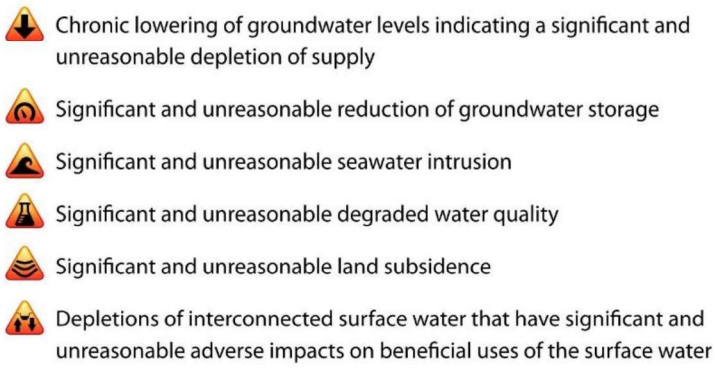
Executive Summary

Chapter 1 - Introduction

On September 16, 2014, Governor Jerry Brown 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 of 2014 (SGMA), which is codified in Section 10720 et seq. of the California Water Code. This legislation created a statutory framework for groundwater management in California that must be achieved during the planning and implementation horizon from 2020 to 2040 and sustained into the future without causing undesirable results. SGMA requires that the following six sustainability indicators must be considered:



SGMA requires governments and water agencies of high and medium priority basins to halt groundwater overdraft and bring groundwater basins into balanced levels of pumping and recharge without causing significant and unreasonable undesirable results related to the six sustainability indicators. Under SGMA, these basins should reach sustainability within 20 years of implementing their sustainability plans. For critically over-drafted high priority basins, including the Kings Groundwater Subbasin (Kings Subbasin) that the North Fork Kings Groundwater Sustainability Agency (NFKGSA) area is part of, the deadline for achieving sustainability is 2040.

The NFKGSA was created by Special Act legislation via Senate Bill 564, passed by the Legislature and signed by Governor Brown on September 16, 2016. The legislation established the NFKGSA as a Groundwater Sustainability Agency (GSA) under SGMA for the portion of the Kings Subbasin that lies within the boundaries of the Agency. The legislation requires the Agency to develop and implement a Groundwater Sustainability Plan (GSP) to manage the groundwater resources to achieve groundwater sustainability within the territory of the Agency, in compliance with the mandates and timelines in SGMA.

While there are a number of small public and private water purveyors and agencies throughout the territory of the Agency, these entities do not have sufficient staff or resources to form a GSA; these entities have agreed that the interests of the area are best served by having a single agency dedicated to management of groundwater resources. Accordingly, the NFKGSA has been deemed the exclusive local agency within the designated territory endowed with powers to comply with SGMA.

The Agency's enabling act in Water Code Appendix Section 143-801 provides, that pursuant to Chapter 8 of Part 2.74 of Division 6 of the Water Code, the Agency may impose a variety of fees as it may determine to be necessary, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activities, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a GSP, and investigations, inspections, compliance assistance, enforcement, and program administration during implementation of the GSP, including a prudent reserve. As a public agency, the NFKGSA will provide a voice for local landowners during GSP development and implementation. This GSP is a living document that will be revised as additional information is gathered and the evaluation criteria contained herein will be reviewed and updated every 5 years.

The GSA is governed by a seven-member Board of Directors representing the seven divisions established when the GSA was formed. Each board member is chosen by the members of that division and is either a resident or landowner within the territory of the NFKGSA. An alternate for each board member is also chosen in the same manner by the same entities. The Board of Directors was formed in January 2017 and board members serve a four-year term of office. The Board has final decision-making authority for the GSA.

The sustainability goal of the Kings Subbasin and this GSA is to ensure that by 2040 the basin is being managed in a sustainable manner 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 and stabilizing the long-term trend of declining groundwater levels without significantly or unreasonably impacting groundwater storage, water quality, land subsidence, or interconnected surface water.

Chapter 2 - Plan Area

The Kings Subbasin is in the San Joaquin Valley Groundwater Basin in central California. The Kings Subbasin is located primarily in Fresno County, but extends into Kings and Tulare Counties. This subbasin and 12 smaller subbasins are in the Tulare Lake hydrologic region. The Kings Subbasin boundary is defined in the Department of Water Resources (DWR) Bulletin 118 as DWR Subbasin No. 5-22.08.

The NFKGSA is one of seven GSAs within the Kings Subbasin and is in the southwestern portion of the subbasin as shown in **Figure ES-1**. There is no overlap among the GSAs within the Kings Subbasin and there are no adjudicated areas in the groundwater subbasin. Each GSA within the Kings Subbasin is preparing its own individual GSP. This is appropriate because of the variations in land uses, crop mixes, groundwater conditions, and surface water supplies among the GSAs, all of which affect the fundamentals and details of the resulting GSPs. The seven GSAs have collaborated since 2016 to coordinate the formation of the GSAs and the required coordinated elements of the GSPs.

Five Groundwater Subbasins border the Kings Subbasin as shown in **Figure ES-1,** including the Madera Subbasin, Kaweah Subbasin, Tulare Lake Subbasin, Westside Subbasin, and Delta-Mendota Subbasin. The Tulare Lake and the Westside Subbasins border the NFKGSA.

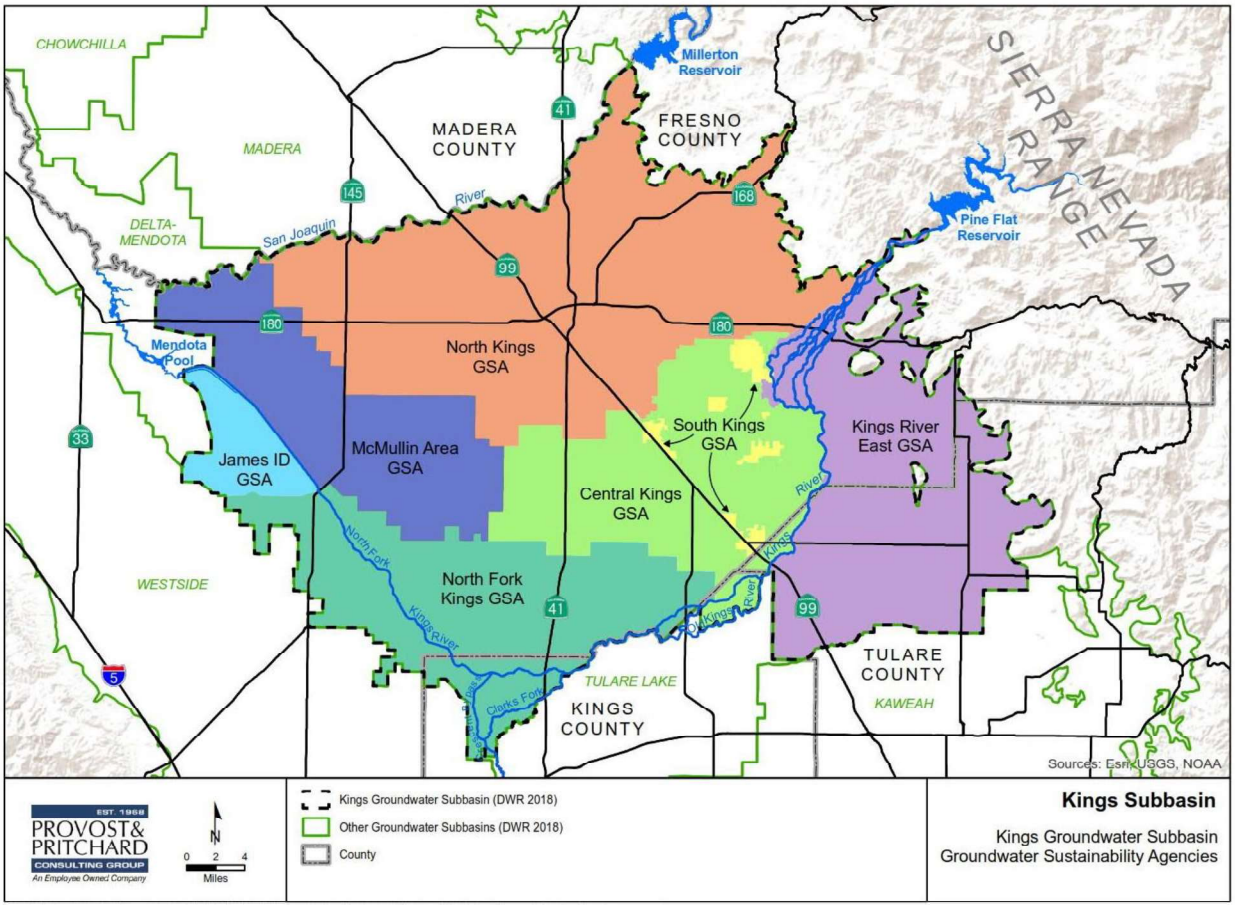


Figure ES-1 Kings Groundwater Subbasin

The NFKGSA area (Plan Area) is located in Fresno and Kings Counties and consists primarily of agricultural land but contains several rural communities and numerous residential properties. Domestic water demands are met solely by groundwater. Agricultural water demands are met through a combination of available surface water and groundwater. The primary source of surface water for agricultural use is the Kings River. Periodically, a small amount of Central Valley Project (CVP) water from the Friant system may be available for purchase in above average water years. The area of the GSA is approximately 168,366 acres. There are no significant federal, state, or tribal lands located within the Plan Area.

The Plan Area is comprised primarily of agricultural land use designations. The highest percentage land use categories in the GSA include agricultural permanent crops (deciduous fruit/nuts and vineyards) at 43%, agricultural annual crops (field crops and pasture crops) at 38%, and other agriculture at 9% of the Plan Area. The remaining 10% of the Plan Area includes urban, rural residential, commercial, industrial, riparian vegetation, native vegetation, and water surfaces.

The members of the NFKGSA are comprised of public agencies, private mutual water companies, and non-districted lands, commonly referred to as "white areas". The NFKGSA members include the following:

Public Agencies

- Clark's Fork Reclamation District
- Laguna Irrigation District
- Liberty Water District (partially overlapping with Liberty Canal Company)
- Riverdale Irrigation District
- Stinson Water District (managed by Stinson Canal and Irrigation Company)
- Lanare Community Services District
- Laton Community Services District
- Riverdale Public Utility District

Mutual Water Companies (privately held water stock companies)

- Burrel Ditch Company
- Crescent Canal Company
- Liberty Canal Company
- Liberty Mill Race Company
- Reed Ditch Company
- Stinson Canal and Irrigation Company
- Upper San Jose Water Company

White Area

- Fresno County non-districted lands

The NFKGSA is a conjunctive use area, utilizing groundwater resources to supplement available surface water supplies to meet water demands. Eight of the public agency members are member units of the Kings River Water Association (KRWA) and have water rights to surface water supplies from the Kings River. The Kings River is prone to highly variable annual runoff that directly relates to mountain precipitation and winter snowpack. The average annual runoff of the Kings River is approximately 1.7 million acre-feet, ranging from a high of 4,476,000 acre-feet (267% of average) to a low of 361,000 acre-feet (22% of average). A monthly water schedule developed by KRWA includes tables and charts that indicate which entities or canal owners are entitled to divert or store water at specific flow increments in the river. The schedule varies monthly with differing amounts of entitlement specified for each member unit depending on the calendar month and amount of river runoff. All of the NFKGSA KRWA member units are considered "lower river units", hence they generally do not receive entitlements on the monthly schedule until the river runoff reaches a certain level when the river naturally would have reached their respective diversion points.

Kings River surface water supplies for the KRWA member units within the NFKGSA can vary widely from year to year depending on hydrologic conditions and the amount of water carried over in storage behind Pine Flat Dam. Some NFKGSA units get very little, if any, surface water in dry years. Surface water stored in Pine Flat is diverted from the Kings River for distribution through various canals within the Plan Area. Water flowing down the canals also seeps into the ground and recharges the groundwater basin aquifer. In above average water years, a portion of the diverted surface water is also typically delivered to recharge basins in the area.

Members of the NFKGSA with water rights typically coordinate the delivery of their surface water with other lower river units each year to improve delivery efficiency. The duration of this

"coordinated run" for irrigation is often only two or three months. As such, groundwater is used to supplement the available surface water supply each year. Approximately 22% of the NFKGSA area is outside of the KRWA service area and does not have water rights to Kings River water supplies, relying solely on groundwater to meet water needs.

The average Kings River water diversions for the NFKGSA members from water year 1996/97 to water year 2010/11 was approximately 163,670-acre feet per year (AF/yr), which approximates normal deliveries. The average annual effective precipitation within the NFKGSA is estimated to be approximately 60,200 AF/yr.

A significant amount of groundwater is pumped within the NFKGSA area on an annual basis to meet municipal, domestic, and agricultural water demands. Municipal and domestic water supply demands are met with groundwater, as surface water supplies are not reliable enough to meet municipal or domestic needs. Surface water supplies for those agricultural entities within the NFKGSA area that have surface water rights are generally insufficient to satisfy all agricultural needs in most years, so growers also rely upon groundwater to supplement the limited surface water supplies. All NFKGSA participants use some amount of groundwater, but those with rights to Kings River water utilize surface water whenever available, thus achieving conjunctive use of surface water and groundwater.

Chapter 3 - Basin Setting

Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model (HCM) provides a description of the general physical characteristics of the regional hydrology, geology, geologic structure, water quality, principal aquifers, and principal aquitards in the basin setting. The HCM is a written description accompanied by graphical representations of the hydrologic and hydrogeologic conditions that lay the foundation for development of water budgets, monitoring networks, and identification of data gaps. The narrative HCM description provided in Chapter 3 describes the Kings Subbasin, followed in each section by description applicable specifically to the NFKGSA. The HCM has been prepared utilizing published studies and existing resources and will be periodically updated as data gaps are filled and new information becomes available.

The Kings Subbasin is an alluvial basin bounded north and south by the San Joaquin and Kings Rivers respectively, the Sierra Nevada mountains on the northeast, and the Westside and Delta-Mendota Subbasins to the west-southwest. The aquifer system is comprised of unconfined and confined groundwater in the western parts of the subbasin where lacustrine clay beds exist. East of the lacustrine clays, locally significant clay beds separate shallower unconfined groundwater from deeper confined groundwater. The Kings Subbasin is dominated by six major geomorphic features including the alluvial fans of the Kings and San Joaquin Rivers, dune sands, compound fans of intermittent streams between the Kings and San Joaquin Rivers, a compound fan south of the Kings River, and an area termed overflow lands near the topographic axis of the valley. The major geomorphic features are closely related to the surficial deposits, which in turn relate to soil types. **Figure ES-2** is a soil map of the NFKGSA area based on the Natural Resource Conservation Service (NRCS) textural classification of soils. In general, coarser materials exist in the eastern half of the GSA and finer grained soils are found in the western parts of the GSA area.

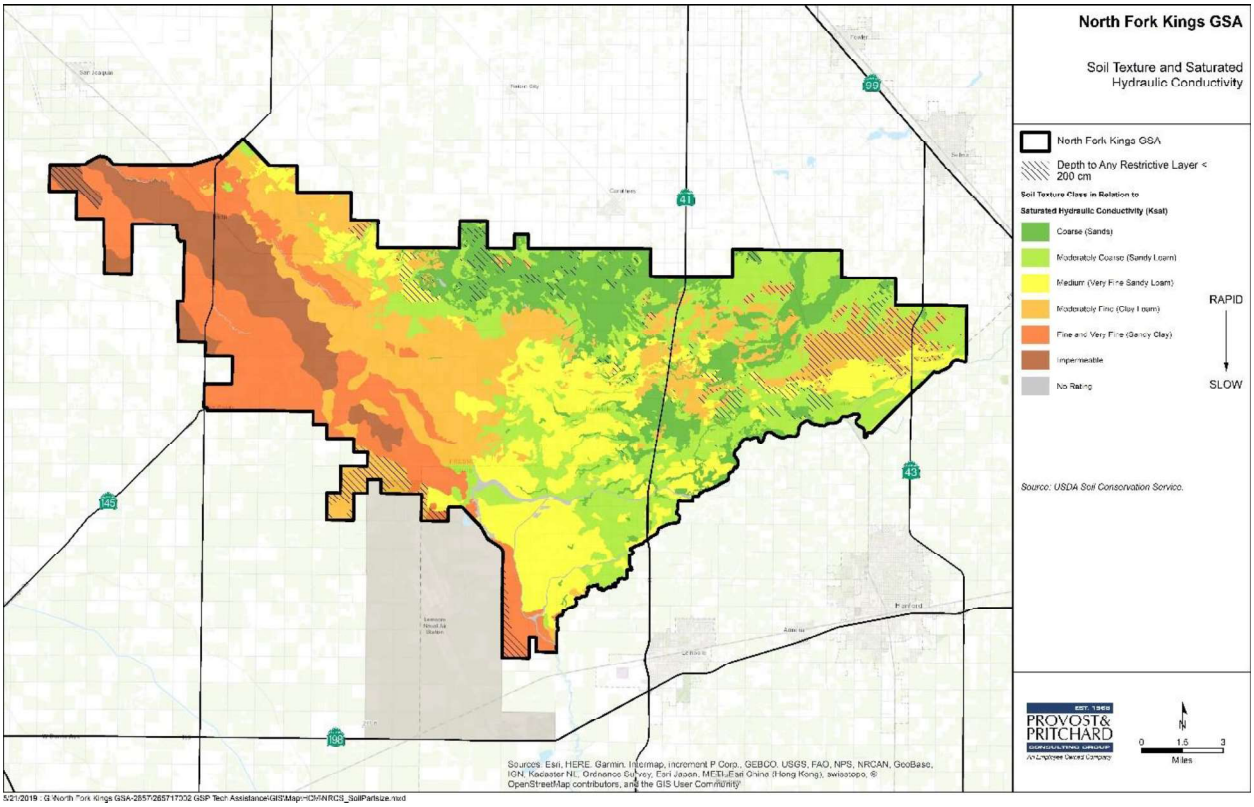


Figure ES-2 NFKGSA Soil Texture and Saturated Hydraulic Conductivity

The Plan Area aquifer has a series of semi-confining and confining clay formations that vary in depth and lateral extent throughout the aquifer. Various United States Geological Survey (USGS) reports have mapped the general extent of the clay layers in the area, as shown in **Figure ES-3**, as well as the depth of the clay layers. The three most prevalent subsurface clay formations that have historically been studied and delineated in the NFKGSA area within the San Joaquin Valley are known as the A-Clay (generally at a depth of 50-70 feet), C-Clay (generally at a depth of 210-260 feet), and E-Clay or Corcoran Clay (generally at a depth of 400-550 feet). The A-Clay is no longer a confining layer but does impact vertical movement of water. The C-Clay is considered semi-confining through most of the area with water levels fluctuating above and below the C-Clay at various times and locations. The Corcoran Clay is a confining layer throughout most of the area, although it thins toward the eastern edge. The Corcoran Clay divides the unconfined and confined aquifer within the GSA. As shown in **Figure ES-3**, there are different interpretations of the eastern extent of the Corcoran clay, likely a result of the thinning nature of the clay in this area where it may not be a true confining layer.

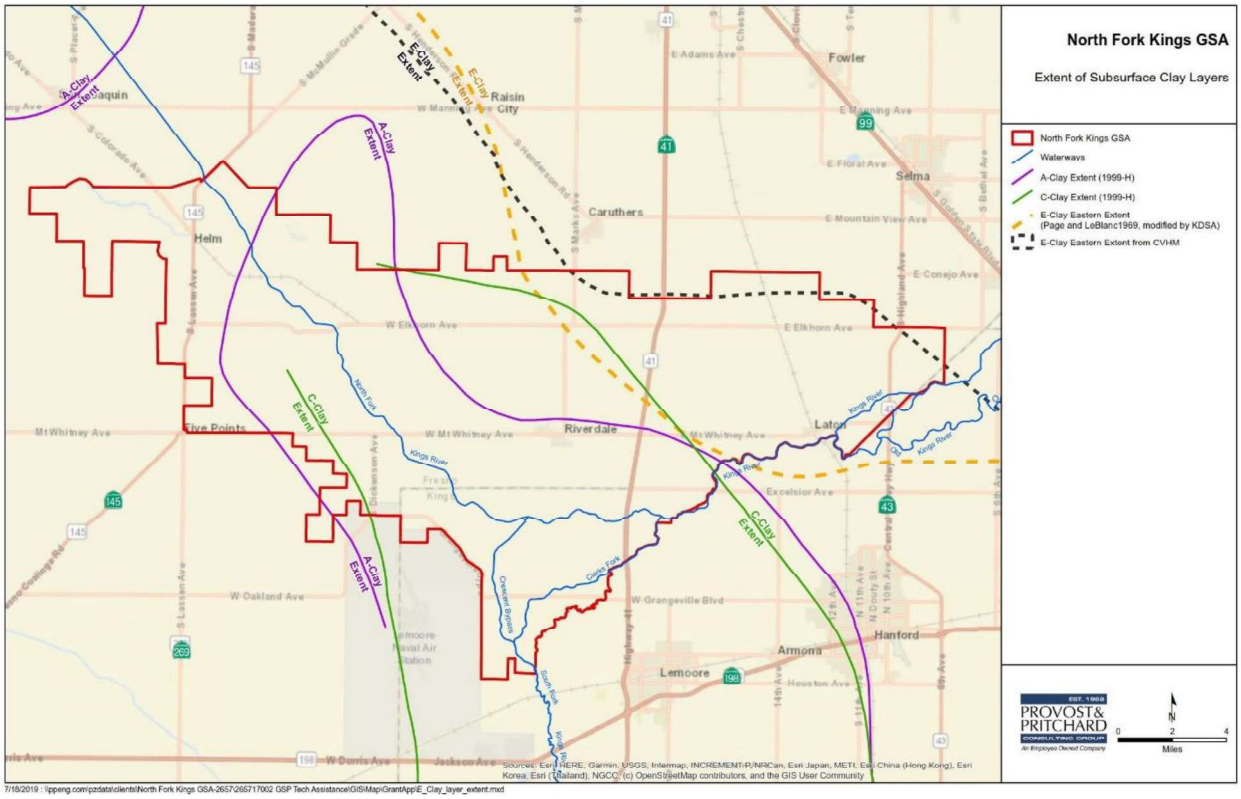


Figure ES-3 Extent of Subsurface Clay Layers

Groundwater Conditions

The natural direction of groundwater flow generally follows the topography from northeast to southwest, sloping from the Sierra Nevada Mountains on the east to the trough of the Valley at the western edge of the Kings Subbasin. In general, groundwater flow is to the southwest within nearly the entire subbasin with a few notable exceptions where municipal and irrigation pumping in parts of the Kings Subbasin have influenced the direction of groundwater flow or the influence of recharge from basins and the major rivers can be seen. Unconfined groundwater conditions extend across essentially the entire Kings Subbasin. Insufficient available surface water supplies have led to heavy agricultural pumping in the region, which has influenced the natural groundwater flow. The current NFKGSA groundwater flow pattern is from east to west and generally follows the flow direction of the Kings River system. The Kings River splits into the North and South Forks in the south central portion of the GSA. Similarly, the groundwater movement bifurcates in this area heading both northwesterly and southerly toward the borders of the GSA as shown in **Figure ES-4**. The highest groundwater elevations are located along the eastern boundary and the lowest groundwater elevations are located near the northwestern border of the GSA where the groundwater generally flows north toward a cone of depression and the McMullin Area GSA (MAGSA).

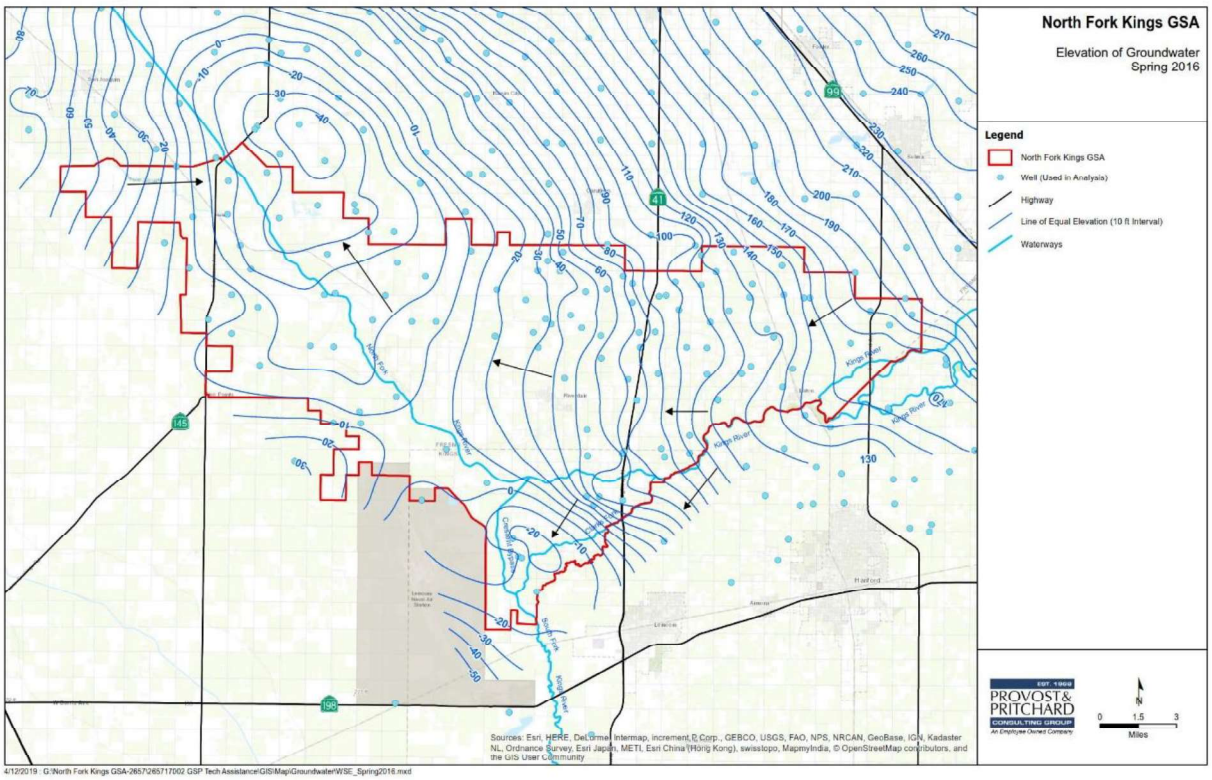


Figure ES-4 Elevation of Groundwater Spring 2016

Groundwater Levels

Groundwater levels have fallen significantly over the last century throughout the San Joaquin Valley, including within the NFKGSA. Pictured below in **Figure ES-5** is a typical unconfined well hydrograph within the Plan Area. Static, or non-pumping, water levels in wells are typically measured in the spring and fall each year to capture the seasonal high and low groundwater levels. The historic trend line shows water levels declining by approximately 2 to 3 feet per year on average within the unconfined aquifer.

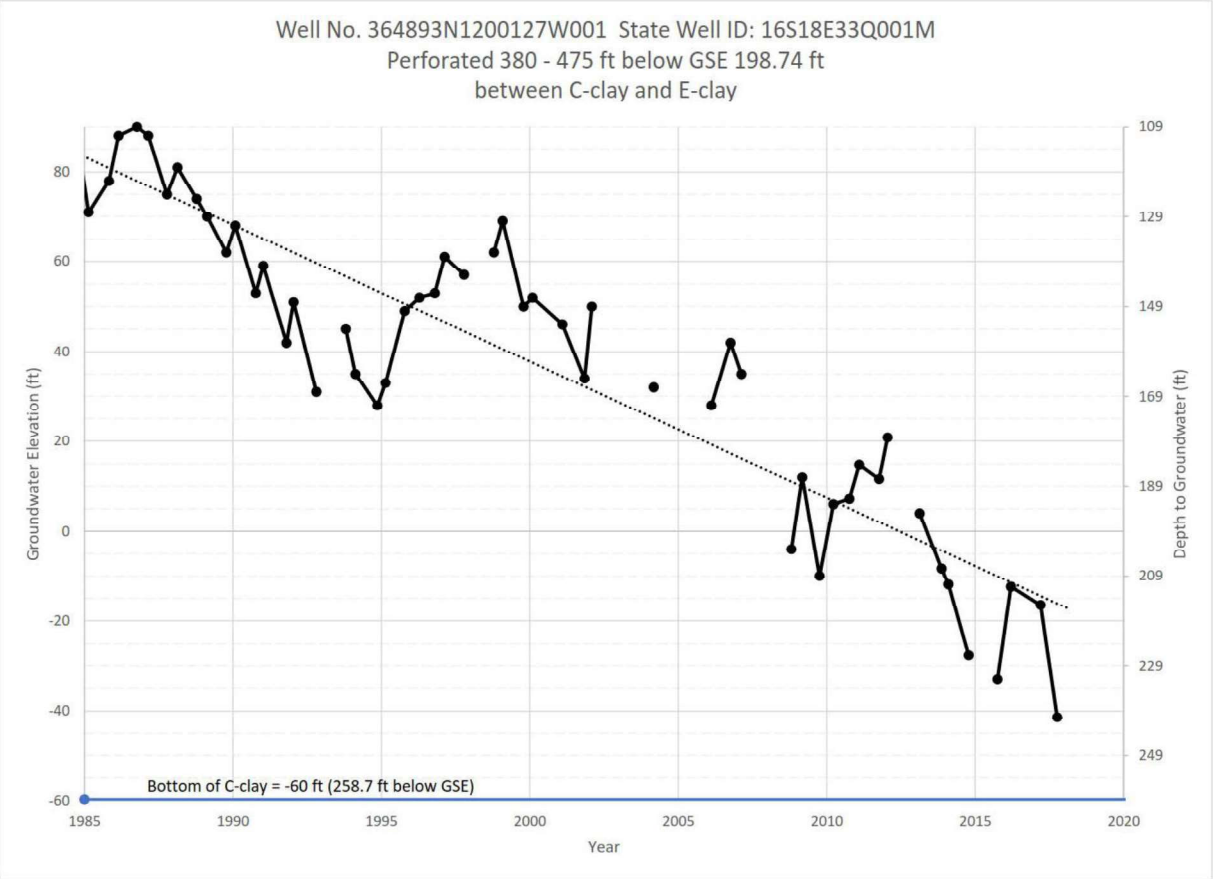


Figure ES-5 Typical Unconfined NFKGSA Well Hydrograph

Groundwater Quality

Groundwater within the NFKGSA area is used to meet agricultural and domestic demands. The groundwater quality assessment for the NFKGSA Plan Area has been prepared using the available information obtained from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program database, which includes water quality information collected by the California Department of Water Resources (DWR), State Water Resources Control Board, Division of Drinking Water (SWRCB & DDW), and the USGS. Additionally, this data has been augmented with information available from previous scientific investigative data collection and reporting efforts. Superimposing the NFKGSA Plan Area boundary over the wells utilized for the cited efforts identified seventy-three (73) wells with well construction information suitable for use in developing an initial characterization of groundwater quality conditions in the Plan Area. Water quality constituents of concern within the Plan Area is shown in **Table ES-1**. Arsenic, Fluoride, Gross Alpha, 1,2,3-Trichloropropane, Uranium, Iron, Manganese, Total Dissolved Solids, Boron, and Molybdenum appear in various aquifer zones and all have incidences of exceeding the United States Environmental Protection Agency (USEPA) public water system quality maximum contaminant levels (MCLs) or Health Advisory Levels. The majority of these contaminants are naturally occurring in geologic formations but can still pose a drinking water health risk for beneficial users within the NFKGSA.

Table ES-1 Chemicals of Concern and California MCLs

Chemical of Concern	California Primary MCL	California Secondary MCL	Lifetime Health Advisory Level
Arsenic	10 µg/L	-	-
Chromium (Total)	50 µg/L	-	-
Fluoride	2,000 µg/L	-	-
Gross Alpha	15 pCi/L	-	
Lead *	15 µg/L	-	-
Nitrate	10 mg/L (as N)	-	-
1,2,3-Trichloropropane	0.005 µg/L	-	-
Uranium	20 pCi/L		
Aluminum	1,000 µg/L	200 µg/L	-
Iron	-	300 µg/L	-
Manganese	-	50 µg/L	-
Total Dissolved Solids	-	500 mg/L to 1,000 mg/L	
Boron **	-	-	6,000 µg/L
Molybdenum	-	-	40 µg/L

* The USEPA regulates the concentration of lead in drinking water by an Action Level, which is similar to an MCL but requires additional testing at customer services.

** The State of California has adopted a Notification Level of 1,000 µg/L.

Land Subsidence

Land subsidence was first monitored in the 1920s, then occasionally through the 1970s during periods when there was less access to surface water in portions of the San Joaquin Valley. The frequency of subsidence monitoring decreased after the 1970s, by which time access to surface water had increased due to the canals and water storage projects built in California, allowing less reliance on groundwater in the 1970s and 1980s to meet water demands in areas outside the NFKGSA. Subsidence monitoring increased again in the 2000s due to more-frequent drought conditions, environmental regulations that resulted in lower surface water allocations to State Water Project (SWP) and Central Valley Project (CVP) contractors, and local farmers and cities increasing reliance on groundwater. Recent monitoring has indicated increased subsidence in portions of the NFKGSA as a result of the recent drought and heavy reliance on groundwater pumping, as indicated by NASA InSAR (satellite) data showing the change in land surface elevation from May 2015 through April 2017 (**Figure ES-6**). Subsidence in the northeastern corner of the NFKGSA area was measured at one to two inches in that two-year period, which is considered minimal. Subsidence increased significantly west and south of that location. The western three-quarters of the NFKGSA area, in areas underlain by the C-Clay and Corcoran Clay, show subsidence over the period ranging between three and five inches with outliers as high as ten to fifteen inches during the two-year period. Some of this subsidence in the NFKGSA may be originating in neighboring areas and will need to be closely monitored in the future.

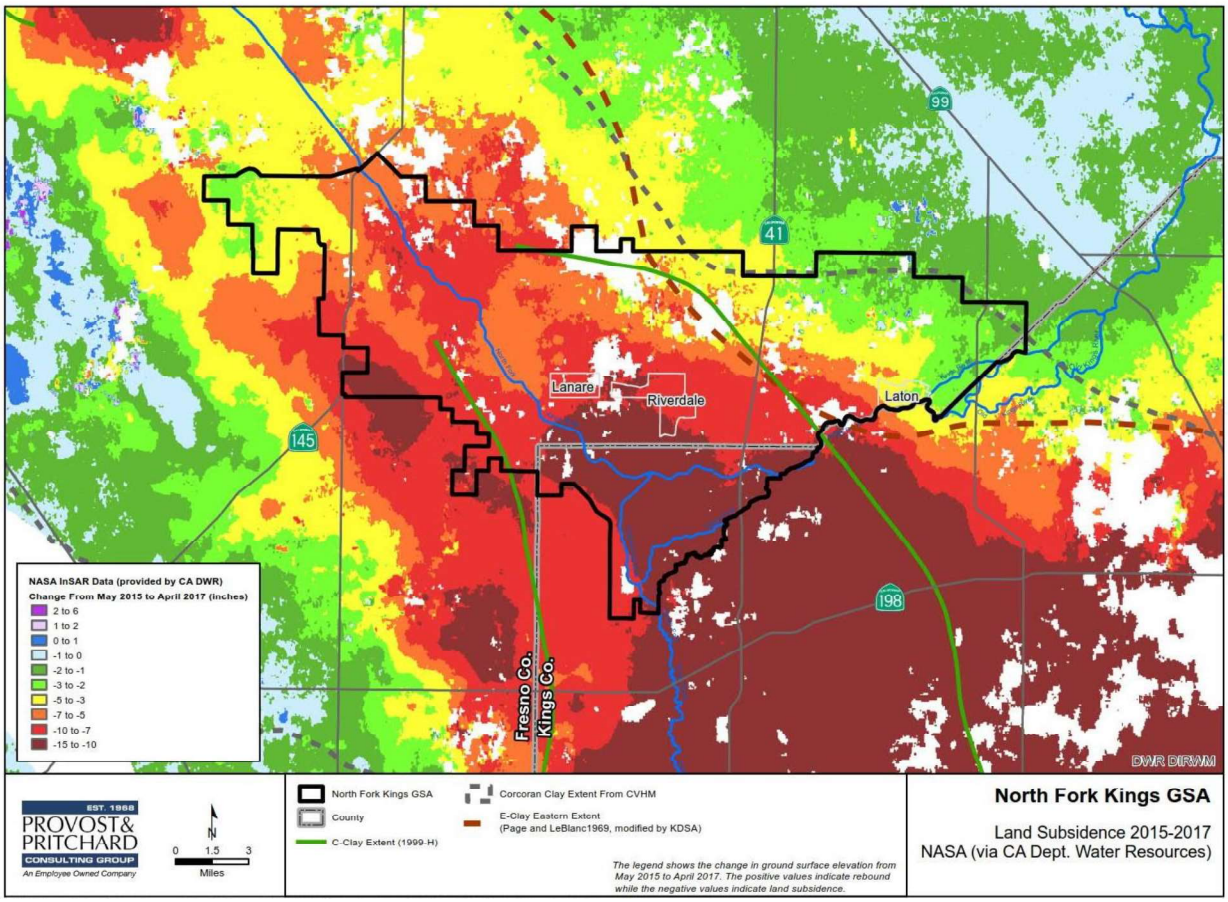


Figure ES-6 Land Subsidence in NFKGSA and surrounding area

Water Budgets

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 in 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 NFKGSA.

Water budgets were prepared for a historical period (1997-2011), current period (2016-2017), and future periods (2040 and 2070). The historical water budget covers a hydrologically average period based on Kings River diversions and was developed to help calibrate the water budget process. The future water budgets are based on numerous assumptions related to climate change, population growth, and water use. These assumptions will likely change over time resulting in different conclusions. There is uncertainty in several aspects of the water budget; the results should be viewed as guidelines rather than precise values.

Historical surface water supplies available to NFKGSA members satisfy approximately 40% of the water demand, while the remainder is met by groundwater pumping. For current conditions, the total water demands within the NFKGSA area are estimated at 403,200 AF/yr with approximately 282,700 AF/yr of groundwater pumping, resulting in a current annual groundwater overdraft

estimated at 63,100 AF/yr. In order to achieve sustainability this amount of overdraft must be eliminated by 2040 through project development to augment the water supply and/or through management actions to reduce the water demand.

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 Chapter 3 of the GSP - the hydrogeologic conceptual model, groundwater conditions, and water budget sections of the NFKGSA plan.

The goal of the Kings Subbasin and this GSA 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 when the basin and this GSA will be considered sustainable are:

- The basin is continuously operated 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 to prevent Undesirable Results of the applicable sustainability indicators.

The seven GSAs within the Kings Subbasin have been coordinating for several years on how to reach and maintain sustainability. As described in the Chapter 3 - Basin Setting, the Kings Subbasin includes significantly varied geologic conditions, water supplies, and land uses that lead to different conditions and obligations within each GSA. The Kings Subbasin setting describes the trend of declining groundwater levels within the Kings Subbasin and this GSA. The degree of decline varies by location based primarily on land use and available surface water supplies. The basin setting information, including historic groundwater conditions, surface water supplies, groundwater flows, land use, and other information were used to establish the water budgets, estimates of storage change within each GSA, and sustainable yield. Coordination efforts between the GSAs have resulted in concurrence of the initial quantities of storage change responsibility for each GSA to correct in order to achieve sustainability. These quantities and each GSAs respective obligation will continue to be monitored and evaluated as additional information is gathered.

Each GSA in the Kings Subbasin is responsible for implementing the projects and management actions necessary to reach sustainability and meet its initial mitigation requirements for storage change. Each GSA has identified measures that will be implemented to ensure the Kings Subbasin will be managed within the sustainable yield, as identified in Chapter 6 – Projects and Management Actions to Achieve Sustainability. Collectively, these projects and programs have been identified to

ensure the Kings Subbasin reaches sustainability by 2040. The projects and programs include technical data and estimates of project benefit; the total of these benefits meet the initial estimates for reaching sustainability within the Kings Subbasin.

The Kings Subbasin has agreed to a phased approach of increasing mitigation to achieve sustainability. The basin has set incremental targets for correcting the overdraft of 10% by 2025, 30% by 2030, 60% by 2035, and 100% by 2040. Each GSA in the Kings Subbasin is planning to implement projects and management actions in accordance with the agreed mitigation targets. The GSAs will continue to meet regularly to review data to ensure all GSAs are meeting their milestones and progress is being made toward sustainability.

Groundwater Levels

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 the water level has declined to a depth that water quality cannot be treated for beneficial use. **Figure ES-7** shows a typical well hydrograph with trendline from WY 1997-2011 average hydrologic period and incremental overdraft mitigation to reach the measurable objective and sustainability in 2040. The measurable objective will include an extension of a current hydrograph gradually stabilizing, and a minimum threshold defined as the depth of groundwater predicted if a historic 5-year drought occurred.

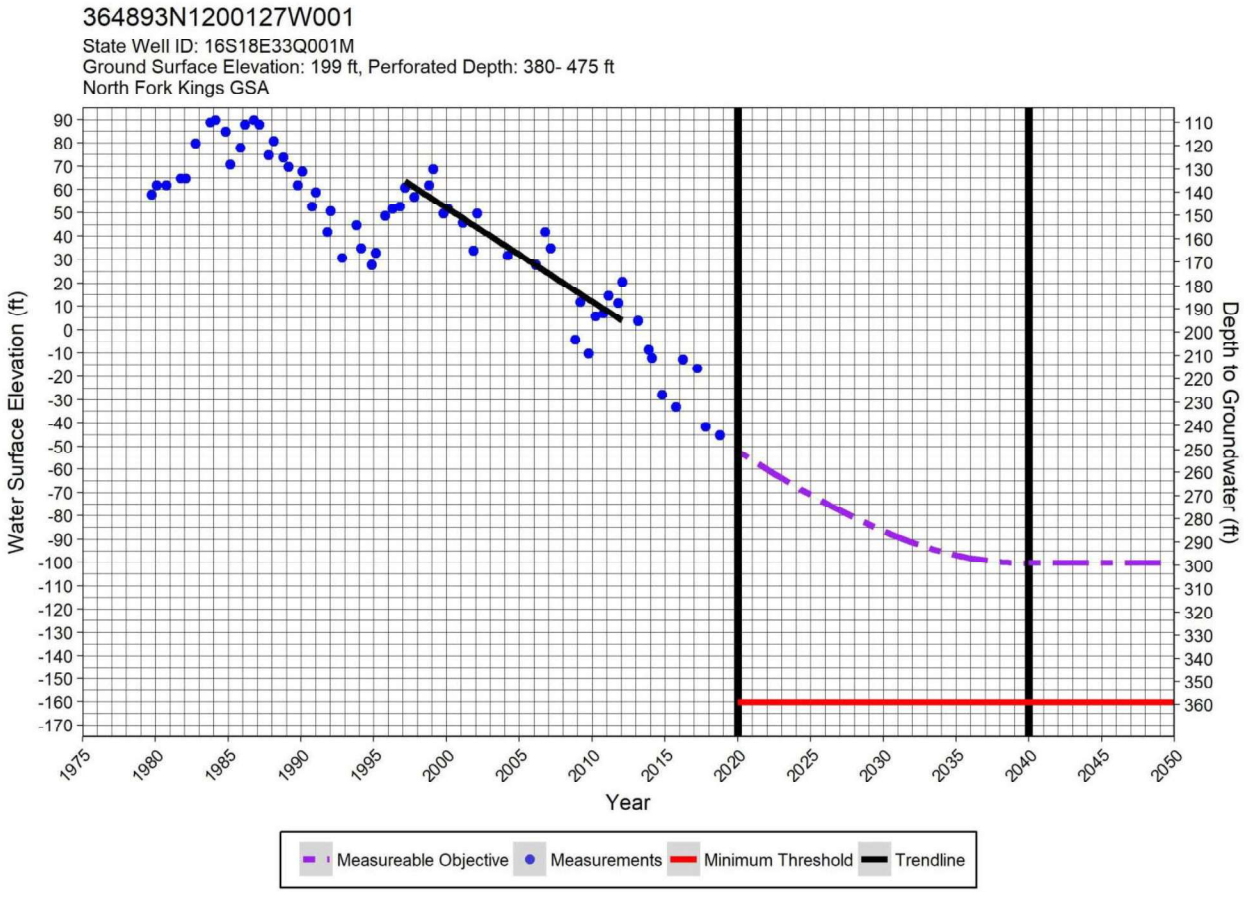


Figure ES-7 Typical NFKGSA Well Hydrograph with Phased Mitigation to Reach Sustainability

Storage Change

As part of the coordination of GSAs within the Kings Subbasin, a common method was used to estimate the change in groundwater storage for the entire subbasin and within each GSA during the hydrologic average base period, identified as the 15-year period from October 1996 to September 2011 based on Kings River surface water diversion into the area. The calculation of estimated groundwater storage change within the Kings Subbasin upper unconfined aquifer zone was approximately -1.8 MAF during the hydrologic average base period from spring 1997 to spring 2012, or an average of about -122,000 AF/year. Estimating storage change in the lower confined aquifer zone is not possible at this time due to limited or absent data from confined wells in the area. In addition, groundwater pumped from the confined portions of the aquifer is captured as storage change in the unconfined aquifer due to downward leakage through wells and aquitards. The estimation of the amount of groundwater in storage is dependent on water level elevations from multiple wells and the depth of groundwater at the beginning and end of the period for which the storage change is estimated, multiplied by specific yield values at various depths. The 2040 goal is to stabilize, over the long-term, changes in groundwater storage. The goal will be to prevent groundwater storage from falling below the overall storage represented by groundwater level measurable objectives, and to never allow groundwater storage to fluctuate below the storage value represented by the groundwater level minimum thresholds.

Water Quality

Groundwater quality monitoring and reporting by community water systems is a requirement of California Title 22 Code of Regulations. With the powers provided by SGMA, a GSA can only regulate and manage groundwater pumping and recharge efforts. Groundwater pollution characterization and mitigation are typically enforced by local agencies and state level programs. The MCL values, which are protective of human health, will be relied upon as the primary criteria for defining minimum thresholds and undesirable results when related to groundwater pumping policies and recharge projects for the constituents of concern in the area. These constituents of concern will be the focus of the SGMA monitoring effort. Groundwater monitoring results from representative community and non-community wells within the NFKGSA monitoring network will be reviewed annually for compliance with State MCL values and changes from historical values, especially tracking trends in water quality. The measurable objective is to maintain water quality at potable water standards, below MCLs for the constituents of concern. In situations where monitoring network wells (either existing or future wells) have a history of being above MCLs for constituents of concern, the measurable objective is for the wells to maintain stable or improving groundwater quality trends so there is no degraded water quality from groundwater management activities.

Land Subsidence

The Minimum Threshold for the annual land subsidence rate in the Plan Area has been established as 12.5 inches/year with a maximum cumulative land subsidence of 100 inches over 20 years. The maximum historical land subsidence rate in NFKGSA is about 10 inches/year as measured by the Kings River Conservation District (KRCD) from 2013-2016, which was in the middle of the recent historic drought. At this historical rate, local stakeholders, landowners, and water agencies have not observed any significant negative impacts from the subsidence. The historical rate of 10 inches/year is used for the Measurable Objective in NFKGSA. The annual minimum threshold is 25% more than this number to allow for operational flexibility during periods of drought. Since there have

been no reported significant and unreasonable impacts with the historical rate of subsidence, it is anticipated that the minimum threshold will not cause undesirable results.

The cumulative amount of land subsidence was determined by reviewing the 2013-2016 subsidence data from KRCD. This shows the minimum subsidence in NFKGSA over a period of 3 years was around 1.0 foot. The 1.0 foot of land subsidence over 3 years has an annual rate of 0.33 feet/year, or 4 inches/year. The annual rate of 4 inches/year was used to estimate the amount of subsidence that would occur over 20 years. The estimate of cumulative land subsidence over 20 years is 80 inches, which was established as the measurable objective. The cumulative minimum threshold is 25% more than this number to allow for operational flexibility during periods of drought.

Surface Water and Groundwater Interaction

This sustainability indicator applies to portions of the Kings Subbasin, but it does not apply to the NFKGSA area since the Kings River is not continuously flowing in the area and usable groundwater levels are more than 30 feet below the ground surface, therefore, there are no Interconnected Surface Waters as defined by SGMA regulations since the aquifer is not continuously saturated. However, the NFKGSA has proposed establishing a shallow groundwater monitoring network along the river to monitor for impacts and changes in near-river gradients and potential impacts to downstream water users or aquatic habitat.

Seawater Intrusion

This sustainability indicator does not apply to the Kings Subbasin.

Chapter 5 - Monitoring Network

This chapter describes the monitoring networks being developed by the NFKGSA that will collect data to determine short-term, seasonal, and long-term trends in groundwater and related surface conditions. This information will yield information necessary to support: 1) the implementation of this Plan, 2) evaluation of the effectiveness of this Plan, and 3) decision making by the NFKGSA management. The results and data from historical monitoring efforts are discussed 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.

The GSAs within the Kings Subbasin have established three monitoring networks within each GSA for groundwater level, groundwater quality, and land subsidence. The objectives of the various monitoring programs include:

1. Establish a baseline for future monitoring.
2. Provide warning of potential future problems.
3. Use data gathered to generate information for water resources evaluation.
4. Help to quantify annual changes in water budget components.
5. Develop meaningful long-term trends in groundwater characteristics.
6. Provide comparable data from various locales within the Plan Area.
7. Demonstrate progress toward achieving measurable objectives described in the Plan.
8. Monitor changes in groundwater conditions relative to minimum thresholds.

9. Monitor impacts to the beneficial uses or users of groundwater.

The primary challenge in developing the water level monitoring network was utilizing available data and navigating through the obstacles and limitations of the three general data gap types: temporal, spatial, and insufficient quality of data. Because of the unique geology and multiple primary clay layers within the NFKGA, well construction information including perforated intervals is required to identify which aquifer zone is being monitored. Composite wells, which are perforated above and below the primary clay layers, are very common within the Plan Area. Some composite wells are included in the monitoring network for future studies and analysis but are not considered high quality monitoring points because composite well water level measurements may be reflecting multiple aquifer zones. Publicly available groundwater level data is limited in terms of high quality monitoring points. These ideal monitoring points must have known construction information, not be composite, have adequate measurement history and frequency, and provide sufficient spatial coverage across the Plan Area.

The NFKGSA intends to expand its groundwater level network as additional well construction information is obtained for existing wells and as new dedicated monitoring wells are installed. Through public education, outreach, video logging of existing wells that have routinely been measured but do not have well construction information available at this time, and construction of new nested monitoring wells, the GSA plans to fill data gaps as discussed further in Chapter 5. The groundwater elevation measurements will be collected every March and October to provide data on the seasonal high and low groundwater conditions. The groundwater level data will be provided to the Kings Subbasin Plan Manager for inclusion in the Data Management System and annual reports. These wells along with additional future wells will be used for groundwater storage calculations.

The groundwater quality monitoring network will rely on the publicly available groundwater quality data from selected representative wells that will be obtained annually and evaluated against sustainable management criteria. Locations were selected to be representative of large and small communities dependent on groundwater and to spatially cover the GSA. The representative groundwater quality monitoring network will be evaluated and revised as needed.

Land subsidence will be primarily monitored using KRCD's land subsidence monitoring program. The monitoring network includes benchmark surveying on an approximate seven-mile grid network with records dating back to 2010. This spatial and temporal network is adequate and designed with the flexibility to increase or decrease measurement frequency and/or benchmark spacing if more or less data is warranted. NASA InSAR remote sensing data will be used to verify any observed subsidence and fill in gaps between the surveyed benchmarks.

Chapter 6 - Projects and Management Actions

Tools available to achieve sustainable groundwater management fall into two primary categories – project development for water supply augmentation and management actions for demand reduction. The first priority of the NFKGSA is developing projects to augment the water supply. If project development is unable to achieve the sustainability required to meet the interim milestones, then management actions or programs will need to be employed. The projects described in Chapter 6 primarily focus on the capture, use, and recharge of available high flow surface water supplies within the GSA to augment the water supply and reduce the impacts of groundwater pumping.

Alternatively, management actions have been developed that primarily focus on reducing water demand and the associated reduction of groundwater pumping, along with increased data collection and associated actions including education and outreach, regulatory policies, incentive-based programs, and enforcement actions. While the GSA considered a number of potential projects and management actions to mitigate the groundwater overdraft within the GSA and help achieve sustainability, not all of the identified potential projects and management actions were feasible for implementation. Projects that are currently envisioned for implementation are discussed in Section 6.2 and included in Table ES-2 with a preliminary identification of the entity that may implement the project.

Some projects and management actions will benefit the entire GSA and/or be implemented GSA-wide, while other projects and management actions will be implemented by entities or landowners individually and will primarily have localized benefits. Each of the included projects and management actions are in various stages of planning, implementation, benefit accrual, and ongoing operations and maintenance (O&M). Some projects and management actions will be implemented sooner than others as subsequently discussed. The GSA understands there are various levels of uncertainty with project and program implementation; it is not unusual for project and program implementation to take longer than originally estimated. In addition, some projects and management actions build upon others, and the accrual of expected benefits may take multiple years to be individually realized and may vary substantially from 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 and benefit accrual may fluctuate over time and will be reevaluated each time this GSP is updated.

Table ES- 1 Preliminary North Fork Kings Project List

Project ID	Project Title	Implemented By	Estimated Benefits AF/yr		Generalized Priority	Estimated Capital Cost to GSA	Estimated Cost per Acre-Foot
			Avg Annual Recharge	Demand Reduction			
NFK1	Basin 11 Improvement Project	Laguna ID	1,420		High		
NFK2	Basin 11 Expansion Project	Laguna ID	1,110		High		
NFK3	Laton North Recharge Project	Laguna ID	3,080	390	High		
NFK4	North Fork Regional Recharge Project	NFKGSA /LID	11,660	280	High	$20.8M	$151
NFK5	Zonneveld Pond Improvement Project	Laguna ID	430		High		
NFK6	On-Farm Recharge	Landowners	5,000 *		High		
NFK7	Cerini Recharge Project	Crescent / Stinson	6,500 *		High		
NFK8	Kamm Recharge Project	Landowner	10,400 *		High		
NFK9	Terra Linda Recharge Project	Landowner	1,560	210	High		
NFK10	Misc. Landowner Recharge Basins	Landowners	4,180 *	500	High		
NFK11	Upgradient Recharge Outside NFKGSA	NFKGSA	4,500 *	430	High	$17.1M	$265
NFK12	Mussel Slough Recharge Project	Laguna ID	4,730	700	Medium		
NFK13	Misc. Dry Well Recharge Systems	Landowners	2,000 *		Medium		
NFK14	Misc. Reverse Subsurface Tile Systems	Landowners	2,000 *		Medium		
NFK15	Laton North Phase 2 Recharge Project	NFKGSA	3,080	390	Medium	$2.5M	$65
NFK16	Pires Recharge Project	Laguna ID	550		Low		
NFK17	North Fork Group Site 16	NFKGSA	130 *		Low	$0.4M	$214
NFK18	North Fork Group Site 3	Laguna ID	320		Low		
NFK19	North Fork Group Site 6	Reed Ditch Co.	150		Low		
Subtotal			62,800	2,900		$40.8M	

* = project is scalable, estimated annual benefits could be increased

The current list of NFKGSA projects total an estimated average annual recharge of 62,800 acre-feet, plus a water demand reduction of 2,900 acre-feet. If the project list were fully implemented as estimated, the combined total of 65,700 acre-feet would almost entirely offset the future 2040 overdraft estimate of 68,900 acre-feet. Any difference between the future 2040 overdraft value and the actual accrual of project benefits will be reduced to zero by implementing management actions and programs to reach sustainability. **Figure ES-8** shows the planned NFKGSA phased mitigation of overdraft reduction to reach sustainability.

Discussed in Section 6.3 is a suite of management actions the GSA may consider during implementation of the GSP to achieve sustainability. Some management actions, such as education and outreach, will be initiated early in the GSP implementation phase. Other management actions may be employed to reduce water demand if project development is not proceeding sufficiently to achieve the sustainability required to meet the interim milestones. Some management actions must be implemented before others, and specific actions may not be implemented at all if sustainability is achieved through other actions or project development. Some management actions could be implemented GSA wide, while the policies and programs for other management actions would be developed by the GSA but implemented by individual entities or landowners. In some cases the landowner may need to choose which management action to implement, such as choosing between

crop conversion and/or fallowing land. This is an economic decision that affects the livelihood of the landowner and there may not be a consistent answer across the entire GSA. It is expected 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.

The Management Actions that may be considered by the GSA as discussed in Section 6.3 are grouped into the following general topics:

- EO - Education and Outreach
- WH – Well Head Requirements
- GA – Groundwater Allocation
- GMT – Groundwater Marketing/Trading
- FI – Fees and Incentives
- GP – Groundwater Pumping Restrictions

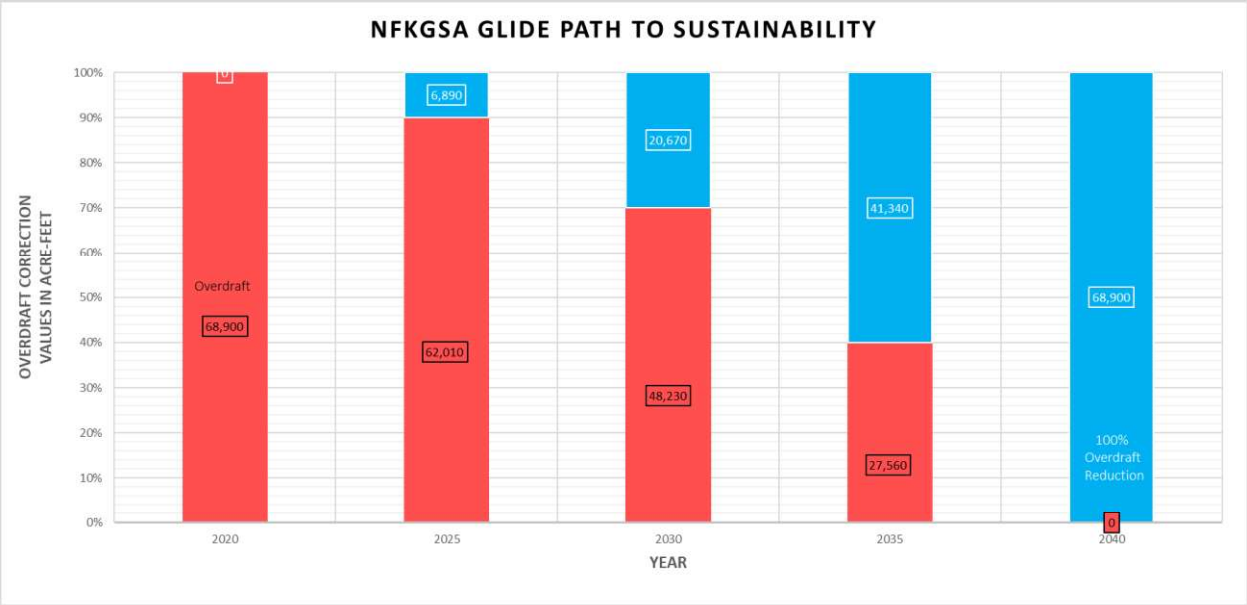


Figure ES-8 NFKGSA Phased Mitigation of Overdraft Reduction to Reach Sustainability

Chapter 7 - Plan Implementation

The adoption of the GSP will be the official start of the Plan Implementation for NFKGSA. After GSP adoption, the GSA will continue its efforts to engage the public and secure the necessary funding to successfully monitor and manage groundwater resources within the 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, fill data gaps, and begin the implementation of both projects and management actions.

This chapter includes a preliminary estimate of GSP implementation costs, identifies funding alternatives, and includes a preliminary implementation schedule for the potential projects and management actions of the NFKGSA GSP. All the projects discussed have been evaluated as

potential investments that would assist in achieving the long-term goals of the GSA. The potential schedules and budgets presented in the GSP are purely estimates and may be adapted or eliminated should the GSA Board deem it necessary.

Successful implementation of this GSP over the planning and implementation horizon (2020-2040) will require ongoing efforts to engage stakeholders and the general public in the sustainability process, communicating the statutory requirement, the objectives of the GSP, and progress toward each identified measurable objective. In the context of this ongoing public communication, announcements of upcoming environmental hearings, project presentations, bid openings, and project construction schedules will be made on a regular basis. Public forums will include opportunities for public comment and feedback, to be addressed in an appropriate manner by Agency staff and/or consultants. The Agency will provide notice to the public and other agencies as the implementation of each project or management action is being considered through public meetings, newsletters, and the GSA website (www.northforkkings.org). The NFKGSA will report the result of the Kings Subbasin and Plan Area operations including current groundwater levels, extraction volume, surface water use, total water use, groundwater storage change, and progress of GSP implementation to the public and DWR on an annual basis, in cooperation with the other GSAs in the Subbasin. The Kings Subbasin has developed a Data Management System to help store and evaluate groundwater related data. In addition, the NFKGSA will provide updated information and amend the GSP at least every five years. The update will include the results of the Kings Subbasin operations and progress in achieving sustainability including current groundwater conditions, status of projects or management actions, evaluation of undesirable results relating to measurable objectives and minimum thresholds, changes in monitoring networks, summary of enforcement or legal actions, and agency coordination efforts to the public and DWR.