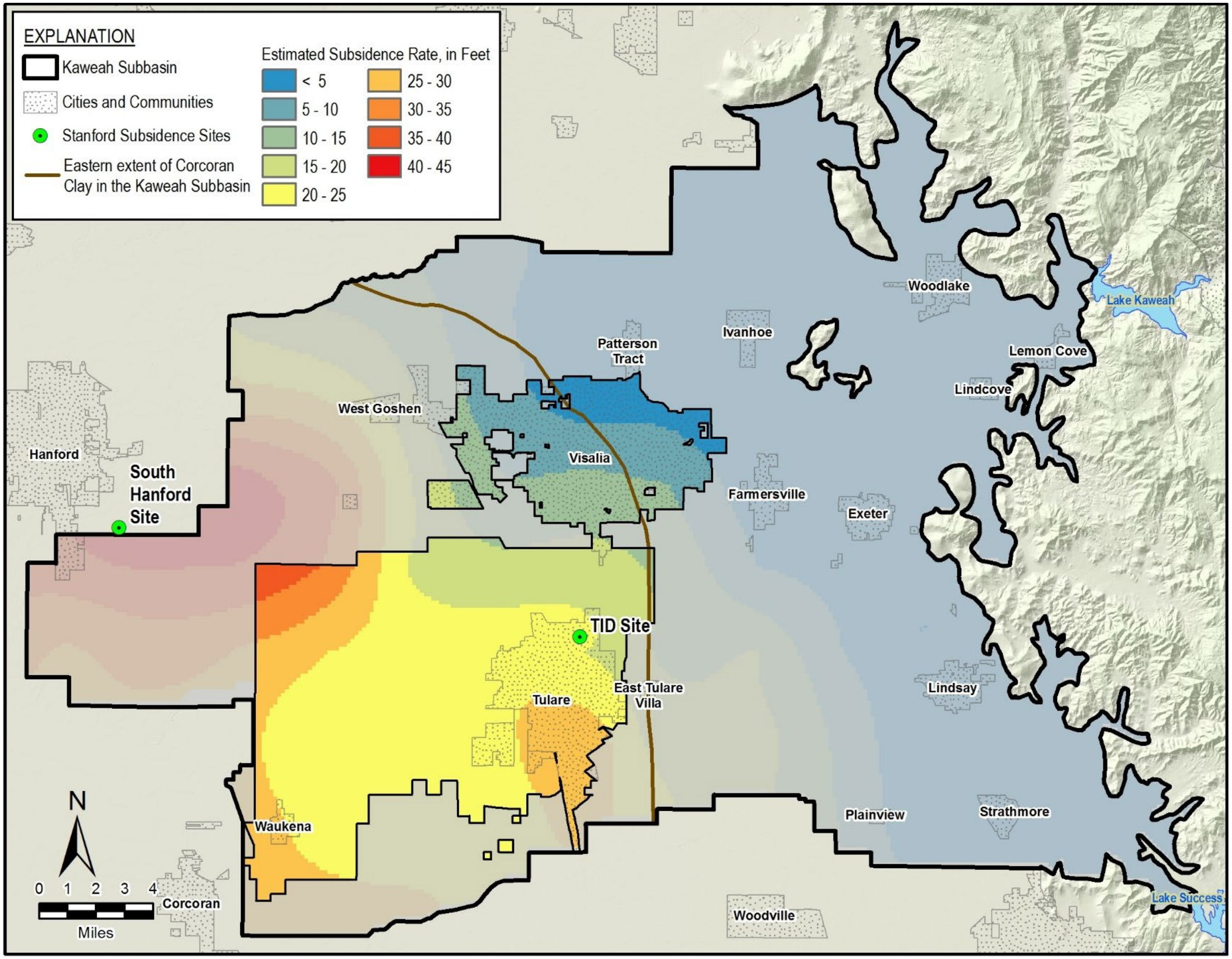


Figure 5-13: Simulated Total Subsidence if Groundwater Levels are Held at Minimum Thresholds

Step 2: Compare Maximum Subsidence to Significant and Unreasonable Impacts

The MKGSA compared the total maximum subsidence shown on Figure 5-13 to the significant and unreasonable criteria detailed in Section 5.6.2.2. In many places, the maximum total subsidence on Figure 5-13 is greater than significant and unreasonable total subsidence for deep wells. Additionally, the maximum total subsidence shown on Figure 5-13 could result in water conveyance infrastructure losing more than 10% of capacity. Figure 5-14 shows water conveyance infrastructure locations in the MKGSA area that might lose more than 10% capacity at the simulated maximum total subsidence amounts.

Step 3: Set Minimum Thresholds Based on Most Protective Subsidence

The total maximum subsidence map shown on Figure 5-13 was modified to represent total subsidence that eliminates expected subsidence impacts. Wherever the total maximum subsidence exceeded significant and unreasonable levels, the amount of allowable subsidence was reduced to be less than significant and unreasonable. This results in minimum thresholds being set either at or less than the significant and unreasonable total subsidence; providing protection to all land uses and users with quantifiable subsidence impacts. The final map of minimum thresholds is shown on Figure 5-15.

Because a significant and unreasonable impact on deep wells occurs after 9 feet of subsidence, no minimum threshold subsidence is greater than 9 feet. Expected maximum total subsidence is less than 9 feet in the northeast portion of the GSA area near Visalia. The maximum total subsidence estimates of less than 9 feet are retained at in this area, providing additional protection to infrastructure. In addition to protecting deep wells, analysis of waterways shows that the subsidence shown on Figure 5-15 does not lead to a significant reduction in waterway capacity. The subsidence shown on Figure 5-15 is therefore used to establish minimum thresholds at each of the subsidence monitoring points. These minimum threshold vertical extents are listed in Table 5-5.

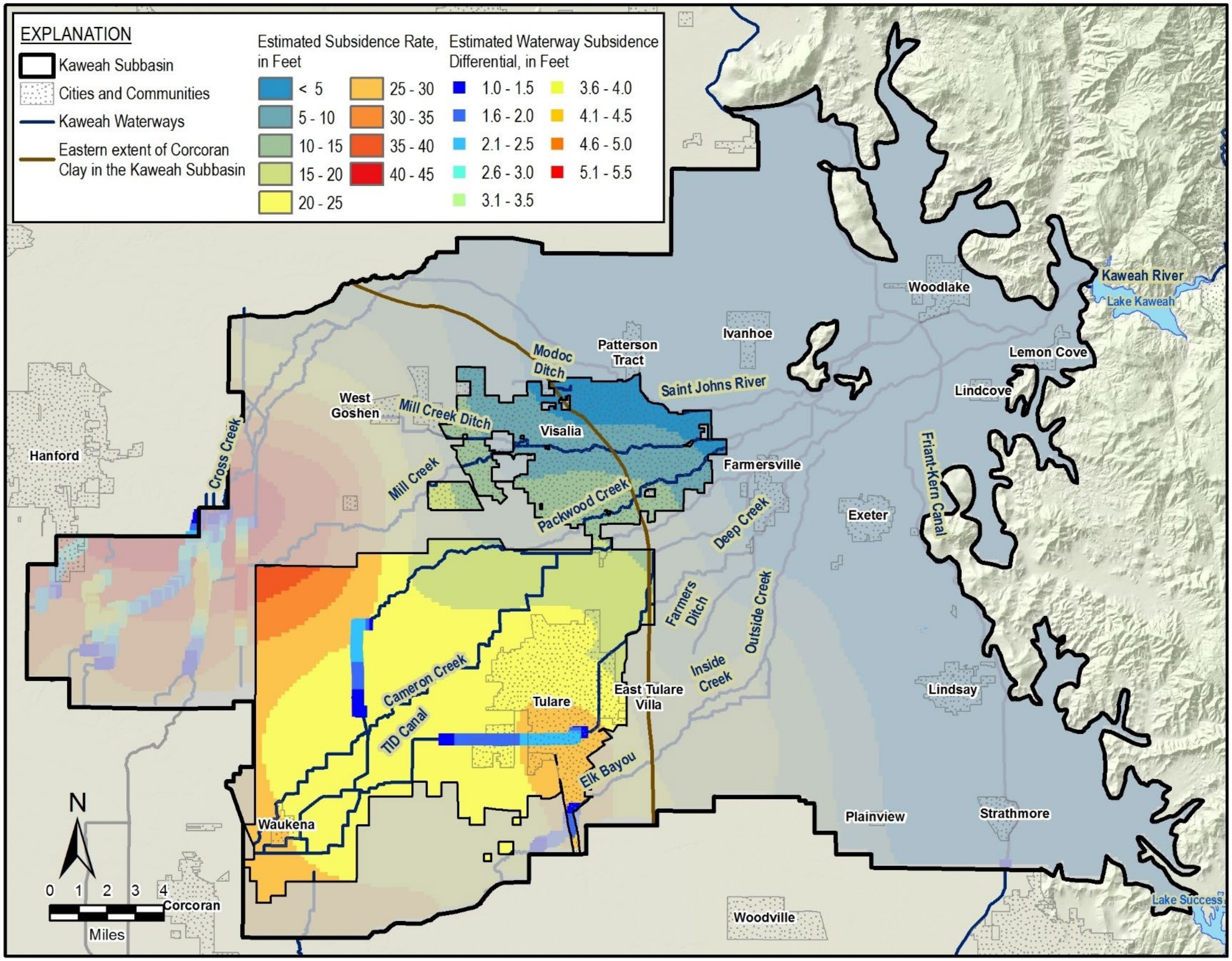


Figure 5-14: Locations of Water Conveyance Potentially Impacted by Maximum Total Subsidence

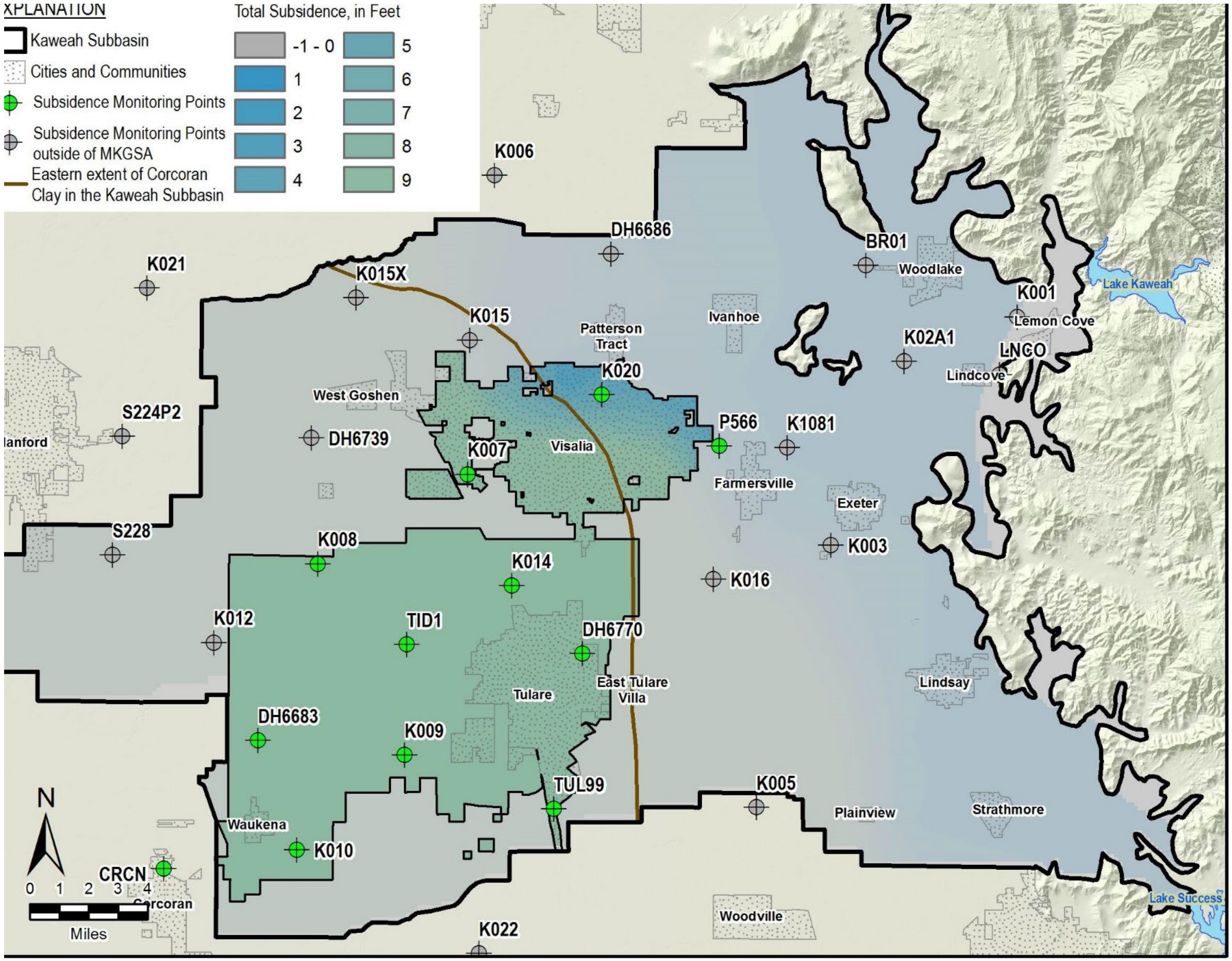


Figure 5-15: Maximum Subsidence Resulting in No Significant and Unreasonable Impacts

5.6.3.1.2 Subsidence Minimum Threshold Rate

The subsidence minimum threshold rate is designed to avoid subsidence rates greater than those seen in previous drought years. Subsidence from two recent drought years were analyzed: April 1, 2015 to April 1, 2016, and April 1, 2021 to April 1, 2022. For additional protection of surface uses and users, the MKGSA, in coordination with other GSAs in the Subbasin, established that the annual subsidence rate should not exceed the 67th percentile subsidence rate from those years. Choosing the 67th percentile allows some subsidence during future droughts while avoiding any impacts from the maximum subsidence observed during recent droughts.

Figure 5-16 shows the ranked subsidence rates at each of the 31 representative monitoring points in the Kaweah Subbasin. Subsidence rates during drought years ranged from -0.04 feet to 1.3 feet across the Subbasin. The 67th percentile of subsidence during these two previous drought years falls between 0.65 and 0.69 feet/year. Based on this analysis, the Kaweah Subbasin GSAs agreed on a maximum subsidence rate of 0.67 feet/year for the minimum threshold rate.

Both the rate and the extents portions of the minimum thresholds must be satisfied to avoid undesirable results. Therefore, subsidence will not continue unabated. If subsidence continues at the minimum threshold rate, it will eventually reach the minimum threshold extent for 9 feet, producing an undesirable result.

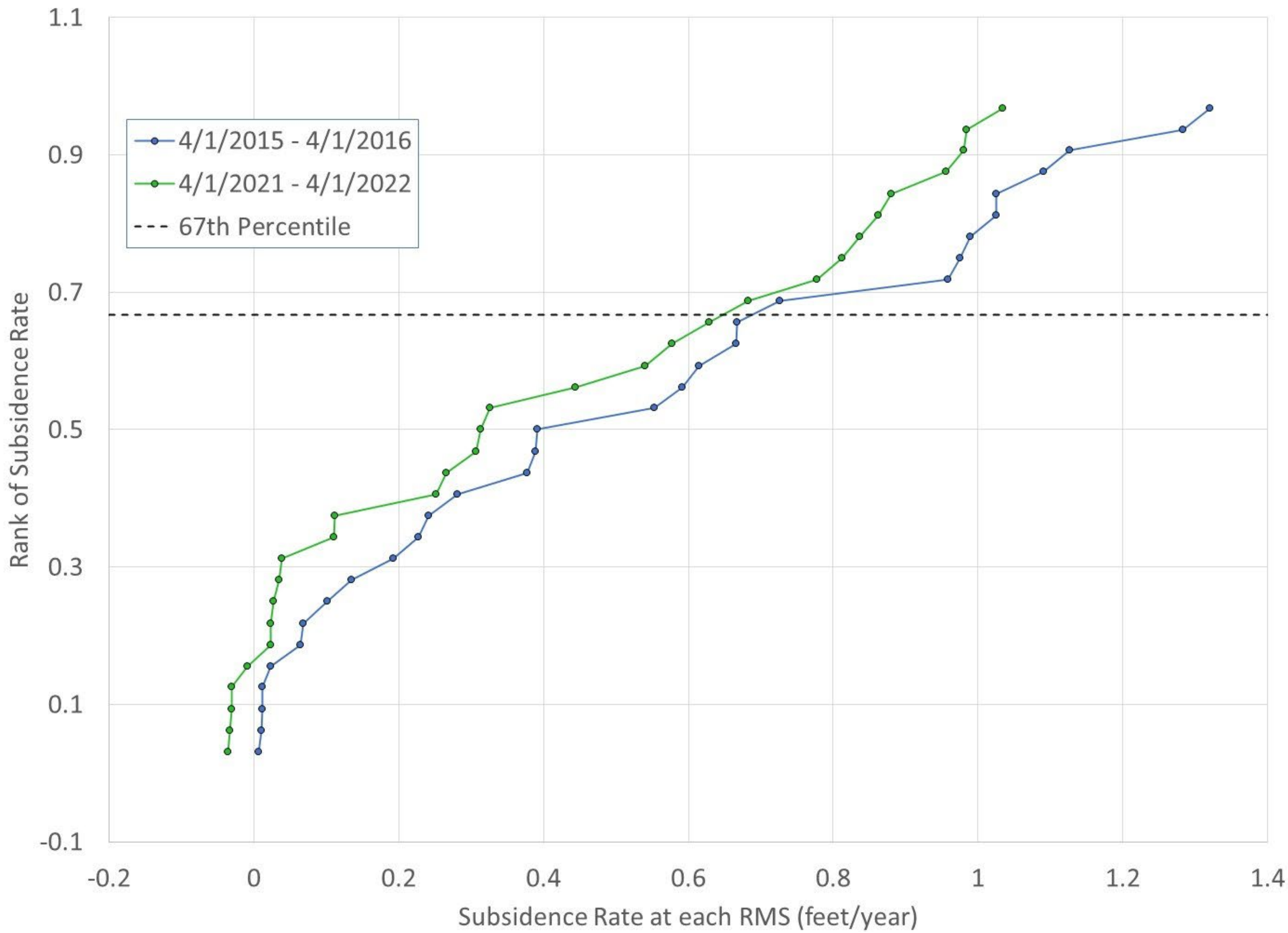


Figure 5-16: Ranked Representative Monitoring Site Subsidence Rates from Recent Droughts

5.6.3.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The land subsidence minimum thresholds were developed using smooth and continuous estimates of subsidence across the Subbasin, based on best available data and tools. Therefore, there are no discontinuities in subsidence minimum thresholds and no conflict between minimum thresholds at individual RMS.

The subsidence minimum threshold has little or no impact on other minimum thresholds, as described below.

- **Chronic lowering of groundwater levels.** The subsidence minimum threshold may limit the amount of groundwater level declines if subsidence minimum thresholds are hit prior to reaching groundwater level minimum thresholds. In general, limiting groundwater level decline will help the MKGSA avoid both the groundwater level and land subsidence minimum thresholds.
- **Reduction in groundwater storage.** Similar to the chronic lowering of groundwater levels, the subsidence minimum threshold may limit the allowable reduction in groundwater storage if subsidence minimum thresholds are hit. The subsidence minimum threshold, however, does not increase or add to any reduction in groundwater storage, and the subsidence minimum threshold does not result in a significant or unreasonable loss of groundwater storage. Although subsidence does result in a loss of storage space in aquitards, this is unusable storage space because it cannot be refilled once subsidence has occurred. Therefore, this loss of aquitard storage plays no part in active groundwater management.
- **Degraded water quality.** A relationship between the land subsidence minimum threshold and water quality minimum thresholds has not been established. However, it is not anticipated that land subsidence will result in significant of unreasonable degradation of water quality.
- **Depletion of interconnected surface water.** Surface water is not interconnected with groundwater in the MKGSA area. Therefore, land subsidence has no impacts on interconnected surface water.

5.6.3.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The MKGSA jurisdictional area is entirely within the Kaweah Subbasin, in the San Joaquin Valley Groundwater Basin. The MKGSA has the following jurisdictional neighbors within the Subbasin:

- Greater Kaweah GSA to the north, east, and south
- El Rico GSA to the west

The Kaweah Subbasin is surrounded by the following subbasins:

- Kings River Subbasin to the north
- Tule Subbasin to the south
- Tulare Lake Subbasin to the west

Land subsidence SMC are developed for the whole Kaweah Subbasin, in coordination with the Eastern Kaweah and Greater Kaweah GSAs. Therefore, the Mid-Kaweah subsidence SMC are aligned with the subsidence for the other GSAs in the Kaweah Subbasin.

Land subsidence throughout the San Joaquin Valley Groundwater Basin is driven by lowered groundwater levels, particularly in the deeper aquifers. Neighboring subbasins are facing similar challenges with subsidence. MKGSA representatives met with representatives from some neighboring subbasins on June 22, 2022, to review approaches and assess potential conflicts. These subbasins expect varying degrees of subsidence to continue throughout the region during GSP implementation, even if groundwater levels are maintained at pre-SGMA levels. Subsequent information suggested that neighboring subbasins plan to set subsidence minimum thresholds around 8-feet; similar to the 9-feet minimum threshold in the MKGSA area. Therefore, there is no expected conflict with surrounding subbasin minimum thresholds.

The MKGSA is committed to minimizing subsidence, and therefore does not anticipate that the subsidence SMC will prevent neighboring subbasins from reaching sustainability. MKGSA will continue to coordinate with surrounding subbasins during GSP implementation to coordinate strategies for minimizing subsidence and the associated impacts.

5.6.3.4 Affects on Beneficial Users and Land Uses

The subsidence minimum threshold was explicitly set to have less than significant impacts on critical water conveyance infrastructure and wells. MKGSA will monitor other land uses and users for which there is no quantitative data on subsidence impact, to ensure that any future subsidence does not result in an undesirable result. The MKGSA is developing a Mitigation Program to lessen subsidence impacts to beneficial users and land uses should unforeseen impacts occur. Mitigation Program details are provided in Section 7.4.8.

5.6.3.5 Relevant Federal, State, or Local Standards

There are no federal, state, or local regulations related to subsidence.

5.6.3.6 Method for Quantitative Measurement of Minimum Thresholds

The minimum threshold will be assessed annually using the subsidence monitoring network described in Section 4.6. The network includes nine subsidence monitoring stations in the Subbasin and two continuous GPS stations on either side of the MKGSA area, including one on the east side within 0.5 miles of the boundary (P566) and one within 2 miles of the southwestern boundary (CRCN) shown on Figure 5-14. Land surface elevation monitoring data will be collected at least annually in the fall and annual subsidence at each monitoring point will be compared to the minimum threshold.

5.6.4 *Land Subsidence Measurable Objectives and Interim Milestones*

The measurable objective for land subsidence represents a target annual subsidence rate in the Subbasin. In accordance with MKGSAs commitment to avoid or minimize subsidence, the measurable objective is set to a rate of zero subsidence.

The MKGSA understands that this goal may not be achievable and has discussed this with DWR representatives. A recent study by Stanford University researchers found that approximately 10 feet of subsidence is expected in the vicinity of the Subbasin even if groundwater levels stabilize immediately, and will last for decades (Lees *et al.*, 2022). By setting the measurable objective to a rate of zero subsidence, MKGSA is committing to move towards zero subsidence and limit impacts on surface uses and users.

5.6.4.1 Methodology for Setting Measurable Objectives

The measurable objective was set to the best possible outcome: a rate of zero subsidence after sustainability is achieved. This was chosen to result in minimal impact on surface uses and users.

5.6.4.2 Measurable Objectives

Measurable objectives for each of the 11 subsidence representative monitoring sites are shown in Table 5-5.

5.6.4.3 Methodology for Setting Interim Milestones

The interim milestones for land subsidence represent target annual subsidence rates that demonstrate progress towards the measurable objective. Because subsidence is driven by groundwater levels, an approach was developed for estimating interim milestones that is similar, but not identical to the groundwater level interim milestones. The modified approach is:

- 2025 interim milestone– current subsidence rates
- 2030 interim milestone – a subsidence rate of two-thirds of the 2025 interim milestone
- 2035 interim milestone – a subsidence rate of two-thirds of the 2030 interim milestone

These subsidence interim milestones do not define the same glide path approach used for groundwater level interim milestones (Figure 5-6). This path accepts more subsidence in the early years of implantation and restricts subsidence in the later years of implementation. This is viewed as the more realistic path that accommodates an initial lowering of groundwater levels during implementation.

5.6.4.4 Interim Milestones

Interim milestones for each of the 11 subsidence representative monitoring sites are shown in Table 5-5.

5.6.5 *Land Subsidence Undesirable Results*

5.6.5.1 Criteria for Defining Land Subsidence Undesirable Results

By regulation, the land surface subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. The primary criteria and metric to determine if land subsidence undesirable results occur in the MKGSA area will be the annual rate of subsidence at each monitoring point. An Undesirable Result will occur in the Subbasin if:

- There is any single minimum threshold exceedance within a one-mile band on either side of the Friant-Kern Canal, or
- More than one third of the RMS sites have exceedances in in the area outside the Friant-Kern Canal band described above.

5.6.5.2 Potential Causes of Land Subsidence Undesirable Results

Undesirable results associated with subsidence are caused by over-pumping or limitations on groundwater recharge operations during drought periods such that groundwater levels fall and remain below previous groundwater lows. Over-pumping and lack of recharge is area specific, and some areas experience greater adverse impacts than others. Over-pumping which may result in new groundwater elevation lows is of particular concern based on current scientific understanding of subsidence trends in this region. Subsidence impacts may occur in the Subbasin even if groundwater levels stabilize, as residual subsidence from past overdraft can continue for many years after groundwater level decline slows or stops (Lees et al., 2022).

Local correlation between groundwater levels and subsidence trends remain difficult to quantify and pinpoint with existing data because of the lack of pumping depth and volume information at specific wells and well fields. While the basin setting and **Appendix 5E** relates subsidence to groundwater levels, a refined understanding of the relationship of pumping at individual wells to subsidence remains a data gap that will be filled over time through collection of data from the land surface subsidence monitoring network, the groundwater elevation monitoring network, and refined extraction data. Additionally, Stanford University is completing a Subbasin-wide subsidence model that will help manage groundwater pumping to minimize subsidence.

5.6.5.3 Effects on Beneficial Users and Land Uses

The stated undesirable result of no more than one-third of the subsidence representative monitoring sites exceeding minimum thresholds allows for some subsidence in the MKGSA area. Subsidence may impact waterways, domestic wells, or municipal wells. To address the effects of this subsidence, this GSA is developing a robust Mitigation Program to lessen the impact on beneficial users and avoid undesirable results. Mitigation Program details are in Section 7.4.8. GSA representatives will reach out and inquire as to any infrastructure damages which may be occurring to determine a corrective course of action, if deemed necessary.

5.7 Depletion of Interconnected Surface Water Sustainable Management Criteria

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 as presented in Section 2 of this document and in the Kaweah Subbasin Report (**Appendix 2A**). 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. For this reason, MKGSA did not develop sustainable management criteria for depletion of interconnected surface water.

MKGSA reviewed the "Natural Community Dataset Viewer" maps for the Kaweah Subbasin to evaluate the possibility of whether groundwater dependent ecosystems could exist in the MKGSA management area. The mapping system identifies stream reaches supporting habitat that *may* rely on groundwater. Collections of Valley Oak and Cottonwood populate some reaches of the St. Johns River, which traverses along the northern boundary of the City of Visalia. The same habitat species reside along reaches of Mill Creek and Packwood Creek, which traverse through Visalia and to the southwest into Tulare ID in the case of Packwood. Certain reaches of the St. Johns River are indicated to be wetlands of the type "Palustrine, Scrub-Shrub, Seasonally Flooded." However, this river (the northern fork of the Kaweah River) carries water primarily during releases from Terminus Dam at Lake Kaweah, and flows occur on an average of four to five months annually within this river channel as well as Mill and Packwood creeks fed by the same releases from the dam.

The water table lies some 60 to 150 feet below the invert of all three of these channel reaches, which is generally 40 to 130 feet below the root zone of the Valley Oak, which represent the deepest root zone of the native trees in MKGSA, which is an alluvial environment. Valley Oaks have a rooting depth that has been measured to as much as 80 feet below ground surface in a fractured-rock environment. However, the MKGSA is underlain by alluvial deposits rather than fractured rock (Lewis and Burgy, 1964; Braatne, et.al., 1996). Because the water table is not connected to the systems and the root zones do not reach the groundwater elevations, the aforementioned habitat species depend on bank seepage and not groundwater. Because there are no interconnected surface waters in the MKGSA jurisdictional area, and such interconnection is not likely to occur in the future, MKGSA did not develop minimum thresholds for interconnected surface waters.

There are no known governmental standards in the Tulare County region for any occurrence of interconnected surface waters with groundwater as a Sustainability Indicator. Insufficient information and flow data exist with which to gauge seasonal connections and relative importance of any vegetative habitat known to intermittently exist along stream channel banks.

5.8 Seawater Intrusion Water Sustainable Management Criteria

The Kaweah Subbasin (No. 5-22.11) of the San Joaquin Valley Basin resides in the interior part of the state, far removed from any seawater body. Furthermore, deep connate water exhibiting high TDS is beyond the reach of producing wells in the Subbasin and is considered isolated from the freshwater aquifers above. This GSA, therefore, has determined that seawater intrusion is not present and is not likely to be able to physically occur. For this reason, MKGSA did not develop sustainable management criteria for seawater intrusion.

5.9 Mutual Influences

The three GSAs within the Subbasin will, commencing in 2020, implement the projects and management actions contained in their respective GSPs, monitoring depth to groundwater at representative well sites for chronic lowering of water levels, and gauging the effectiveness of their implementation relative to measurable objectives. Should groundwater levels and reductions in groundwater storage decline below their measurable objectives, the triggers identified in Section 5.4 will require further management actions to correct the trends.

However, it will remain a challenge as to why downward trends may occur and which projects and management actions undertaken by the GSAs are falling short. As identified in the Subbasin Coordination Agreement, a forum has been established in which the GSAs will discuss and agree on the relative trigger activations within each GSA. Groundwater budgets for each GSA will be estimated and used in this discussion forum. The Subbasin numerical model will be employed to aid in determining where triggers are to be activated in an effort to adhere to the measurable objectives and interim milestones set by each GSA.

As described for this Subbasin, this process will extend outwardly into neighboring subbasins over time as implementation continues. This regional discussion may result in inter-basin coordination agreements; however, emphasis now is centered on ensuring that the Kaweah Subbasin GSAs embrace a mechanism to ensure adherence with their measurable objectives and efforts to achieve sustainable yield by 2040.

Section 5 – SMC – Minimum Thresholds, Measurable Objectives

The development of this MKGSA Minimum Thresholds and Measurable Objectives Section was informed by DWR's Sustainable Management Criteria BMP. This document is provided in **Appendix 3B**.

6. Application of Basin Setting Water Budget

Table 32 of the Kaweah Basin Setting (**Appendix 2A**) contains the Subbasin hydrogeologic water budget for the current period 1997-2017. Table 2-1 of Section 2 is based on this water budget and depicts the hydrogeologic water budget for MKGSA, showing all components of inflow to and outflow from the MKGSA region. The hydrogeologic water budgets are recognized in the Subbasin numeric model and its application to future scenarios incorporating groundwater pumping projections and planned projects and management actions of each GSA. These water budgets do not mandate the process by which the GSAs will achieve sustainability by 2040.

6.1 Water Accounting Framework Allocation

The Subbasin GSAs have discussed water budgets in the context of groundwater law and have developed a means to account for various components of the water budget consistent with commonly accepted rules regarding surface and groundwater rights. These discussions also included recognition of water storage and conveyance infrastructure within the Subbasin as owned/operated by various water management entities within each GSA.

These discussions (reflected in the Subbasin Coordination Agreement) culminated in an agreed-to methodology to assign groundwater inflow components to each GSA consistent with categories that recognize a native, foreign, and salvaged portion of all such components. In general, this methodology defines the native portion of groundwater inflows to consist of those inflows which all well owners have access to on a pro-rata basis; the foreign portion to consist of all imported water entering the Subbasin from non-local sources under contract by local agencies or by purchase/exchange arrangements; and the salvaged portion to consist of all local surface and groundwater supplies stored, treated, and otherwise managed by an appropriator/owner of the supply and associated water infrastructure systems (e.g., storm water disposal systems and waste water treatment plants).

The methodology and apportionment of groundwater inflow components is as shown in Table 6-1.

Table 6-1: Groundwater Inflow Components

Components of Groundwater Inflow (*)
Native – Inflows which all well owners have access to on a pro-rata basis
• Percolation from rainfall
• Streambed percolation (natural channels) from Kaweah River watershed sources
• Agricultural land irrigation returns from pumped groundwater
• Mountain front recharge
Foreign – All imported water entering the Subbasin from non-local sources under contract by local agencies or by purchase/exchange agreements
• Streambed percolation from imported sources
• Basin recharge from imported sources
• Ditch percolation from imported sources
• Agricultural land irrigation returns from imported sources
Salvaged – All local surface and groundwater supplies stored, treated, and otherwise managed by an appropriator/owner of the supply and associated water infrastructure systems
• Ditch percolation from previously appropriated Kaweah River sources
• Additional ditch/field recharge from over-irrigation
• Captured storm water returns
• Wastewater treatment plant returns
• Basin percolation from previously stored Kaweah River sources
• Agricultural land irrigation returns from Kaweah River watershed sources

(*) Except for mountain-front recharge, sub-surface inflows in and out of the Subbasin are excluded from this apportionment and no ownership claims are asserted nor disavowed per this apportionment.

Applying the categorical apportionment in Table 6-1 to each GSA and their member entities that hold appropriative and contract water rights and/or salvaged water infrastructure systems results in the following apportionment to each GSA, shown in Table 6-2.

Table 6-2: GSA Apportionment

(values in acre-feet)

	Native Water			
	East	**Greater**	**Mid**	**Total**
Percolation of Precipitation. (Ag and 'Native' non-Ag land)	23,666	44,213	20,974	**88,854**
Streambed Percolation from Kaweah River Sources	16,767	31,324	14,860	**62,952**
Irrigation Return from Pumped GW	41,484	77,501	36,766	**155,752**
Mountain Front Recharge	14,976	27,978	13,273	**56,227**
Total Native	**96,894**	**181,017**	**85,874**	**363,784**
GSA% of Total Native	**27%**	**50%**	**24%**	**100%**

	Foreign Water			
	East	**Greater**	**Mid**	**Total**
Streambed Percolation from Imported Sources	0	11,730	2,523	**14,253**
Ditch Percolation from Imported Sources	0	1,204	21,745	**22,949**
Basin Percolation from Imported Sources	0	1,050	14,305	**15,355**
Irrigation Returns from Imported Sources	12,073	1,241	7,140	**20,453**
Total Foreign	**12,073**	**15,225**	**45,713**	**73,010**
GSA% of Total Foreign	**17%**	**21%**	**63%**	**100%**

	Salvaged Water			
	East	**Greater**	**Mid**	**Total**
Ditch Percolation from Kaweah River Sources	8,835	49,771	34,880	**93,486**
Additional Storage	226	6,892	5,697	**12,815**
Stormwater Return Flows	508	2,370	8,491	**11,368**
WWTP Return Flows	1,470	3,129	13,878	**18,477**
Basin Percolation from Kaweah River Sources	0	16,005	23,479	**39,484**
Irrigation Returns from Kaweah River Sources	4,555	31,039	11,981	**47,574**
Total Salvaged	**15,593**	**109,205**	**98,406**	**223,205**
GSA% of Total	**7%**	**49%**	**44%**	**100%**

	East	**Greater**	**Mid**	**Total** *
Grand Total	**124,560**	**305,447**	**229,992**	**659,999****
GSA% of Total	**19%**	**46%**	**35%**	**100%**

***Excludes net sub-surface inflow of ≈ 60 taf/yr.,**
**** Sustainable Yield for the Kaweah Subbasin**
Note: Data is based on water budget for the period Water Year 1997 to 2017 for the Kaweah Subbasin

Comparing these resulting groundwater inflow assignments to MKGSA to annual groundwater pumping for the same current period (1997-2017), as identified in Table 6-3**,** results in an imputed water balance surplus for MKGSA of about 38,000 AF on an average basis. Yet, as acknowledged in Section 2 of this Plan, MKGSA, like the balance of the Subbasin, experiences a historical decline in groundwater levels and attendant depletion of groundwater in storage within its jurisdictional region.

Table 6-3: Imputed Water Balance (1997-2017)

(values in 1,000 AF)

	MKGSA
Groundwater Inflow Balance	230.0
GSA Total Pumping Extraction (*)	192.2
Imputed Balance	37.8

(*) Obtained from data furnished by the Subbasin consultant to the three Subbasin GSAs which was supplemental to the Basin Setting report

Figure 6-1 is a graphical depiction of both the annual hydrogeologic water budget and water accounting framework water balance during this current period for MKGSA. The correlation is quite evident, with both showing positive responses during wet cycles and negative responses during droughts. Whereas the average water accounting framework water balance is positive, the comparable hydrogeologic water budget is negative by about 13,000 AF. This reduction in storage is to be expected, as water levels decline in the range of 3 feet per year over much of the GSA region. The relative contributions of multiple causes of these declines is the subject of further study and hydrogeologic analyses.

It is the intent of the Subbasin GSAs, as stipulated in the Coordination Agreement, to continue to discuss water balances and groundwater conditions during GSP implementation and, in so doing, manage the location, extent, and financial contributions to projects and management actions of each. The groundwater net inflow balances and hydrogeologic water budgets of each GSA region will be given due consideration in these future discussions. Therefore, the Subbasin GSA groundwater inflow water balances are preliminary and a starting point from which to establish a future framework to assess GSA responsibilities in achieving the Subbasin sustainability goal and eliminating undesirable results by 2040.

As additional data becomes available and water budget components are refined, the Subbasin water budget will be periodically reevaluated, no less frequent than the five-year GSP assessments as submitted to DWR. Likewise, the individual GSA water balances will also be reviewed as this reevaluation occurs at the Subbasin level.

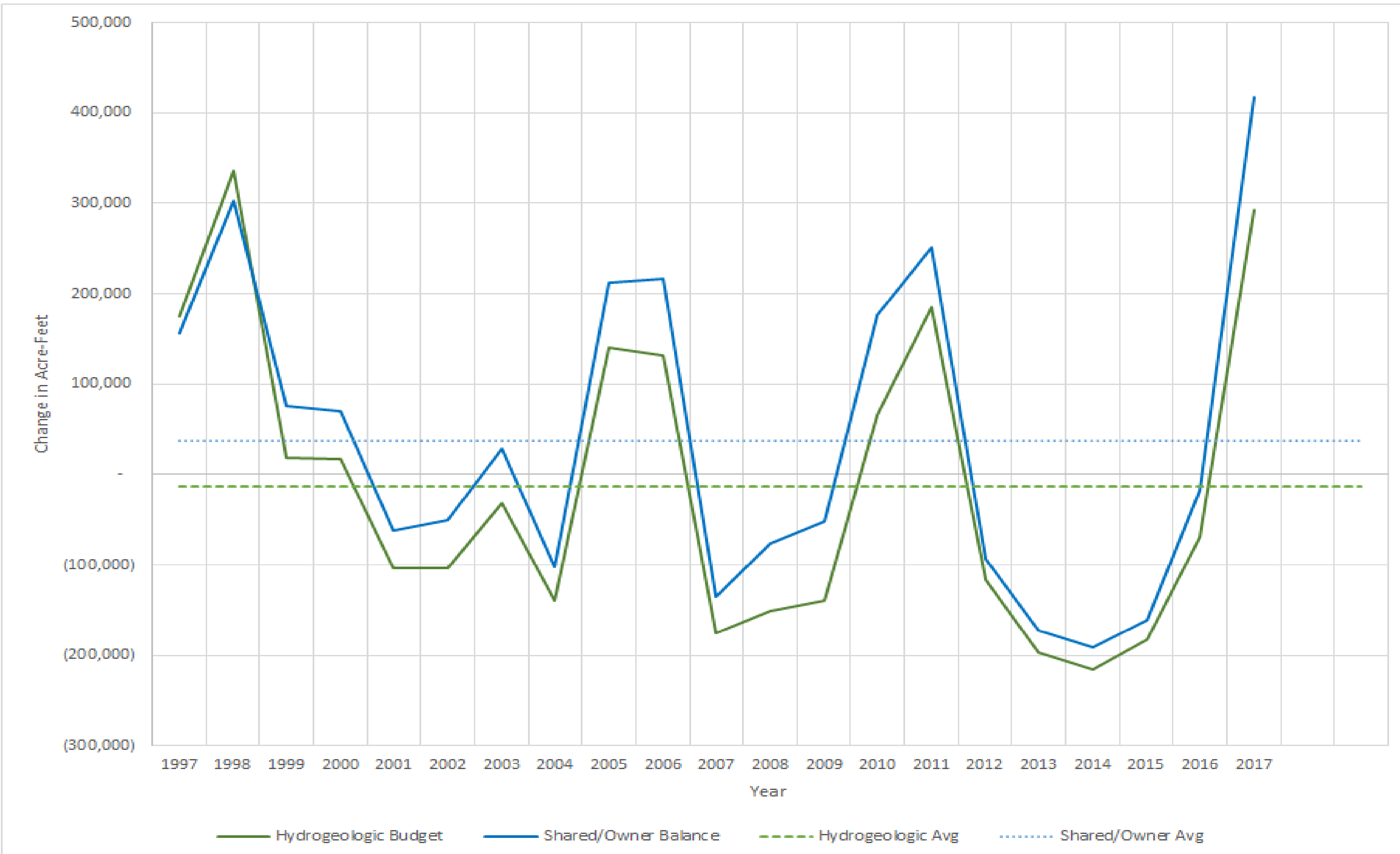


Figure 6-1: MKGSA Hydrogeologic Water Budget and Shared/Owner Water Balance

6.2 Water Budget Reconciliation

The shared/owner water balance as defined in Section 6.2 may be reconciled as against the hydrogeologic water budget set forth in Section 2.3, as both methods of quantifying the groundwater inflow components necessarily arrive at the same volume in acre-feet. The reconciliation for the Kaweah Subbasin is as shown following:

- Groundwater inflow budget (avg. of 1997-2017):
- Total inflow = 814 taf (Table 32 of **Appendix 2A**)
- Mountain front recharge = 56 taf (Table 6-2)
- Sub-surface inflow = 209 taf (Table 32 of **Appendix 2A)**

The shared/owner balance excludes the sub-surface inflow from other adjacent subbasins, as this estimated quantity and accounting therefor awaits further discussions with the relevant GSAs within these adjacent subbasins. With this assumption, the reconciliation of the Subbasin groundwater budget to the GSAs' shared/owner water balance is:

814 taf – (209 taf+56 taf) ≈ 660 taf

Adding back in the mountain front recharge results in:

660 taf + 56 taf ≈ 720 taf, i.e., the safe yield of the Subbasin as discussed in **Appendix 2A**.

6.3 GSA Member Allocation Strategy

MKGSA Members (City of Visalia, City of Tulare and Tulare Irrigation District) recognize that the GSA water budget as discussed in Section 6.2 may be further apportioned across the three Management Areas as established in Section 2 of this Plan. This segregation will take into consideration the existing water management and associated facility ownership agreements among the MKGSA Members as they relate to groundwater recharge activities. This apportionment will aid in determining Member participation in the various projects as well as shape the extent of management actions such as pumping restrictions, all as outlined in Section 7. Any allocation strategy will give due consideration to the Sustainability Plan Cooperative Statement adopted by the MKGSA Board as stated in Section 7.3.19.

Section 6 – Water Supply Accounting

The development of this MKGSA Water Supply Accounting Section was informed by DWR's Water Budget BMP. This document is provided in **Appendix 2B**.

7. Projects and Management Actions

7.1 Summary

This Section discusses water supply availability for projects (Section 7.2), describes each project (Section 7.3), describes management actions (Section 7.4), discusses an implementation plan (Section 7.5), and summarizes the analyses of water supply benefits afforded by each applicable project (Section 7.6). These Subsections collectively comply with the requirements of Section §354.44 of DWR's Regulations.

Projects and management actions described in this Plan include groundwater recharge projects and programs, surface reservoir projects, leveraged surface water exchange programs, a groundwater extraction measurement implementation program, a conceptual groundwater marketing program, future urban and agricultural conservation, a groundwater allocation mechanism among well owners and operators, and other projects and management actions. Following are each project and management action, along with the measurable objective and associated sustainability indicator that will benefit therefrom. The MKGSA will work to create and enhance ecosystem benefits through the development and implementation of the projects and programs selected to achieve sustainable groundwater management in the MKGSA and described in this section.

In early 2021 the California Department of Water Resources provided direction to GSAs regarding how to incorporate projects and management actions developed after the submission of the 2020 GSPs. The MKGSA Board of Directors approved a process to evaluate new projects and management actions and approve them for a current list of approved GSP projects and management actions. A project proponent is required to submit a MKGSA Request for Proposal application (Application), which can be found at https://www.midkaweah.org/_files/ugd/55be79_acf2aebd507c4717805fa8287b76a19b.pdf. Upon receipt of the Application, it is reviewed by the MKGSA Advisory Committee for reconsideration or approval. If the project or management action is approved by the MKGSA Advisory Committee, it is then presented to the MKGSA Board of Directors for consideration. Upon approval from the MKGSA Board of Directors the project of management action is added to the List of Projects from the MKGSA GSP, which is kept updated on the MKGSA website at https://www.midkaweah.org/_files/ugd/55be79_a4ddab98dbab4cbe9b1578190140ee4f.pdf.

Table 7-1: MKGSA Project Benefits and Cost

Project/Management Action	**GW Levels**	**Reduction in Storage**	**Water Quality**	**Land Subsidence**	**Estimated Cost (Millions)**
Projects:					
• Cordeniz Recharge Basin	✓	✓	✓	✓	$3.38 M O&M $10K/yr.
• Okieville Recharge Basin	✓	✓	✓	✓	$2.9 M O&M $10K/yr.
• Tulare ID/GSA Recharge Basin	✓	✓	✓	✓	$6.4 M O&M $10K/yr.
• On-Farm Recharge Program	✓	✓	✓	✓	TBD

Project/Management Action	GW Levels	Reduction in Storage	Water Quality	Land Subsidence	Estimated Cost (Millions)
Projects:					
• McKay Point Reservoir	✓	✓	✓	✓	$4.5 M O&M $10K/yr.
• Kaweah Subbasin Recharge Project	✓	✓	✓	✓	$1.6 M O&M $10K/yr.
• Vadose Zone Well Battery (*TBD*)	Not Applicable				GSA share only
• River Siphon Rehabilitation	✓	✓	✓	✓	$2 - 2.6 M
• Visalia/Tulare ID Exchange Program	✓	✓	✓	✓	N/A
• Sun World/Tulare ID Exchange Program	✓	✓	✓		N/A
• Friant/Tulare ID Exchange Programs (*TBD*)	Not Applicable				N/A
• Temperance Flat Reservoir (*TBD*)	Not Applicable				
• Tulare/Tulare ID Catron Basin	✓	✓	✓		$1.5 M O&M $10K/yr.
• Visalia/Tulare ID Cameron Creek Project	✓	✓	✓		TBD
• Visalia/KDWCD Packwood Creek Project	✓	✓	✓		$1.6 M
• Visalia Eastside Regional Park	✓	✓	✓		$1.74 M
• Groundwater Recharge Assessment Tool	Not Applicable				N/A
Tulare ID Existing Recharge Facility Report	Not Applicable				N/A
Management Actions:					
• Extraction Measurement Program	Not Applicable				
• Extraction Allocation Implementation	✓	✓	✓	✓	
• Groundwater Marketing Program	Not Applicable				
• Geophysical Data Survey Project	Not Applicable				
• Well Characterization Project	Not Applicable				
• Urban Water Conservation Program	✓	✓			
• Agricultural Water Conservation and Management Program	Not Applicable				
• Small Systems/Domestic Well Owner Assistance	Not Applicable				
• Regulatory Agency Collaboration	Not Applicable				

Where applicable, the locations of these Projects are depicted on Figure 7-1 at the end of this Section.

7.2 Water Supply Considerations

Most of the projects and management actions listed in Section 7.1 will provide added water supply benefits, either in the form of groundwater storage or regulation of surface flows otherwise leaving the Kaweah Subbasin. Importantly, an assessment of the water supply availability is required to appropriately analyze the projects and management actions and their respective capabilities, particularly in a region subject to critical overdraft and considered as having limited surface water supplies exhibiting a high degree of variability from year to year. Such an assessment is included herein in Section 7.6.

For the groundwater recharge projects, an analysis of available surplus water supplies to the MKGSA Members, coupled with estimated capacities of each project, has been conducted to determine the associated benefits. This analysis is further described in Section 7.6.1. For the surface water storage projects, an analysis of local or regional flood flows otherwise leaving the Subbasin that would be diverted into storage for later in-lieu deliveries has been conducted as summarized in Section 7.6.2. For the applicable exchange programs, the Friant supplies available to TID coupled with local supplies of the exchanging entities are analyzed to determine the additional exchange water to be delivered into the GSA region, the results of which are shown in Section 7.6.3. For the Packwood Creek recharge facilities now in operation, an estimation of groundwater benefits is presented in Section 7.6.4. These analyses are used to determine the projected water supply benefits (in terms of added groundwater storage) for a number of the afore said projects.

7.3 Projects

The projects as described below are arranged in the order as listed in Section 7.1, beginning with those that are being pursued by TID, then those sponsored by Tulare and Visalia, and then efforts to provide guidance for project design and refinement. The project description, its implementation circumstances and status, public noticing, permitting and regulatory compliance, water sources and legal authority, and project costs are all discussed for each project individually and address §354.44(a) and (b)(1)-(8) of the Regulations.

Anticipated benefits of the recharge facilities/programs are discussed both individually herein and in the aggregate in Section 7.5.2 using the methodology set forth in Section 7.6.1; benefits of other projects/programs are discussed individually herein and, in the case of the local reservoir storage projects, with application of the methodology set forth in Section 7.6.2. Similarly, benefits of the exchange programs are articulated in Section 7.6.3, and for the Packwood Creek channel recharge project, in Section 7.6.4. These sections address 354.44(b)(5) of the Regulations.

Funding for project implementation and associated costs are also discussed individually for projects currently underway, and collectively in Section 7.3.19 for planned projects to be implemented later, to address §354.44(b)(8) of the Regulations.

7.3.1 *Cordeniz Recharge Basin*

7.3.1.1 Description

The Cordeniz Basin is a 60-acre groundwater recharge facility that began construction in 2013 and was completed in March 2020 on the northwest corner of Road 84 and Avenue 248 within the TID service area. The project involves the construction of a five-foot-deep basin, which will be served by the Serpa Ditch. It is anticipated that the project will add additional recharge infiltration capacity of approximately 25 AF per day based on bore-hole soil samples collected during the pre-construction phase. Four groundwater monitoring wells adjacent to the facility are included in the project. Federal funding was provided under Part III of the San Joaquin River Restoration Settlement.

Cordeniz Basin Under Construction by TID Field Staff

7.3.1.2 Status of Implementation

Construction commenced in the fall of 2013, and the project was completed and operational by March 2020. Due to the dry conditions that have been experienced since March 2020, the only recharge activities that have been conducted at the site were in January 2021.

7.3.1.3 Permitting and Regulatory Compliance

The project's design and approval complied with NEPA (a FONSI was determined) and CEQA (a Mitigated Negative Declaration was submitted). All public noticing requirements were satisfied as part of this compliance process.

7.3.1.4 Water Sources and Legal Authority

All water re-diverted into the facility from the Serpa Ditch stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit thereof and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are described in Section 7.6.1. In addition, surplus water from Kaweah or CVP sources has historically been available for purchase, and TID or other GSA Members will continue to purchase supplies, as they have historically, as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the project insofar as its benefits are concerned.

7.3.1.5 Project Costs and Funding

The Cordeniz Basin project's capital cost was $3.38 million, and its annual maintenance cost is $10,000. Construction funding was, in part, provided by the USBR under a grant program, with the balance funded by TID.

7.3.1.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 80,500 AF with average annual benefits at 1,610 AF/year. Maximum recharge in wet years is estimated to be 3,600 AF. The measurable objectives/optimal objectives (see Section 5 of this GSP) to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, as it is generally accepted that high quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) provides improvements to groundwater quality and has historically had a dilution effect to both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.2 *Okieville Recharge Basin*

7.3.2.1 Description

The Okieville Recharge Basin involves the construction of a 20-acre recharge facility, and supporting infrastructure, adjacent and up-gradient of the disadvantaged community of Okieville (a DAC). The project's purpose is two-fold: one, to increase the availability of wet-year recharge capacity and, two, to provide water quality benefits to the residents of Okieville. It is anticipated that the project, fed by an irrigation canal known as Packwood Creek, will add additional recharge infiltration capacity of approximately 10 AF per day. Application of high-quality Sierra watershed surface supplies dedicated to recharge up-gradient of the community should improve the quality of local groundwater pumped by the Okieville-Highland Acres Mutual Water Company well and delivery system. The District also intends to implement a monitoring program, including monitoring wells, to determine the empirical benefits of groundwater recharge on both the quantity and quality of groundwater available to the community.

7.3.2.2 Status of Implementation

TID received a DWR SGMA Implementation grant in 2021 to provide funding for the project. TID entered into a Purchase Agreement with the landowner and anticipates closing escrow on the property by July 2022. The CEQA analysis is complete and TID is addressing various other permitting requirements. The project design is at 30% stage and should be completed by Fall 2022, at which time it is anticipated that the project will be put out for a public construction bid. Construction is slated to begin in Fall 2022 with completion by Summer to Fall of 2023.

7.3.2.3 Permitting and Regulatory Compliance

CEQA analysis is complete for the project. TID is currently working on acquiring the other required permits like the Dust Control Plan permit from the San Joaquin Valley Air Pollution Control District and the Stormwater Pollution Prevent Plan from the State Water Resources Control Board.

7.3.2.4 Water Sources and Legal Authority

All water re-diverted into the facility from Packwood Creek stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit thereof and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These additional supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the project insofar as its benefits are concerned.

7.3.2.5 Project Costs and Funding

The Okieville Recharge Basin Project's capital cost, including its appurtenant facilities and monitoring wells, is estimated at $2.5 million, and its annual maintenance cost is $10,000. Construction funding in part is to be provided by the approximately $1.9 million SGMA Implementation Grant awarded in 2021. The remainder of the costs to complete the project will be covered by TID and represents a 24% cost share.

7.3.2.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 31,500 AF, with average annual benefits at 630 AF/year. Maximum recharge in wet years is estimated to be 1,400 AF. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, as it is generally accepted that high quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the KSB computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.3 *TID/GSA Recharge Basin*

7.3.3.1 Description

TID currently owns and/or operates some 1,350 acres of "sinking" (recharge) basins for canal flow regulation and groundwater recharge purposes. These basins are kept full in surplus water seasons and, based on historical operations and the analysis described in Section 7.2.1, it is known that more basin capacity could be utilized in the wet years. As a function of agricultural land for sale exhibiting optimal infiltration characteristics and proximity to district conveyance facilities, as much as another 160 acres may be acquired for GSA Members, removed from agricultural use, and converted to a recharge basin.

7.3.3.2 Status of Implementation

Using the Groundwater Recharge Assessment Tool (GRAT) as described in Section 7.3.17, TID will continue to pursue suitable parcels for acquisition and to the degree compatible with its on-farm programs. Due to high capital costs, the development of new basins is currently considered less desirable than on-farm programs and, only with very nominal landowner participation would the District aggressively pursue additional sinking basins. With the on-farm program anticipated to be fully functional by 2025, any new recharge basin project would be identified and pursued for operational capability by 2030.

7.3.3.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by the San Joaquin Air Pollution Control District, and a Storm Water Pollution permit as called for by the SWRCB. In the event that federal funds are utilized for development of this project, compliance with NEPA will also be pursued.

7.3.3.4 Water Sources and Legal Authority

All water re-diverted into the facility from the TID canal system stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the project insofar as its benefits are concerned.

7.3.3.5 Project Costs

Based on recent experiences of TID in acquiring land and constructing recharge basins, an estimated cost per acre is $40,000, which amounts to $6.4 million for a 160-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be in the range of $10,000.

7.3.3.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 255,000 AF, with average annual benefits at 5,090 AF/year. Maximum recharge in wet years is estimated to be 11,400 AF. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.4 *On-Farm Recharge Programs*

7.3.4.1 Description

On-farm recharge in surplus flow seasons has historically been informally practiced within TID and other areas in the San Joaquin Valley. Nominal incentives existed in the past, with most growers avoiding interference to cropping plans and possible yield impacts. Now, with SGMA mandates, a shift in grower receptivity to these types of programs is occurring. By incorporating targeted incentives to growers and landowners, this historical and informal practice can be formalized and greatly expanded as part of the GSP. For example, in 2017 (a year where Kaweah watershed runoff was 193 percent of average) TID achieved participation by 12 farmers to over-irrigate 540 acres and fill on-site regulation ponds. As a result, about 6,900 AF was ultimately infiltrated into groundwater storage over and above TID's routine recharge operations.

Four types of on-farm programs are being designed, partly in response to the 2017 pilot program. These are (a) a crop buy-out program where planted fields are flooded and associated growers are compensated for crop damages; (b) a shallow-basin program where parcels are deepened for optimum recharge, and associated growers may continue planting forage crops and can receive monetary compensation in the event of flooding; (c) an over-irrigation program where growers take delivery of water for over-irrigation of permanent plantings or open-ground crops on a voluntary basis with reduced water costs, and;(d) a mandatory program where landowners may ultimately be required to dedicate a designated percentage of their lands for winter/spring recharge in surplus supply years.

The combined four approaches are being designed to achieve the optimal amount of participating lands in the overall program. It is projected that as many as 600 acres of participating parcels may be enrolled in the voluntary programs depending on the level of need determined by TID and as dictated by surplus flow availability.

7.3.4.2 Status of Implementation

Beginning with the winter of 2019, solicitations are being made to TID growers to accept surplus flows should the wet conditions continue into the early spring. Land use agreements are being signed and water will be furnished at no cost for participants. By the winter of 2020, at the inception of GSP implementation, more formal programs incorporating the aforementioned four options will be better defined. The GRAT, as described in Section 7.3.17, will be relied upon to help determine the ideal parcels to include in the overall program as a function of soil type, proximity to conveyance facilities, and other parameters. It is anticipated that by 2025, the program may be fully developed.

7.3.4.3 Permitting and Regulatory Compliance

Concerning the pilot on-farm programs implemented thus far, TID concluded that legally no permitting or CEQA compliance need to be pursued. The delivery of water, allotted to the District under its appropriative and contract water rights, to parcels within its service area has long been practiced. Should it be concluded differently for any of the formalized programs in the future, CEQA, likely in the form of a Negative Declaration, will be pursued and complied with.

7.3.4.4 Water Sources and Legal Authority

All water re-diverted to parcels within TID stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new program. They are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this program will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the program insofar as its recharge benefits are concerned.

7.3.4.5 Project Costs

On-farm programs primarily involve the delivery of TID water to farm fields, and operational and maintenance costs are anticipated to be similar to what the district has historically experienced. Some operational costs my increase with additional canal deliveries; however, this is anticipated to be nominal. Any financial incentives offered to growers to accept water on their properties will become a cost component as well.

7.3.4.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and the intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 180,000 AF, with average annual benefits at 3,610 AF/year. Maximum recharge in wet years is estimated to be 8,900 AF. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

There are concerns that on-farm recharge efforts may accelerate the downward movement of nitrates accumulating below the root zone in agricultural fields through the vadose zone into the aquifer and degrade water quality, particularly for potable uses by domestic well owners. Researchers at UC Davis and others have been looking at this issue and preliminary conclusions are that there can be a spike in nitrate concentrations at the water table initially; however, repeated recharge will have a flushing effect and nitrate concentrations will be lowered. It has been preliminarily recommended that an on-farm program make use of the same land parcels over an extended period of time to ensure the benefits of this flushing effect.

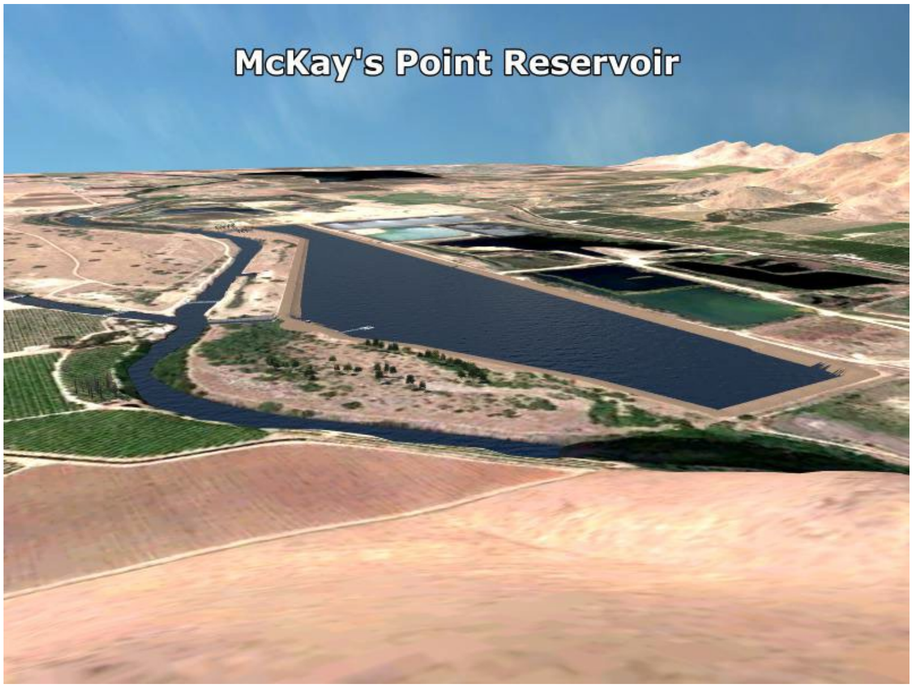
As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

7.3.5 *McKay Point Reservoir*

7.3.5.1 Description

McKay Point Reservoir is a partnership between the TID, Visalia & Kaweah Water Co., and the Consolidated Peoples Ditch Co. (collectively called the Owners) to construct a 4,000 acre-foot off-stream storage reservoir adjacent to the St. Johns River at McKay Point. TID will have access to at least one-third of the available storage space, i.e., about 1,500 AF, based on its joint ownership of the property and project along with the other Owners. The reservoir would be utilized to manage and regulate Kaweah River water otherwise lost in flood release operations to meet irrigation needs and groundwater recharge operations, under appropriation by the Owners. For TID, the Reservoir also allows flood water to be captured at the McKay Point Reservoir while imported supplies from the Friant-Kern Canal can be diverted into the District for groundwater recharge. Once the McKay Point Reservoir is at capacity, imported Friant supply diversions would be reduced or eliminated and releases from the reservoir would convey water into recharge facilities within TID.

Adjacent to the McKay Point Reservoir site are existing mining pits from which a majority, if not all, extractable aggregates have been removed in past years. TID may be able to utilize these pits to expand the storage available for the reservoir project; however, this will require additional planning and CEQA compliance.



Artist Rendering – McKay Point Reservoir

7.3.5.2 Status of Implementation

Site excavation and facility construction are anticipated to commence in early 2021 and be finished by early 2031. Agreements have been executed with an aggregate processing contractor, West Coast Sand and Gravel, Inc., to excavate the site to reservoir design specifications.

7.3.5.3 Permitting and Regulatory Compliance

Project planning is currently in the CEQA phase with the preparation of an EIR; the public review draft is anticipated to be completed by December 2019 and will include a requisite public review process and hearing(s). Tulare County is also providing a conditional use permit in the form of a Surface Mining and Reclamation Act (SMARA) permit, which will include a separate public hearing process.

7.3.5.4 Water Sources and Legal Authority

All water re-diverted into the reservoir from the St. Johns branch of the river stems from the Owners' appropriative rights to Kaweah River water and, as such, does not impose impacts on third parties. The projected allotments available from this source, which vary from year to year, are as determined in Section 7.6.2. In addition, water for purchase belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners.

To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, they too have legal authority to participate in the project insofar as its benefits are concerned.

7.3.5.5 Project Costs and Funding

The total project cost, including reservoir excavation, appurtenant facilities, perimeter cut-off walls, and inlet/outlet structures is estimated at $12 to $14 million, and TID's share thereof would be one-third, or about $4.5 million. Much of this cost will be offset by payments from the excavation contractor for its access to aggregate materials to be processed and sold to the local construction industry.

7.3.5.6 Expected Benefits and Targeted Measurable Objectives

As described in Section 7.3.5.1, TID's share of the project's storage capacity is about 1,500 AF. Using the methodology referenced in Section 7.2 and overlaying this storage capacity against the historical hydrologic period, the facility would retain (new yield) about 730 AF per year on average to be devoted to summer re-diversions into the TID/MKGSA delivery system for downstream recharge or to offset groundwater pumping, i.e., in-lieu recharge. The reservoir expansion project, by similar analysis, is expected to add another 480 AF of yield on average. These estimates assume only one fill of the off-stream reservoirs per year; however, in many years Terminus Dam on the Kaweah River must enter into a short-duration flood space evacuation several times, so the yield estimates are conservative.

As described in Section 7.6.2, the project is anticipated to provide about 730 AF of new stored water to be devoted to in-lieu or direct recharge within the TID service area. Projected over the 50-year SGMA Planning and implementation horizon, this would amount to 36,500 AF on an accrual basis. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically stored in the reservoir. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.6 *Kaweah Subbasin Recharge Facility*

7.3.6.1 Description

This project consists of the acquisition and development of new groundwater recharge facilities within the Kaweah Subbasin and is intended to be a partnership with other adjacent GSAs or other public agencies to facilitate additional groundwater recharge capabilities within the Subbasin. At least 160 acres are to be acquired in a location exhibiting good infiltration capacity and nearby a TID-operated feeder canal for re-diversion of Kaweah River supplies in surplus years. The TID/MKGSA share of the project is assumed to be 25 percent, and recharge accomplished by the facility would be credited to TID and its parent GSA in like percentage. The project, targeted for that portion of the Subbasin immediately upgradient of the GSA, would also help to raise groundwater levels for groundwater users within the Mid-Kaweah area.

7.3.6.2 Status of Implementation

Discussions are ongoing between TID and the two other subbasin GSAs as to participation, location, and funding options for the project. Once identified, more specific planning and CEQA compliance will commence. At this time, it is projected that suitable land identification, planning, and construction would be completed by 2030.

7.3.6.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by Tulare County, and a Storm Water Pollution Permit as called for by the RWQCB.

7.3.6.4 Water Sources and Legal Authority

All water re-diverted into the facility from the TID canal system stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. Likewise, other project participants may possess their own water rights for re-diversion into the facility. The projected allotments available from these sources for TID, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSAs may continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSAs, by virtue of the authorities granted to them as public entities, they too have legal authority to participate in the project.

7.3.6.5 Project Costs

Based on recent experiences of TID in acquiring land and constructing recharge basins, an estimated cost per acre is $40,000, which amounts to $6.4 million for a 160-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be in the range of $10,000. TID/MKGSA's share would be 25 percent of these costs based on the shared percentage assumed herein.

7.3.6.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the SGMA 50-year Planning and implementation horizon are estimated at 381,500 AF, with average annual benefits at 7,630 AF/year. Maximum recharge in wet years is estimated to be 17,100 AF. TID/MKGSA's share at 25 percent would thus be an annual recharge benefit of 1,910 AF, accruing to 95,500 AF during the 50-year Planning and implementation horizon. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.7 *Vadose Zone Injection Well Battery*

7.3.7.1 Description

This project would consist of shallow injection wells that extend a sufficient distance below grade into the vadose zone to ensure that water quality, as a result of the injected recharge water, is not a concern. These wells may also aid in bypassing restricting clay layers near the surface. Small wells would be drilled, and a perforated casing inserted to allow for water to flow into the pore spaces of soil under gravity head pressure. Similar systems have been widely used in the storm water capture and recharge industry and the district has investigated utilizing these as linear recharge systems along District canals and ditches. They would be placed within the right-of-way to depths that vary from 35 to 50 feet below ground surface. In surplus years, water would be delivered to these injection wells for groundwater recharge. The injection recharge flow rate is not presently known; however, the District anticipates the recharge rates to be in the range of 300 to 500 gallons per minute. Over time these systems may clog due to water quality, so the system would require increased maintenance and replacement costs.

7.3.7.2 Status of Implementation

Research is ongoing as to the feasibility of injection wells in the southern San Joaquin Valley given its somewhat common aquifer characteristics. It is therefore not known whether these wells will play a role in future groundwater recharge operations and, as such, any water balance benefits from such future programs are not included herein nor counted in the benefits accomplishments identified in Section 7.5.2. Given this limited information, further details concerning future injection well projects are omitted in this section; however, any such projects that materialize in the future will be identified during the GSP five-year assessment periods.

7.3.8 *TID River Siphon Rehabilitation Projects*

7.3.8.1 Description

TID is pursuing the repair/replacement of two reinforced concrete box siphons, each connecting to its primary intake canal (maximum capacity about 700 cubic feet per second (cfs) at each end. The inverted siphon structures each convey water under a river, namely the St. Johns River and the Lower Kaweah River, both located about five miles east of Visalia in Tulare County. The reinforced concrete siphons have become badly cracked due to erosive forces and perhaps internal head pressures and air entrainment. There is visible (from the riverbeds during low flows) and probably significant leakage from the siphons that should be eliminated if at all possible.

The siphons are sizable, ranging in cross-sectional area from 64 to 92 ft^2 and in length from 300 to 400 feet. Rehabilitation would consist of the placement of an interior liner to greatly reduce the friction losses by up to 30 percent in each siphon barrel. The current flow capacity would thus increase by about 100 cfs. The liner would also reduce or eliminate any leakage now occurring from each siphon. Should this not prove feasible, full replacement of one or both siphons may be pursued.

Currently TID has adequate unused conveyance capacity during the winter and spring months to convey additional water for groundwater recharge purposes. Climate change studies generally predict more intense and short-duration storm events and capturing flood flows resulting therefrom could prove challenging. Should such predictions bear out, the siphon projects afford the opportunity to significantly increase capacity during peak flow events.

Inlet Structure – Lower Kaweah River Siphon

7.3.8.2 Status of Implementation

TID has been conducting reconnaissance-level studies of the siphons to determine wear, concrete strength, cavitation, leakage, expected life, and risk of failure. The structures have been determined to pose no immediate risk of failure; however, head pressures and undermining during high river flows are problematic. An acceleration of planning to rehabilitate or replace the siphons could occur if it is concluded that conveyance capacity to transport Kaweah or Friant water sources into the area needs to be increased to optimize capture of peak flood release flows from Terminus Dam or Friant Dam. It is not known when the project would be completed; however, the project status will be further addressed in the first five-year GSP assessment submitted to DWR.

7.3.8.3 Permitting and Regulatory Compliance

All required permits, CEQA, and other regulatory compliance measures will be adhered to as planning proceeds. This may include pursuit of a Section 404 of the Clean Water Act permit as administered by USACE and a Lake and Streambed Alteration permit from CDFW, if required.

7.3.8.4 Water Sources and Legal Authority

All water re-diverted into and through the siphon structures from the TID Main Intake Canal is supported by TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, they too have legal authority to participate in the project insofar as its benefits are concerned.

7.3.8.5 Project Costs and Funding

The capital cost to rehabilitate both siphon structures is in the range of $2 million or more, and full replacement in the range of $26 million. Annual maintenance costs for these structures are minimal. Funding for this project would come from TID and its landowners as well as any applicable federal or state grant programs from which an award would be forthcoming.

7.3.8.6 Expected Benefits and Targeted Measurable Objectives

It is premature now to quantify expected benefits of these projects, except to note that an increase of 100 cfs over multiple days of a flood release event would amount to a significant volume of water otherwise being forced into the historic Tulare Lake Bed or released down the San Joaquin River. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

7.3.9 *City of Visalia/TID Exchange Program*

7.3.9.1 Description

Under this agreement executed in 2013, the City of Visalia delivers tertiary-treated wastewater to the district in exchange for excess surface water in wet years diverted by the district to specific recharge locations that benefit the groundwater pumping system serving the city. This leveraged exchange provides for one AF of surplus water returned to the city on average for every two AF of wastewater effluent delivered to TID. Per the agreement, the city commits to provide at least 11,000 AF of treated water annually for delivery to TID's canal system for groundwater recharge on an in-lieu basis by virtue of the supply to growers.

7.3.9.2 Status of Implementation

The city's $132 million in upgrades to its existing wastewater treatment plant (WWTP) were completed in the fall of 2018 and the exchange is anticipated to fully commence in 2019. Deliveries of recent wet-season flows to Visalia for recharge have already occurred.

7.3.9.3 Permitting and Regulatory Compliance

The City Council adopted an EIR and Notice of Determination for the plant upgrades in February 2013. All other permits related to the water exchange with the RWQCB have been obtained by the City. To address delivery of treated wastewater into the district's canal system and then to growers, TID sought agreements with landowners desiring to take delivery of the water, and the city will be submitting all requisite delivery and other operational information to the RWQCB on an annual basis. Further, TID obtained NEPA compliance with USBR for the exchange, acknowledging the delivery of CVP water for groundwater recharge purposes for Visalia's benefit. In summary, the program is fully permitted and now in full operation.

7.3.9.4 Water Sources and Legal Authority

All water delivered to city recharge locations is supported by TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. TID complied with NEPA by developing an Environmental Assessment and the USBR adopted a FONSI in 2014 for the devotion of CVP water toward this exchange program. Considered legally as "salvaged" water, the city's WWTP effluent conveyed to the TID canal system is under their ownership and likewise poses no issues with third parties.

7.3.9.5 Project Costs and Funding

Aside from the capital cost already incurred for the city's upgrades to its WWTP and various costs for permitting and environmental compliance, there are no costs associated with this exchange.

7.3.9.6 Expected Benefits and Targeted Measurable Objectives

Because the city effectively provides for additional recharge capacity not previously accessible by TID, one-half of the average delivery to TID (i.e., 5,500 AF) annually will be included as additional recharge within the MKGSA area. This supply will consist primarily of imported water from the CVP into the Kaweah Subbasin. The WWTP effluent deliveries to TID do not amount to new water since this source of groundwater recharge currently occurs within the GSA area. A projected operation of this exchange over a 90-year hydrologic record is as shown in Section 7.6.3.

There are, however, water quality benefits associated with the upgrades to the city's WWTP to tertiary levels. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

7.3.10 *Sun World Int'l./TID Exchange Program*

7.3.10.1 Description

In 2014, TID executed an exchange agreement with Sun World International, which calls for an exchange of Sun World's local Kaweah River supply for TID's CVP Friant supply. Sun World is a company with landholdings in the San Joaquin Valley and elsewhere in California; however, none are currently within the Kaweah Subbasin. The company does, however, possess a contractual right to Kaweah River water via one of the local ditch companies. Sun World's local supply, which would have otherwise been transferred directly or indirectly out of the subbasin, is now committed for diversion into TID, and TID owes back water on a leveraged basis ranging from 2:1 to 3.5:1 depending on year type, i.e., 2 to 3.5 AF to TID for every 1 AF provided to Sun World.

7.3.10.2 Status of Implementation

The exchange is now underway and TID is tracking the delivery balances to each entity.

7.3.10.3 Permitting and Regulatory Compliance

The delivery of additional Kaweah River water to TID requires no additional approvals from the local river Watermaster, as TID is already an appropriator on the river. TID's exchange water from the CVP is being directed by Sun World to the Lower Tule River Irrigation District within which it has land holdings and the district is a fellow Friant contractor. Annual exchange notices are required by USBR to document these deliveries as among Friant contractors, and TID complies with this long-standing protocol.

7.3.10.4 Water Sources and Legal Authority

All water re-diverted into TID's canal system for in-lieu or direct recharge stems from Sun World's contractual rights to Kaweah River water and, as such, does not impose impacts on third parties. TID's transfers of its CVP water to another Friant Unit contractor as allowed for under its USBR contract also poses no impacts to third parties.

7.3.10.5 Project Costs

Aside from costs to construct the exchange agreement by the parties, there are no additional costs to TID to effectuate the exchange from year to year. Sun World continues to pay the charges associated with its Kaweah contract supply; TID receives remuneration from Sun World by way of exchange fees and water cost reimbursements, all of which are intended to assist in the purchase of surplus water in wetter years.

7.3.10.6 Expected Benefits and Targeted Measurable Objectives

Based on a 90-year analysis of the exchange using historical Kaweah River hydrology depicting Sun World's average annual supply and resulting exchange supplies inuring to TID, the exchange arrangement is projected to supply new yield (net exchange amount) on the order of 3,400 AF annually and, over the 50-year Planning and implementation horizon, would accrue to 170,000 AF. This analysis is shown in Section 7.6.3. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect to both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model was used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

7.3.11 *TID/Friant Leveraged Exchange Programs*

7.3.11.1 Description

Similar to the recently instituted exchange agreement with Sun World, TID continues to evaluate other exchange arrangements with entities within the CVP Place of Use. The fundamental concept applied in such evaluations is for TID to provide some degree of firm dry-year water supply to entities with permanent crops in exchange for a larger volume of return water. In this way, TID adds new water into the GSA region for either direct or in-lieu groundwater recharge. Exchanges of this nature could be year-to-year or over a specified period of years. TID has a long practice of engaging in such exchange arrangements.

7.3.11.2 Status of Implementation

New exchange opportunities may arise from time to time, but their specific implementation and duration cannot be projected at this stage. Therefore, any water balance benefits from such future programs are not included herein nor counted in the benefits accomplishments identified in Section 7.5.2. Given this limited information, further details concerning future exchange opportunities are omitted in this section; however, those that materialize in the future will be identified during the GSP five-year assessment and update periods.

7.3.12 *Temperance Flat Reservoir*

7.3.12.1 Description

The Temperance Flat Reservoir is an on-stream 1.2 MAF storage reservoir designed to impound water upstream of Millerton Reservoir on the upper San Joaquin River.

The reservoir is intended to capture excess wet-year water that would have traditionally spilled from Millerton Reservoir and been sent down the San Joaquin River and out to the Delta. Temperance Flat Reservoir is being developed based upon participation in specific storage levels, therefore allowing participants to manage their storage based upon individual assets and needs. This allows participants to not only capture flood releases, but to also manipulate Class 1 and Class 2 supplies for better utilization.

7.3.12.2 Status of Implementation

This project is still early in the planning stages in terms of participation and many of the specific details, particularly in terms of financing, have yet to be determined. Under the auspices of the San Joaquin Valley Water Infrastructure Authority, a considerable volume of feasibility analyses and design/construction cost determinations were made as part of an application to the California Water Commission under the state's Water Storage Investment Program. An award of $171 million was garnered and, while insufficient for full design and construction, planning for the project continues at the federal, state, and local levels.

Given this status and the fact that any yield to entities in the Kaweah Subbasin would not be realized for at least 25 years due to the lengthy planning/construction time needed for such a major project, the project is not assumed to aid in realizing sustainable yield by 2040 but may have relevance for the SGMA 50-year planning and implementation horizon. Thus, its cumulative benefits are not estimated in Section 7.5.2. Given this limited information, further details concerning Temperance Flat Reservoir are omitted in this section; however, the project may be reassessed during the GSP five-year update periods.

7.3.13 *City of Tulare/TID Catron Basin*

7.3.13.1 Description

The City of Tulare currently owns a 100-acre agricultural parcel surrounding its WWTP. This project proposes to turn the property into a storm water detention/ groundwater recharge basin. The city currently distributes a majority of their storm water through the district canal system that runs adjacent to the property. During large storm events, the district canal system can become overwhelmed with storm water and flooding events have occurred in the area just upstream of the proposed project site. The project would be designed to pump storm water into the proposed basin for subsequent infiltration or release it back to the canal system as capacity is made available when the storm passes. The project would also be used to accept surface water that the district can make available for recharge purposes. The site is anticipated to accept and infiltrate up to 50 AF per day. The use of higher-quality district surface water should help the current nitrate concentration residing under the WWTP holding ponds near the proposed project site.

7.3.13.2 Status of Implementation

The project is in its early planning and design stages; however, the proposed site has been secured for this purpose. It is anticipated that the project would be completed and operational by 2026.

7.3.13.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by Tulare County, and a Storm Water Pollution permit as called for by the RWQCB.

7.3.13.4 Water Sources and Legal Authority

Storm water diverted into the site from Tulare's storm sewer system is considered salvaged water from a legal standpoint, and the city has the right to utilize this water as owner/operator of the storm water collection system. Recaptured storm water supplies are abandoned flows that, if not recaptured and treated, would not be usable water supplies. For these reasons, the recapture does not impose impacts on third parties. All water re-diverted into the site from the TID canal system stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members, will continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, such as the City of Tulare, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, they too have legal authority to participate in the project insofar as its benefits are concerned.

7.3.13.5 Project Costs

Based on recent experiences of TID in constructing recharge basins, an estimated cost per acre is at least $15,000, which amounts to $1.5 million for a 100-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be in the range of $10,000.

7.3.13.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 80,000 AF with average annual benefits at 1,600 AF/year. Maximum recharge in wet years is estimated to be 3,500 AF. Recharge estimates exclude water diverted into the facility for detention purposes, assumed to be half of all water diverted. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San

Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.14 *City of Visalia/TID Cameron Creek Recharge Project*

7.3.14.1 Description

This project involves the development of check structures and automated gates to create a linear recharge facility within the Cameron Creek system. This project is based upon the nearby Packwood Creek recharge system completed in 2016 as a partnership between the City of Visalia and TID. Several structures would be built to hold upstream water levels in the creek and create large pools of water to take full advantage of the high infiltration characteristics of the channel. The initial reach of Cameron Creek is located just east of Visalia at its diversion structure off of TID's Main Intake Canal and travels along the southern boundary of the City of Visalia.

7.3.14.2 Status of Implementation

Visalia and TID entered into an agreement in 2001 to provide, among other things, the development of recharge facilities and placement of structures within Cameron Creek to enhance recharge for the benefit of both parties. This project is in furtherance of this agreement. Over the intervening time, temporary earthen berms were placed in the creek to enhance recharge in wet seasons. Reconnaissance-level field surveys were conducted to identify suitable locations for permanent check structures, and preliminary design work using the Packwood Creek Project (see Section 7.3.15) as a model will be underway by 2022. Operational status is anticipated by 2025 and any changes to this projection will be addressed in the first five-year assessment to be furnished to DWR.

7.3.14.3 Permitting and Regulatory Compliance

Cameron Creek is a man-made channel with easements under ownership of TID. As such, no streambed alteration permits, or dredge/fill permits will be needed from state and federal agencies. CEQA will be complied with, likely under a Negative Declaration for the project.

7.3.14.4 Water Sources and Legal Authority

All water diverted into the channel from the TID's Main Intake Canal is supported by TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, they too have legal authority to participate in the project insofar as its benefits are concerned.

7.3.14.5 Project Costs

The project will be similar in its key features and operations to the Packwood Creek Project described in Section 7.3.15. Depending on the number of automated check structures to be placed in the creek, the capital cost could be similar as well. As project design proceeds, the costs will be better known.

7.3.14.6 Expected Benefits and Targeted Measurable Objectives

Based on TID's operational records of historical diversions into Cameron Creek, conveyance losses (seepage infiltration) upwards of 25 percent have been recorded. With the presence of check structures and more frequent use of the channel for recharge purposes, higher seepage rates and resulting groundwater recharge can be anticipated. As design and operations analyses become more refined, project benefits can be better estimated. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which Cameron Creek traverses.

7.3.15 *Packwood Creek Water Conservation Project*

7.3.15.1 Description

This project, a joint effort of the City of Visalia, TID, and the KDWCD, consists of improvements to the existing Oakes Basin for habitat enhancement and the placement of four automated check structures within Packwood Creek northeasterly of Visalia. Supervisory Control and Data Acquisition (SCADA) retrofits to an existing check structure are also part of this project. The creek can be fed with flows re-diverted from the Lower Kaweah River and from the Friant-Kern Canal farther upstream into the river system. The check structures operate to maintain a designated flow while keeping water levels higher to maximize streambed and bank pools' recharge surface area between structures.

New Automated Check Structure in Packwood Creek

7.3.15.2 Status of Implementation

The project was completed in 2015 and has been utilized for recharge purposes since that time.

7.3.15.3 Permitting and Regulatory Compliance

All environmental permits and other necessary compliance actions have been completed. For CEQA purposes, the project was approved under a Mitigated Negative Declaration; for NEPA purposes under a FONSI.

7.3.15.4 Water Sources and Legal Authority

The project proponent KDWCD, as a water conservation district in California, has the authority to pursue projects for groundwater management purposes. Water re-diverted into the creek stems from either the Kaweah River system or the Friant Unit of the CVP. Both KDWCD and TID possess appropriative rights to Kaweah River water and contract entitlements to CVP water. The city can and has, from time to time, purchased local Kaweah River water and CVP water for recharge purposes. TID possesses the rights-of-way for the Packwood Creek channel, and KDWCD and the city maintain the various reaches of the creek channel along its upper reaches. When not in use by the city for recharge purposes, KDWCD, a member of a neighboring GSA, may also use the channel and appurtenant facilities for groundwater recharge.

7.3.15.5 Project Costs and Funding

The entire project, including the habitat improvements to the Oakes Basin and all SCADA equipment and appurtenances, cost $1.6 million. Of this total, $800,000 was provided by a USBR WaterSMART grant and the balance from Visalia/KDWCD/TID funding sources. Ongoing O&M costs are anticipated to be minimal and within the associated budget of TID for SCADA system maintenance.

7.3.15.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's total accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 73,250 AF, with average annual benefits at 1,465 AF/year. It is assumed that half of these benefits are commingled with the benefits being achieved under the Visalia/TID exchange described in Section 7.3.9, thus the net benefits of this project would amount to 36,620 AF over the Planning and implementation horizon and 730 AF/year. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which the creek generally traverses.

As described in the Coordination Agreement, the KSB computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

7.3.16 *Visalia Eastside Regional Park & Groundwater Recharge*

7.3.16.1 Description

This project to be built by the City of Visalia consists of a 250-acre park featuring diverse recreational opportunities, native plants, wildlife habitat, and integrated groundwater replacement and storm water retention facilities. The dedicated groundwater recharge element is planned to encompass upwards of 50 acres. The park is sited in the northeast region of the city and is traversed by several ditches and channels that will feed the recharge element of the facility. A groundwater education center is planned for the park.

7.3.16.2 Status of Implementation

A park master plan is being developed through the input of a task force of a diverse group of stakeholders. The park is anticipated to be completed by 2022. Public workshops have been held to vet the park concepts and various features.

7.3.16.3 Permitting and Regulatory Compliance

Visalia will be pursuing all necessary permits and compliance with CEQA needed for a functioning park and recharge facility.

7.3.16.4 Water Sources and Legal Authority

The water to be devoted to the park's recharge facility will come from both the exchange return flows from TID's CVP supplies (see Section 7.3.9) as well as Kaweah River sources acquired on an annual basis by the city. As a chartered city, Visalia has all necessary authorities to construct the park facility and acquire water for recharge purposes.

7.3.16.5 Project Costs and Funding

The entire project is estimated to cost $1.74 million, with $1.57 million awarded to the city from the Watershed and Urban Rivers allocation from Prop 1 and the balance from the city. Additional funding may also come from the state's Land and Water Conservation Fund administered by California State Parks.

7.3.16.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 7.2 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 95,000 AF, with average annual benefits at 1,910 AF/year. It is assumed that half of these benefits are commingled with the benefits being achieved under the Visalia/TID exchange described in Section 7.3.9, and thus the net benefits of this project would amount to 47,500 AF over the planning and implementation horizon and 950 AF/year. Maximum recharge capability in wet years is estimated to be 4,300 AF. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which the park resides.

As described in the Coordination Agreement, the Kaweah Subbasin computer model has been used to simulate the water-level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing water-level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not a SGMA-defined measurable objective, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

7.3.17 *Groundwater Recharge Assessment Tool*

7.3.17.1 Description

Since 2016, TID, along with Madera ID, has been working with Sustainable Conservation in the development of its GRAT. GRAT is an online tool that helps assess the potential for various recharge activities and locations within an area of study. The tool allows for assessment of on-farm recharge, fallowing, and recharge basin development based on various criteria, such as access to conveyance facilities, soil types, recharge potential, and retention for continued usage. TID intends to use this tool to enhance the capabilities of the various projects and programs for groundwater recharge, irrigation demand reduction, and SGMA compliance. Shown on Figure 7-1 is a home screen of the GRAT computer software application.

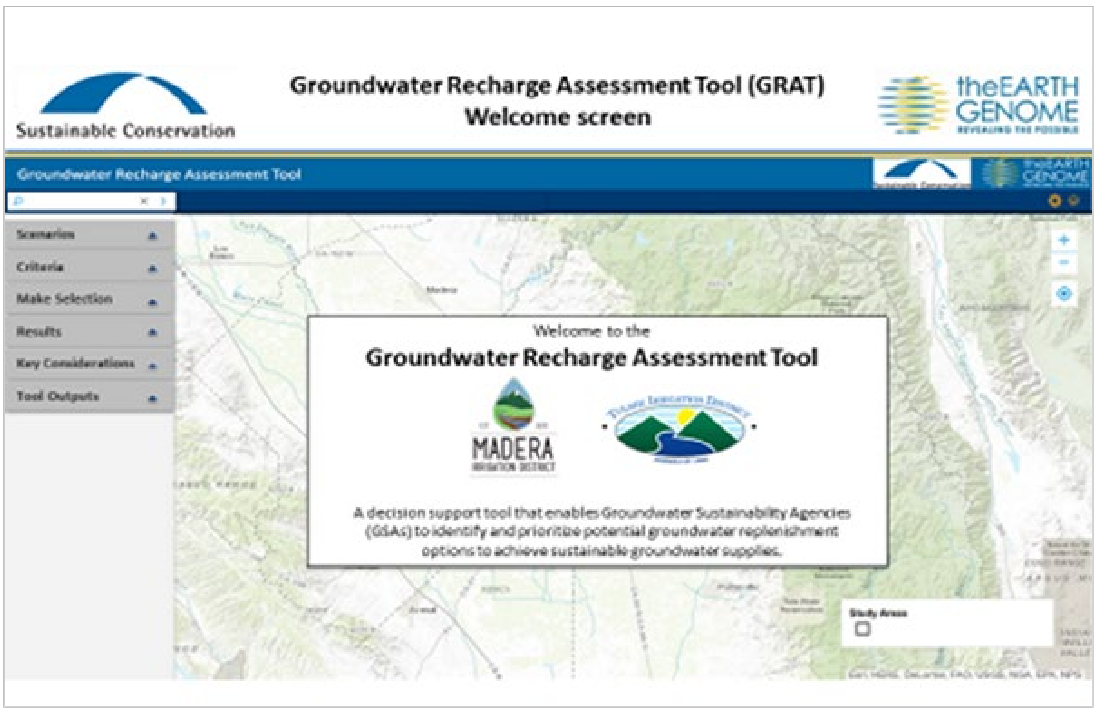


Figure 7-1: Groundwater Recharge Assessment Tool

7.3.17.2 Status of Implementation

GRAT is essentially complete, with periodic updates to add additional features being considered by Sustainable Conservation.

7.3.17.3 Permitting and Regulatory Compliance

No permits or other regulatory considerations are necessary for application of GRAT, since it is an aid for reconnaissance purposes only.

7.3.17.4 Water Sources and Legal Authority

GRAT does not involve the commitment or diversion of water.

7.3.17.5 Project Costs

Being one of two pilot project locations for the development of GRAT, no costs have been incurred to-date. However, an annual subscription fee upwards of $10,000 may be required in the future as Sustainable Conservation continues to expand upon and refine the tool.

7.3.17.6 Expected Benefits and Targeted Measurable Objectives

Use of GRAT in the identification, prioritization, and optimization of numerous on-farm participants and potential recharge basins is expected to identify those locations that offer maximum delivery conveyance capacity and optimal infiltration characteristics. The individual projects selected using GRAT will determine the estimated benefits to be provided, along with the associated measurable objectives to be met with their implementation.

7.3.18 *TID Existing Recharge Capacity Evaluation*

7.3.18.1 Description

TID from time to time has considered alternative maintenance practices for its sinking basins utilized throughout the district for canal flow regulation and groundwater recharge. A total of 15 basins encompassing some 1,400 acres represent the extent of these facilities. A series of reports has been compiled in the recent past by the district to more formally address ways by which recharge in these existing facilities may be increased and optimal infiltration rates be sustained over time.

With the passage of SGMA, a more robust analysis of this valuable recharge capacity within the district was undertaken and culminated in the report "Groundwater Recharge Capacity Evaluation Phase III: Hydrogeologic Investigations to Maximize Recharge Capacity," (Report) completed in February 2018 and included herein as **Appendix 7A**. In addition to recharge basins, the Report looked at optimizing the district's extensive system of unlined conveyance facilities and on-farm programs to increase aquifer recharge in wet seasons.

7.3.18.2 Status of Implementation

TID is evaluating the extensive recommendations of the subject Report and addressing the timing and funding needs to proceed with implementing some or all of the recommendations. Given this situation, the implementation of chosen system improvements will be identified during the GSP five-year assessment and annual update periods where appropriate.

7.3.18.3 Permitting and Regulatory Compliance

Most of the recommendations contained in the Report deal with maintenance efforts and operational actions for existing facilities. TID routinely undertakes O&M practices on a regular basis on all its facilities, and it has concluded that no additional permits or regulatory compliance are necessary. For any basin expansions or extensions to such facilities, any necessary construction permits and CEQA compliance will be pursued prior to construction.

7.3.18.4 Water Sources and Legal Authority

Like other projects described in Section 7.3, all water diverted into existing facilities stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties.

7.3.18.5 Project Costs and Funding

As specific maintenance practices or facility improvements are identified, the associated costs will be estimated as well, and a determination will be made as to whether they can be absorbed as part of the District's ongoing annual O&M budget funding practices or whether capital funding is necessary.

7.3.18.6 Expected Benefits and Targeted Measurable Objectives

As specific O&M recommendations are selected and ready for implementation, estimates will be made of the additional groundwater recharge that may result therefrom. The measurable/optimal objectives to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

7.3.19 *Future Project Funding by Members*

The MKGSA Members, by policy, have agreed to pay for administration and planning activities on a one-third basis through June 2020, the end of the GSA's fiscal year immediately following the plan's submittal deadline. During GSP implementation, and in recognition of MKGSA's water budget role and its segregation into the respective Member Management Areas as described in Section 2.5 of this Plan, the GSA Board adopted the following "Sustainability Plan Cooperative Statement" at its August 2018 regular meeting:

> *"Objectives: In compliance with SGMA, the MKGSA Members will strive to (a) identify strategies to avoid agricultural land retirement, (b) create opportunities for city Members to satisfy water demands in UWMPs and in General Plan/RHNA obligations, (c) preserve adequate groundwater supplies for unincorporated communities and schools and (d) define responsibilities for Projects & Management Actions in their GSP.*
>
> *In furtherance of these Objectives, the Members will support a Kaweah Sub-Basin and internal Management Area water budget apportionment, as well as sustainable management criteria and associated projects and management actions for its GSP, to provide the most opportune ability to both realize the urban General Plan growth projections of the cities of Visalia and Tulare and ensure the sustainability of agricultural*

> *production acreage and supporting communities within the Tulare Irrigation District. Notwithstanding their differing water rights, supplies and apportionment of the Kaweah Sub-Basin water budget as among the East, Greater and MKGSAs, the Members are committed to shape and distribute this water budget in a fashion to achieve these Objectives."*

The MKGSA water budget as set forth in Section 2.2 has been further apportioned among the Members (City of Visalia, City of Tulare and Tulare Irrigation District) and described in Section 6.3 elsewhere in this Plan. The Member jurisdictional areas are identified as Management Areas as delineated in Section 2.5. In addition, the Members have negotiated the role that the various water management agreements among them, all executed prior to the passage of SGMA and identified in Section 1.2, play in this apportionment. As of January 2020, the preliminary participation level by the Members in each of the future projects and programs as summarized herein in Section 7.3 is set forth as follows:

Tulare ID	33.3%
City of Tulare	33.3%
City of Visalia	33.3%

The participation levels as indicated may change during implementation pending further discussions among the Members. Each Member will determine the nature of its capital funding needs for the Projects and whether Prop 26 or Prop 218 provisions are to be complied with.

In addition to local Member financial contributions to projects, additional grant funds may be forthcoming. Both cities and TID remain attentive to upcoming state and federal grant funding opportunities. Prop 68 contains some $100 million for GSP implementation efforts, and it is the intent of this GSA and the Subbasin GSAs as a whole to pursue this upcoming opportunity. TID has had success in the past in garnering federal grant funding for water management projects, and USBR's WaterSMART program continues to be available to federal contractors for groundwater recharge and other water management/efficiency projects. Other grant funding sources include USBR's Part III Investment Strategy Program as part of the Water Management Goal of the San Joaquin River Restoration Program and state funding to be made available in the future from the IRWM and possibly Flood-MAR programs.

7.4 Management Actions

The management actions as described below are arranged in the following order: An extraction measurement, allocation, and marketing programs; geophysical survey project; urban and agricultural conservation programs; and a the MKGSA Mitigation Program. The description, its implementation circumstances and status, public noticing, permitting and regulatory compliance, water sources and legal authority, program costs and funding, and benefits are all discussed for each Action individually and address §354.44(a) and (b)(1)-(8) of the Regulations.

7.4.1 *Extraction Measurement Program*

7.4.1.1 Description

Within the GSA, all extractions by two of the Members, i.e., the cities of Tulare and Visalia, are fully metered and groundwater extractions and associated constituent levels are reported at least annually to the SWRCB. However, extraction measurements by private well owners within TID, the third GSA Member, have not been heretofore required. Extractions from these wells, primarily for irrigated agricultural operations, must now be reported in the aggregate annually to the state according to §10728 and measured according to §10725.8 of SGMA.

TID plans to initiate a pilot program to determine the most feasible means of complying with SGMA's measurement provision. The measurement alternatives and data processing methods to be evaluated are as depicted on Figure 7-2**.**

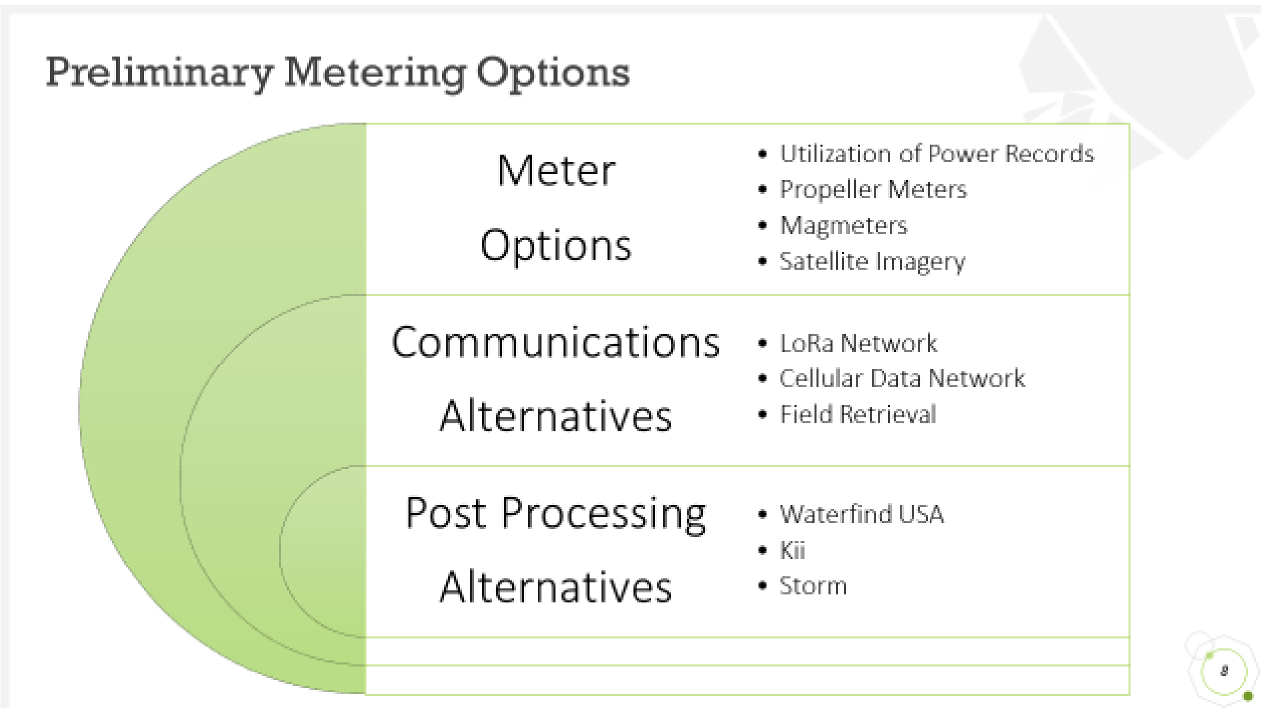


Figure 7-2: Data Measurement Alternatives

7.4.1.2 Status of Implementation

Commencing in July 2017 TID conducted a survey of all agricultural wells within the District. The survey was conducted from the vantage point of public roads; access on private property to obtain a more accurate count was not undertaken. The survey results are summarized below:

Table 7-2: Summary of TID Well Survey Results, July 2017

	6”	8”	10”	12”	Unknown	Total
Groundwater Well Discharge Sizing (estimated)	92	292	204	12	177	777

Given the large number of deep wells, TID intends to assess the optimal and cost-effective means to measure extractions during the period 2020 to2022. The four fundamental options identified are (a) satellite imagery for evapotranspiration (ET) measurements, (b) utilization of energy records and pump/motor characteristics, (c) propeller meters, and (d) Magmeters. Options for data acquisition from the field data include visual readings by District staff or use of LoRa or cellular networks for remote access. Post-processing of collected data may be done by utilization of one of several vendor software applications, including Waterfind USA, Kii, or STORM.

With results in hand by 2022, and in conjunction with grower/stakeholder outreach on the findings, TID plans on initiating a measurement installation program with the intended completion date of 2025.

7.4.1.3 Permitting and Regulatory Compliance

Authority for groundwater measurement collection and processing resides within SGMA as previously cited. It is not anticipated that additional permitting or regulatory reliance will be necessary to implement a pilot-level program or to scale up to full coverage within the GSA by 2025.

7.4.1.4 Water Sources and Legal Authority

Legal authority for this program is as previously cited in Section 7.4.1.1. In addition, this program will be in compliance with the monitoring protocols required by Water Code §10727.2 and § 354.32-354.34 of the Regulations.

7.4.1.5 Program Costs and Funding

Costs for a chosen means to measure groundwater extractions within TID vary widely from $200,000 to upwards of $4 million for capital and installation, and from under $50,000 to as much as $250,000 annually for O&M. According to SGMA §10725.8(b), costs associated with individual measurement devices are to be borne by the well owner/operator, so the cost exposure to TID and/or the GSA in implementing a measurement program is not known. Since the city GSA Members already fund and operate extraction metering facilities, the costs associated with an extraction measurement program as described herein lie primarily with TID.

7.4.1.6 Expected Benefits and Targeted Measurable Objectives

The primary benefit of any measurement program will be for compliance with SGMA mandates. Further, improved knowledge regarding extraction volumes and their seasonal timing will add to the knowledge base of the aquifer and should aid in improving the Subbasin numeric model's predictive capabilities and future groundwater management in general.

7.4.2 *Groundwater Extraction Allocation Implementation*

7.4.2.1 Description

In accordance with SGMA §10726.4, a GSA has the authority to regulate groundwater extractions and impose an allocation mechanism. In the absence of sufficient surface water to support the local water needs, the beneficial users and uses within the MKGSA must turn to groundwater. In response to continued declines in groundwater, the MKGSA intends to develop groundwater allocations that promote reduced groundwater and use, and help meet its Measurable Objectives by 2040. As groundwater levels decline, allocations will need to be reduced to achieve sustainability, while periods of rising groundwater levels can yield larger allocations of groundwater pumping.

7.4.2.2 Status of Implementation

Upon submission of the 2020 MKGSA GSP, the State of California experienced another prolonged drought, which is still in place as of the drafting of these GSP revisions. In Spring 2021, landowners within the Kaweah Subbasin, including within the MKGSA began noticing increased declines in groundwater levels. Based on the groundwater level declines, impacts to groundwater wells, and drying of rural and disadvantaged community wells, the MKGSA began looking into immediate actions that could be taken to address the emergency drought conditions and subsequent declines in groundwater levels. The MKGSA worked for approximately 10 months in coordination with the MKGSA Advisory Committee, the public, and interested parties to developed and approved the Emergency Ordinance to Establish an Extraction Limitation for the Mid-Kaweah Groundwater Sustainability Agency Service Area (Emergency Ordinance). The Emergency Ordinance approved in May 2022 is attached as **Appendix 7F**.

The Emergency Ordinance established a groundwater pumping cap, measured and tracked as evapotranspiration. Due to the inability to implement GSA-wide metering in time to initiate the Emergency Ordinance, the MKGSA has contracted with Land IQ to track field level evapotranspiration using satellite images and ground sensors for calibration. Growers will be allocated 2.5 acre-feet per acre of evapotranspiration for the partial Water Year 2022 (May 1, 2022 to September 31, 2022). The allocation was set based upon historic contributions to the groundwater by landowners within the MKGSA. However, the landowners recognized during the development of the Emergency Ordinance that this value is likely to change with changing groundwater conditions. Growers will pay fees based on status of surface water usage. Surface water users pay a fee based on the costs to implement the Emergency Ordinance. Landowners who only use groundwater pay a higher fee based on the estimated cost to replace the water that is pumped in a future year as surface water. Growers are provided flexibility to move the groundwater within land ownership or management within 5 miles and can carryover any unused groundwater into the next Water Year. The GSAs in the Kaweah Subbasin developed the Water Dashboard. This is an online water tracking tool that allows growers to track their crop ET and determine their groundwater consumption and balances.

7.4.2.3 Permitting and Regulatory Compliance

The MKGSA is a lawfully formed GSA pursuant to SGMA and has the powers and authorities provided to GSAs through the legislative enactment of SGMA and amendment to the Water Code. Water Code section 10725.2 states: "A groundwater sustainability agency may adopt rules, regulations, ordinances, and resolutions for the purpose of this part, in compliance with any procedural requirements applicable to the adoption of a rule, regulation, ordinance, or resolution by the groundwater sustainability agency."

Pursuant to Water Code section 10725, a GSA may exercise the powers described in Section 5 provided the GSA adopts and submits a GSP to the DWR. This Ordinance is designed to implement the provisions of the Agency GSP and may be amended at any time if necessary to achieve consistency with the GSP and any steps needed to achieve sustainability.

The Emergency Ordinance is exempt from CEQA pursuant to Water Code section 10728.6 and CEQA Guidelines sections 15061(b)(3), 15307 and 15308.

7.4.2.4 Water Sources and Legal Authority

Legal authority for a groundwater allocation or pumping restriction program is grounded in SGMA §10726.4 and further articulated in §354.44(b)(2) of the Regulations.

7.4.2.5 Program Costs and Funding

Costs to implement, maintain, and provide administration of the Emergency Ordinance are covered by fees collected on the amount of water consumed as Evapotranspiration (ET). For every acre-foot of evapotranspired water, a fee of $10 is collected for Emergency Ordinance funding. Those fees were established by providing a summary of the services and fees required to create and operate the Emergency Ordinance and spreading those costs over time and estimated allocation of ET.

7.4.2.6 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be the achievement of sustainable yield by 2040, thereby eliminating all undesirable results by that time. The measurable objectives to be fully met with this allocation program, along with the projects identified in Section 7.3, include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

7.4.3 *Groundwater Marketing Program*

7.4.3.1 Description

During the planning phase for certain of the projects identified in Section 7.3 and a groundwater allocation program outlined in this section, MKGSA has begun the process to develop a voluntary groundwater marketing program. With the existence of a groundwater allocation program and suitable measurement program, MKGSA plans to be in a position of administering the marketing program within the confines of the GSA.

7.4.3.2 Status of Implementation

In 2019 TID received a WaterSMART grant from the U.S. Bureau of Reclamation to develop a Groundwater Marketing Strategy. The Water Marketing Strategy (Strategy) project goal is to develop a water marketing strategy in the Kaweah Subbasin that each GSA can consider implementing within their jurisdictional area. TID hired a consultant with experience in facilitation and water markets (Stantec, supported by Dr. Matthew Feinup) to guide the development of the Water Marketing Strategy.

A 11-member committee was established to represent all of the beneficial users and uses of groundwater in the Kaweah Subbasin, and this Water Marketing Strategy Committee (Committee) is tasked with developing the Strategy. The Strategy is a document that will establish the elements that best represent the beneficial users and uses of the subbasin and help achieve groundwater sustainability. Elements such as who can participate, how far can groundwater be bought or sold, how formal are the purchases, and how to monitor the trades are sample elements of what will be established in the Strategy by the Committee.

The Committee has been meeting since Mid-2021 and has established a list of Guiding Principles that will be used to guide the development of the Strategy. The Committee has also investigated groundwater rights and has completed a study of the existing water markets in California and across the world.

The Committee is now working on elements of the Strategy with an anticipation of have the Strategy completed by early 2023. Upon completion, each Kaweah Subbasin GSA, including the MKGSA will consider approving the Strategy and implementing a groundwater market.

7.4.3.3 Permitting and Regulatory Compliance

Any permitting or other regulatory compliance needs deemed necessary to implement and administer a marketing/transfer program, all in furtherance of SGMA §10726.4, will be identified and pursued during the first five years of GSP implementation.

7.4.3.4 Water Sources and Legal Authority

Legal authority for a groundwater marketing and transfer program is grounded in SGMA §10726.4. The water source will be limited to groundwater allocations as assigned on an annual or permanent share basis.

7.4.3.5 Program Costs and Funding

The development of the Kaweah Subbasin Water Marketing Strategy is being partially funded by the U.S. Bureau of Reclamation via a WaterSMART grant. The grant is covering approximately 50% of the project costs, estimated to be approximately $800,000. The other costs are being covered by TID and the Kaweah Subbasin GSAs.

7.4.3.6 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be to provide groundwater rights holders options in the management of their groundwater assets. With the ultimate cessation of unlimited access to groundwater for beneficial uses (notwithstanding quality or depth considerations), these water rights holders may find that alternatives allowing for the transfer of limited allocations may prove attractive in a robust and properly functioning market. While such a program will not add to the GSA's overall groundwater balance/budget, it may well encourage the distribution of allocations in the most economically efficient manner. Adding no new supply or additional pumping restrictions within the GSA as a whole, it is assumed that this program will not measurably aid in meeting any of the measurable objectives as defined in this GSP.

7.4.4 *Subbasin Geophysical Data Survey Project*

7.4.4.1 Description

TID served as a pilot program for hydrogeological subsurface data collection using electromagnetic geophysical methods (via a company called SkyTEM) in the fall of 2015. This innovative airborne survey method acquires deep aquifer resistivity data to better ascertain its characteristics and geology. The work was arranged and funded by Stanford University with some administrative oversight by TID staff. The data collection was done by means of helicopter fly-overs along pre-selected flight lines within TID, a process known as airborne electromagnetic surveying (AEM). Work products from this research and data analysis have been presented locally and statewide, and interest in furthering this means of sub-surface data collection has developed. The instrumentation used in the fly-over transects is depicted on Figure 7-3.

TID and Stanford University have also collaborated on the acquisition of a towable electromagnetic imaging system called TowTEM that measures the resistivity of soils at shallow depths of 100 ft or less. The resistivity information that is gathered is correlated to soil types and the output is a three-dimensional model of sediment textures.

The district is planning on using this information, in partnership with Stanford University, to determine areas that are best suited for groundwater recharge activities. This would take the form of identifying areas where potential recharge basins could be constructed or where on-farm recharge programs would yield the highest infiltration rates.

Stanford has also obtained a grant from National Academy of Sciences to integrate InSAR ground displacement data with AEM techniques to improve groundwater modeling tools for the Kaweah Subbasin (see Stanford proposal in **Appendix 7B**).

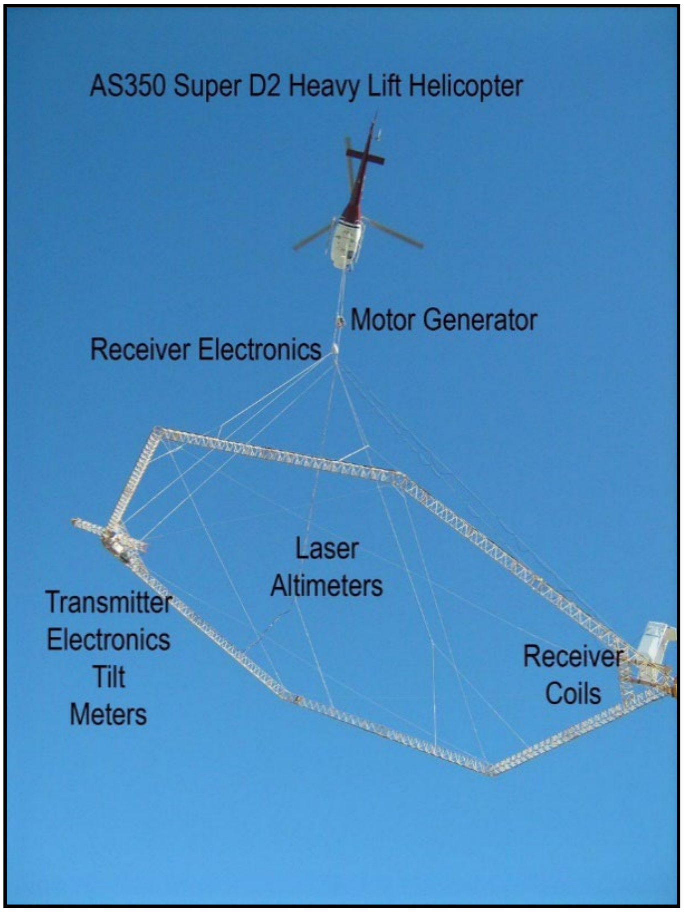


Figure 7-3: Airborne survey instrumentation

Additional data collection has now been completed (November 2018) for the Kaweah Subbasin under a new pilot program, one of four in the state proposed by Stanford University. As with the 2015 effort, data processing is being undertaken by Aqua Geo Frameworks in partnership with SkyTEM.

It is recognized that this additional data collected will enhance the understanding of the Kaweah Subbasin and its underlying aquifer characteristics, assist with the Basin Setting and Hydrogeologic Conceptual Model as necessary elements of GSPs, and provide new calibration parameters for the Subbasin numerical simulation model. The project will also provide direct benefits to the GSAs and landowners that overlie the proposed new flight lines, providing detailed subsurface information not previously available to those areas and landowners.

7.4.4.2 Status of Implementation

The fly-over data collection effort has been completed. Post-processing of the electromagnetic data into depictions of aquifer layers and geology is now underway, and the *Hydrogeologic Framework of Selected Areas of the Kaweah Sub-Basin Region in Tulare and Kings Counties, California* report, compiling all data and mapping, is included as **Appendix 7C**.

Regarding the TowTEM Project, Stanford University and TID have now secured the unit and the support equipment. The TowTEM system is currently being deployed to investigate ongoing recharge project and potential recharge projects. The most recent use of the TowTEM system was to conduct a survey of the Catron Property to determine the soil characteristics underlying that project site. The TowTEM system has also been used by Stanford and TID to help others locally and statewide to better understand their recharge projects. TID has assisted CalWater in Visalia to investigate a proposed recharge project and has surveyed a site for Sequoia Riverland Trust and Kaweah Delta Water Conservation District to provide soil lithography on a proposed recharge/habitat project at the Kaweah Oaks Preserve.

7.4.4.3 Permitting and Regulatory Compliance

All necessary permits for the project, including an FCC license due to electromagnetic wave signals, were acquired by SkyTEM.

7.4.4.4 Water Sources and Legal Authority

Not applicable.

7.4.4.5 Project Costs and Funding

The costs for the project are being paid as follows:

- $300,000 from Stanford University for data collection costs
- $160,000 from Subbasin GSAs for data collection costs
- $25,000 from Subbasin GSAs for data management by consultant(s)

7.4.4.6 Expected Benefits and Targeted Measurable Objectives

The anticipated benefits of this project include enhanced knowledge of the subbasin's geology and a more robust hydrogeologic conceptual model (HCM) description as a result. It is further anticipated that the data and resultant three-dimensional mapping will aid with the subbasin numerical model's predictive accuracy and in siting recharge projects and dedicated monitoring wells across the region for optimal and targeted recharge benefits. These benefits are expected to be realized and documented in the first five-year GSP assessment to be conducted by each subbasin GSA and submitted to DWR. Measurable objectives anticipated to be better met by virtue of this improved knowledge and resulting project planning would include groundwater level stabilization and, by proxy, groundwater storage stabilization and reductions in land subsidence rates; reduced water quality degradation may result as well.

7.4.5 *Well Characterization Project*

7.4.5.1 Description

Many agricultural wells have limited or no information as to depth, casing characteristics, or screen intervals. This project would entail video logging and spinner logging to ascertain local lithography and well production zones. Well flow/quality profiling would be used where appropriate to help determine vertical distribution of flows from aquifer zones contributing to pumping and associated water quality.

7.4.5.2 Status of Implementation

This project will be defined and pursued during the first several years of GSP implementation and progress will be documented in the succeeding five-year assessment report to DWR.

7.4.5.3 Permitting and Regulatory Compliance

Not applicable.

7.4.5.4 Water Sources and Legal Authority

SGMA, in §10725.2, allows GSAs to pursue various means to improve its understanding of the subbasin and producing wells therein. It is this general authority under which this project will be undertaken.

7.4.5.5 Project Costs and Funding

Costs associated with this project will be defined during the early stages of GSP implementation. An appropriate fee collection structure from GSA members will be determined during that time.

7.4.5.6 Expected Benefits and Targeted Measurable Objectives

Expected benefits from this project include improved understanding of groundwater production from wells within the GSA and associated aquifer responses to groundwater extraction operations. Overall improvements in characterization of principal aquifers and aquitards is expected once we are able tie specific wells and their water level and water quality information with specific aquifers. Measurable objectives are anticipated to be better met by virtue of this improved knowledge and incorporation into the Subbasin numeric model would include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduced water quality degradation.

7.4.6 *Urban Water Conservation*

7.4.6.1 Description

As referenced in Section 2.5.1.4 of the subbasin Basin Setting document, urban water usage in the future is expected to comply with the conservation mandates contained in SB 606 and AB 1668, both bills signed into law in May 2018. Based on that legislation, indoor residential use is to be capped at 55 gallons per capita per day (gpcd) in 2019 and ramped down to 50 gpcd by 2030, and outdoor residential use is to be capped in the future based on local climate and size of landscaped areas. Standards for outdoor usage are to be defined in a SWRCB rule-making process to be completed by June 2022.

7.4.6.2 Status of Implementation

The cities of Tulare and Visalia are currently evaluating their respective compliance measures for indoor use and are awaiting additional information and guidelines concerning regional outdoor and landscape compliance measures. The two cities presently are complying with the 20X2020 mandates contained in SB 7X-7 and as embodied in their respective Urban Water Management Plans (UWMPs). As the SWRCB establishes its compliance deadlines for both indoor and outdoor usage, anticipated to occur by 2025, the two city GSA Members will have a clearer picture of an implementation schedule.

7.4.6.3 Permitting and Regulatory Compliance

Urban water conservation compliance currently derives from SB7X-7 passed in 2009 (Water Conservation Act of 2009), and the UWMPs of both Tulare and Visalia, along with associated ordinances, reflect that Act's mandates of a 20 percent reduction in urban per capita water usage by 2020. Future achievements in urban conservation will be as derived from the passage of AB 1668 and SB 606 in 2018. Future amendments to UWMPs and modified ordinances of both cities will eventually embody these recent laws.

7.4.6.4 Water Sources and Legal Authority

As stated in Section 7.4.6.3, legal authorities for any additional urban water conservation will be as derived from the passage of AB 1668 and SB 606.

7.4.6.5 Program Costs and Funding

Costs to implement recent urban water conservation objectives are not known at this time. Funding would be as provided by each urban Member for their respective programs.

7.4.6.6 Expected Benefits and Targeted Measurable Objectives

Given the early implementation stages of AB 1668 and SB 606, its benefits in terms of reduced groundwater pumping by Tulare and Visalia can only be roughly approximated. The Pacific Institute, in its 2014 report "Urban Water Conservation and Efficiency Potential in California" estimated that indoor usage could be reduced by 33 to 40 gpcd, and that outdoor/landscape usage could be reduced by 20 to 50 gpcd. These values are on a statewide basis and likely unrealistic in some regions; however, the report postulates that total urban water usage could be reduced by as much as 30 to 60 percent. Savings of this magnitude would represent a significant reduction in groundwater pumping by both cities. The measurable objectives to be partially met with additional urban conservation include groundwater level stabilization and, by proxy, groundwater storage stabilization.

7.4.7 *Agricultural Water Conservation and Management*

7.4.7.1 Description

TID, as the single member of the GSA providing agricultural water service, complies with all provisions of SB 7 (amending Division 6, Part 2.55 of the Water Code) passed into law in November 2009 regarding agricultural water conservation and management. Efficient management practices in the law, related to SGMA objectives, include volumetric water pricing, incentives for conjunctive use and increased groundwater recharge, and development of an overall water budget. AB 1668 and SB 606, passed in 2018, did not materially add to these objectives, save for those districts serving between 10,000 and 25,000 acres who must now prepare water management plans under the newer laws.

While these new laws do not require water use objectives or savings thresholds, they do encourage more efficient use of water by the agricultural sector and its suppliers.

7.4.7.2 Status of Implementation

Most provisions of the conservation laws are being complied with by TID. Water management plans, as originally required by USBR with the passage of the Central Valley Project Improvement Act (CVPIA) in 1992, are being regularly prepared by the district for submittal to DWR. The District is in conformity with accuracy limits as established by the state based on a measurement verification program conducted by the Irrigation Training & Research Center (ITRC) at Cal Poly San Luis Obispo.

7.4.7.3 Permitting and Regulatory Compliance

Regulatory compliance resides with those provisions of SB7, AB 1668, and SB 606 now codified into state law.

7.4.7.4 Water Sources and Legal Authority

As an irrigation district per Division 11 of the California Water Code, TID is empowered with ensuring the beneficial use of all water thereby furnished.

7.4.7.5 Program Costs and Funding

Costs for water management plan report preparation and submittals are ongoing for TID, and any future costs related to surface water measurement compliance and associated funding would be borne by that district.

7.4.7.6 Expected Benefits and Targeted Measurable Objectives

There are no direct benefits to be derived and quantified from compliance with the aforementioned agricultural conservation laws at the present time. TID will continue to divert for beneficial use all local and imported water supplies to which it is entitled. Should agricultural demands for irrigation water diminish as a result of some of the conservation provisions, a larger portion of diverted supplies by TID will be devoted to groundwater recharge in the future.

7.4.8 *Mid-Kaweah GSA Mitigation Program*

7.4.8.1 Description

As discussed in Section 5 of this Plan, the measurable objectives for groundwater levels infer a lowering of levels over time until sustainability has been achieved by the MKGSA, the Kaweah Subbasin, and interconnected subbasins by 2040. These objectives should result in a significant reduction in the rates of decline during the GSP implementation phase as compared to pre-SGMA conditions; however, some shallow wells may experience reduced production capacity or may go dry altogether during this intervening period. This is not something new to this Subbasin or other subbasins within the San Joaquin Valley and the deepening or replacement of wells over several decades has been the norm, particularly during drought periods.

The implementation of SGMA sets in motion the alleviation of overdraft over time. Stakeholders expressed interest in helping small-system and domestic well owners that have limited financial options to service or replace their pump and well facilities. To address this situation, the MKGSA's Advisory Committee is in the process of developing the MKGSA Drinking Water Well Mitigation Program (Mitigation Program).

In Fall 2021, the MKGSA Advisory Committee received a report from Self-Help Enterprises on a rural domestic well mitigation program. MKGSA Advisory Committee members recognized the ongoing lowering of groundwater levels in achieving measurable objective groundwater elevations (see Section 5) and the need to provide mitigation for the continued decline in groundwater levels to the measurable objectives or in the worst case, the minimum thresholds (see Section 5). The MKGSA Advisory Committee established an ad-hoc committee to begin developing the Mitigation Program. A member from the disadvantaged committee seat, agricultural seat, at-large Tulare seat, and at-large Visalia seat are appointed to the ad-hoc committee. The ad-hoc committee is charged with developing a Mitigation Program that could be brought back to the MKGSA Advisory Committee for consideration and recommendation to the MKGSA Board of Directors.

At the Subbasin level, the three GSAs have committed to a Program Framework (Mitigation Framework). The Mitigation Framework is included in Section 6 of the Kaweah Subbasin

Coordination Agreement. The Mitigation Framework intends to coordinate the development of individual mitigation programs in each GSA's GSP. In the case of the MKGSA, the MKGSA Advisory Committee ad-hoc committee will be initially developing the MKGSA Mitigation Program. The Mitigation Framework establishes a scope of work and schedule for the following elements to be included in the MKGSA Mitigation Program:

- Identify Need for Mitigation – Identify the wells or land uses that will potentially require mitigation. The Kaweah Subbasin GSAs have initially determined, through the data set used for Chronic Lowering of Groundwater Levels SMC, the initial number of wells that may be impacted from groundwater levels reaching needing mitigation. The MKGSA plans to refine this analysis to improve upon the identification of wells impacted from lowering groundwater levels. The MKGSA will also investigate impacts from land subsidence on wells and surface water channels as outlined in Chapter 4.

- Evaluation – Once the wells and land uses have been identified, the MKGSA shall determine the type and degree of impacts from lowering groundwater levels and land subsidence.

- Qualification – The MKGSA will determine the qualification for access to mitigation per rules and regulations, policies, or emergency ordinances put in place by the MKGSA.

- Mitigation – The MKGSA shall identify the appropriate mitigation measures to be applied to the impacts. Initial discussions of mitigation efforts are discussed in the Mitigation Framework document in the Coordination Agreement.

- Outreach – The MKGSA will implement a robust outreach program in addition to outreached managed at the Kaweah Subbasin level through the Mitigation Framework. The MKGSA Advisory Committee shall play a pivotal role due to the presence of the beneficial users that are represented on the Committee. Further workshops and materials presented in multiple languages shall be provided.

- Mitigation Program Adoption Schedule – As a participating GSA in the Coordination Agreement, the MKGSA has agreed to develop a Mitigation Program by June 30, 2023. This date will be used by the Advisory Committee Ad-Hoc Committee as the deadline for development of a Mitigation Program by the MKGSA Board of Directors. The MKGSA will also be working with the Kaweah Subbasin GSAs to establish an Interim Domestic Well Mitigation Program to provide immediate assistance to well owners for the period between now and the implementation of the Mitigation Program.

- Mitigation Program Funding Source – The Kaweah Subbasin GSAs will investigate and pursue grant funds and other financial support to fund mitigation efforts. Beyond the funding identified at the subbasin level, the MKGSA will be developing a funding source to cover the costs not determined at the subbasin level.

- Annual Reporting and Mitigation Evaluations – The MKGSA shall be responsible for providing the necessary data and information to provide updates in the Annual Reports submitted to DWR.

The Mitigation Workplan establishes a schedule for developing Workplan Elements. The schedule can be found in the Coordination Agreement, Appendix 6. The schedule calls for the Kaweah Subbasin coordinated elements to be completed by Quarter 3 of 2023. The individual GSAs are striving to complete GSA-specific Drinking Water Well Mitigation Plans by December 31, 2023.

7.4.8.2 Subbasin Drinking Water Well Mitigation Program Elements

Chronic Lowering of Groundwater Levels

The chronic lowering of groundwater levels SMCs are developed by the Kaweah Subbasin GSAs to protect the relevant and applicable beneficial uses and users of groundwater in the Subbasin. Beneficial users of groundwater are domestic pumpers, disadvantaged communities, small water systems (2 to 14 connections), municipal water systems (>14 connections), agricultural pumpers, California Native American Tribes, environmental users, and entities engaged in monitoring and reporting groundwater elevations.

Since wells are how users access groundwater, the approach used to develop SMC is based on water supply well depths. The depth of wells across the Subbasin varies by depth to groundwater and beneficial user type. Because of well depth variability, the Subbasin is subdivided into analysis zones based on GSP management area boundaries, clusters of beneficial user types, aquifers, and completed well depths. Completed well depth statistics inform significant and unreasonable groundwater levels, with the SMC being based on protecting at least 90% of all water supply wells in the Subbasin.

Minimum thresholds 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.

A total of 3,758 water supply well records are available in the Subbasin since 2002 (**Appendix 5C**). Of these, 3,353 supply well records, or about 89% have well depth statistics and are used for identifying significant and unreasonable groundwater elevations for beneficial groundwater users and uses (**Appendix 5A**). Most wells in the Subbasin are completed to depths between 100 and 700 feet. The most common completed well depth is 350 to 400 feet. Well depth by type and aquifer was reviewed to assess which beneficial users would be impacted by lower groundwater levels. Most supply wells in the Subbasin are either used for agricultural or domestic water supply. Agricultural wells are more numerous than other types of water supply wells and cover the widest range of depths, including the deepest depths of all wells. The shallowest wells tend to be domestic supply wells with few domestic wells installed deeper than 450 feet. There are relatively fewer public supply wells, with the majority less than 450 feet deep, although there are some that are deeper than 800 feet.

A statistical approach using percentiles was taken to develop a realistic view of active wells given well status uncertainties. A percentile well depth, or percentage of wells that would be deeper than a particular depth, was calculated for each analysis zone and aquifer. For example, the 90th percentile well depth (for wells ranked from deepest to shallowest), is the depth that 90% of wells are deeper than or equal to. This means 10% of wells are shallower than the 90th percentile depth. The 10% shallowest completed well depth are not used in the analysis because their status may be uncertain and they may not reflect standard well design practices.

The number of well records in the WCR dataset with construction information, above or below the protective elevation are summarized in Table 7-3**.** Some of these shallow wells are likely destroyed and replaced with deeper wells, Domestic well depths tend to be shallower than wells used for other purposes, so a slightly higher number and percentage of domestic wells are potentially impacted by groundwater declines compared to other wells. Of the 297 wells shallower than the 90th percentile well depth, 58% are domestic wells, 39% are agricultural wells, and 3% are public supply wells. However, in total, 90% of all well types installed since January 2002 are deeper than protective well depths, including 88% of domestic wells, 94% of agricultural wells, and 92% of public supply wells. Although the full set of WCR wells lacks construction information for many wells, MKGSA assumed the percentages of well use type and depth are the same for the full set of WCR wells as the subset of wells with construction information. Therefore, the subset percentages may be used to scale up the number of potentially impacted wells to the full set of WCR wells. Table **7**-**4** summarizes the potential number of wells within MKGSA that may be impacted using the full dataset that includes well records without construction information. From this analysis, approximately 22 domestic wells may be impacted.

Table 7-3: Summary of Basin wide Potential Well Impacts of Groundwater Levels at 90% Protective Depths

Well Use Type	Deeper than 90% Protective Depth		Shallower than 90% Protective Depth		Total Number
	Number of Wells Deeper than the Protective Depth	Well Use Type Percentage	Number of Potentially Impacted Wells	Well Use Type Percentage	
Domestic	1,193	39%	171	58%	1,364
Agricultural	1,742	57%	117	39%	1,859
Public Supply	108	4%	9	3%	117
Industrial	13	0%	0	0%	13
Total	**3,056**		**297**		**3,353**

Table 7-4 **Mid-Kaweah GSA Potentially Impacted Wells**

Well Use Type	Well Records with Known Depth			All Well Records		
	Number of Wells	Number of Potentially Impacted Wells	Percentage Potentially Impacted Wells	Number of Wells	Number of Potentially Impacted Wells	Density of Impacted Wells (wells / square mile)
Domestic	214	17	8%	269	22	0.13
Agricultural	309	18	6%	354	21	0.13
Public Supply	37	0	0%	41	0	0
Industrial	3	0	0%	4	0	0
Total	**563**	**35**		**668**	**43**	**0.26**

Land Subsidence

The Kaweah Subbasin GSAs have identified potential impacts to domestic, municipal, and public water supply wells due to subsidence. The most common impact to wells is the failure of well casings due to the increased compaction of fine soils that exert increased pressures on well casings. Many of the wells in the Subbasin are shallow and subject to only small amounts of subsidence. However, the Kaweah Subbasin GSAs believe that where substantial subsidence could cause well failure, mitigation measures can be provided. The Kaweah Subbasin GSAs have investigated mitigation measures such as providing swaging of well casing failures (a sleeve is installed to repair the failure), or pre-installation preventative measures such as compression sleeves that allow for some vertical deformation in well casings. The Kaweah Subbasin GSAs plan to develop a methodology for determining criteria that would support well failures resulting from subsidence, and criteria for installing new wells that would allow new well installations to be considered for pre-mitigation measures such as subsidence compression sleeves.

7.4.8.3 Status of Implementation

This is a high-priority Program that is necessary to mitigate the impacts of declining groundwater levels and land subsidence and to provide water supply to meet basic health and safety needs. The MKGSA Advisory Committee has appointed an ad-hoc committee to develop a Mitigation Program that will be presented to the Advisory Committee for consideration and recommendation to the MKGSA Board of Directors. Per the Kaweah Subbasin Mitigation Program Framework, the objective is to have this for consideration by the MKGSA Board of Directors by June 30, 2023. During program development, the Kaweah Subbasin GSAs are developing an Interim Domestic Well Mitigation Program to provide limited mitigation funding.

7.4.8.4 Permitting and Regulatory Compliance

The public and relevant entities will be given the opportunity and time to comment on the Program prior to adoption by the GSA.

The MKGSA is required to comply with any CEQA requirements prior to approval and implementation of the Mitigation Program. No other permits or other regulatory requirements are expected to be necessary for the Program at this time.

In providing mitigation to local drinking water well for declining groundwater levels or subsidence, any work required to mitigate for those impacts will require a well drilling or modification permit from the County of Tulare.

7.4.8.5 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities to "perform any act necessary or proper" to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. Because the DWR is required to evaluate whether the GSP provides a reasonable means to mitigate for continued overdraft, a mitigation program is a necessary or proper act to implement SGMA. (23 CCR §355.4(b)(6).)

Legal authority to implement any of the aforementioned assistance measures resides with the GSA's and its Members' ability to implement such actions deemed necessary to achieve its specific and limited purposes as stated in the Joint Powers Agreement referenced in Section 1.2 of this Plan.

7.4.8.6 Program Costs and Funding

The GSAs in the Kaweah Subbasin are coordinating the identification and securing of State of California and/or Federal funds to assist in the Mitigation Program. The State has many existing grant programs for community water systems and well construction funding. County, State, and federal assistance will be needed to successfully implement the Mitigation Program. The GSAs will work with local NGOs that may be able to provide assistance or seek grant funds to help finance the Mitigation Program.

Funds not secured at the Kaweah Subbasin level will need to be secured by the MKGSA. The MKGSA is working with an ad-hoc committee of the MKGSA Advisory Committee to establish the MKGSA Mitigation Program and will be investigating local resources to provide mitigation not funded by grant funds. Initial discussions at the ad-hoc committee have been to investigate local land assessment, groundwater pumping fees, or impact fees to fund the Mitigation Program.

Table 7-5 includes preliminary estimated costs for implementing the Program. These will be refined during Program development and finalized prior to efforts to secure funding.

Table 7-5: Estimated MKGSA Mitigation Program Costs

Item	Description	Estimated Cost
Develop Policies and Procedures	Each GSA will have consulting and legal costs to develop the Program policies and procedures, which costs will vary by GSA.	$150,000
Develop Funding	The Subbasin will collaborate with programs and funding sources that already exist. Each GSA will need to develop long-term funding. This could include preparation of grant applications, a loan, or other options. These costs will vary by GSA.	$125,000
Public Outreach	Public outreach will be performed in each GSA. These costs will vary by GSA and will be refined during development of the Program.	$60,000
Project Administration	General administration costs for the Program will vary by GSA and will be determined during the development of the Program.	$45,000
Well Mitigation	Well mitigation costs will vary by GSA and location within each GSA in accordance with groundwater levels and the specific minimum thresholds that have been determined. An estimate of well mitigation costs will be developed by each GSA as part of their Program development and funding plan development.	$1,050,000
	Estimated Total Cost	**$1,430,000**

Cost Summary:

- Develop Policies and Procedures – assumes 940 staff hours (Interim General Manager and Water Resources Engineer) at an average hourly rate of $80 per hour. It also includes $25,000 in legal fees and $50,000 in hydrogeologist fees to assist.
- Develop Funding – assumes three grant applications at the Kaweah Subbasin level with a cost share of 33% of a grant application costs of $25,000 each. The costs also assumes the need to conduct a Prop 218 process at the MKGSA level to establish a funding stream not covered by potential grants and is estimated at $100,000 for an Engineer's Report, ballots, public noticing, public outreach and a public hearing.

- Public Outreach – includes 12 public workshops at $2,000 each (total of $24,000), monthly public noticing mailers at $1,500 per month (total of $18,000), translation services estimated to be $12,000, and development of flyers at $6,000.
- Project Administration – assumes mitigation applications for approximately 25 wells that require 5 total working days each to administrate (total of 40 hours). A rate of $50 per hour was used (District Water Resources Engineer), which means that each well will take approximately $2,000 in administrative costs. For all 25 wells this would be approximately $45,000.
- Well Mitigation – the average cost of a domestic (drinking water) well was estimated to be $50,000 per well based on conversation with local drilling companies. If the MKGSA estimates that 21 wells will require mitigation for chronic lowering of groundwater and for subsidence (new well drilling costs include the potential subsidence sleeve) then the total costs of replacement wells would be $1,050,000. The MKGSA is currently evaluating the costs associated with mitigation, which may not include the full replacement of a well.

7.4.8.7 Expected Benefits and Targeted Measurable Objectives

The proposed Program will directly mitigate impacts due to the following:

- Chronic lowering of groundwater levels; and
- Land Subsidence.

The Mitigation Program will provide a direct benefit to the beneficial users in the GSA who have had their well or land use impacted because of continued overdraft conditions while the GSA implements other project and management actions to achieve sustainability. The metric for measuring program benefits will be the number of impacted wells and/or extent of land uses that are mitigated under this Program.

The benefit of implementing the Mitigation Program is to ensure that ongoing groundwater extractions due to the lack of surface water will be mitigated such that beneficial users of groundwater can be safeguarded against any future declines down to the prescribed MTs (set in Section 5) are mitigated and water is available for household use. The Mitigation Program will not impact groundwater extractions or recharge.

7.4.9 *Collaboration with Other Agencies*

MKGSA intends to collaborate and partner with other regulatory agencies during GSP implementation to ensure that its minimum thresholds and measurable objectives as set forth in Section 5 of this Plan are maintained and that the water quality objectives of these other entities are achieved. The means to achieve such collaboration include:

1. Provide Education and Information

- Groundwater Basin Conditions
- Funding Opportunities
- Remediation/Treatment Technologies

2. Active GSA Coordination with Water Quality Agencies and Coalitions
   - Participate in meetings (salinity prioritization & optimization study, management zones) as a contributor of information, but also seeking information
   - Exchange/Share groundwater quality data and information between GSAs and other groundwater quality leads
   - Request information to better inform 5-year GSP updates, include data in DMS as it becomes publicly available
3. Identify, Pursue, Administer Grants in Partnership with Water Quality Agencies

Other forms of collaboration are underway as well, to and including that with NASA's Airborne Snow Observatory (ASO). Information from the ASO program centered on the Kaweah and San Joaquin River watersheds will aid with surface water management in ways to optimize reservoir releases for irrigation demand and groundwater recharge. Having greatly improved data regarding snowpack and water content will assist surface water managers with avoiding untimely reservoir releases and spills out of the subbasin and Tulare Lake regional watershed and subsequent loss of water otherwise available for recharge.

7.5 Implementation Plan

7.5.1 *Implementation Schedule*

Shown on Figure 7-4 is a bar chart depicting completion/implementation dates for the relevant projects and management actions as identified in this Section 7.

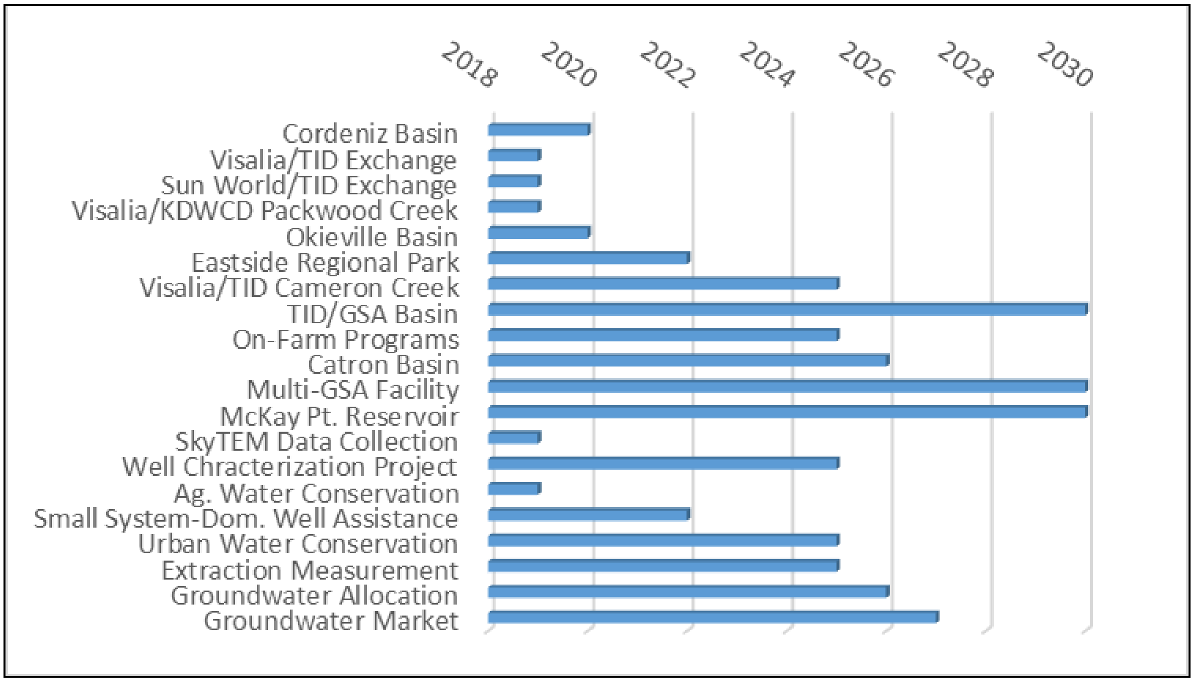


Figure 7-4: Project and Management Action Implementation Dates

As highlighted in Section 7.2 and further articulated in Section 7.5.2, the water supply availability of the Members within this GSA, coupled with this GSA's assigned share of the Subbasin water budget as articulated in Section 6 of this Plan, is such that it is reasonable to assume that implementation of targeted recharge projects as summarized in Section 7.3 will address most, if not all, of the undesirable results identified by this and other Subbasin GSAs. It is, therefore, the objective of the MKGSA that preference be given to the development and implementation of projects prior to implementation and enforcement of an extraction allocation program to achieve sustainable yield by 2040 and to ensure achievement of the sustainability goal in concert with other Subbasin GSAs during the 50-year planning and implementation horizon as called for in §354.42 of the Regulations.

In addition, it is the intent of the Members to pursue all projects described in Section 7.3 with the understanding that each will exhibit specific and targeted benefits to individual Members as well as generalized added water benefits to the GSA region. Notwithstanding this intent, some of the more facility-intensive and thus costly projects may be given a lesser priority in terms of completion timeframes as compared to, for example, the on-farm recharge programs under evaluation by TID. Refinement of project selection criteria will occur as GSP implementation commences in 2020.

Upon implementation of this Plan and via annual reporting thereon and at five-year assessments to be provided to DWR (per §356.2(c) and 356.4 of the Regulations, respectively), this assumption regarding projects and associated objectives will be re-evaluated. Should some projects not be on-line and/or future hydrology prove inadequate to provide needed recharge supplies, the measurable objective and interim milestone triggers defined in Section 5 of the Plan will dictate more aggressive implementation of a groundwater allocation program as summarized in Section 7.4.2, in accordance with §354.44(b)(1)(A) of the Regulations.

As planning and permitting for applicable projects and management actions proceeds, the GSA shall use its Advisory Committee input, Communications and Engagement Plan, and existing stakeholder outreach efforts (all as summarized in Section 1.5 of this Plan) to inform the general public and stakeholders of the intent to pursue said projects and management actions. Similar public notification processes will be adhered to as required for CEQA and NEPA compliance where applicable for projects. The public notification process is to address §354.44(b)(1)(B) of the Regulations.

7.5.2 *Cumulative Accomplishments*

The focus of the groundwater benefits as quantified in Section 7.3 relate to water added to the groundwater budget. Commensurate increases in water levels and, for many of the projects, water quality would occur. These benefits, however, depend on other hydrogeologic factors and, in the case of water levels, are less discernable on an individual project basis. Section 5 of this Plan discusses how the MKGSA intends to address minimum thresholds and measurable objectives using empirical data, computer model output and a proxy relationship between water recharge and water level changes. Further study of these hydrogeologic factors across the Subbasin will be pursued with application of the Subbasin numerical model presented in the Basin Setting.

Based on the anticipated completion schedule and average annual groundwater benefits provided by the applicable projects, the graph on Figure 7-5 depicts the accrual of said benefits to the GSA's water budget. Accrued benefits amount to about 25,000 AF annually by 2030 based on the assumptions employed coupled with surplus water supply availability with the projects' planned capacities which is deemed realistic as Tulare ID has access to 141,000 AF of Class 2 supplies and even in wet year is not able to fully utilize this contract supply. This is depicted in the figure by the "Cumulative Added Storage" line and reflects all projects operating at maximum capacity during wet years, which amounts to nearly 360 cfs. TID's current diversion capacity is 1,000 CFS and during the wet years our demand/recharge programs have been running about 700 CFS during the winter months. This flowrate may at times exceed the available diversion capacity (not needed for irrigation demand) of TID's intake conveyance system into the MKGSA region, and therefore it cannot be assumed that all projects could receive water at their respective design capacities during such times of limitation.

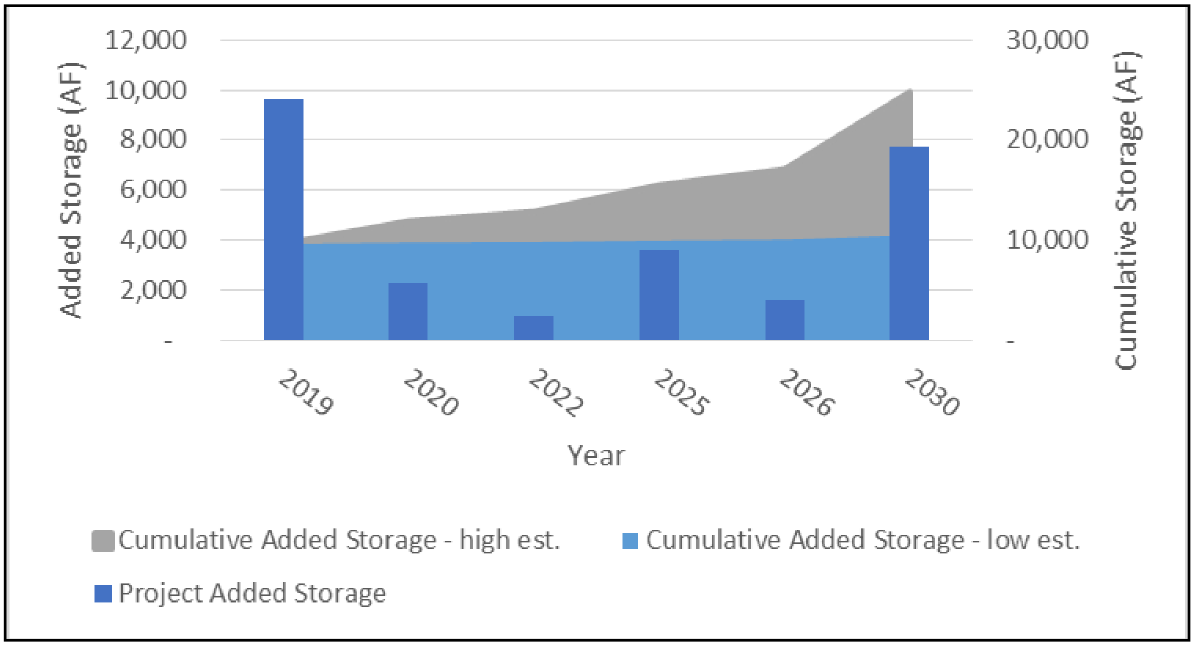


Figure 7-5: Estimated Cumulative Added Storage

These annual and aggregate benefits expressed on an average basis may, of course, be significantly different as a function of future hydrology. The five-year assessments and associated information related to project benefits to be submitted to DWR will make apparent any such runoff patterns.

With all planned projects online, it may well be the case that surplus water diversion allotments on a daily basis from the Kaweah River and/or the Friant Unit of the CVP are insufficient to sustain full project capacity. This might occur due to other Kaweah appropriators claiming larger shares of flow allocations historically turned down or conveyance capacity limitations within the upper reaches of the Friant-Kern Canal causing a pro-rate among those competing for diversion capacity. However, this may be tempered somewhat for the foreseeable future due to the fact that the Kaweah Subbasin diversion structures along the canal are all upstream of the subsidence reaches causing severely limited access to water in lower reaches such as in the Tule Subbasin region.

The Friant WA report referenced in Section 7.6 includes estimated volumes of surplus flows to each Friant contractor for five-year types ranging from wet to critically dry. These assumed volumes coupled with the depiction of surplus days from Table 7-7 in that section result in an implicit assumption of a surplus flow diversion rate in the range of only 225 cfs from the Friant-Kern Canal as shown in Table 7-6, some of which may be taken up to meet irrigation demands if not met by Kaweah supplies during these surplus periods.

Table 7-6: Surplus Flow Diversion Rate from the Friant-Kern Canal

Year Type	Category	Surplus Water (*) (taf)	No. Days Occurrence	Diversion Rate (cfs)
I	Critical-Dry	0	0	
II	Dry	16.2	35	233
III	Normal-Dry	13.9	32	219
IV	Normal-Wet	37.7	86	221
V	Wet	49.8	111	226

*Friant surplus water includes Class 2, Other, 16(b) and Recirc. (by exchange) as determined in FWA report "Estimate of Future Friant Division Supplies for Use in Groundwater Sustainability Plans" (see Appendix 2A in Basin Setting report)

To refine surplus water availability any further is beyond the scope of this analysis, and the adaptive management approach utilized in the GSP five-year assessments will reveal a clearer picture of the projects' accomplishments. In the interim it is assumed that the projects' recharge capabilities could range from a high of 25,000 AF per year to a low of 10,000 AF per year. This range of recharge accomplishments is depicted in the "Cumulative Added Storage" bandwidth on Figure 7-5 and is a more conservative and suppositional estimate of the water storage benefits of the projects as described in Section 7.3.

Using the methodologies summarized in Section 7.2 and detailed in Section 7.6, the projects for which quantifiable water-added benefits will operate so as to build groundwater in storage over time can be assumed. These benefits are expressed on an average annual basis, and the detailed analyses indicate that depletions in storage during droughts, such as those that occurred during the 90-year historical hydrologic period of simulation, are more than replenished during the wet-year recharge cycles. As stated in Section 7.4.2, should actual projects' operations dictate otherwise during the implementation phase, groundwater extraction allocations will be initially employed across non-de minimis well owners such that extractions in dry periods do not exceed the projects' recharge capabilities in wet periods, all in accordance with §354.44(b)(9) of the Regulations.

7.5.3 *Relationship to Measurable Objectives*

The approach utilized in setting measurable and optimal objectives, as explained in Section 5 of this Plan, reflects the realistic completion schedule for the projects in Section 7.3 and their respective groundwater benefits on an average basis. As a worst case, an additional scenario where only management actions would be employed to achieve sustainability is described as well. The projects' collective ability to add to the GSA's water budget deficit thus dictates an optimal objective for the sustainability indicator keyed to reductions in groundwater storage, and the more conservative measurable objective is based on management actions to adhere to historical trends for a limited duration (2030). Also as discussed in Section 5 of this Plan, a numeric model simulation is used to develop an optimal objective for the sustainability indicator keyed to lowering of groundwater levels. In addition, an empirical relationship based on historical data is summarized in this section to also add credence to the anticipated water level gains with the advent of additional groundwater recharge afforded by the projects.

Gains in storage achieved by the projects will be better ascertained than commensurate water level increases. Water levels are significantly influenced by the implementation efforts of neighboring

GSAs, both on an intra- and inter-basin level. The application of the Kaweah Subbasin numerical model, as previously noted, will be used to aid in determining water level changes as a result of project implementation by this and surrounding GSAs.

7.6 Benefits Analyses

7.6.1 *Surplus Water Recharge Analysis*

As described in Section 1 of this Plan, the MKGSA region, primarily via the conjunctive-use operations of TID, has benefited from historical practices of groundwater recharge. There are, however, wet seasons and years during which local Kaweah River flows and surplus entitlements from the Friant Unit are not imported into the area because all such facilities are at capacity. TID's allotments from these sources ramp up significantly in wet seasons and, as such, are ideally suited for groundwater recharge projects and programs. Through historical operations, records, and communications with water facility managers, Table 7-7 has been utilized both by TID and the MKGSA to assess the future availability of CVP/Friant and Kaweah River surplus sources.

As indicated in Table 7-7**,** between the two sources there exist about 54 days on average during which surplus flows are available for diversion and recharge. The number of days from each source individually are not additive, as there occur overlapping days within certain months, particularly in the wetter year types. That some of these surplus diversion capacity estimates during the months of January to June may be taken up with limited irrigation demands may be the case; however, it is beyond the scope of this analysis to assume future irrigation patterns as they relate to surplus flow availability. For the on-farm programs described in Section 7.3, only the months of January to March were assumed for delivery of surplus flows to participating grower lands, bringing the average number of surplus flow days down to about 20 on average.

Table 7-7: Surplus CVP Availability

Uncontrolled Season Months[1]								
Year Type	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Total**	**Frequency of Occurrence**
I				0			**0**	0.35
II		0	4	25	7		**36**	0.15
II		0	9	16	7		**32**	0.2
IV		10	15	30	31	0	**86**	0.15
V	5	10	20	30	31	15	**111**	0.15
Wt. Avg.							**41**	
[1] The numerical entry denotes # days in months during which Uncontrolled Season Class 2 supplies are assumed to be available under climate change scenarios as projected by Friant WA's Technical Memorandum Dec. 2018								
Surplus Kaweah River Availability[2]								
Year Type	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Total**	**Frequency of Occurrence**
I	0	0	0	0	0	0	**0**	0.35
II	0	0	0	0	0	0	**0**	0.15
II	2	2	2	2	4	4	**16**	0.2
IV	4	6	10	11	9	9	**49**	0.15
V	10	9	6	10	6	8	**49**	0.16
Wt. Avg.							**18**	
[2] The numerical entry denotes # days of spill to Tulare Lake Bed from Lower Kaweah and St. Johns channels under climate change projections for 2030 and 2070								
Combined SVP Surplus + Terminus Flood Release Months								
Year Type	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Total**	**Frequency of Occurrence**
I	0	0	0	0	0	0	**0**	0.35
II	0	0	4	25	7	0	**36**	0.15
II	2	2	11	18	11	4	**48**	0.2
IV	4	16	25	30	31	9	**115**	0.15
V	15	19	26	30	31	23	**144**	0.16
Wt. Avg.							**54**	

Under the auspices of USBR, in 2011, TID conducted a System Optimization Review (**Appendix 7D**), and in it an estimation of surplus flows from the Kaweah River was made. This analysis (shown in Table 7-8) indicated 70 such days on average but acknowledged that the 1996 to 2006 period of analysis was wetter than average and was determined on a watershed basis, not just for TID's particular service area. The analysis nevertheless corroborated the use of a conservative count of 19 days of Kaweah surplus flows, on average accessible by TID which, unlike the empirical analysis, is based on operational history. Furthermore, it may be assumed that other water rights holders along the Kaweah River system and members of other Kaweah Subbasin GSAs may, for purposes of SGMA compliance, incorporate projects to take advantage of flood release flows to which they are entitled (the Kaweah River is designated as a "fully appropriated stream system" by the SWRCB) but have historically allowed to be reallocated to others, including TID, by policy of the KSJRA Watermaster. Thus, the use of a more conservative estimate of surplus flows accessible to TID is warranted for this analysis and the projected water budget.

Table 7-8: Estimated Surplus Flow from the Kaweah River

Surplus Flow Analysis for Kaweah River						
CY	**Dates**		**Duration (days)**	**Volumes (AF)**	**Avg. Rate (AF/Day)**	**Annual Total (AF)**
1996	1/18	4/11	84	-	-	-
1997	2/15	3/22	35	384,000	10,970	
	11/16	11/22	6	2,000	333	
	12/12	12/19	7	12,000	1,710	398,000
1998	1/16	7/19	184	663,000	3,600	
	11/15	11/16	11	19,000	1,730	
	12/9	12/17	8	9,800	1,230	691,800
1999	1/21	3/1	39	39,000	1,000	39,000
2000	2/15	3/22	36	68,000	1,890	
	11/16	11/22	6	7,000	1,170	
	12/12	12/19	7	8,000	1,140	83,000
2001	3/1	3/9	8	9,600	1,200	
	5/19	5/26	7	26,000	3,710	
	12/6	12/16	10	13,000	1,300	48,600
2002	12/31	1/11	11	25,600	2,330	
	2/11	2/25	14	20,378	1,460	
	11/10	11/22	12	49,000	4,080	
	12/10	12/22	12	15,000	1,250	109,978
2003	1/9	1/18	9	16,000	1,780	
	2/10	2/23	13	22,500	1,730	
	5/19	6/6	18	96,000	5,330	
	12/15	12/22	7	7,300	1,040	141,800
2004	1/6	1/13	7	15,000	2,140	
	3/29	4/6	8	18,000	2,250	
	11/16	11/23	7	8,300	1,190	
	12/15	12/21	6	7,800	1,300	49,100
2005	1/5	2/1	27	56,600	2,100	
	3/28	4/25	28	55,000	1,960	
	5/16	6/2	17	92,300	5,430	
	12/12	12/22	10	15,600	1,560	
2006	1/3	1/21	18	51,600	2,870	
	2/14	2/24	10	19,000	1,900	
	3/21	6/14	85	320,000	3,760	390,600
Avg.			69.7			

Utilization of these flows by TID/MKGSA is entirely within the water rights hierarchy as administrated by the local Watermaster and CVP contract entitlement allotments made by the USBR. Surplus CVP availabilities as indicated in Table 7-8 are derived from application of the Technical Memorandum (TM) “Estimate of Future Friant Division Supplies for use in Groundwater Sustainability Plans,” Friant Water Authority, December 2018, included as an appendix to the Basin Setting report (**Appendix 2A**). The TM reflects an assumed climate change scenario for the San Joaquin River Watershed. Kaweah River flood month data are as adjusted by the climate change treatise contained in that report (an appendix to Section 2 of the GSP), and as summarized in

Section 2 of this Plan. Peak flows are projected to decrease by about five percent and shift in occurrence from May back to March. TID's historical data summarizing surplus flow days by month were adjusted accordingly.

Shown on Figure 7-6 is a graphical depiction of Table 7-8, in which the colored bars indicate the number of surplus days in each of the months January to June for dry, average, and wet year types.

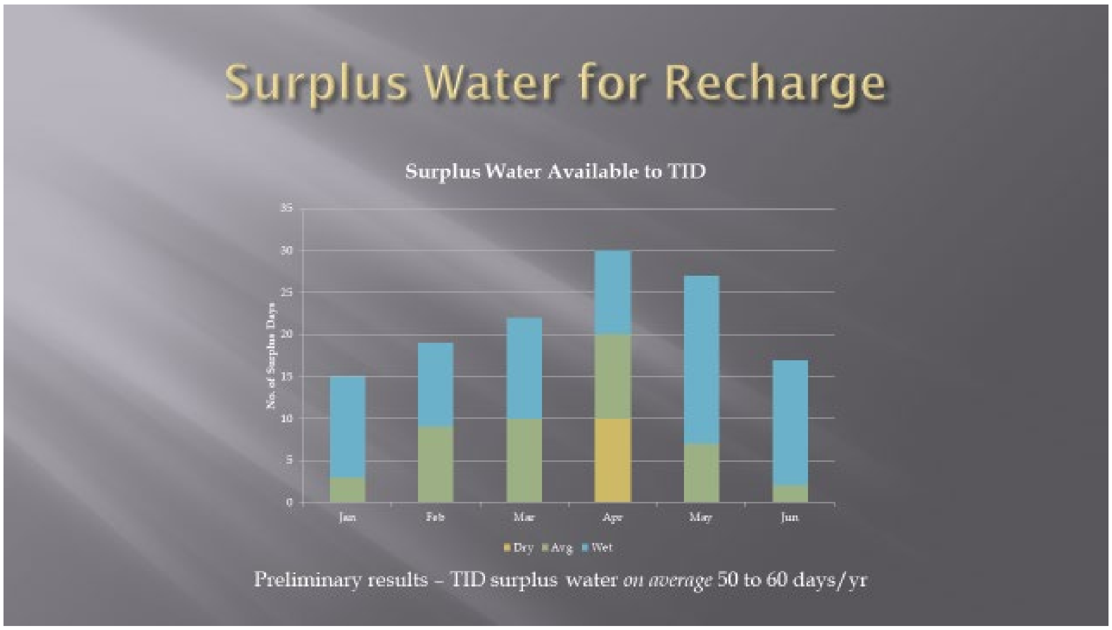


Figure 7-6: Surplus Water for Recharge

The data in Table 7-8 have been overlaid against a 90-year historical period of record to determine, by year type I – V, the number of days in each year during which additional recharge may be conducted assuming the presence of new projects/programs.

For the new groundwater recharge projects listed in Section 7.3, an assumed infiltration rate of 0.5 feet per day has been assumed in this analysis, which is representative of an average across soil types found in the MKGSA region. For a few of the projects, specific soils information is available and other rates are utilized. Soil borings and other data collected during the detailed planning and permitting stages of these projects will help refine the anticipated recharge benefits. The on-farm programs assume a lesser infiltration rate of 0.25 feet per day given canal turnout and field capacity limitations. For the joint-participation facility within the Greater Kaweah GSA, an infiltration rate of 0.75 feet/day is assumed due to differing soil types in that easterly region of the Subbasin.

Diversion capacity in existing conveyance facilities serving TID and city recharge locations is generally under-utilized in the months of January through June. TID operators indicate that 200 to 300 cfs of unused intake capacity is available during these months and at times more, even in wet years when irrigation demands are low. More is expected to be available with construction of the St. Johns and Lower Kaweah River Siphon improvement projects listed in Section 7.1 and described further herein.

The recharge analysis combines the assumed surplus water availability data in Table 7-8**,** infiltration rates, and total acreage of the groundwater recharge projects listed in Section 7.1 to produce an average annual recharge benefit for these projects in the aggregate. Based on relative acreage of each, individual recharge benefits are determined as well. For an assumed diversion rate of 200 cfs dedicated to new projects, the graph shown on Figure 7-7 below depicts the relationship between maximum recharge capacities needed vs. average annual recharge achievements.

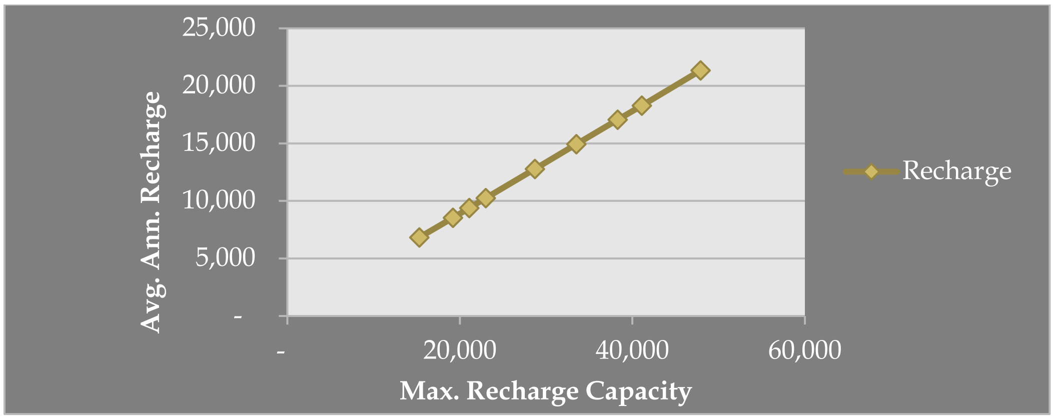


Figure 7-7: Recharge Capacities and Achievements

(values in AF)

The full spreadsheet analysis from which the graph is derived is included for each project in **Appendix 7E**. The spreadsheets contained therein depict, on a yearly time step, the operation of the several recharge projects and their capture of wet-year surplus flows for added water budget benefits to the GSA area.

7.6.2 *Flood Flow Capture Analysis*

For new local surface storage projects, an approach similar to that applied in Section 7.2.1 was utilized, and Table 7-8 data for the Kaweah River system indicates 19 days (as adjusted by assumed climate change on Kaweah River runoff) on a weighted average basis during which surplus flows may be diverted into new surface storage. This surplus flow availability is overlaid against the historical hydrologic period to determine the frequency and storage volumes achievable for an assumed reservoir capacity. The full analysis over the aforementioned historical period of record is as depicted in **Appendix 7E**. The spreadsheets contained therein depict, on a yearly time step, the operation of the storage facility and its capture of flood waters over time to then be regulated for delivery into the GSA area.

For the Temperance Flat Reservoir Project on the San Joaquin River, a detailed yield analysis is premature since this project, if built, is not expected to be operational for another 20 years or so but could be completed within the SGMA 50-year planning and implementation horizon. TID, along with other public entities in Tulare County and within the Friant and larger CVP service areas, would determine its level of storage participation in the project and utilize this for improved management of river flows over and above San Joaquin River Restoration Project (SJRRP) requirements that otherwise leave the San Joaquin Valley and enter the Sacramento-San Joaquin Delta. As an approximation, preliminary design and operational simulations indicate an average annual yield of 150,000 AF and TID's participation level may be 10 percent thereof, or 15,000 AF.

7.6.3 *Water Exchange Analyses*

Similar to the determination of surplus water availability applied for recharge projects and as described in Section 7.6.1, this same methodology using TID's projected surplus CVP sources was coupled with the exchanging entity's projected local supply (WWTP treated effluent in the case of Visalia; local Kaweah water in the case of Sun World) to determine the net gains in water diverted into the GSA region and additive to its water budget over time. The full analysis over the aforementioned historical period of record for each of these exchange programs is depicted in **Appendix 7E**. The spreadsheets contained therein depict, on a yearly time step, the operation of the two-way exchanges providing additional water to the GSA area.

7.6.4 *Other Analyses*

One in-channel recharge project, i.e., the Packwood Creek Water Conservation Project, has associated with it a calculation of average annual recharge quantities determined as part of a USBR WaterSMART grant application submitted by the KDWCD. That calculation is included in **Appendix 7E**.

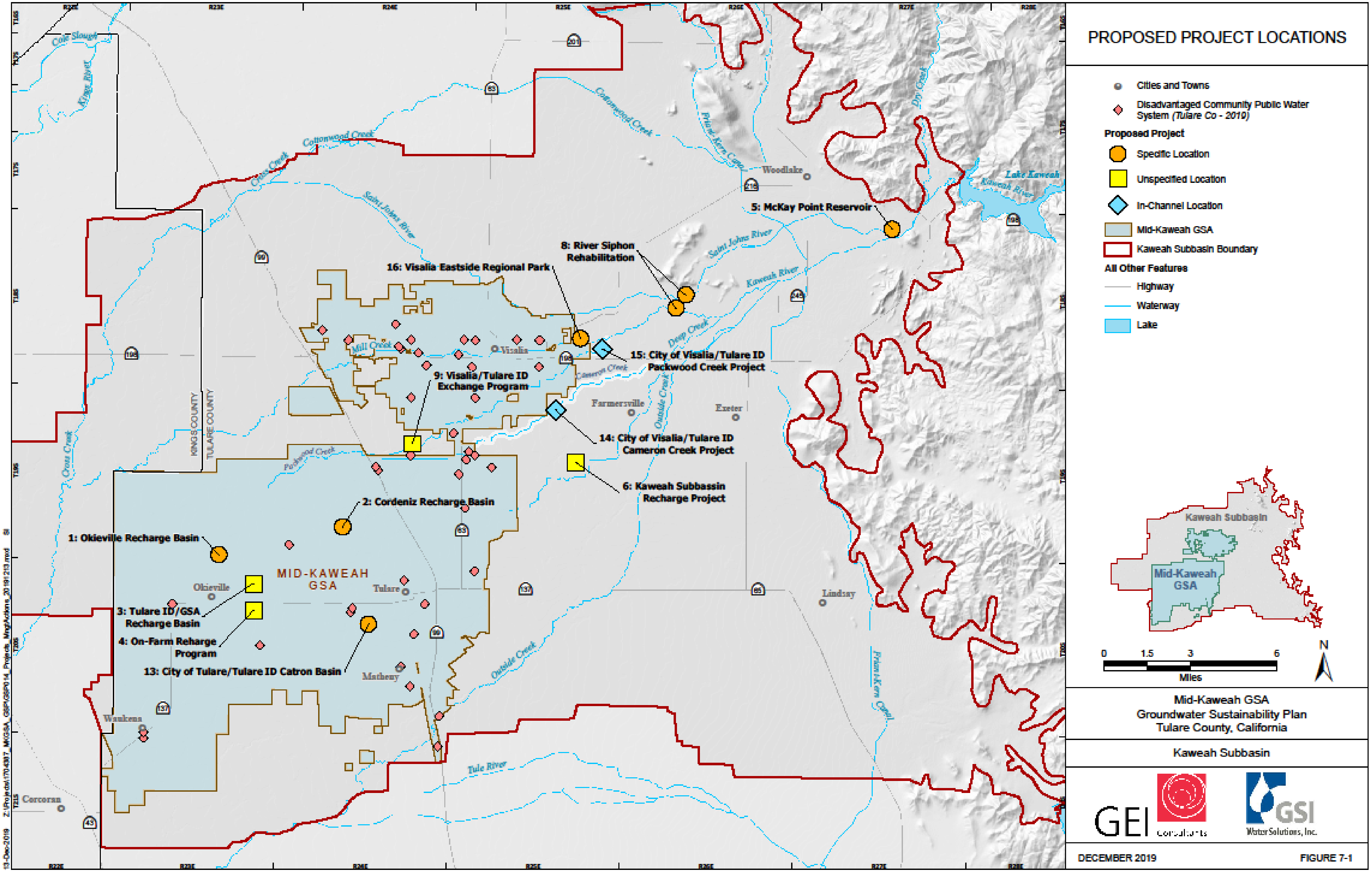


Figure 7-8: Proposed Project Locations

8. DWR Reporting

8.1 Annual Reporting Summary

According to §356.2 of the Regulations, the MKGSA is required to provide an annual report to DWR by April 1 of each year following the adoption of the first GSP. The first annual report will be provided to DWR on April 1, 2020 and will include data for the prior Water Year (WY), which will be WY 2019 (October 1, 2018 to September 30, 2019). The Annual Report will establish the current conditions of groundwater within the MKGSA, the status of the GSP implementation, and the trend towards achieving the interim milestones.

8.1.1 *General Information*

In accordance with §356.2(a), each Annual Report will include, at the front of the report, an executive summary that will summarize the activities and the condition of groundwater levels within the MKGSA for the prior year. The executive summary shall also include a map of the MKGSA, including the monitoring network.

8.1.1.1 Introduction

The annual report will include an introduction that will describe the following:

- A description of the MKGSA and the three agencies that are members of the MKGSA
- The general conditions of the MKGSA for the prior water year (precipitation, surface water allocations, crop demands, municipal demands, etc.)
- Any significant activities or events that would impact the water supply and/or groundwater conditions for the MKGSA

8.1.2 *Basin Conditions*

Included in the annual report will be a discussion of specific local water supply conditions per §356.2(b). This section will provide a description of the water supply conditions for the preceding water year along with a graphical representation of the conditions. A water year shall be defined as the 12-month period starting October 1 through September 30 of the following year. For example, WY 2019 shall include water supply conditions from October 1, 2018 to September 30, 2019. Water supply conditions that will be discussed include:

- Groundwater Elevations – elevation data from the monitoring network
- Groundwater Extractions – groundwater pumping estimates and measurements for agricultural, municipal and domestic pumping
- Surface Water Supply – data from surface water supplies to irrigation demand, conveyance losses, and groundwater recharge

- Total Water Use – total water uses by agricultural, municipal and domestic sectors
- Change in Groundwater Storage – a determination of the groundwater (volumetric) change

Below is a discussion of the individual MKGSA conditions that will be included in the Annual Report.

8.1.2.1 Groundwater Elevations in MKGSA

Groundwater elevation data for the MKGSA will be collected per Section 4.4 groundwater level monitoring network of this GSP. The Annual Report will include a description of the monitoring network, including any modifications that may have been made in the previous water year to the monitoring network. A graphical representation of the monitoring network will be provided in the map provided in the Executive Summary.

As outlined in Section 4.4.2 Monitoring Frequency, the MKGSA will monitor groundwater elevations seasonally, with a goal to take measurements in the spring (seasonal high before summer irrigation demands) and the fall (seasonal low after the summer irrigation demands). The Annual Report shall discuss the period in which measurements were taken and any observations about groundwater usage that would impact the groundwater elevation readings.

The annual report shall include figures that incorporate the groundwater elevations collected in the prior water year. The first set of figures shall be the development of groundwater contour maps that show the lines of equal elevation for groundwater for spring and fall readings of the current water year. The second set of figures shall be the individual hydrographs for each monitoring well showing the prior water year elevation reading and the historical readings for that monitoring well. The hydrographs shall show all historical data for each monitoring well.

Groundwater contour maps submitted during the first five years may reflect a composite of the principal aquifers within the subbasin due to data gaps as discussed in Section 2 of this Plan. As additional dedicated monitoring wells are installed, and as more knowledge is gained regarding subbasin hydrogeology, groundwater conditions within each separate aquifer will be better understood. The geophysical data collection project described in Section 7 will also aid in this regard.

8.1.2.2 Groundwater Extractions

Groundwater extractions for the MKGSA will be reported for the prior water year in the annual report. A summary discussion of the amount of groundwater pumped, the usage of the groundwater, and the percentage of the water supply for the MKGSA shall be included in the annual report. The Annual Report will provide a summary table that indicates the amount of groundwater per water use sector and the method of measurement (metered or estimate). A sample of the table is provided in Table 8-1.

Table 8-1: Sample Groundwater Extraction Summary

Water Use Sector	Measurement Method	City of Tulare	City of Visalia	Tulare Irrigation Dist.
M&I	Metered			
	Estimate			
Domestic	Metered			
	Estimate			
Agriculture	Metered			
	Estimate			
Total				

8.1.2.3 Surface Water Supplies

The MKGSA shall include a discussion of the surface water supplies diverted to the area for use by MKGSA members. The majority of surface water diversion and usage is by the TID. TID has a long history, over 100 years, of diverting and beneficially using surface water. The discussion shall include a general description of the surface water made available to the MGKSA and how the surface water was used. There shall also be a discussion of how the prior water year surface water supplies compared to historic supplies.

The annual report shall include a discussion of how surface water supplies were used to meet agricultural demand. This description shall include a graphical representation of the cropping patterns shown for the agricultural areas of the MKGSA.

The annual report shall also discuss how surface water was applied to groundwater recharge activities. The MKGSA partners conduct various groundwater recharge activities, and a description of what activities took place in the prior water year shall be provided.

8.1.2.4 Total Water Use

Total water use shall be reported in the annual report in a tabular format. A sample of the table is provided in Table 8-2

Table 8-2: Sample Total Water Use Summary

Water Use Sector	Measurement Method	City of Tulare	City of Visalia	Tulare Irrigation Dist.
M&I	Groundwater			
	Surface Water			
Domestic	Groundwater			
	Surface Water			
Agriculture	Groundwater			
	Surface Water			
Total				

8.1.2.5 Change in Groundwater Storage

The Annual Report shall include a discussion and analysis of the change in groundwater storage for the prior water year compared to historical trends. The annual report will also describe the events and conditions that would have contributed to the increase or decrease in groundwater storage. A graphical representation of the change in groundwater storage for the prior water year will be included. This graph shall also show the historical change in groundwater storage.

8.1.3 *GSP Implementation Progress*

The annual report shall include a description of the GSP implementation progress in accordance with §356.2(c). This section will provide an update on progress for the prior water year in achieving the interim milestones as defined in Section 5 and the implementation of projects and management actions as described in Section 7.

8.1.3.1 Interim Milestones

Based on the interim milestones established in Section 5, the Annual Report shall determine if the prior water year had met, exceeded, or failed to reach the interim milestones. The Annual Report shall also discuss the conditions and actions that contributed to the interim milestones.

8.1.3.2 Implementation of Projects

The annual report shall include a list of projects from Section 7 that were anticipated to be implemented as of the prior water year. This section shall also include the status of those projects and note any completed projects or projects that were delayed. A discussion shall be provided of projects that were implemented or developed in the prior water year that were not originally discussed or outlined in the GSP.

8.1.3.3 Implementation of Management Actions

The Annual Report shall include a list of management actions from Section 7 that were anticipated to be implemented as of the prior water year. This section shall also include the status of those management actions and note any completed management actions or those that were delayed. A discussion shall be provided of management actions that were implemented or developed in the prior water year that were not originally discussed or outlined in the GSP.

8.1.3.4 Implementation of Adaptive Management Actions

Based on the ability of the MKGSA to achieve the interim milestones established in Section 5 of the GSP, MKGSA shall implement adaptive management actions to adjust projects and management actions to achieve future interim milestones.

In the event that an Annual Report establishes that the MKGSA has fallen short of a five-year Interim Milestone, the MKGSA shall implement adaptive management actions through each of the Management Area's projects and management actions to achieve the next five-year interim milestone. The adaptive management actions can come in the form of providing projects to increase groundwater recharge, reduce water consumption, or reduce pumping through management actions. The Annual Report shall include a preliminary evaluation and estimation of the ability of the adaptive management actions to achieve the future Interim Milestone.

8.2 Five-Year Assessments

In accordance with §356.4 of the Regulations, the MKGSA will conduct a periodic evaluation of its Plan no less frequently than at five-year intervals and provide a written assessment to DWR of such evaluations. The assessments will include, but not be limited to, the following:

- Overall summary of then-current groundwater conditions and descriptions of each Sustainability Indicator for applicable minimum thresholds, measurable objectives, and interim milestones
- Summary of projects and management actions recently implemented and their localized and collective effect on groundwater conditions
- Review of Plan elements subject to reconsideration and potential revision, including minimum thresholds and measurable objectives, based on significant new information acquired since the prior Plan assessment
- Evaluation of the Basin Setting and any needed changes thereto based on new data and water budget assessments, including estimated overdraft conditions
- Description of alterations to the monitoring network and its improvements to address data gaps
- Description of any new information made available or developed since Plan adoption or prior five-year assessment, and whether such information warrants changes to the current Plan
- Description of any completed or proposed Plan amendments

- Summary of GSA actions regarding Plan implementation, including any relevant ordinances or regulations issued thereby, and any legal or enforcement actions against groundwater users or others
- Summary of further collaboration and coordination between GSAs in the Kaweah Subbasin, GSAs in inter-connected subbasins, and land use agencies within Tulare County including Members of this GSA

8.2.1 *Monitoring Network Assessment and Improvement*

The MKGSA recognizes that its initial monitoring network as described in Section 4 of this Plan includes existing monitoring sites lacking sufficient information such as well depth, screen intervals, and reliable well-log records, thereby reflecting significant data gaps. Assessing these data gaps is a priority and will be conducted in accordance with §352.2 and §354.38 of the Regulations. Specific elements of such an assessment are to include:

- Targeting GSA areas where an insufficient number of monitoring sites exist or where sites are considered unreliable or do not meet monitoring network standards
- Identifying data gap locations and reasons for their occurrence and surrounding issues that restrict monitoring and data collection
- Actions to be undertaken to close identified data gaps, including the addition and/or installation of new monitoring wells or surface-water measuring facilities, closure of inadequate well density areas, and needed adjustments to monitoring and measurement frequencies
- Improvement to the monitoring program and network to provide sufficient information to gauge the effectiveness of projects and management actions, including an assessment of the network's ability to determine exceedance of minimum thresholds, capture spatial or temporal variation in groundwater conditions, and adverse impacts upon beneficial uses and users of the groundwater resource
- The periodic assessment will also include a general determination of whether the monitoring network has been or is capable of evaluating groundwater conditions and impacts of GSA projects and management actions on the ability of adjacent subbasins to meet their sustainability goals or to implement their respective GSPs

8.2.2 *Review of Subbasin Coordination Agreement*

In accordance with §357.4(i) of the Regulations, the three GSAs encompassing the Kaweah Subbasin will review and, as necessary, revise their Coordination Agreement as part of the five-year assessments conducted by each. Any revisions to the Agreement will be incorporated therein as amendments or restatement and executed by each GSA.

8.3 Reporting Provisions

The MKGSA shall comply with the provisions of §353.4 of the Regulations, in submitting any and all annual reports and five-year Plan assessments. Materials will be submitted in the manner required by DWR and be accompanied by a transmittal letter signed by the designated Subbasin Plan Manager or other authorized person.

8.4 Reporting Standards

The MKGSA shall comply with the reporting standards provided in §353.4 of the Regulations in submitting annual reports and five-year Plan assessments.

9. References

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