Executive Summary

Chapter 1 - Introduction

On September 16, 2014, Governor Edmund G. Brown, Jr. signed into law a three-bill legislative package, composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA) which was passed in 2014 and is codified in Section 10720 et seq. of the California Water Code. This legislation created a statutory framework for groundwater management that can be sustained during planning and implementation without causing undesirable results.

SGMA requires governments and water agencies of high- and medium-priority basins to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge. Under SGMA, these basins should reach sustainability within 20 years of implementing their sustainability plans. For critically over-drafted basins, including the Kings Subbasin that the McMullin Area Groundwater Sustainability Agency (MAGSA) area is part of, the deadline for achieving sustainability is 2040.

In his signing statement, Governor Brown emphasized that "groundwater management in California is best accomplished locally." With ongoing financial and technical assistance from the Department of Water Resources (DWR) and substantial financial and practical involvement from its stakeholders and landowners, MAGSA is working to achieve basin-wide collaboration between neighboring groundwater sustainability agencies and helping to achieve groundwater sustainability within its local area of responsibility and the subbasin as a whole.

Chapter 2 - Plan Area

The Kings Groundwater Subbasin (Kings Subbasin) is part of the San Joaquin Valley Groundwater Basin. It is bordered by five groundwater subbasins which include the Madera, Kaweah, Tulare Lake, Westside, and Delta-Mendota Subbasins, shown in **Figure ES-1** Groundwater Subbasins**.** The San Joaquin River and the Kings River are the two principal rivers within or bordering the subbasin. Likewise, the San Joaquin River and the James Bypass segment of the Kings River form part of the northern and western boundary of the MAGSA. The Fresno Slough and James Bypass are along the western edge of the subbasin and connect the Kings River to the San Joaquin River system.

MAGSA is one of seven Groundwater Sustainability Agencies (GSAs) within the Kings Subbasin, shown in **Figure ES-2 Groundwater** Sustainability Agencies within the Kings Subbasin. There is no overlap among the GSAs and there are no adjudicated areas in the groundwater subbasin.

The only state lands within the MAGSA area are the ecological reserve properties acquired and managed by California Department of Fish and Wildlife (CDFW). There are no tribal or federal lands located within the Plan area. Mid-Valley Water District (MVWD), Raisin City Water District (RCWD), and Fresno County are the three local entities participating in the MAGSA Groundwater Sustainability Plan (GSP) and are shown in **Figure ES 3**.

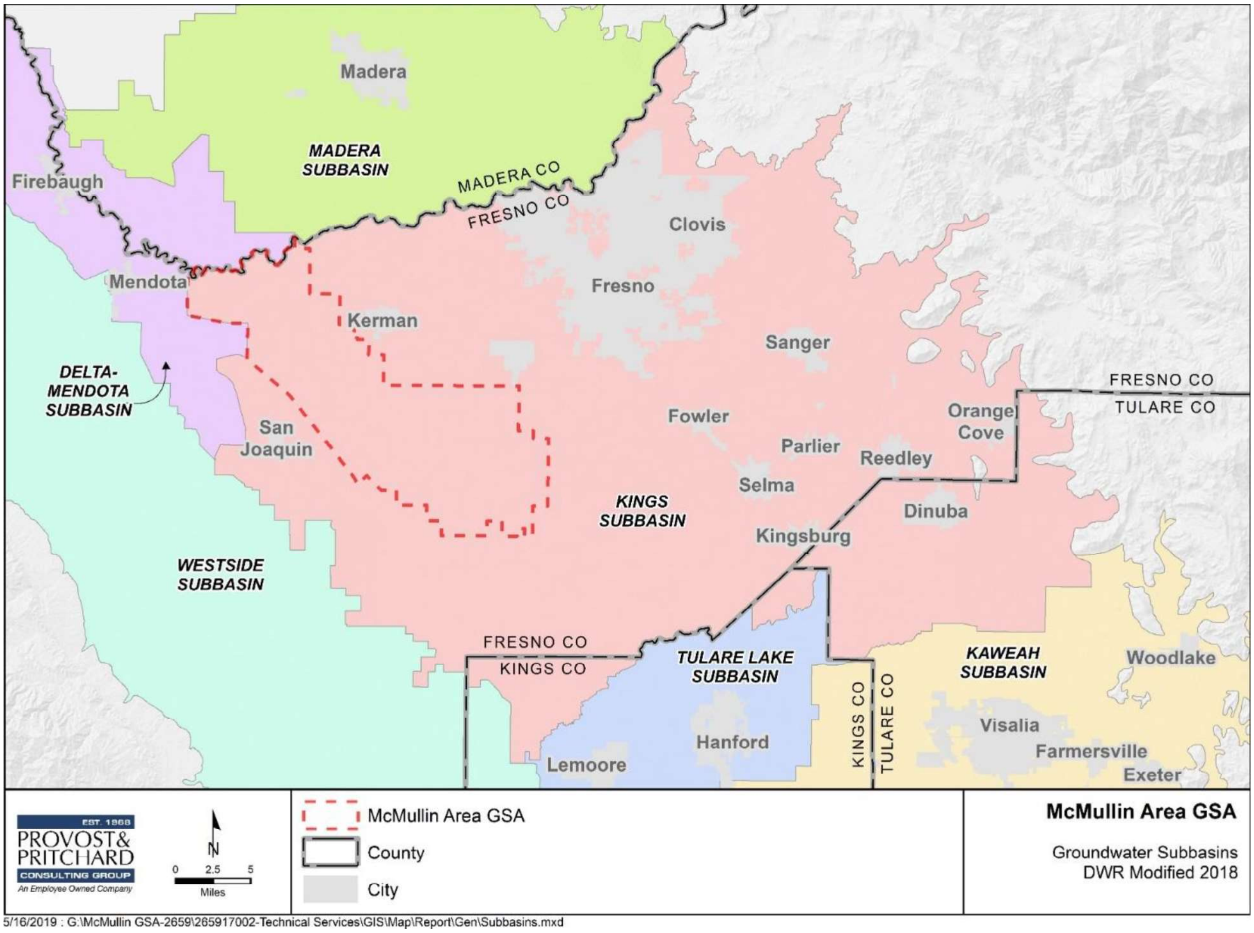


Figure ES-1 Groundwater Subbasins

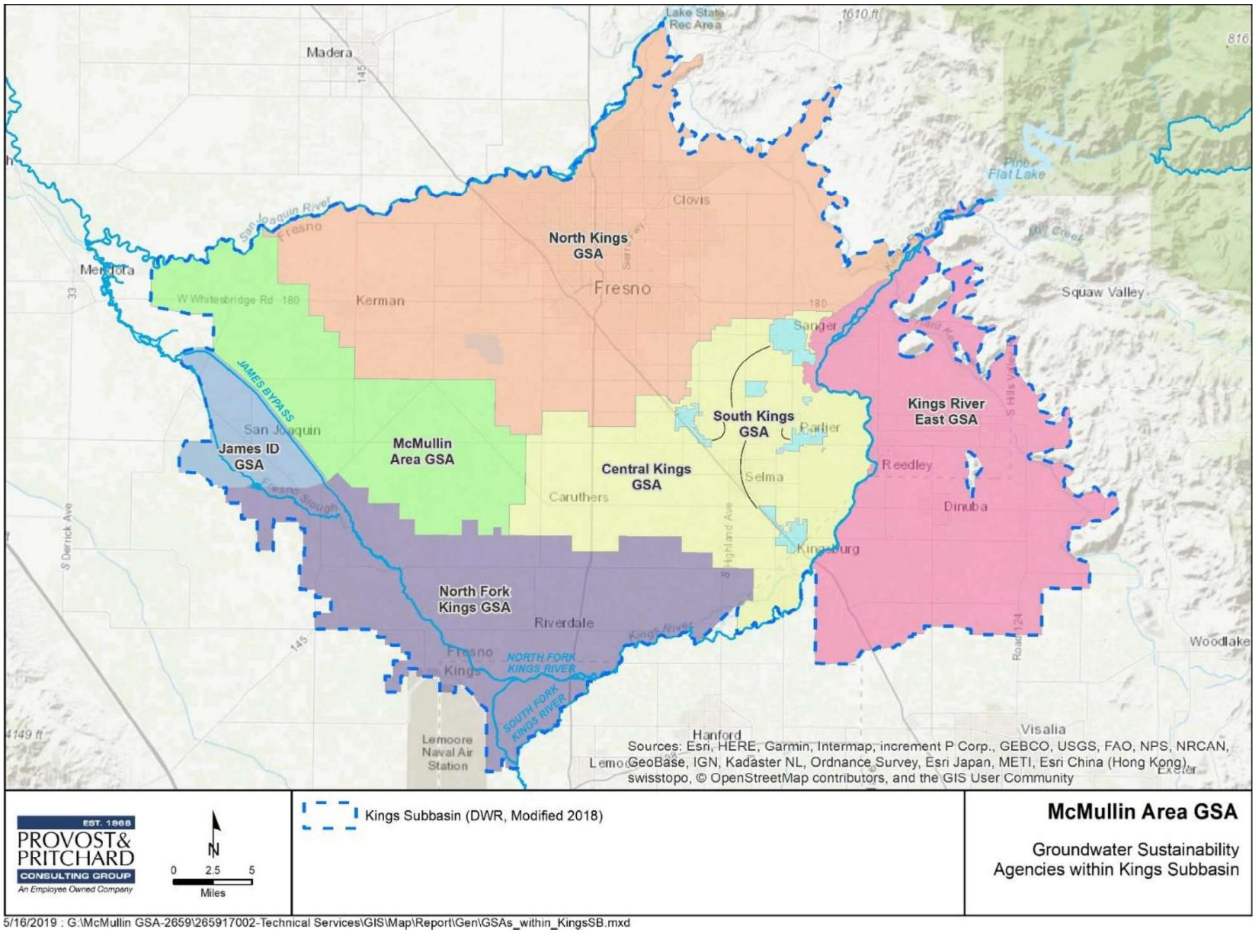


Figure ES-2 Groundwater Sustainability Agencies within the Kings Subbasin

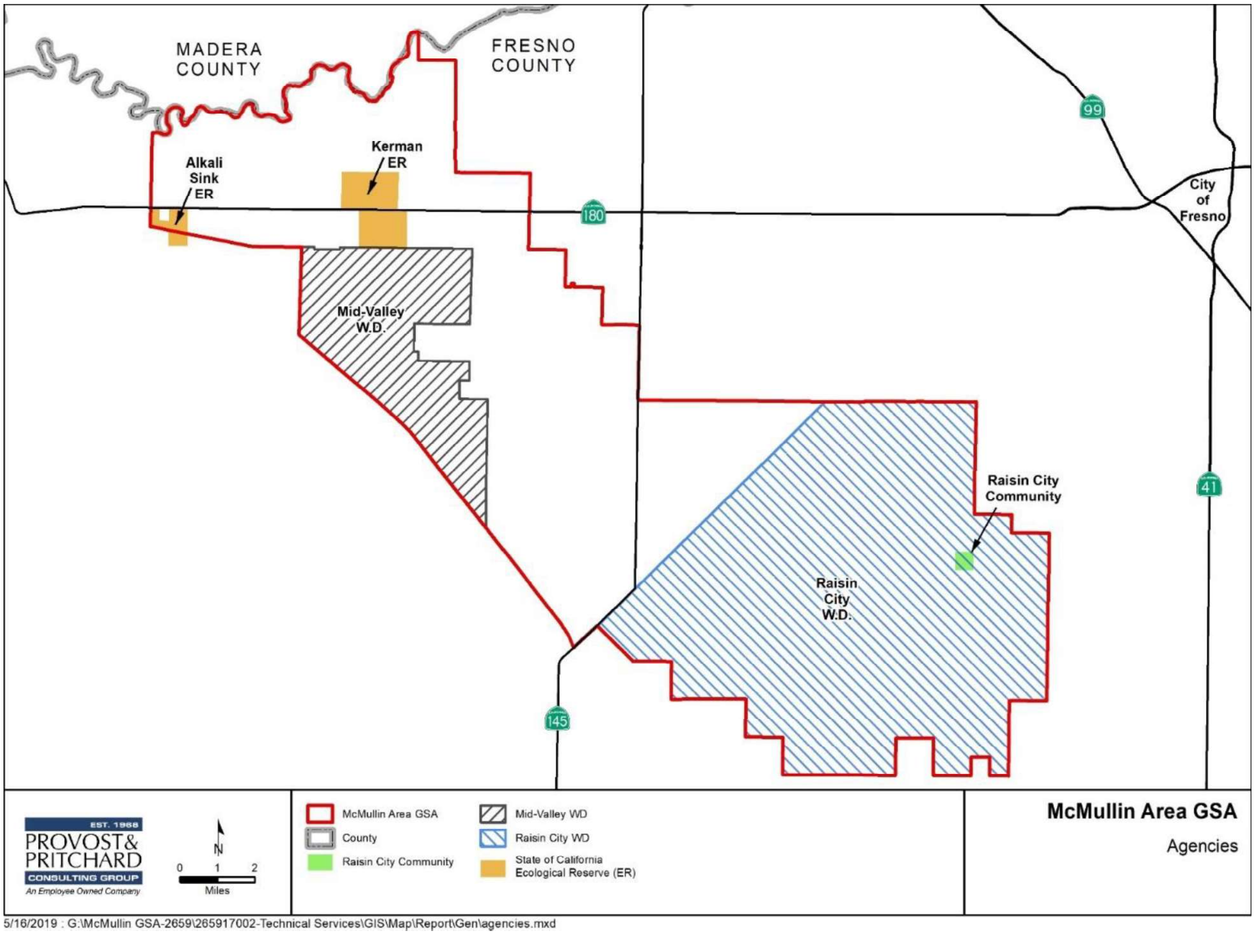


Figure ES-3 Participants in MAGSA Groundwater Sustainability Plan

Predominant water use and water source types for each of the plan's participants are shown in **Table ES-1**. The only community water system within MAGSA is for Raisin City, known as Fresno County Service Area #43 (water system #1000551). There are other public water systems in the MAGSA, but they are associated with industrial/commercial businesses (mainly around dairies, poultry farms and food processing plants). All the agencies and public water systems use groundwater.

Table ES-1 Water Uses and Water Sources

Agency / Water Company	Water Use	Water Source
County of Fresno	Agricultural Residential	Groundwater
Raisin City Water District	Agricultural	Groundwater Surface (Flood water)
Mid Valley Water District	Agricultural	Groundwater Surface (Flood water)

Mid-Valley Water District (MVWD) and Terranova Ranch located within the MAGSA service area also receive small quantities of available flood water, on occasion, from the north fork of the Kings River and/or the James Bypass segment of the Kings River that is diverted and conveyed toward the Terranova Ranch or the Gilmore Ranch which is a landowner within MVWD. MVWD may also receive United States Bureau of Reclamation (USBR) 215 Water when it is available. **Table ES-2** summarizes the volumes of flood water in acre feet (AF) diverted by MVWD since 1986. **Table ES-3** summarizes the volume of flood water (in AF) that Terranova Ranch estimates it has diverted.

Table ES-2 Mid-Valley Water District History of Water Deliveries

Date	Kings Floodwater AF	USBR Section 215 AF
1986	0	0
1987	0	0
1994	0	0
1995	4,983	0
1997	0	0
1998	7,757	0
1999	0	0
2000	0	0
2002	0	0
2003	0	368
2005	0	849
2006	3,648	268
2017	7,889	0

Table ES-3 Terranova Ranch History of Water Deliveries

Date	Kings Floodwater AF
1986	0
1987	0
1994	0
1995	4,500
1997	0
1998	4,500
1999	0
2000	0
2002	0
2003	0
2005	0
2006	4,500
2017	4,500

Chapter 3 - Basin Setting

Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model (HCM) has been prepared to provide an easy to understand description of the general physical characteristics of the regional hydrology, land use, geology, geologic structure, water quality, principal aquifers, and principle aquitards in the study area.

It should be kept in mind that an HCM is not a numerical groundwater model or a water budget model. However, an HCM is useful in providing the context to develop water budgets, monitoring networks, and identification of data gaps. Refer to **Section 3.3** for information on the GSA's water budget.

This HCM was prepared following the requirements set forth in the California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 5, Sub article 2 (§354.14). Many topics discussed in this HCM, such as groundwater quality and groundwater flow, are discussed in greater detail in the Groundwater Conditions and Water Budget chapters.

The narrative HCM description is accompanied by graphical representations of the MAGSA portion of the Kings Subbasin that have attempted to clearly portray the geographic setting, regional geology, basin geometry, and general water quality. The HCM has been prepared utilizing existing qualified published studies and resources and will be periodically updated as data gaps are populated and other new information becomes available.

Current and Historical Groundwater Conditions

This section includes a description of important current and historical groundwater conditions within the MAGSA based on the best available data. Groundwater conditions described in Section 3.2 include groundwater levels, groundwater storage, groundwater quality, land subsidence, and surface water and groundwater interconnections. The section provides historical monitoring data collected by various agencies including DWR, Kings River Conservation District (KRCD), NASA, and others. Refer to Chapter 5 –

Monitoring Networks for descriptions of the monitoring programs that will continue to be used to collect data for implementation.

Water Budget

A water budget is an accounting of all the water that flows into and out of a specified area and describes the various components of the hydrologic cycle. A water budget includes all the water supplies, demands, modes of groundwater recharge, and non-recoverable losses, making it possible to identify how much water is stored in a system and changes to groundwater storage during a given period. Aggregated water budgets have been prepared for the entire Kings Subbasin as well as detailed water budgets for the MAGSA. A schematic diagram of a water budget indicating the primary inflows and outflows and impacts on the groundwater system is shown in **Figure ES-4** below:

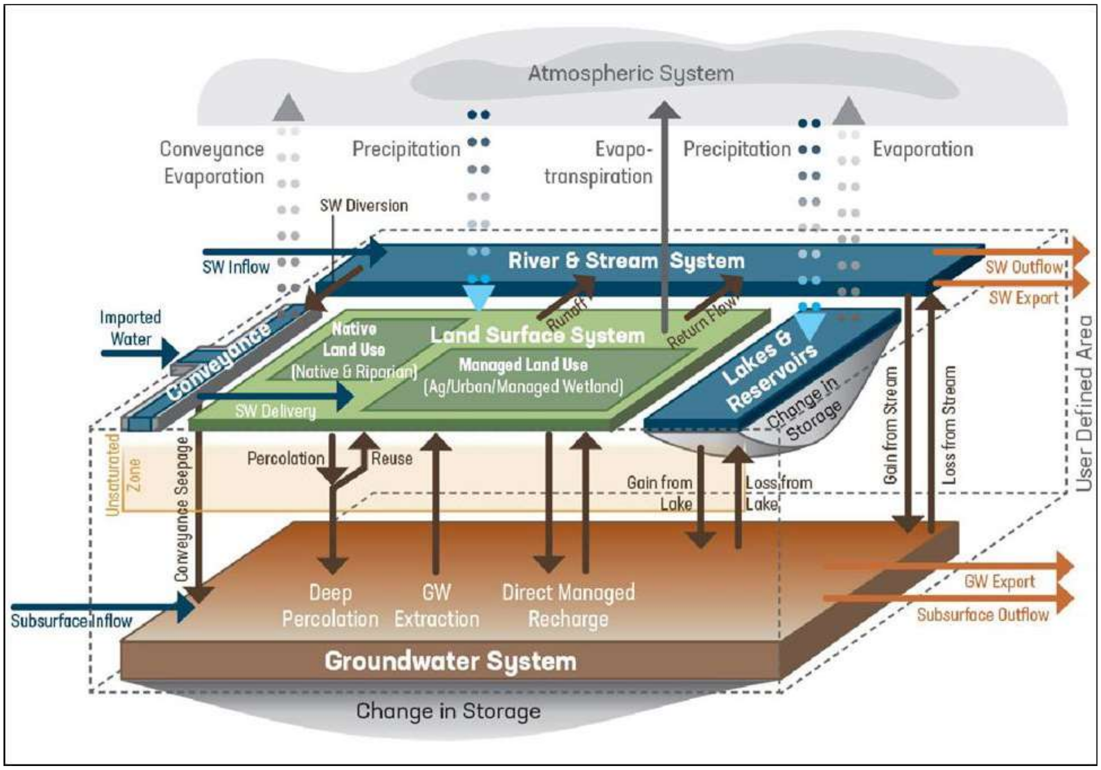


Figure ES-4 Water Budget Schematic

Purpose of Water Budget

Water budgets quantify the components of water supply, water use, and change to groundwater storage. The water budgets can be used as tools in numerous aspects of groundwater sustainability management including:

- Determining sustainable yield
- Identifying overdraft
- Identifying beneficial groundwater uses
- Identifying data uncertainties and monitoring needs
- Quantifying the effects of proposed projects and management actions
- Supporting the development of sustainable management criteria

The results of the MAGSA water budgets are shown in **Table ES-4**.

Table ES-4 Water Budgets

Description	MAGSA Annual Change in Groundwater Storage	
	Method 1	Method 2
Historical (1997-2011)	(61,600)	(18,000)
Current (2016-2017)	(69,400)	(18,000)
Future (2040)	0	0
Future (2070)	-	

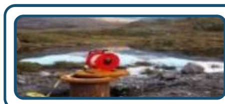
Based upon the foregoing and historical groundwater it is estimated that the sustainable yield for the subbasin is 1,140,000 AF/yr.

Chapter 4 - Sustainable Management Criteria

SGMA defines sustainable groundwater management as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results. The avoidance of undesirable results is important to the success of the GSP. Several requirements from GSP regulations have been grouped together under the heading of Sustainable Management Criteria, including a Sustainability Goal, Undesirable Results, Minimum Thresholds, and Measurable Objectives for various indicators of groundwater conditions. Development of these Sustainable Management Criteria is dependent on basin information developed and presented in the hydrogeologic conceptual model, groundwater conditions, and water budget chapters of the MAGSA plan (DWR, 2017).

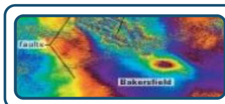
Indicators for the sustainable management of groundwater were determined by SGMA based on those items that are most important to the health and general well-being of the public. There are six indicators that must be monitored throughout the planning and implementation period of the GSP and identified in **Table ES-5**. This chapter will describe the indicators and why they are significant and will define the management thresholds.

Table ES-5 Monitoring Requirements


Groundwater Levels

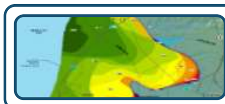

Groundwater Storage


Water Quality



Land Subsidence


Depletion of Interconnected Surface Water


Seawater Intrusion

The sustainability goal of the Kings Subbasin and this GSA is "to ensure that, by no later than 2040, the basin is being operated to maintain a reliable water supply for current and future beneficial uses without experiencing undesirable results." This goal will be met by balancing water demand with available water supply to stabilize declining groundwater levels without significantly and unreasonably impacting water quality, land subsidence or interconnected surface water. The goal of the Kings Subbasin is to correct and end the long-term trend of a declining water table understanding that water levels will fluctuate based on the season, hydrologic cycle and changing groundwater demands within the basin and its proximity.

The conditions with the basin and this GSA will be considered sustainable when:

- The basin is managed within its sustainable yield.
- The current rate of decline of the groundwater table within the basin monitoring network indicator wells has been corrected and the multi-year trend of water elevations in these wells has been stabilized.
- Groundwater levels are maintained at a level that prevents Undesirable Results for the applicable sustainability indicators.

The seven GSAs within the Kings Subbasin have been coordinating within the basin for several years on how to reach and maintain sustainability within the Subbasin. As described in the Section 3 - Basin Setting, the Kings Basin includes significant and varied geologic conditions, water supply and land use that lead to differing conditions and obligations within each GSA. The basin setting describes the trend of declining groundwater levels within the basin and the GSAs. The degree of decline varies by location due primarily to type of land use and availability of surface water supplies. The Basin setting information, including historic groundwater conditions, surface supply, groundwater flows, land use and other information were used to establish the water budget, initial estimates of overdraft within each GSA and sustainable yield. The coordination effort among the GSAs has resulted in agreed upon estimated initial overdraft quantity reductions for each GSA to correct in order to reach interim milestones and sustainability in 2040. These quantities and each GSA's respective obligation will continue to be monitored and evaluated as additional information is gathered.

Each GSA in the Kings Subbasin is responsible for implementing projects and management actions intended to enhance its ability to reach sustainability and meet its initial mitigation requirements for overdraft. Examples of the types of measures that may be implemented to ensure the basin will be operated within the sustainable yield are identified in detail in Chapter 6 – Projects and Management Actions to Achieve Sustainability of the GSP for each GSA in the basin. Collectively, these projects and programs have been identified to ensure the basin reaches sustainability by 2040. The projects and programs include technical data and estimates of project benefit, and the sum of these benefits within the basin meet is believed to support the initial estimates for successfully achieving sustainability within the basin.

The Subbasin GSAs have agreed to a phased approach of increasing mitigation to achieve sustainability. Each of four (4) phases has set incremental targets and time periods for correcting the overdraft of 10% by 2025, 30% by 2030, 60% by 2035 and 100% by 2040 respectively. Each GSA in the Basin is planning to implement projects and management actions in accordance with the agreed mitigation targets. The GSAs will continue to confer regularly to review data to ensure all GSAs are meeting their milestones and progress is being made toward overall basin sustainability, in accordance with the Coordination Agreement.

Water Level

Current and historical information on water level is discussed in Section 3.2.1 and the water level monitoring network is discussed in section 5.2. Section 4.2 will discuss the Undesirable Result, Minimum Threshold, and Measurable Objective set for water levels. A summary of the Minimum Threshold and Measurable Objective for water levels can be seen in **Table ES-6**. The values in the table are the water surface elevation (WSE) for the Interim Milestones, Measurable Objective, and Minimum Threshold. More details and the methodology to set the criteria can be found in Section 4.2.

Table ES-6 Groundwater Level Sustainable Management Criteria

Monitor Well ID	Interim Milestones (WSE)				Measurable Objective	Minimum Threshold (WSE)
	2020	2025	2030	2035	2040 (WSE)	
13-1	54.1	44.2	35.9	30.4	28.6	-40.5
13-2	107.1	100.7	95.4	91.8	90.7	42.6
13-3	110.4	101.8	94.7	89.9	88.4	12.7
14-1	80.3	74.2	69.7	65.7	64.6	44.9
14-2	27.3	18.8	11.8	7.1	5.6	-53.1
14-3	62.4	56.3	51.2	47.8	46.7	24.1
14-4	81	69.5	59.9	53.5	51.5	14.7
14-5	19.2	13.7	9.1	6.1	5.1	-12.4
14-6	46.1	37.7	30.8	26.2	24.8	-23.2
15-1	11.2	3.2	-3.5	-7.9	-9.3	-34.9
15-10	33.9	26.2	19.9	15.7	14.4	-9.9
15-2	-15.7	-27.1	-36.5	-42.8	-44.8	-81.1
15-3	79.4	74.1	69.8	66.9	66	21.1
15-4	88.2	83.3	79.3	76.5	75.7	43.2
15-5	-37.7	-44.4	-50	-53.7	-54.9	-135.7
15-6	-30.4	-41.1	-50	-55.9	-57.7	-91.9
15-7	74.5	68.9	64.2	61	60	28.4
15-8	-29.4	-43.5	-55.2	-63	-65.4	-110.4
15-9	-51.4	-63.9	-74.2	-81	-83.2	-122.8
16-1	-26.8	-39.1	-49.2	-56	-58.1	-97.3
16-2	-50.8	-70.3	-86.6	-97.4	-100.8	-163.3
16-3	-16.5	-25.6	-33.1	-38.1	-39.7	-80
16-4	39.4	27.5	17.5	10.9	8.8	-29.5

The GSAs within the Kings Subbasin have defined the Undesirable Result for groundwater levels to be significant and unreasonable when either the water level has declined to a depth that a new productive well cannot be constructed, or when the water level has declined to a depth that water quality cannot be treated for beneficial use.

Storage Change

Current and historical information on storage change is discussed in Section 3.2.3 and the storage change monitoring network is discussed in section 5.3. Section 4.3 will discuss the Undesirable Result, Minimum Threshold, and Measurable Objective set for storage change.

As part of the coordination of GSAs within the Kings Subbasin, a common method was utilized to estimate the change in groundwater storage for the entire subbasin and within each GSA during the hydrologic average base period, which was identified as the 15-year period from October 1996 to September 2011 based on Kings River surface water diversion into the area. The calculation estimated storage change within the upper unconfined groundwater for the Kings Subbasin to be approximately -1.8 MAF during the hydrologic average base period from spring 1997 to spring 2012, or an average of about -122,000 AF/yr. Estimated storage change in the lower confined aquifer is not possible at this time due to limited or no data from confined wells in the area.

An undesirable result would occur if the change in the total amount of groundwater in storage resulted in an amount less than the estimated amount of total groundwater in storage above the Groundwater Level Minimum Thresholds for all GSAs.

Water Quality

Current and historical information on water quality is discussed in Section 3.2.5 and the water quality monitoring network is discussed in section 5.5. Section 4.5 will discuss the Undesirable Result, Minimum Threshold, and Measurable Objective set for water quality. A summary of the Minimum Threshold for water quality can be seen in **Table ES-7**. The criteria to define minimum thresholds will be based on the MCL values of the chemicals of concern discussed in the Groundwater Conditions chapter, **Section 3.2.5** of this GSP. More details and the methodology to set the criteria can be found in Section 4.5.

Table ES-7 Chemicals of Concern and California MCLs

Chemical of Concern	California Primary MCL (mg/L unless otherwise shown)
Arsenic	0.01
Chloride	500**
Manganese	0.5*
Sodium	50.000
Uranium	20 (pCi/L)
Nitrate as NO_3	45
Dibromo-Chloropropane (DBCP)	0.0002
1,2,3-Trichloropropane (TCP)	5×10^{-6}
Total Dissolved Solids (TDS)	1,000**

*=Notification Level, No MCL
**=Upper Secondary MCL

Undesirable results determinations will be based on the aggregated effect of: 1) the degradation of water quality to excess of MCLs (i.e. California potable water standards) where concentrations of chemicals of concern were historically below MCLs; and 2) a statistically significant increase in groundwater degradation where concentrations of chemicals of concern were historically above MCLs. The occurrence of an undesirable result will be defined as 6 of the 12 representative monitoring wells having reached either of these two criteria for two consecutive years at the same wells. For the purposes of this GSP statistical significance is defined as a result not likely to occur from random fluctuations (seasonal or otherwise) or by chance but instead can likely be attributed to a specific cause (i.e., groundwater pumping).

Land Subsidence

According to USGS, land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials. The main form of subsidence in the MAGSA area is deep subsidence from declining confined aquifer groundwater levels. Current and historical information on land subsidence is discussed in Section 3.2.6 and the land subsidence monitoring network is discussed in section

5.6. Section 4.6 will discuss the Undesirable Result, Minimum Threshold, and Measurable Objective set for land subsidence. A summary of the Minimum Threshold and Measurable Objective for land subsidence can be seen in **Table ES- 8** and **Table ES-** 9 respectively. More details and the methodology to set the criteria can be found in Section 4.6.

Table ES- 8 Minimum Threshold for Land Subsidence

Minimum Threshold Parameter	Minimum Threshold Quantity
Annual Land Subsidence Rate	12 inches/year over an area of 36 square miles
Maximum Cumulative Land Subsidence	5 feet over 20 years

Table ES- 9 Measurable Objective for Land Subsidence

Measurable Objective Parameter	Measurable Objective Quantity
Annual Land Subsidence Rate	6 inches/year over an area of 36 square miles
Maximum Cumulative Land Subsidence	3 feet over 20 years

The MAGSA has minimal land subsidence as described in detail in Section 3.2.6, and there have been no known significant impacts from land subsidence within the MAGSA.

An example of an undesirable result for land subsidence would be the significant and unreasonable loss of functionality of structures and infrastructure and major damage to roads within the Kings Basin due to land subsidence.

In MAGSA, land subsidence would be considered significant and unreasonable when infrastructure, such as roads, the distribution systems, levees, wells, and pumps begin to fail or take critical damage. There are two major highways located within the MAGSA, State Route 180 and State Route 145. Existing infrastructure includes James ID canals within MAGSA and the James Bypass adjacent to MAGSA's westerly boundary. MAGSA currently does not have regional conveyance canals, but there are several canals proposed in the list of projects in Chapter 6. When those canals are built as part of the projects identified, it would be undesirable if subsidence caused the canal to lose significant conveyance capacity. Other infrastructure in MAGSA includes the levee along the San Joaquin River.

Surface Water Groundwater Interconnection

The San Joaquin River is the only surface water body of significance within the MAGSA. Information to evaluate the presence of interconnected surface water systems in the MAGSA in a few locations along the San Joaquin River is available through the USBR's SJRRP, a USGS groundwater flow model documentation report (USGS SIR 2014-5148, 2014), and Friant Water Users Authority and Natural Resources Defense Council (FWUA and NRDC, 2002). Based on the model reports and regional studies, it appears that there may be intermittent seasonal connections between surface water and groundwater in at least a limited number of locations along the San Joaquin River in the MAGSA. However, this data does not provide significant evidence of a continuous connection throughout the year, therefore it can be reasonably presumed that the system is not interconnected As a result of the foregoing, it has been concluded that the interconnected surface water and groundwater criteria is not applicable to the MAGSA.

Chapter 5 - Monitoring Network

This chapter describes the monitoring network being developed by the MAGSA that will be utilized to collect critical data to determine short-term, seasonal, and long-term trends in groundwater and related surface conditions. This data will yield vital information necessary to support: 1) implementation of this Plan, 2) evaluation of the effectiveness of this Plan, and 3) informed decision making by the MAGSA management. The chapter describes current and future monitoring programs. The data from historical monitoring efforts can be found in Section 3.2 – Current and Historical Groundwater Conditions. The Monitoring Network chapter describes the current and proposed monitoring programs, identifies data gaps, and describes the plans to fill data gaps for each sustainability indicator.

Water Level

The majority of MAGSA members are agricultural producers and/or landowners. In general, groundwater levels in these members' wells have not been measured on a regular basis. A small number of private wells have been monitored consistently and have detailed temporal groundwater elevation data; however, most landowners have not performed measurements at all or, at best, they have monitored wells on a sporadic "as needed" basis, and the timing of fall and spring measurements has not been consistent. In the future, the agency will monitor groundwater levels every March and October to provide consistency in the measurements. The water level monitoring network is shown in **Figure ES-5**

Storage Change

Groundwater storage capacity will be calculated using local groundwater levels and specific yield values. This methodology has proven to be adequate in estimating annual change in groundwater storage in other regions of the Kings Subbasin. Specific yield values for various depths have been determined through an extensive literature search. Groundwater storage calculations are largely dependent on the groundwater level monitoring network, which is being expanded for SGMA. Collection of well attribute information described above will also benefit groundwater storage monitoring.

Water Quality

Groundwater quality in the MAGSA is generally well suited for irrigation and domestic use, although groundwater issues for drinking water may exist in localized areas within the GSA. While some of these chemical concerns are caused by humans, others are naturally occurring. Groundwater pollution characterization and mitigation are typically enforced by other local agencies and state level programs.

The GSA will review and analyze publicly available routine groundwater monitoring data reported by the community and non-community public supply wells and data from the Groundwater Ambient Monitoring and Assessment Program (GAMA) monitoring wells around the American Avenue Landfill in order to understand how and if groundwater pumping is exacerbating groundwater quality concerns and where to enforce pumping restrictions or other mitigation measures should it become necessary.

Groundwater quality concerns within the MAGSA have been identified in this GSP's Groundwater Conditions Chapter (**Section 3.2**). Groundwater monitoring and reporting by community water systems and non-community public supply wells is a requirement of California Code of Regulations (CCR) Title 22. Community and other public supply wells within the MAGSA monitoring network area already being routinely monitored for a wide range of contaminants, including the chemicals of concern, by the water purveyors under Title 22. The publicly available groundwater quality data reported by GAMA from selected wells (public supply wells and monitoring wells associated with the American Avenue Landfill) will be obtained annually and evaluated against sustainable management criteria.

Selected public supply wells and American Avenue Landfill monitoring wells, will form the basis of the monitoring wells for groundwater quality are shown on **Figure ES-6**. The groundwater quality monitoring network will be evaluated and revised if needed in subsequent GSP 5-year revisions.

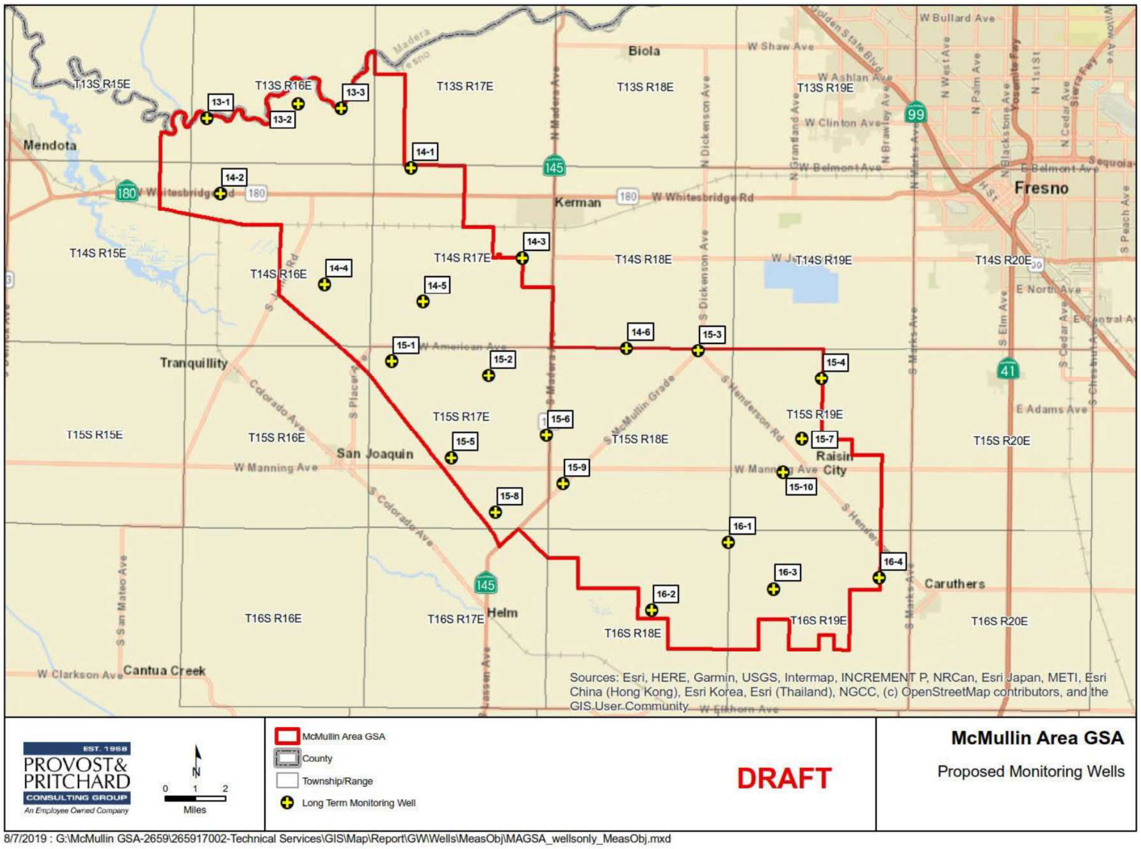


Figure ES-5 Water Level Monitoring Network

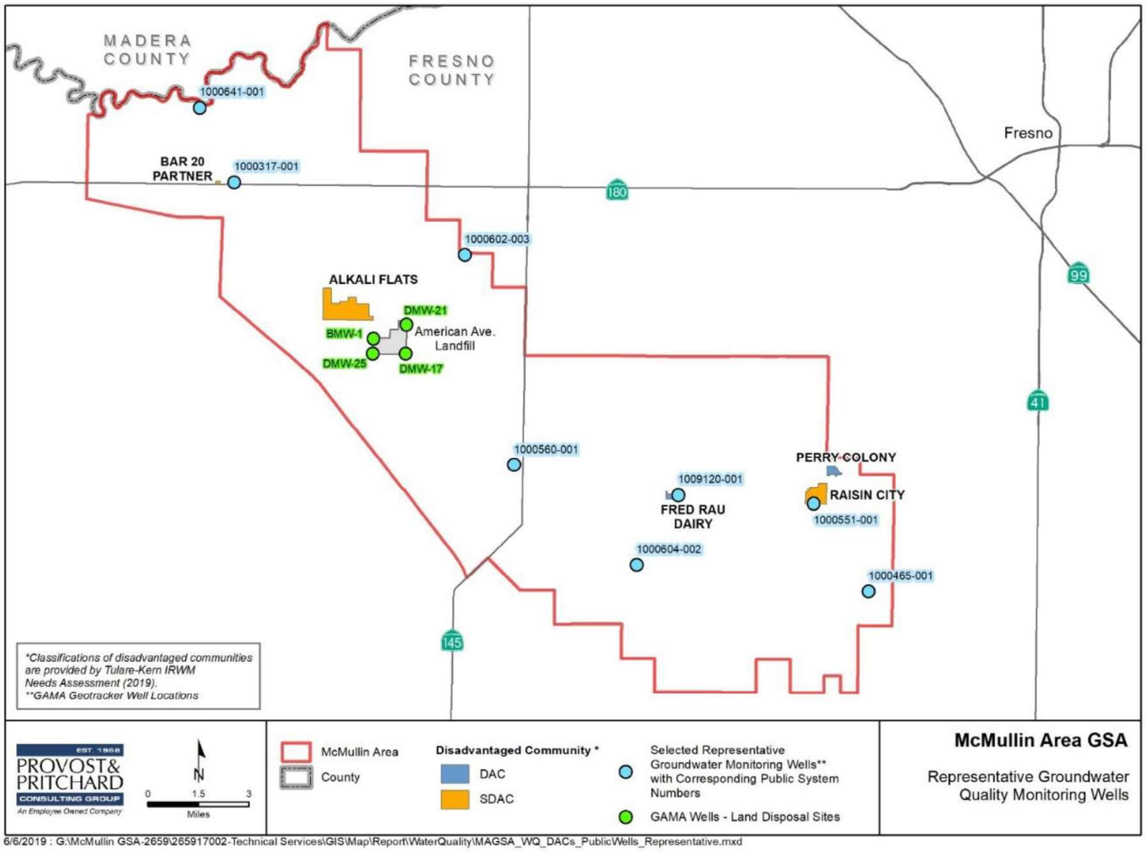


Figure ES-6 Water Quality Monitoring Network

Land Subsidence

While some local agencies in the San Joaquin Valley monitor for land subsidence, the majority rely on monitoring performed by regional water agencies or the State and Federal government. Measurement and monitoring for land subsidence are performed by a variety of agencies including USGS, KRCD, USBR, USACE, University NAVSTAR (Navigation Satellite Timing and Ranging) Consortium (UNAVCO), and various private contractors. Interagency efforts between the USGS, USBR, the U.S. Coast and Geodetic Survey (now the National Geodetic Survey), and DWR resulted in an intensive series of investigations that identified and characterized subsidence in the San Joaquin Valley. NASA also measures subsidence in the Central Valley and has maps on their websites that show the subsidence for a defined period (https://earthobservatory.nasa.gov/IOTD/view.php?id=89761&eocn=image&eoci=related_image). The MAGSA monitoring network will utilize data collected by KRCD **Table ES-7**, and use the NASA InSAR (Interferometric Synthetic-Aperture Radar) data, **Figure ES-8,** to verify the areas of subsidence.

Surface Water Groundwater Interconnections

There is a current monitoring network established by the SJRRP that consistently collects groundwater elevation data along the SJR on an annual basis. This data is collected in a joint effort between the SJRRP and the USBR. The USBR monitoring wells are located along the SJR and can be seen in **Figure ES 9.** Regional groundwater data provided by the USBR and the SJRRP as well as the USGS Flow Model (USGS SIR 2014-5148, 2014) indicate that at various times of the calendar year, the incessant flow of the SJR has run dry below Gravelly Ford. Additionally, in 2006 a considerably wet year, the USGS SIR Report indicated that the estimated depth to water table along the portion of the San Joaquin River adjacent to MAGSA was approximately 20 feet. This, therefore, identifies that the groundwater and surface water systems are not continuously interconnected. MAGSA will continue to monitor the annual data collected from the USBR and will discuss any changes to the monitoring network if necessary due to new reports or findings from the future USGS flow models.

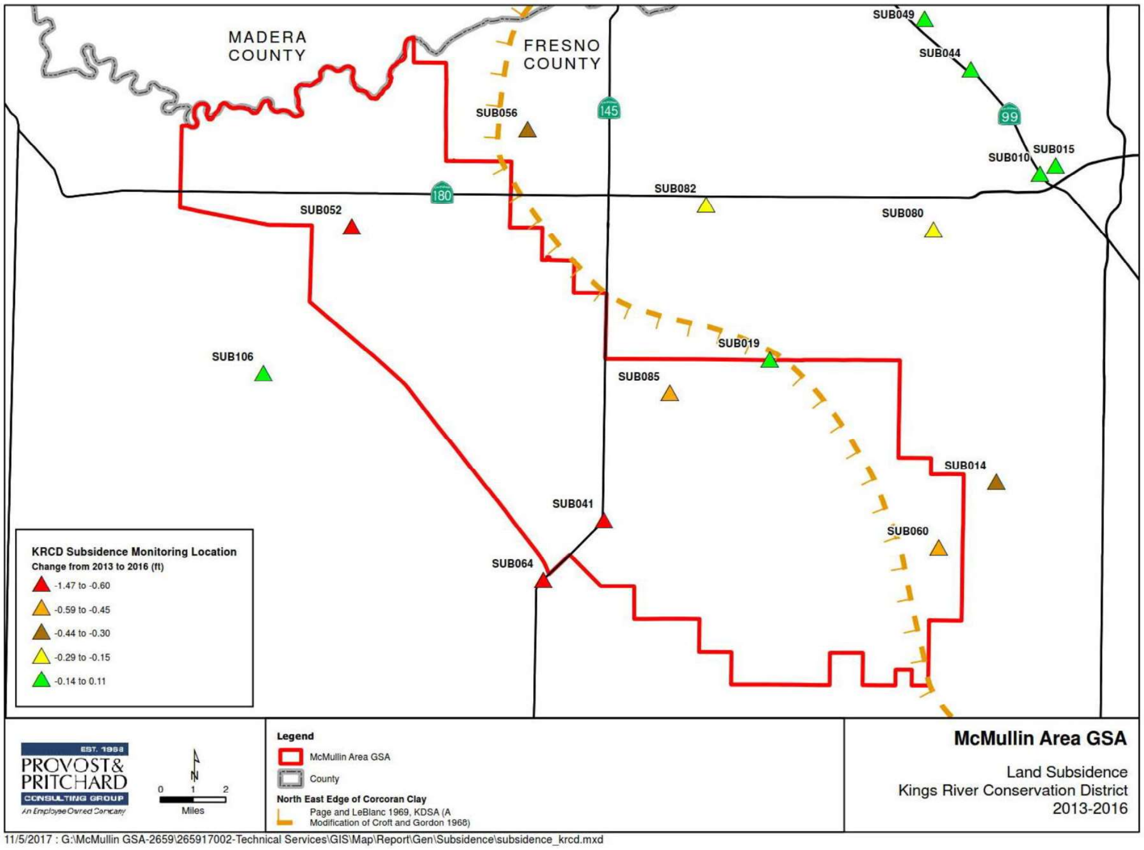
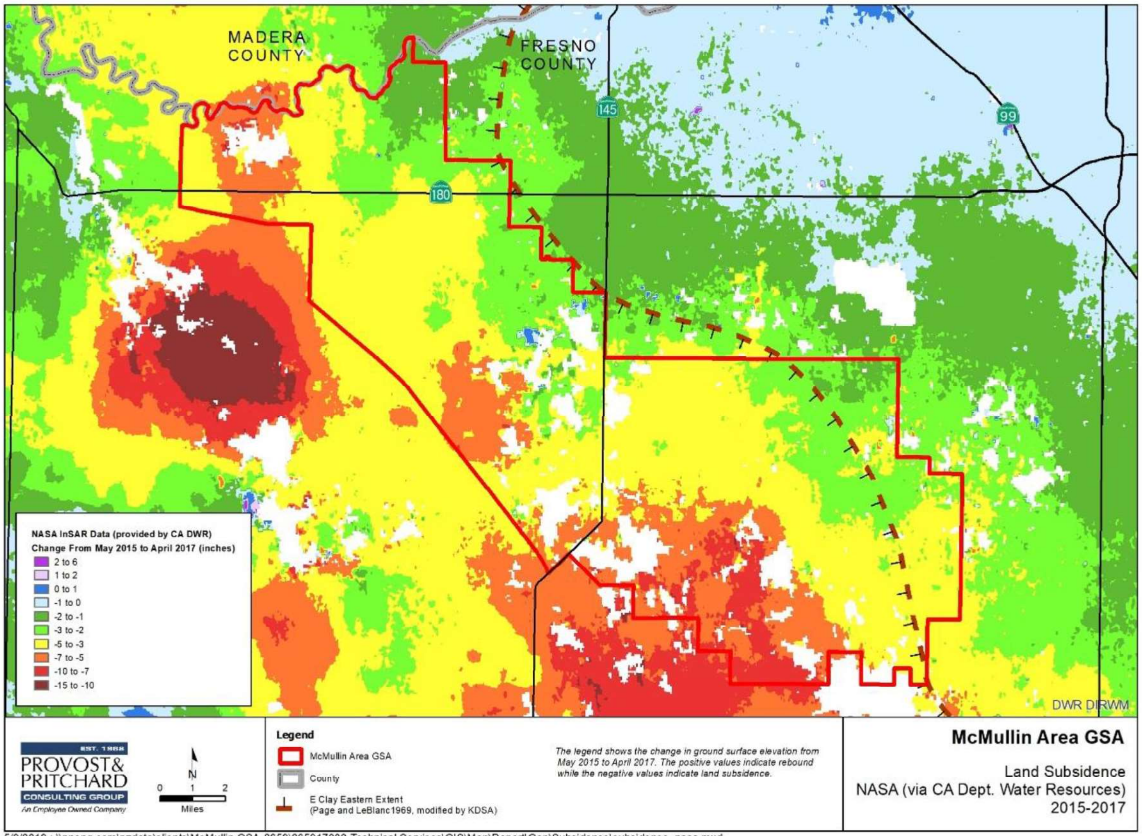


Figure ES-7 KRCD Land Subsidence Monitoring Locations Map



5/9/2019 : \\ppeng.com\pzdata\clients\McMullin GSA-2659\265917002-Technical Services\GIS\Map\Report\Gen\Subsidence\subsidence_nasa.mxd

Figure ES-8 NASA Land Subsidence Monitoring Map

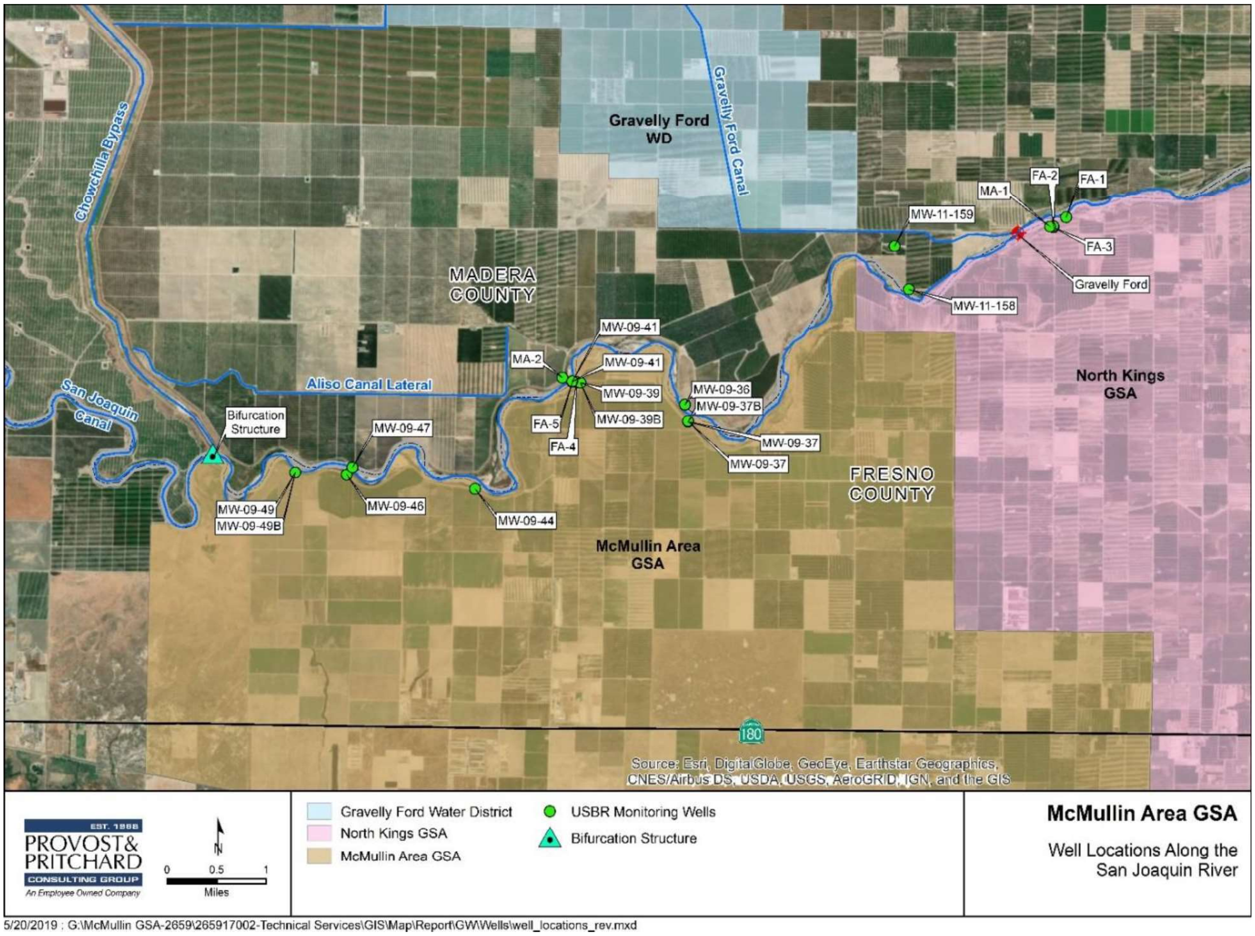


Figure ES 9 USBR San Joaquin River Restoration Project Monitoring Wells

Chapter 6 - Projects and Management Actions

Projects

Each of the following projects are in various stages of development, ranging from conceptual, to projects that have been constructed. Thus, each of the following projects have had a different level of investigation that has been completed, from projects with limited information, to a feasibility level, to field surveys for a channel capacity study, or recently constructed. The agency will maintain a list of proposed projects and their characteristics, along with their development status, and will use this list to prioritize and secure funding as opportunities may become available. Projects discussed in this Plan will remain a part of the potential projects that the GSA may choose to implement; however, other projects may come up with higher yield or lower cost and will be considered. The projects that are currently being considered are shown on **Figure ES-10** and **Figure ES-11.** They have been prioritized based on a cost-benefit matrix and are listed in order as follows:

1. Fresno City Wastewater Treatment Plant Recharge Basin, FID Houghton Canal System
2. Fresno City Wastewater Treatment Plant Recharge Basin, FID Lower Dry Creek System
3. Southwest Groundwater Banking
4. Lassen Avenue Reverse Flow & Recharge
5. James Bypass Surface Water Supply & Recharge
6. McMullin On-Farm Flood Capture, Phase 2 and 3
7. Houghton Wasteway Expansion
8. South Sandridge Canal Water Supply & Recharge
9. Stinson North Canal Phase 2
10. Stinson North Canal Phase 1
11. Grantland Area Recharge
12. Consolidated ID Wristen Ditch Intertie

The process being used for project implementation has generally been as follows:

1. Identify potential projects
2. Prepare conceptual level feasibility study and cost estimate
3. Prioritize potential projects
4. Obtain agreement with project partner(s)
5. Secure funding
6. Prepare environmental documents and obtain permit and regulatory approvals
7. Design and prepare construction documents
8. Implement project construction
9. Operate and maintain the project for sustainability

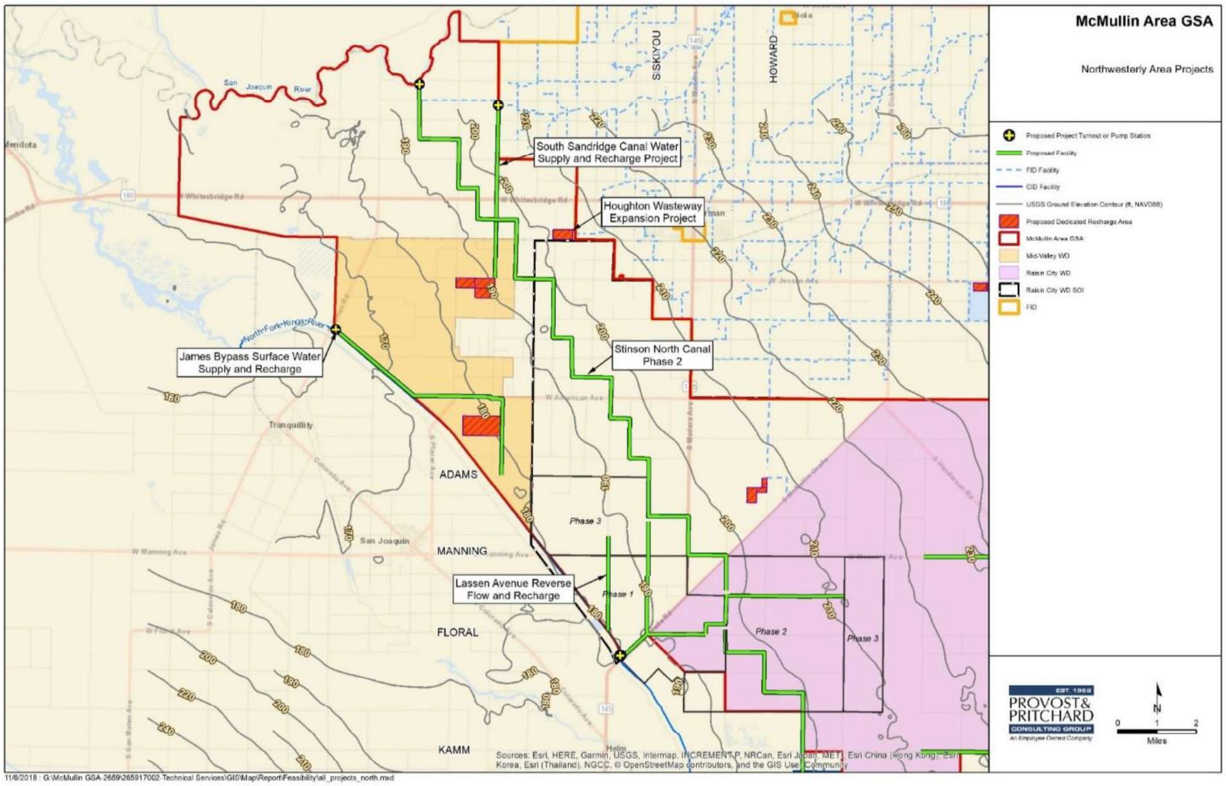


Figure ES-10 MAGSA Projects for Groundwater Sustainability (Northwesterly Area)

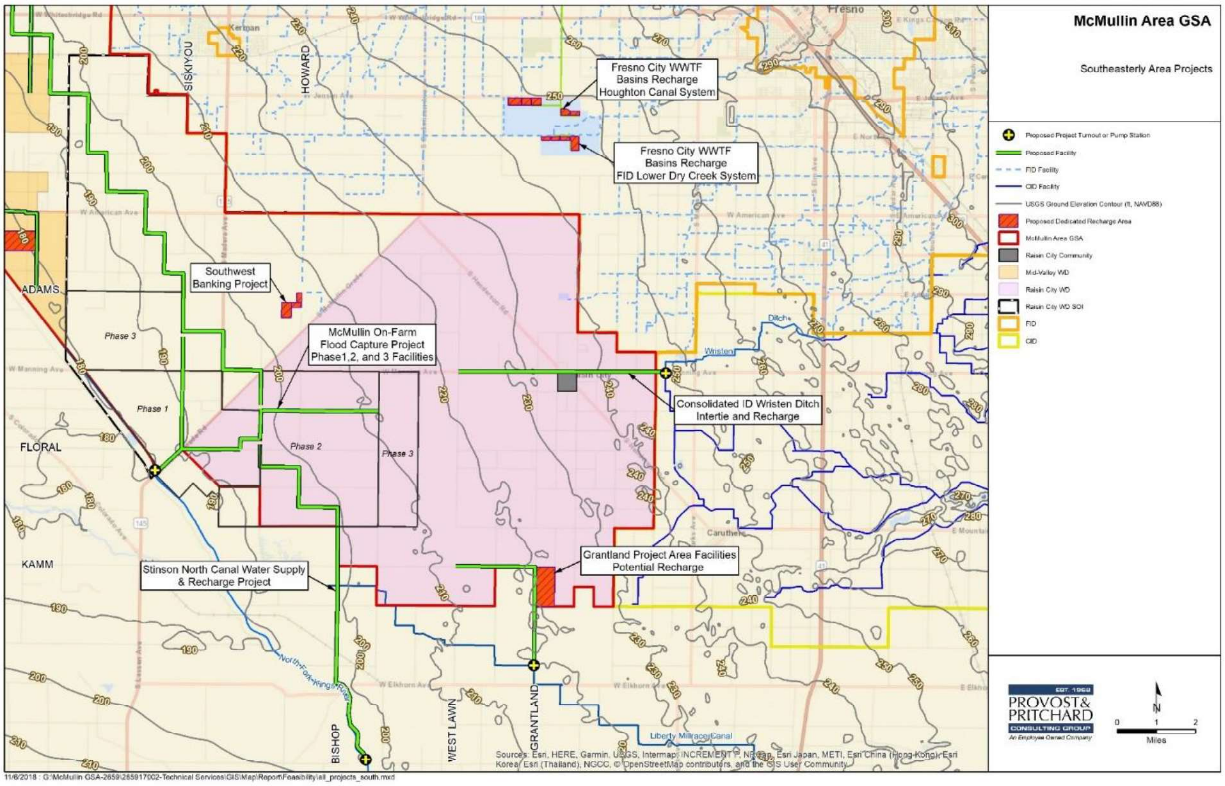


Figure ES-11 MAGSA Projects for Groundwater Sustainability (Southeasterly Area)

For each project, the conceptual costs were annualized over a 30-year period assuming a 5% interest rate to estimate an annual repayment cost. The portion of the water cost due to capital expenditures, on an average annual basis was calculated, all of which is summarized together in one location for all the projects investigated in **Table ES-10**.

Table ES-10 Project Cost & Yield Summary

Rank	Projects	Capital Cost	Annual Capital Payment	Average Annual Yield (AF)	Annualized Cost Per AF
1	Fresno City Wastewater Treatment Plant Recharge Basins, FID Houghton Canal System	$3,537,000	$230,000	6,745	$41
2	Fresno City Wastewater Treatment Plant Recharge Basins, Lower Dry Creek System	$2,223,000	$145,000	4,385	$41
3	Southwest Groundwater Banking	$6,221,000	$405,000	2,625	$154
4	Lassen Avenue Reverse Flow & Recharge	$3,263,000	$212,000	3,000	$71
5	James Bypass Surface Water Supply & Recharge	$38,017,000	$2,473,000	29,760	$83
6	McMullin On-Farm Flood Capture, Phase 2 and 3	$29,795,000	$1,938,000	27,120	$71
7	Houghton Wasteway Expansion	$4,922,000	$320,000	2,190	$146
8	South Sandridge Canal Water Supply & Recharge	$8,736,000	$568,000	4,800	$119
9	Stinson North Canal Phase 2	$110,245,000	$7,172,000	59,400	$121
10	Stinson North Canal Phase 1	$61,114,000	$3,976,000	39,670	$100
11	Grantland Area Recharge	$22,043,000	$1,434,000	7,920	$181
12	Consolidated ID Wristen Ditch Intertie	$13,420,000	$873,000	3,175	$275

Notes:

1. Assumes 5% interest rate loan annualized over a 30-year period.
2. No operations or maintenance costs are included, except on City of Fresno projects.
3. Water purchase costs will be an additional cost.

The costs and yields are based on very broad assumptions and include a thirty percent contingency. Actual water costs will be greater than estimated as none of the project include the actual water supply purchase cost which is yet to be negotiated with the organization with the water supply. Also, if the water is recharged, there is still the cost to recover the supply as groundwater.

Management Actions

GSAs have a variety of tools which can be used to achieve sustainable groundwater management. The projects primarily focus on the capture, use, recharge, and increase of surface water supplies within the GSA and surrounding areas. Alternatively, there are other management actions which primarily focus on the reduction of groundwater demand. These could be accomplished through increasing data collection, education and outreach, regulatory policies, incentive-based programs, and enforcement actions.

Section 6.3 will discuss a suite of management action options the GSA may consider during the GSP implementation. The menu of management actions discussed may not be implemented in a strictly linear fashion, as numbered in the GSP, and specific actions may not be implemented if sustainability is achieved through projects or other actions. It is expected that the GSA will further develop and craft management actions in response to stakeholder input on parallel timelines and adapt to the estimated schedules according to the best available information and best available science at any given time in accordance with, *354,44(c)*. The GSA understands there are various levels of uncertainty with project and program implementation per, *344.44.(d)*. It is not unusual for project and program implementation to take longer than originally estimated. In addition, the accrual of expected benefits may take multiple years to be individually realized and vary substantially year to year. Depending upon the success or failure of the initial GSP project and management action efforts to increase water supplies, reduce groundwater demands, and improve data collection, the various implementation timelines may fluctuate over time.

This chapter is not a comprehensive list of management actions and future additions and revisions may be enforced by the GSA as needed to achieve sustainability. The management action categories identified in this GSP include:

1. Education and Outreach
2. Well Head Requirements
3. Groundwater Allocation
4. Groundwater Marketing and Trading
5. Fees and Incentives
6. Groundwater Pumping Restrictions

It is the mission of this GSP to promote responsible water resource management, while effectively enforcing the policies and standards set in place by the McMullin Area Groundwater Sustainability Agency to conserve and protect the region's water resources for future generations to come.

Chapter 7 - Plan Implementation

The adoption of the GSP will be the official start of the Plan Implementation for MAGSA. The GSA will continue its efforts to engage the public and secure the necessary funding to successfully monitor and manage groundwater resources within the McMullin Area in a sustainable manner. While the GSP is being reviewed by DWR, the GSA will coordinate with various stakeholders and beneficial users to improve the monitoring network and begin the implementation of both projects and management actions.

The proposed estimated budgets and implementation timelines for the suggested projects and management actions of the MAGSA GSP can be found in Chapter 7. All the projects discussed have been evaluated as potential investments that would assist in achieving the long-term goals of the GSA. Of the projects, McMullin's On-Farm Flood Capture project has already begun construction. The potential schedules and budgets outlined in sections 7.1 and section 7.3, are purely estimates and may be adapted or eliminated should the GSA board deem it necessary.