New Stone Water District
Groundwater Sustainability Agency

Revised and Adopted
Groundwater Sustainability Plan 2025 Update
in compliance with the
Sustainable Groundwater Management Act

December 2024

LIMITATION

In preparation of this Groundwater Sustainability Plan (Plan), the professional services of Provost & Pritchard Consulting Group were consistent with generally accepted engineering principles and practices in California at the time the services were performed.

Section 3 of this Plan, Basin Setting, was prepared in general conformance with section 354.12 of the water code either by and /or under the direct supervision of the appropriate professional as indicated herein.

Per Regulation Requirements:

> §354.12 Introduction to Basin Setting
> This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.
>
> Note: Authority cited: Section 10733.2, Water Code.
> Reference: Section 10733.2, Water Code.

DATE SIGNED 1/29/2025

This Plan is a work product of the New Stone Water District Groundwater Sustainability Agency (NSWD GSA) members and associated stakeholders. Judgments leading to conclusions and recommendations were made based on the best available information but are made without a complete knowledge of subsurface geological and hydrogeological conditions. This Plan is intended to provide information from readily available published or public sources. We understand that the interpretations and recommendations are for use by the NSWD GSA in assisting the GSA in making decisions related to potential water supplies and groundwater management activities in light of California's new and evolving Sustainable Groundwater Management Act (SGMA) regulations.

Subsurface conditions or variations cannot be known, or entirely accounted for, in spite of significant study and evaluation. Future surface water and groundwater quantity, quality, and availability cannot be known. Trends have been estimated and projected based upon past historical data and events and are used for planning purposes. It should be noted that historic trends may not be indicative of future outcomes. Historic hydrology has been used to identify averages and potential extremes that may be experienced in future years; however, it will be important for the GSA to continually evaluate all the parameters that make up the agency water budget. Additionally, the rapidly changing regulatory environment surrounding the SGMA and State regulatory agencies may render any or all recommendations invalid in the future if not implemented and necessary approvals, permits, or rights obtained in a timely manner. Information contained in this GSP should not be regarded as a guarantee that only the conditions reported and discussed are present within the NSWD GSA or that other conditions may exist which could have a significant effect on groundwater availability.

In developing methods, conclusions, and recommendations this Plan has relied on information that was prepared or provided by others. It is assumed that this information is accurate and correct, unless noted. Changes in existing conditions due to time lapse, natural causes including climate change, operations in adjoining GSAs or subbasins, or future management actions taken by a GSA may deem the conclusions and recommendations inappropriate. No guarantee or warranty, expressed or implied, is made.

Prepared by:

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Abbreviations

AF or af .... Acre-feet
af/ac .... acre-feet per acre
AFY .... Acre-feet per Year
bgs .... below ground surface
BMP .... Best Management Practices
Bypass .... Chowchilla Bypass
Cal-SIMETAW .... California Simulation of Evapotranspiration of Applied Water
CASGEM .... California State Groundwater Elevation Monitoring Program
CBP .... Chowchilla Bypass gauging station
CDEC .... California Data Exchange Center
CEQA .... California Environmental Quality Act
cfs .... cubic feet per second
CIMIS .... California Irrigation Management Information System
CVFPB .... Central Valley Flood Protection Board
CVP .... Central Valley Project
CVRWQCB .... Central Valley Regional Water Quality Control Board
CV-SALTS .... Central Valley Salinity Alternatives for Long-Term Sustainability
CWC .... California Water Code
DAC .... Disadvantaged Community
DBCP .... Dibromo-Chloropropane
DE .... Davids Engineering
DQO .... Data Quality Objective
DTSC .... Department of Toxic Substances Control
DWR .... Department of Water Resources
EC .... Electroconductivity
E-clay .... Corcoran Clay
EDB .... Ethylene-Dibromide
EPA .... Environmental Protection Agency
ESJWQC .... East San Joaquin Water Quality Coalition
ET .... Evapotranspiration
FSS .... Facilitation Support Services
FT .... Foot
GAMA .... Groundwater Ambient Monitoring and Assessment

GDE .... Groundwater Dependent Ecosystem
GIS .... Geographic Information System
GMP .... Groundwater Management Plan
GPD .... Gallons per Day
GPM .... Gallons per Minute
GSA .... Groundwater Sustainability Agency
GSP .... Groundwater Sustainability Plan
GWS .... Groundwater System
HCM .... Hydrogeologic Conceptual Model
HEC-RAS .... Hydrologic Engineering Center's River Analysis System
IM .... interim milestone
ILRP .... Irrigated Lands Regulatory Program
ISP .... Implementation Service Plan
ISW .... interconnected surface waters
ITRC .... Irrigation Training & Research Center
IWFM .... Integrated Water Flow Model
Ksat .... Saturated hydraulic conductivity
LSCE .... Luhdorf & Scalmanini
MCL .... Maximum Contaminant Level
MCSim .... Madera-Chowchilla Groundwater Surface Water Simulation Model
Mg/L .... Milligram per liter
MID .... Madera Irrigation District
MO .... Measurable Objective
MOU .... Memorandum of Understanding
MSL .... Mean Sea-Level
MT .... Minimum Threshold
MUN .... Municipal and domestic supply
NASA .... National Aeronautics and Space Administration
NAVSTAR .... Navigation Satellite Timing and Ranging
NOAA .... National Oceanic and Atmospheric Administration
NO_3 .... nitrogen
NRCS .... Natural Resource Conservation Service
NSWD .... New Stone Water District
NSWD GSA .... New Stone Water District Groundwater Sustainability Agency
PMA .... Projects and Management Actions

P&P .... Provost & Pritchard
PBO .... Plate Boundary Observatory
PRISM .... Parameter-elevation Regressions on Independent Slopes Model
Qb .... Flood Basin Deposits
Qoa .... Quaternary Older Alluvium
Qt .... Terrace Deposits
QTc .... Quaternary and Tertiary age continental deposits
Qya .... Quaternary Younger Alluvium
RCWD .... Root Creek Water District
RMS .... Representative Monitoring Site
RWQCB .... Regional Water Quality Control Board
SAGBI .... Soil Agricultural Groundwater Banking Index
SGMA .... Sustainable Groundwater Management Act
SJR .... San Joaquin River
SJRR .... San Joaquin River Restoration
SJRRP .... San Joaquin River Restoration Program
SJVAPCD .... San Joaquin Valley Air Pollution Control District
SMC .... Sustainable Management Criteria
SVOC .... semi-volatile organic compound
SWPPP .... Stormwater Pollution Prevention Plan
SWRCB .... State Water Resources Control Board
SWS .... Surface Water System
TCE .... Trichloroethylene
TCP .... Trichloropropane
TDS .... Total Dissolved Solids
Ti .... Ione Formations
UNAVCO .... University NAVSTAR Consortium
UR .... Undesirable Result
USBR or Reclamation .... United States Bureau of Reclamation
USGS .... United States Geological Survey
VOC .... volatile organic compound
WHPA .... Wellhead Protection Area
μg/L .... micrograms/liter

Executive Summary

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 (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.

From the first edition of DWR Publication 118 in 1978, the San Joaquin River Basin, including the Madera Subbasin, has been determined to be in a state of overdraft and has been identified by the state as being "Critically Overdrafted." Since 1995, the Madera Subbasin has lost approximately 2.6 million acre-feet (AF) of water from subsurface storage through a combination of groundwater pumping and below-normal recharge driven by an extended drought and low surface water supplies. This is still small compared to the estimated storage capacity of 50 million AF within the subbasin (assuming 1500 feet of thickness).

While the Madera Basin is required to be sustainable, it should be noted that within the basin different areas can and should be evaluated separately. This Groundwater Sustainability Plan (GSP) covers about 4,200 acres in the northwestern area of the basin that is adjacent to the Chowchilla Bypass covering the New Stone Water District Groundwater Sustainability Agency (NSWD GSA). The NSWD GSA is coterminous with the New Stone Water District (NSWD or District) boundary. The District is predominantly agriculture and consists of two landowners. The NSWD GSA was created on December 22, 2016.

Water supply to meet the NSWD GSA agricultural demands comes primarily from groundwater pumping. Although the NSWD GSA does have an appropriative water right along the Chowchilla Bypass (referred to as Eastside Bypass/Chowchilla Canal in permit) of 15,700 AF/year (permit number 19615), surface water is not consistently used for irrigation. The Chowchilla Bypass is a designated floodway into which water is diverted from the San Joaquin River only in relatively wet years.

Groundwater levels have been regularly monitored in three wells within or on the border of the GSA for the California Statewide Groundwater Elevation Monitoring (CASGEM) program. Groundwater quality monitoring is also an important aspect of groundwater management in NSWD. Water quality analytical data returns averages of 840 μmhos/cm and 5.6 milligrams per liter (mg/L) of specific conductance and nitrate, respectively, are below their respective maximum contaminant levels (MCLs). The GSA is included in areas monitored by National Aeronautics and Space Administration (NASA) and the United States Bureau of Reclamation's (USBR) San Joaquin River Restoration Project (SJRRP) land surface subsidence monitoring. Current land subsidence rates in NSWD GSA range from -0.15 to -0.45 feet per year from south to north over the years 2011 to 2017.The NSWD is also located within the East San Joaquin Water Quality Coalition (the Coalition or ESJWQC) boundary and participates in its monitoring efforts.

Water conservation has been and will continue to be an important tool in water management, as well as a key strategy in achieving sustainable groundwater management. The NSWD practices water conservation by using drip irrigation for the majority of their crops. Water is not imported into NSWD GSA, except for water from the Chowchilla Bypass during flood releases. The NSWD GSA includes natural recharge areas but does not currently have intentional recharge from constructed recharge basins. At this time, NSWD anticipates using its water right of surface water from the Chowchilla Bypass for direct recharge in the future.

NSWD GSA lies within the Poso Farm and Firebaugh northeast quadrangles. The topography of the NSWD GSA is relatively flat and ranges between approximately 150 to 160 feet above msl. Within the NSWD GSA area, surface materials are comprised solely of Quaternary age deposits. For the NSWD GSA area, the NRCS has generally described soils as soil textural class fine sandy loam. There are also small pockets of loamy sand and sandy loam. The Corcoran Clay is present below the entirety of NSWD GSA. The top of the Corcoran Clay lies between 200 to 350 feet below ground surface (bgs) under the District and is between 40 and 60 feet thick.

The aquifers in the NSWD GSA are used primarily for irrigation purposes. The vertical aquifer boundary for the NSWD GSA is the base of freshwater, which under NSWD GSA is approximately 400 to 800 feet below msl. Aquifer characteristics of importance to the NSWD GSA are mainly transmissivity, hydraulic conductivity, and storativity. NSWD GSA has specific yields of the deposits of 8.3%, 13.3% and 14.8%. Transmissivity values ranged from 22,500 to 184,400 gallons-per-day (gpd)/ft with an average of 44,000 gpd/ft within the District.

On average, the District's well depths within the GSA are about 350 feet. Groundwater elevation data from about 2000 to present show an average water level between 40 and 60 feet above sea level. Due to the size of the GSA, the relative uniformity of the land, and the lack of consistent monitored data points, groundwater inflow and outflow is assumed to be equal until more data can be collected.

Groundwater storage was determined using multiple methods. The first method used the water budget analytical model or the checkbook balance method. It uses inputs from all water sources, consumptive uses, and losses to determine groundwater surplus or overdraft over a hydrologically average period. The second method used average specific yield, basin area, and average change in groundwater levels to determine change in storage over the hydrological average period. The final method used Geographic Information System (GIS) mapping tools to calculate the difference in volume between contour maps for each year in the hydrological average period.

The Madera subbasin used a model method to calculate the area's water budget. Within the Madera subbasin, it was calculated that the overdraft is between 242,500 and 363,700 AF/year. In place of a model, the complete water budget including historical, current, and projected, for NSWD was created using information from the basin setting, along with data from sources such as California Irrigation Management Information System (CIMIS), National Oceanic and Atmospheric Administration (NOAA), DWR, Irrigation Training & Research Center (ITRC), etc. The period of record chosen to analyze the historical data was 2003-2012. This period was chosen because it represents 100% of the long-term calculated natural flow (1901-2016) in the San Joaquin River and it closely reflects current management practices and facilities available to the District. Also, this period includes a mix of dry, normal, and wet years. Using this method, the overdraft for the District was calculated to be about 1,600 AF/year.

Indicators for the sustainable management of groundwater include groundwater levels, groundwater storage volume, land subsidence, water quality, interconnected surface water, and seawater intrusion. For NSWD GSA, the lowering of groundwater levels and depletion of groundwater storage is considered significant and unreasonable if pumping of groundwater has caused 30 percent of wells in the Subbasin to go below the MT for two consecutive fall water level measurements. With groundwater levels anticipated to decline further during the Implementation Period as Projects and Management Actions (PMA) are implemented, wells may go dry. GSAs in the Subbasin are in the process of developing a temporary Domestic Well Mitigation Program to mitigate wells which go dry during the Implementation Period. Also, water quality degradation is considered significant and unreasonable when concentrations of contaminants, such as nitrate as nitrogen, arsenic and salts, have reached levels that drastically impact crop yield. For the District, land subsidence is considered significant and unreasonable when critical infrastructure, such as the Chowchilla Bypass, or distribution systems, wells, and pumps begin to fail or take critical damage. While the Subbasin GSAs have undertaken efforts to study, review, and analyze potential interconnected surface water along the San Joaquin River from Millerton to the Mendota Pool, the portion of the Subbasin which is NSWD GSA does not contain interconnected surface and groundwater systems. The Chowchilla Bypass, adjacent to the NSWD GSA, is a flood control structure owned by the State of California that only flows during high-flow events and is likely disconnected. Due to the lack of connected water systems, interconnected surface water will not be monitored or considered when making management decisions. The Madera Subbasin and NSWD GSA do not need to account for seawater intrusion since they are not located adjacent to the coast.

Monitoring is a fundamental component of a groundwater management program and is needed to measure progress of reaching measurable objectives and the goal of groundwater sustainability. New monitoring networks will be developed, and existing networks enhanced when necessary, using the Data Quality Objective (DQO) process, which follows the U.S. Environmental Protection Agency (EPA) *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The monitoring network for the groundwater level sustainability indicator will include the one well previously measured for CASGEM well located within or on the border of the GSA as well as three District wells that were not part of the CASGEM program. These wells will also be used to monitor the groundwater storage and groundwater quality sustainability indicators. The GSA is approximately 80 miles from the ocean and, therefore, seawater intrusion is not feasible and will not be monitored. The monitoring network for NSWD GSA will utilize the USBR SJRRP and continuous University Navigation Satellite Timing and Ranging (NAVSTAR) Consortium (UNAVCO) data to continue to monitor the areas of subsidence. The GSA will develop and maintain a data management system for storing and reporting information for the implementation of this GSP.

Implementation of projects and management actions will assist the NSWD GSA in achieving groundwater sustainability by 2040. NSWD GSA analyzed several project types and groundwater management programs during the GSP planning process, which include, Groundwater Recharge Projects, Surface Water Acquisition Projects, Water Conservation Projects, and Management Programs. NSWD GSA will aim its efforts first towards constructing a new Chowchilla Bypass turnout, new canals, and recharge basins within its boundary. If basin overdraft isn't mitigated or if sustainable thresholds are not being met after implementation of NSWD GSA and landowner projects, the management actions and other potential projects listed may be enacted, and the priority of these projects will be increased. The severity of the situation will dictate the actions taken. Priority will be given to actions and projects that can be implemented in a relatively short amount of time and have a high benefit-to-cost ratio.

The adoption of the GSP will be the official start of the Plan Implementation for NSWD. The GSA will continue its efforts to secure the necessary funding to successfully monitor and manage groundwater resources within the District in a sustainable manner. While the GSP is being reviewed by DWR, NSWD GSA will begin the implementation of both projects and management actions.

The GSA will annually report the result of basin operations including current groundwater levels, extraction volume, surface water use, total water use, groundwater storage change, and progress of GSP implementation. The GSA will also report, at least every five years and whenever the GSP is amended, the result of basin 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 network, summary of enforcement or legal actions, and agency coordination efforts.

This GSP was developed in coordination with the Madera Subbasin GSAs for consistent explanations of data and methodologies.

1 Introduction

1.1 Purpose of Groundwater Sustainability Plan

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 (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 Madera Subbasin that the NSWD GSA 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), the NSWD GSA is working to achieve area-wide collaboration between neighboring water agencies and helping to achieve groundwater sustainability.

1.2 Sustainability Goal

From the first edition of DWR Publication 118 in 1978, the San Joaquin River Basin, including the Madera Subbasin, has been determined to be in a state of overdraft and has been identified by the state as being "Critically Overdrafted." Since 1995, the Madera Subbasin has lost approximately 2.6 million acre-feet of water from subsurface storage through a combination of groundwater pumping and below-normal recharge driven by an extended drought and low surface water supplies. This is still small compared to the estimated storage capacity of 50 million AF within the subbasin (assuming 1500 feet of thickness). Chapter 3 of this GSP discusses this chronic water imbalance in more depth.

While the Madera Subbasin has lost a great deal of its stored water in recent decades, the aquifers beneath the subbasin still contain more water than the total of all the reservoirs on the watersheds above the subbasin. That extensive storage volume has long masked the effects of overdraft from year to year, providing a buffer against the extreme fluctuations in surface water supplies depending on the rain year. Water agencies in the subbasin must work together to maintain the viability of the aquifer so that buffer capacity is always available.

The sustainability goal for the Madera Subbasin is to implement a package of projects and management actions that will, by 2040, balance long-term groundwater system inflows with outflows based on a 50-year period representative of average historical hydrologic conditions. The six sustainability indicators, establish measurable objectives, and minimum thresholds that will ensure no undesirable results of significant and unreasonable economic, social, or environmental impacts occur as a result of GSP activities, as defined based on local values expressed in this GSP. Efforts are in progress to address and mitigate undesirable results if they do occur during the implementation of this GSP.

1.3 Undesirable Results

In order to accomplish this overarching goal, this plan identifies undesirable results, which are outcomes after 2040 that will be realized should the plan's strategies not be effective or not be effectively implemented. Undesirable results are marked by minimum thresholds or data points which if not met mean an undesirable result has been realized. Positive outcomes defined in this GSP will take time to achieve. The NSWD has put a plan in place to build facilities that are thought to be of sufficient size and magnitude to accomplish its goal. The NSWD GSA is also reliant upon its neighboring agencies to do the same. It is understood that it will take time to achieve the regional goals. None of the goals can be realized in a year. Measurable Objectives and Interim Milestones have been defined to gauge progress during the intervening years and to help assure not only that the GSA is moving toward its sustainability goals, but also that the rate of progress is as planned and sufficient to meet the overall implementation schedule.

Undesirable results occur when significant and unreasonable effects for any of the six sustainability indicators defined by SGMA are caused by groundwater conditions occurring in the Subbasin. The overarching sustainability goal and the absence of undesirable results after 2040 through implementation of the project and management actions (PMAs). The sustainability goals will be maintained through proactive monitoring and management by the GSAs. **Table 1-1** summarizes whether, for each of the six sustainability indicators, undesirable results have occurred, are occurring, or are expected to occur in the future in the Subbasin without and with GSP implementation.

Table 1-1 Summary of Undesirable Results Applicable to the Subbasin

Sustainability Indicator	Historical Period (before 2015)	Existing Conditions	Future Conditions without GSP Implementation	Future Conditions with GSP Implementation (after 2040)
Chronic Lowering of Groundwater Levels	Yes	Yes	Yes	No
Reduction of Groundwater Storage	Yes	Yes	Yes	No
Land Subsidence	Yes	Yes	Yes	No
Seawater Intrusion	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Degraded Water Quality	Yes	Yes	Yes	No[1]
Depletion of Interconnected Surface Water	Yes	Possibly[2]	Possibly	No

[1] There may be future continued degradation of groundwater quality that is not related to GSP Projects and Management Actions.
[2] Insufficient data exists to fully evaluate interconnected surface water along the San Joaquin River.

The regulations define undesirable results as occurring when significant and unreasonable effects are caused by groundwater conditions for a given sustainability indicator. A summary of the Minimum Thresholds (MTs), Measurable Objectives (MOs) and Undesirable Results (URs) coordinated across the Subbasin is provided in **Table 1-2**, tabulated for the entire Subbasin. Locally defined undesirable results were based on discussion with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

Table 1-2 Summary of MTs, MOs, and Undesirable Results

Sustainability Indicator	Minimum Threshold	Measurable Objective	Undesirable Result (After 2040)
Chronic Lowering of Groundwater Levels	Set equal to the Fall 2015 measurement, if that observed data point is available at the RMS. Otherwise, set equal to the expected Fall 2015 groundwater level determined from MCSim results, with adjustment, if necessary, to account for the offset between historical observed and modeled data.	Set equal to the Fall 2010 measurement, if that observed data point is available at the RMS. Otherwise, set equal to the expected Fall 2010 groundwater level determined from MCSim results, with adjustment, if necessary, to account for the offset between historical observed and modeled data.	Same 30 percent of wells in the subbasin below minimum threshold for two consecutive fall measurements.
Reduction of Groundwater Storage	Same as MTs for chronic lowering of groundwater levels. (Groundwater levels used as proxy.)	Same as MOs for chronic lowering of groundwater levels. (Groundwater levels used as proxy.)	Same 30 percent of wells in the subbasin below minimum threshold for two consecutive fall measurements (Groundwater levels used as proxy)
Degraded Water Quality	Nitrate as N = 10 mg/L or existing level plus 20% (whichever is greater) Arsenic = 10 µg/L or existing level plus 20% (whichever is greater) TDS = 500 mg/L or existing level plus 20% (whichever is greater)	Baseline constituent concentrations	10 percent of wells in the subbasin above the minimum threshold for the same constituent due to projects and/or management actions, based on average of most recent three year period
Land Subsidence	0 feet/year, subject to uncertainty of +/- 0.16 feet/year	0 feet/year, subject to uncertainty of +/- 0.16 feet/year	Average subsidence across greater than 25 percent of RMS exceeding the minimum threshold for two consecutive years.
Depletion of Interconnected Surface Water[1]	A percent of time surface water is connected to shallow groundwater that is equal to historical conditions for a similar climatic/hydrologic period.	A percent of time surface water is connected to shallow groundwater that is equal to historical conditions for a similar climatic/hydrologic period.	Greater than 30 percent of RMS wells below minimum threshold for two consecutive annual five-year rolling average annual evaluations.
Seawater Intrusion	Not Applicable	Not Applicable	Not Applicable

[1] Interim SMCs will be replaced as a result of the Subbasin data gap analysis and findings from the ISW MOU.

While the Madera Basin is required to be sustainable, it should be noted that within the basin different areas can and should be evaluated separately. This GSP covers about 4,200 acres in the northwestern area of the basin that is adjacent to the Chowchilla Bypass. Sustainability goals, undesirable results, minimum thresholds, and measurable objectives are further discussed in Section 4 of this GSP.

1.4 Coordination Agreements

Regulation Requirement:

§ 357.4. Coordination Agreements

(a) Agencies intending to develop and implement multiple Plans pursuant to Water Code Section 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies, and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting.

(b) Coordination agreements shall describe the following:

(1) A point of contact with the Department.

(2) The responsibilities of each Agency for meeting the terms of the agreement, the procedures for the timely exchange of information between Agencies, and procedures for resolving conflicts between Agencies.

(3) How the Agencies have used the same data and methodologies for assumptions described in Water Code Section 10727.6 to prepare coordinated Plans, including the following:

(A) Groundwater elevation data, supported by the quality, frequency, and spatial distribution of data in the monitoring network and the monitoring objectives as described in Subarticle 4 of Article 5.

(B) A coordinated water budget for the basin, as described in Section 354.18, including groundwater extraction data, surface water supply, total water use, and change in groundwater in storage.

(C) Sustainable yield for the basin, supported by a description of the undesirable results for the basin, and an explanation of how the minimum thresholds and measurable objectives defined by each Plan relate to those undesirable results, based on information described in the basin setting.

(c) The coordination agreement shall explain how the Plans implemented together, satisfy the requirements of the Act and are in substantial compliance with this Subchapter

(d) The coordination agreement shall describe a process for submitting all Plans, Plan amendments, supporting information, all monitoring data and other pertinent information, along with annual reports and periodic evaluations.

(e) The coordination agreement shall describe a coordinated data management system for the basin, as described in Section 352.6.

(f) Coordination agreements shall identify adjudicated areas within the basin, and any local agencies that have adopted an Alternative that has been accepted by the Department. If an Agency forms in a basin managed by an Alternative, the Agency shall evaluate the agreement with the Alternative prepared pursuant to Section 358.2 and determine whether it satisfies the requirements of this Section.

(g) The coordination agreement shall be submitted to the Department together with the Plans for the basin and, if approved, shall become part of the Plan for each participating Agency.

(h) The Department shall evaluate a coordination agreement for compliance with the procedural and technical requirements of this Section, to ensure that the agreement is binding on all parties, and that provisions of the agreement are sufficient to address any disputes between or among parties to the agreement.

(i) Coordination agreements shall be reviewed as part of the five-year assessment, revised as necessary, dated, and signed by all parties.

The Madera Subbasin is home to seven Groundwater Sustainability Agencies (GSAs). They are Madera Irrigation District GSA, Madera County GSA, City of Madera GSA, Madera Water District GSA, Gravelly Ford Water District GSA, Root Creek Water District GSA, and New Stone Water District GSA. The Madera County GSA on behalf of all the GSAs in the subbasin applied to and received funding from the DWR for grant funds to prepare a GSP. Gravelly Ford WD and Root Creek WD were originally part of the regional GSP development until 2018 when they each decided to prepare their own GSP. New Stone WD GSA had made the decision to prepare an individual GSP when coordination began, which led to the development of this GSP. The joint GSP includes Madera Irrigation District GSA, Madera County GSA, City of Madera GSA, and Madera Water District GSA. Since three of the seven GSAs within the basin decided to prepare individual GSPs, the subbasin needs a Coordination Agreement to comply with SGMA.

The Madera County GSA developed a draft Coordination Agreement for review and distributed it to the GSAs on April 24, 2019. Since NSWD GSA planned to pursue development of its own GSP, the District edited the draft Coordination Agreement to represent regional cooperation and coordination and resubmitted the draft Coordination to the County on June 3, 2019.

As of January 22, 2020, the coordination agreement was executed by the NSWD GSA and the agreement was submitted to DWR with the initial GSP. It is acknowledged that the DWR did not recognize the coordination agreement until October 9, 2020, after mediation resolved disputes internal to the basin and the Coordination Agreement was signed by all GSA agencies within the Subbasin. As a response to the Letter from the DWR on September 22, 2022, the districts and their representatives have continued to meet monthly and met with DWR representatives on November 10, 2022, and December 8, 2022. In 2023, the GSAs took action to approve the First Amendment to the Madera Subbasin Coordination Agreement.. Madera Irrigation District (MID) GSA took action to approve the First Amendment to the Madera Subbasin Coordination Agreement and the Memorandum of Understanding Establishing a Domestic Well Mitigation Program for the Madera Subbasin of the San Joaquin Valley Groundwater Basin, but did not take action to approve the March 2023 Revised GSP. On April 16, 2024, and as documented in MID GSA Resolution NO. 2024-GSA01, the MID GSA took action to approve and adopt the March 2023 Revised GSP. To date, all four Joint GSP GSAs have taken action to approve the March 2023 Revised GSP. In 2025, the Subbasin GSAs amended the Coordination Agreement for the 2025GSP Plan Amendment. The Second Amendment to the Madera Subbasin Coordination Agreement, is included as Appendix A.

Since original GSA formation, subsequent GSP development, completion of the March 2023 Revised GSP, and now through GSP implementation and the Plan Amendment and Periodic Evaluation process, the GSAs in the Subbasin have committed to continued coordination in an effort to eliminate areas of disagreement. Despite multiple GSPs in the Subbasin, the GSAs have worked continuously over the last several years to seek consensus, striving to bring consistency across the 4 GSPs where possible and eliminating contradictory policies, procedures, and methodologies. The following subsections seek to efficiently and accurately detail continued coordination activities being undertaken by the GSAs in the Subbasin since the Fall of 2023, prior to DWRs approval of the March 2023 Revised GSP on December 21, 2023.

Facilitation Support Services (FSS) Grant

Understanding the importance of continued coordination and prior to approval of the March 2023 Revised GSP by DWR on December 12, 2023, the GSAs in the Subbasin were the recipient of a Facilitation Support Services Grant (FSS Grant) from DWR. The Implementation Service Plan (ISP) included assistance in the nine categories listed below.

1. Stakeholder Assessments
2. Governance Development
3. Stakeholder Communication and Engagement Planning and Support
4. Public and Stakeholder Outreach
5. Targeted Outreach to Underrepresented Groundwater Users
6. Tribal Government Outreach and Engagement
7. Meeting Facilitation
8. Intrabasin and Interbasin Coordination Support
9. Interest-Based Negotiation

The original contract for the FSS Grant was held by the MID GSA on behalf of the Subbasin (DWR Contract #4600013267). Upon FSS Grant receipt, the GSAs in the Subbasin embarked on a robust and detailed Stakeholder Assessment. Since completion of the initial Stakeholder Assessment, the Root Creek Water District (RCWD) GSA has taken over the contract for the FSS Grant and continued facilitation and coordination is currently focused on 4 of the 9 categories listed above; (1) Governance Development (Coordination Agreement modification(s)), (2) Stakeholder Communication and Engagement Planning and Support, (3) Interest-Based Negotiation, and (4) Meeting Facilitation. A primary focus during Plan Amendment has been modification of the Coordination Agreement. Engagement in activities stemming from the FSS Grant have been broadly supported by the GSAs and continued facilitation support services in the Subbasin will continue to be a valuable component of GSP implementation.

MCSim Groundwater Model

The Madera-Chowchilla Groundwater Surface Water Simulation Model (MCSim) was initially developed in 2018 to assist development of the Chowchilla Subbasin GSP and Madera Subbasin Joint GSP. MCSim is a numerical groundwater flow model based on the Integrated Water Flow Model (IWFM) code developed and maintained by DWR. An update of MCSim (MCSim_v2), was completed in 2024 as part of the first plan amendment to the Madera Subbasin Joint GSP. This update included the following actions:

- Extension of the historical period through water year 2023;
- Refinements of the texture model;
- Refinements of stratigraphy, particularly related to the Corcoran Clay extent and bedrock outcrop areas;
- Addition of the IWFM subsidence package; and
- Re-calibration of the model.

Descriptive documentation of the MCSim Groundwater Model recalibration is included in Appendix 6.D of the Madera Subbasin Joint GSP.

Importantly, and aside from the technical updates, the MCSim Model continues to be supported broadly by the GSAs in the Subbasin and serves as a uniform and consistent basis for development of GSA water budgets, future subsidence estimates, and the establishment of Sustainable Management Criteria (SMCs). Refinements to the MCSim Model as detailed herein were reviewed and discussed in great detail during development of the 2023 Revised GSPs and 2024 Plan Amendment and Periodic Evaluation processes and have streamlined the GSAs' responses to many of the corrective actions identified by DWR in their December 21, 2023, GSP approval letter. Moving forward, the MCSim Model will be updated on a five-year interval and diligently used by the GSAs in the Subbasin as a predictive tool to aid in siting of planned and proposed PMAs and evaluation of the benefit of implemented PMAs, in addition to broader management of the Subbasin.

GSA Technical Meetings

Since development of the 2023 Revised GSPs and serving at the direction of each GSA, the technical teams for each GSA (or group of GSAs in the case of the Joint GSP) have continued meeting on a regular basis. As part of the 2024 Plan Amendment, the technical teams for each GSA have met on a bi-weekly or weekly basis to discuss methodologies and preferred technical approaches for addressing DWR's identified deficiencies.

Regulation Requirement:

§ 357.2. Interbasin Agreements
Two or more Agencies may enter into an agreement to establish compatible sustainability goals and understanding regarding fundamental elements of the Plans of each Agency as they relate to sustainable groundwater management. Interbasin agreements may be included in the Plan to support a finding that implementation of the Plan will not adversely affect an adjacent basin's ability to implement its Plan or impede the ability to achieve its sustainability goal. Interbasin agreements should facilitate the exchange of technical information between Agencies and include a process to resolve disputes concerning the interpretation of that information. Interbasin agreements may include any information the participating Agencies deem appropriate, such as the following:

(a) General information:
(1) Identity of each basin participating in and covered by the terms of the agreement.
(2) A list of the Agencies or other public agencies or other entities with groundwater management responsibilities in each basin.
(3) A list of the Plans, Alternatives, or adjudicated areas in each basin.
(b) Technical information:
(1) An estimate of groundwater flow across basin boundaries, including consistent and coordinated data, methods and assumptions.
(2) An estimate of stream-aquifer interactions at boundaries.
(3) A common understanding of the geology and hydrology of the basins and the hydraulic connectivity as it applies to the Agency's determination of groundwater flow across basin boundaries and description of the different assumptions utilized by different Plans and how the Agencies reconciled those differences.
(4) Sustainable management criteria and a monitoring network that would confirm that no adverse impacts result from the implementation of the Plans of any party to the agreement. If minimum thresholds or measurable objectives differ substantially between basins, the agreement should specify how the Agencies will reconcile those differences and manage the basins to avoid undesirable results. The Agreement should identify the differences that the parties consider significant and include a plan and schedule to reduce uncertainties to collectively resolve those uncertainties and differences.
(c) A description of the process for identifying and resolving conflicts between Agencies that are parties to the agreement.
(d) Interbasin agreements submitted to the Department shall be posted on the Department's website.

It is understood that coordination needs to exist between the adjacent subbasins. Some initial discussions occurred with the Triangle T GSA, but the other Madera Subbasin GSAs asked that there be regional cooperation rather than discussions between the GSAs. At the request of the other Madera Subbasin GSAs, the NSWD GSA has not had any ongoing dialogue with the agencies in the Chowchilla or Delta-Mendota Subbasins.

1.6 Agency Information

Regulation Requirement:

§354.6(a) The name and mailing address of the Agency

New Stone Water District Groundwater Sustainability Agency
9500 S. De Wolf
Selma, CA 93662

Contact: Roger Skinner

1.6.1 Organization and Management Structure of the GSA

Regulation Requirement:

§354.6(b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan. **§354.6(c)** The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.

The NSWD GSA is coterminous with the New Stone Water District (NSWD or District) boundary. The District is predominantly agricultural and consists of two landowners. The NSWD GSA and the NSWD have the same general manager and rely upon consultants and contracted operational staff.

Within the Madera Subbasin and per the coordination agreement, the Basin Plan Manager is presently Gabriella Lion.

The contact information is as follows:

Name: Gabriella Lion
Phone: 559-834-6677
Mailing Address: P. O. Box 1350, Selma, CA 93662
Email: glion@lionraisins.com

1.6.2 Legal Authority of the GSA

Regulation Requirement:

§354.6(d) The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the plan.

The New Stone Water District Groundwater Sustainability Agency was created on December 22, 2016.

The legislation established the Agency as a GSA under Water Code 10720 (the Sustainable Groundwater Management Act) for the portion of the Madera Subbasin that lies within the boundaries of the Agency. The legislation requires the Agency to develop and implement a GSP to achieve groundwater sustainability management within the territory of the Agency in compliance with the mandates and timelines in SGMA.

The NSWD is the only water purveyor and/or agency throughout the territory of the GSA. Accordingly, the Agency has been deemed the exclusive local agency within the designated territory endowed with powers to comply with SGMA.

The Agency's enabling act is codified in Water Code Appendix Section 143-801. The section 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 to fund its groundwater sustainability program, including but not limited to permit fees and fees on groundwater extraction and other regulated activities.

Additionally, the NSWD is a local public agency. The District was organized in 1983 under the California Water District Law, Section 34000 *et seq.* of the California Water Code (CWC) of the State of California. Pursuant to CWC Sections 34000 *et seq.,* the District has the authority to protect and enhance the water resources available to it.

NSWD has the authority to manage the groundwater resources within its service area through CWC, Division 6, Part 2.75 (Sections 10750 et seq.) It is the primary agency responsible for its groundwater management plan, and it provides for management of the groundwater basin within its political boundary. The groundwater management plan is consistent with the provision of CWC, Sections 10750 et seq., as amended January 1, 2003.

The District boundaries encompass approximately 4,200 acres. The NSWD satisfies the definition of "local agency" which is described in the CWC 10701 (a) as any city, county district, agency, or other political subdivision of the state for the local performance of governmental or proprietary functions within limited boundaries.

1.6.3 Cost of Plan Implementation and Sources of Revenue

The costs for implementing the plan fall into a number of different categories. These consist of monitoring, facilities, planning and organizational, and purchase of surface water supplies. While the law was passed in 2014, the NSWD upon its founding was intent on balancing groundwater supplies and groundwater levels and as such endeavored to acquire surface water supplies and construct facilities. The District will fund the management actions through District funds and will pursue grant funding. The following **Table 1-3** Estimated Costs for Implementation Management Actions lists the potential future costs associated with the plan:

Table 1-3 Estimated Costs for Implementation Management Actions

Implementation of Projects and Management Actions	Estimated Costs Per 5-Year Period				Total 20-Year Cost
	2020 - 2025	2025 - 2030	2030 - 2035	2035 - 2040	
Bypass Turnout	$125,000	$125,000	$125,000	$125,000	$500,000
Distribution System	$375,000	$375,000	$375,000	$375,000	$1,500,000
Recharge Basins/Canal	$200,000	$200,000	$200,000	$200,000	$800,000
New wells	$500,000	$500,000	$500,000	$500,000	$2,000,000
Aquifer Storage	$750,000	$750,000	$750,000	$750,000	$3,000,000
Total Cost	$1,950,000	$1,950,000	$1,950,000	$1,950,000	$7,800,000
Average Annual Cost	$390,000	$390,000	$390,000	$390,000	

Regulation Requirement:

§354.6(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

This GSP is organized in accordance with the outline in the GSP Guidelines published by DWR.

Section 2 describes the Plan area, including geographic setting, existing water resources planning and programs, relationship of the GSP to other general plan documents within the Agency boundary, and additional GSP components.

Section 3 describes the basin setting. It includes a detailed discussion of the hydrogeologic conceptual model used to prepare the GSP, current and historical groundwater conditions, a discussion of the area groundwater budget, and a description of why there are no management areas.

Section 4 sets forth the Agency's adopted sustainability goals, addresses the mandated undesirable outcomes, defines minimum thresholds for each undesirable outcome, and sets measurable outcomes for both intermediate Plan years and for the Plan's complete implementation.

Section 5 describes the network of monitoring wells and other facilities adopted by the Agency to measure Plan outcomes and assesses the need for improvements to the network in order to provide fully representative data. Monitoring protocols and data analysis techniques are also addressed.

Section 6 lists and describes each project and management action adopted by the Agency in pursuit of sustainability. The section includes project details, required permits, anticipated benefits, project capital and operations/maintenance costs, project schedule, and required ongoing management operations.

Section 7 describes the Plan implementation process, including costs, sources of funding, an overall schedule through full implementation, description of the required data management system, methodology for annual reporting, and how progress evaluations will be made over time.

Section 8 summarizes the references and sources used to prepare and document this Plan.

2 Plan Area

Regulation Requirement:

§354.8 Each Plan shall include a description of the geographic areas covered, including the following information:

(a) One or more maps of the basin that depict the following, as applicable:

1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.
2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.
3) Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.
4) Existing land use designations and the identification of water use sector and water source type.
5) The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the department, as specified in section 353.2, or best available information.

The Madera Groundwater Subbasin is the southernmost subbasin within the San Joaquin Valley Basin north of the San Joaquin River (**Figure 2-1** and **Figure 2-2**). The Madera Subbasin boundary is defined in the California DWR Bulletin 118 as DWR Subbasin No. 5-22.06 (2006). The majority of surface water in the subbasin is supplied from the Chowchilla, Fresno, and San Joaquin Rivers. The Sierra Nevada foothills and three Groundwater Subbasins border the Madera Subbasin north of the San Joaquin River. These subbasins include the Merced, Chowchilla, and the Delta-Mendota Subbasins. The Kings Subbasin adjoins the Madera Subbasin south of the San Joaquin River. **Figure 2-2** shows the bordering subbasins and **Figure 2-3** shows the local water agencies.

Seven GSAs have formed within the 347,600-acre Madera Subbasin. NSWD GSA contains approximately 4,182 acres in the northwestern portion of the Madera subbasin and is bounded on the east by the Chowchilla Bypass (Bypass). There is no overlap among the surrounding GSAs and there are no adjudicated areas in the groundwater basin. The Bypass along the east side of the District provides the conveyance of surface water to NSWD GSA. The Bypass is the only existing conveyance facility that could deliver surface water to District lands.

The land immediately surrounding the NSWD is unincorporated County land. To the south, the county land is in the Madera subbasin, and to the north, the county land is in the Chowchilla subbasin. There are no federal, state, or tribal lands within the NSWD area.

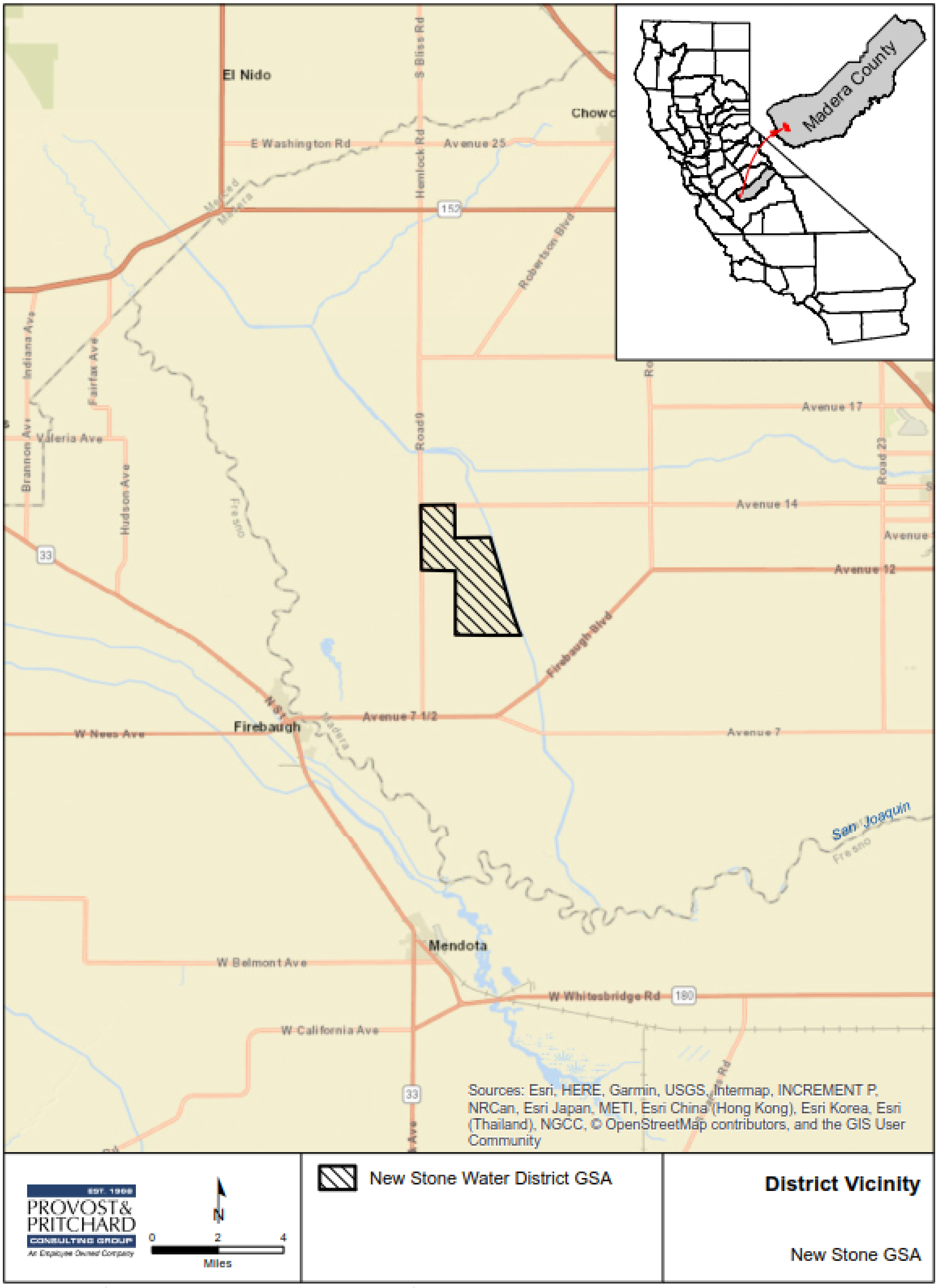


Figure 2-1 District Map

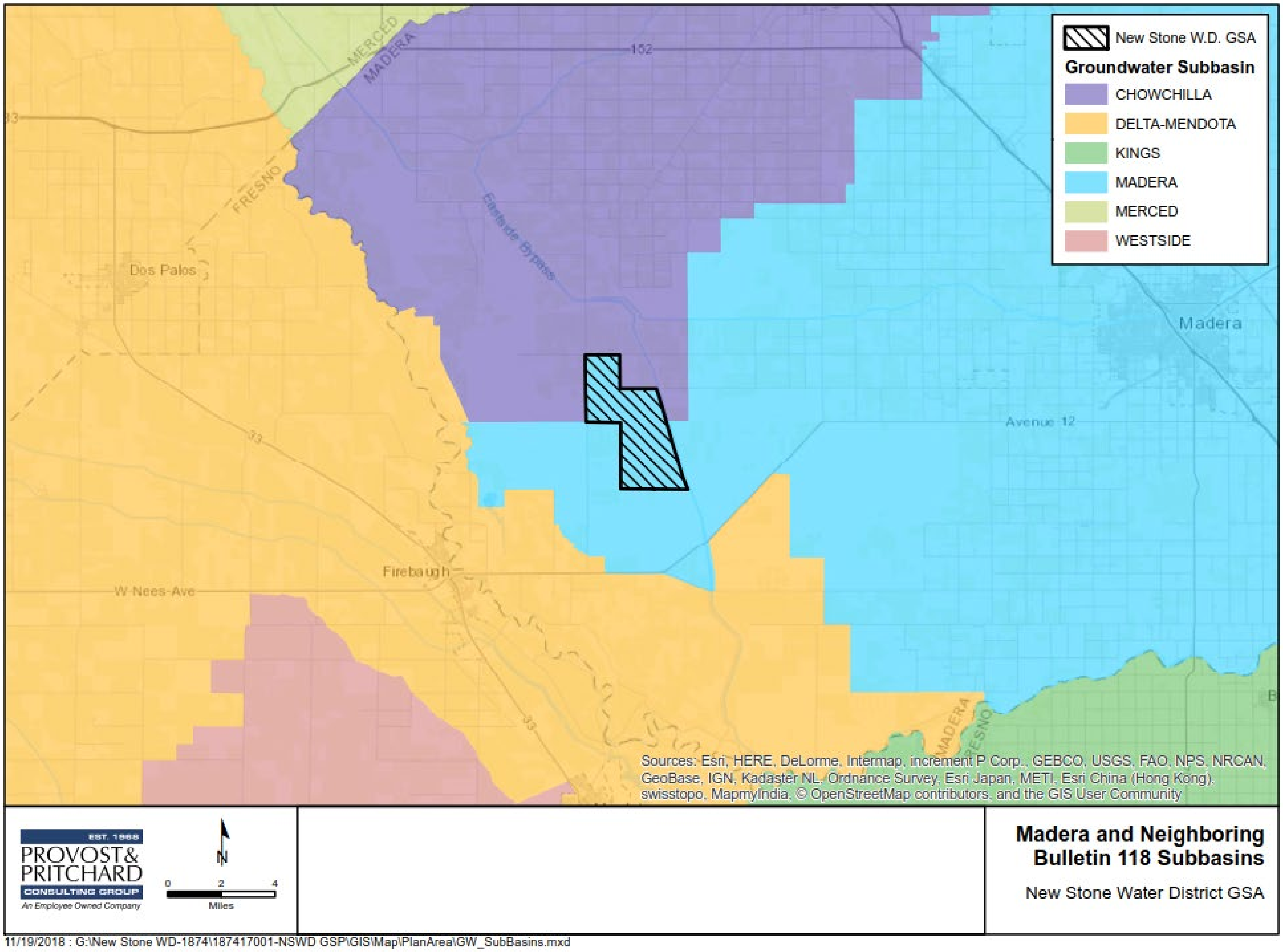


Figure 2-2 Madera and Neighboring Subbasins

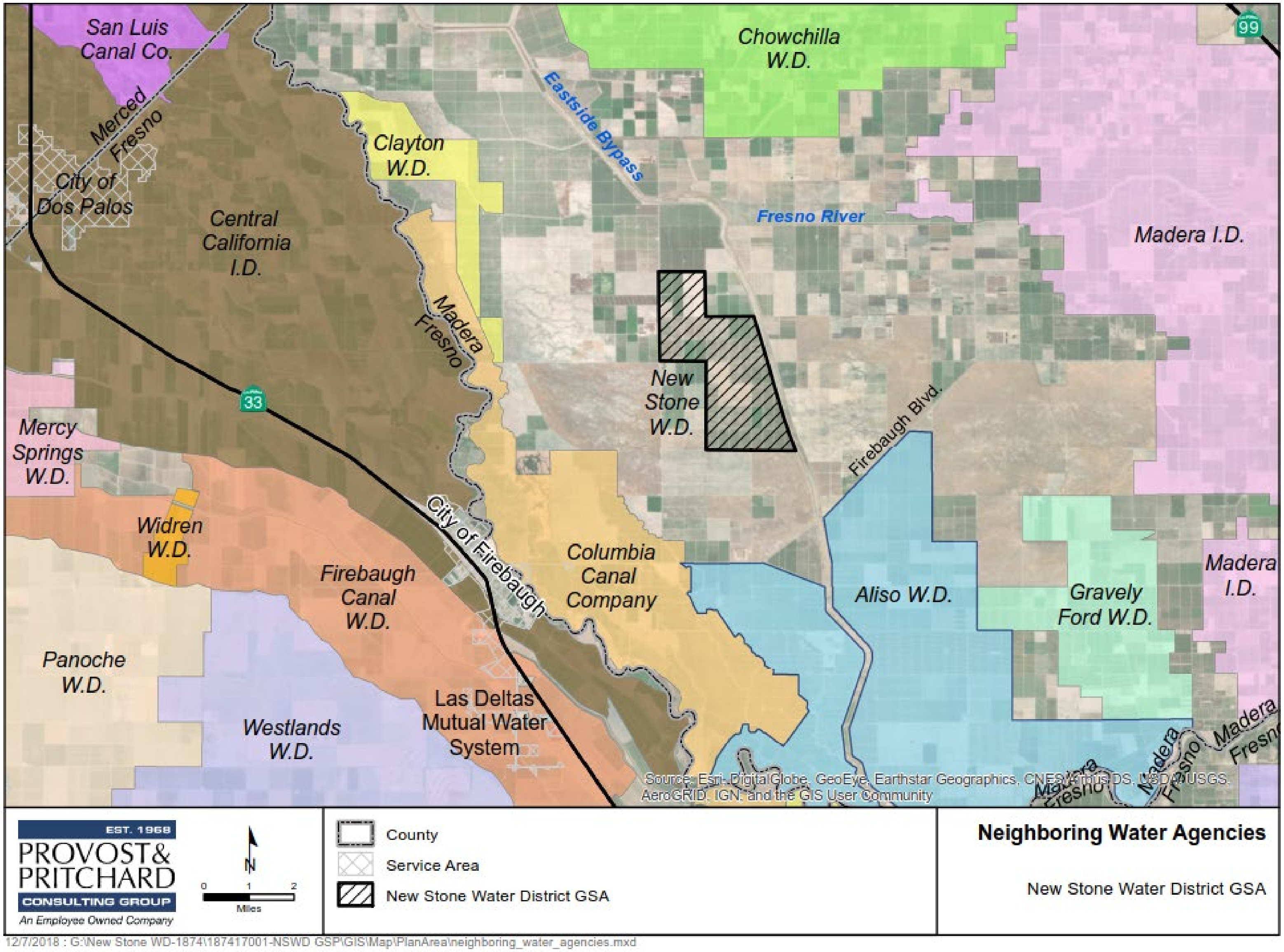


Figure 2-3 Neighboring Water Agencies

General land use in Madera County was last surveyed by DWR in 2011. The County General Plan (**Figure 2-4**) and zoned districts within the NSWD can be observed on the County interactive map available from:

https://countymadera.maps.arcgis.com/apps/webappviewer/index.html?id=d955f25b15ed4e4e9a7ac4ecad0edd2a

Land Use. The land within NSWD is exclusively used for agriculture. The Madera County Agricultural Commissioner provides annual data for cropping within the County, which was used for understanding the plantings in the District. Previously, cropping and the associated water use were estimated by using the DWR land use data; however, the DWR data source is not available on an annual basis. Of the approximate 4,182 acres of the NSWD GSA, the area primarily consists of grape vines (about 3,145 acres) with some areas of alfalfa (about 626 acres) and corn (about 231 acres) as well.

The evapotranspiration (ET) for each crop in the District, along with irrigation method (drip and surface irrigation), can be estimated for each month. Based on the crop type and acreage, as well as the ET, the estimated agricultural demand for the year 2016 is included in **Table 2-1**.

Table 2-1 Estimated Monthly Agricultural Demand (2016)

Alfalfa				Corn				Grapes			
Month	Acres	ET (Feet)	Estimated Demand (AF)	Month	Acres	ET (Feet)	Estimated Demand (AF)	Month	Acres	ET (Feet)	Estimated Demand (AF)
January	626	0.08	50	January	231	0.00	0	January	3145	0.00	0
February	626	0.19	120	February	231	0.00	0	February	3145	0.00	0
March	626	0.34	210	March	231	0.00	0	March	3145	0.00	0
April	626	0.48	299	April	231	0.00	0	April	3145	0.08	264
May	626	0.62	388	May	231	0.10	24	May	3145	0.40	1243
June	626	0.64	401	June	231	0.42	98	June	3145	0.48	1522
July	626	0.67	422	July	231	0.84	193	July	3145	0.45	1400
August	626	0.63	394	August	231	0.66	152	August	3145	0.27	864
September	626	0.50	310	September	231	0.31	72	September	3145	0.12	390
October	626	0.35	217	October	231	0.00	0	October	3145	0.02	74
November	626	0.13	82	November	231	0.00	0	November	3145	0.00	0
December	626	0.09	57	December	231	0.00	0	December	3145	0.00	0
Total for 2016		**4.71**	**2949**	**Total for 2016**		**2.33**	**538**	**Total for 2016**		**1.83**	**5758**

Water Source. Water supply to meet the NSWD GSA agricultural demands comes primarily from groundwater pumping. Although the NSWD GSA does have an appropriative water right along the Chowchilla Bypass (referred to as Eastside Bypass/Chowchilla Canal in permit) of 15,700 acre-feet/year (permit number 19615), surface water is not consistently used for irrigation. The Chowchilla Bypass is a designated floodway into which water is diverted from the San Joaquin River only in relatively wet years. The District formerly used Bypass water to irrigate crops; however, when a drip system was installed, the water could no longer be used. As a result, part of the District's canal conveyance system adjacent to the Bypass was backfilled to make more room for grape vines.

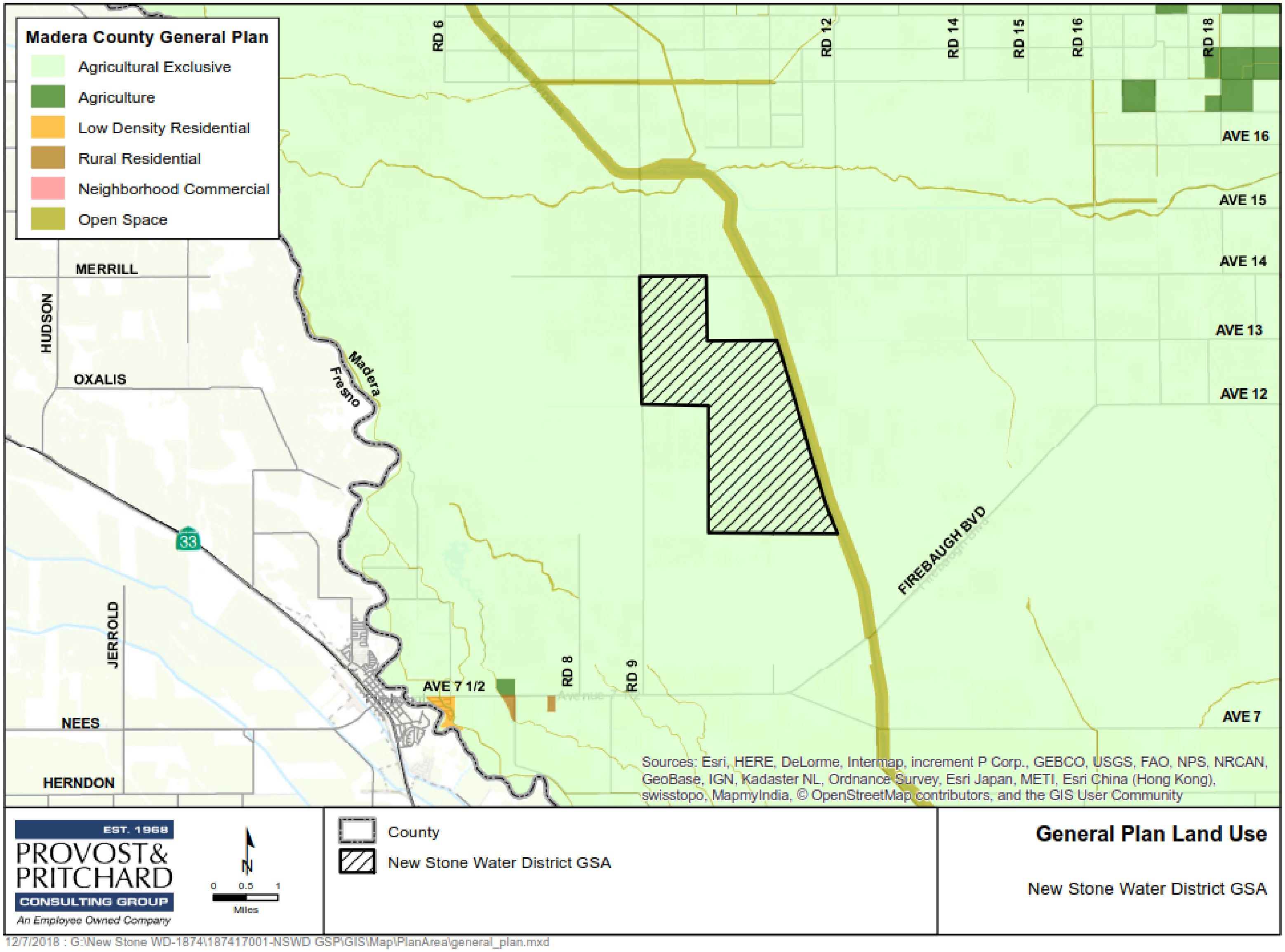


Figure 2-4 County General Plan Land Use

Figure 2-5 shows well density in the NSWD area. There are an estimated 31 active wells in the District area. The map is based on a well canvass that was performed in 2007. This is considered the best available data and includes known well locations for individual landowners as well as state wells. Well logs from the DWR, if available, have been reviewed to determine the construction of the well. However, this has not been able to be determined. A discussion of groundwater well pumping is included in **Section 3.1.8.3**.

2.1 Summary of Jurisdictional Areas and Other Features

Regulation Requirement:

§354.8(b) A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.

Groundwater Basin Boundaries

The Madera Subbasin is a large groundwater subbasin located within the southern part of the San Joaquin Valley Basin, in the Central Valley of California. The groundwater basin boundary is defined in DWR Bulletin 118 as DWR Basin No. 5-22.06. The groundwater basin covers 614 square miles (394,000 acres). DWR estimated the amount of stored groundwater as of 1995 for the entire San Joaquin Valley Basin at about 12.6 million AF to a depth of 300 feet (DWR, Bulletin 118). They also state in Bulletin 118 that the amount of stored groundwater in this subbasin as of 1961 was 24 million AF to a depth of <1000 feet.

Groundwater Management Plan Area

The NSWD does not have a Groundwater Management Plan, but the District is covered in the Madera Regional Groundwater Management Plan under Madera County that was adopted in December 2014. The NSWD is identified in **Figure 2-2**. The District is in the southwest portion of Madera County at the approximate center of the San Joaquin Valley. The area is not specifically described in the Plan and is surrounded by County area; therefore, there are no immediately adjacent water agencies (**Figure 2-3**).

2.2 Water Resources Monitoring and Management Programs

2.2.1 Monitoring and Management Programs

Regulation Requirement:

§354.8(c) Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.

Groundwater Level Monitoring

The CASGEM program was created by SBx7 6, Groundwater Monitoring, a part of the 2009 Comprehensive Water Package. Groundwater levels have been regularly monitored in three wells within or on the border of the GSA for the CASGEM program. These wells have state well IDs 11S14E36R001, 11S15E30A001, and 11S15E31J001. Water depths have been measured in these wells by the USBR on a bi-annual basis since the late 1950s or early 1960s. Well logs and construction information are not available for these wells. Several other nearby wells not in the GSA are also monitored for the CASGEM program.

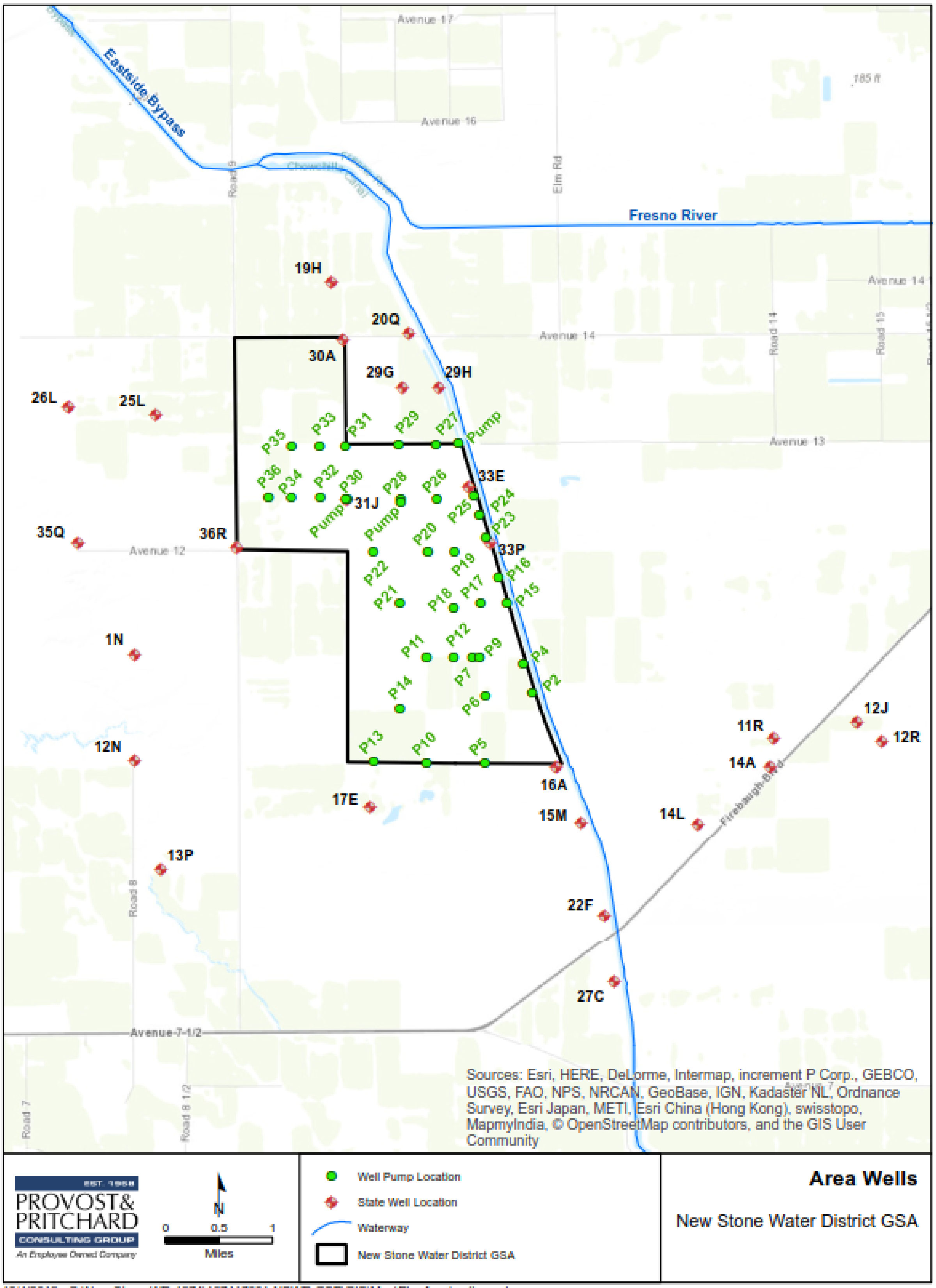


Figure 2-5 Well Density 2018

Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect of groundwater management in NSWD. Monitoring groundwater quality serves the following purposes:

1. Spatially characterize water quality according to soil types, soil salinity, geology, surface water quality, and land use;
2. Establish a baseline for future monitoring;
3. Compare constituent levels at a specific well over time (i.e., years and decades);
4. Determine the extent of groundwater quality problems in specific areas;
5. Identify groundwater quality protection and enhancement needs;
6. Determine water treatment needs;
7. Identify impacts of recharge and surface water use on water quality;
8. Identify suitable crop types that are compatible with the water characteristics; and
9. Monitor the migration of contaminant plumes.

A discussion on groundwater quality in the NSWD GSA is in **Section 3.2.5**. Several agencies are involved in the monitoring and mitigation of groundwater quality in the surrounding area. These agencies include the County of Madera, State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCB), United States Geological Survey (USGS), and California Department of Toxic Substances Control (DTSC). Data from these sources indicate that common constituents of concern in NSWD GSA and the region are nitrate and total dissolved solids (TDS). Data available within and near the GSA show that levels of these constituents are generally below respective regulatory levels for drinking water (see **Section 3.2.5** for details). Contaminant plumes are not known within the GSA.

Land Surface Subsidence Monitoring

The GSA is included in areas monitored by the USBR's SJRRP and continuous data from UNAVCO. Data from these sources show that subsidence has been occurring at significant rates within and surrounding the GSA. The monitoring network for NSWD GSA will include the USBR SJRRP and UNAVCO data to continue to monitor the areas of subsidence. If data from these sources becomes unavailable in the future, a new monitoring network will be established to monitor land subsidence.

Surface Water Monitoring

The only surface water feature in NSWD GSA is the Bypass, which is located along the eastern edge of the NSWD GSA. The Bypass is a designated floodway into which water is diverted from the San Joaquin River only in relatively wet years.

<u>Imported Surface Water</u>.
NSWD does not import any surface water into the area.

Irrigated Lands Regulatory Program

The NSWD is located within the East San Joaquin Water Quality Coalition (the Coalition or ESJWQC) boundary. The Coalition is a group of agricultural interests and growers formed to represent all "dischargers" who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne and Mariposa Counties and portions of Calaveras County. The ESJWQC has been approved by the Executive Officer of the Central Valley Regional Water Quality Control Board to serve as a third-party group to conduct water quality monitoring and reporting on behalf of its enrolled grower members to meet requirements of the Irrigated Lands Regulatory Program (ILRP). In fulfillment of required reports and monitoring, the ESJWQC completed a Groundwater Assessment Report which evaluated readily available groundwater quality data and assessed areas within the Coalition boundary with increased potential to influence groundwater quality.

The Coalition has collected surface water quality data since 2004 and more recently began collecting groundwater quality data as part of a long-term trend monitoring program. This information is summarized annually and submitted to the Central Valley Regional Water Quality Control Board (CVRWQCB) in compliance with requirements of the ILRP.

GSP Monitoring and Management Plans

The NSWD GSA will be responsible for collecting data or using existing programs to monitor the various groundwater conditions. The monitoring network and its goals are described in detail in **Chapters 4** and **5** of this GSP.

2.2.2 Impacts to Operational Flexibility

Regulation Requirement:

> **§354.8(d)** A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.

The development of relationships between NSWD, various regulatory agencies, and other local water agencies is an important part of an effective groundwater sustainability plan. The District is in the Madera groundwater subbasin, which extends beyond many political boundaries and includes other municipalities, irrigation districts, water districts, private water companies, and private water users. This emphasizes the importance of inter-agency cooperation, and the District has historically made efforts to work conjunctively with many other GSAs.

Several existing water management constraints impact operational flexibility and water operations. These programs are described below for each program and possible measures to adapt to them.

Contaminant Plumes

As noted above, water quality data indicate that common constituents of concern in NSWD GSA and the region are nitrate and TDS and that concentrations of these constituents are generally below respective regulatory levels for drinking water. A review of the DTSC and SWRCB online databases, EnviroStor and GeoTracker, show no active contaminated sites within 4 miles of the GSA. The USGS from 2005 to 2006 performed their Groundwater Ambient Monitoring and Assessment (GAMA) program which undertook investigation to characterize the groundwater condition in the Southeast San Joaquin Valley (Burton et al, 2012). There are no known contaminant plumes in the area currently; however, should one be discovered or created, the monitoring and management of the plume may impact the operational flexibility of this plan in the following ways:

1. New wells may not be installed in specific areas because they may capture contaminated water or cause a plume to migrate.
2. Some existing wells may not be utilized and may either be abandoned or placed on standby.
3. Groundwater recharge basins may not be constructed in specific areas because they may cause a plume to migrate.
4. Wellhead treatment may be required at some wells, thus increasing the cost to produce water. These wells are often put on standby and only used to help meet peak demands.

Flood Control Operational Limitations

New Stone Water District is situated next to the Bypass that carries flood flows. The District has a right to use some of the flood water. However, its current system is undersized and cannot distribute the permitted volume. Plans to upgrade the system are being considered so that the full extent of the water right can be used soon. No other flood control operations currently exist in the District. The development of future recharge facilities will be highlighted in future Annual Reports or Periodic Evaluations, as appropriate.

San Joaquin River Restoration Program

In 2006, after an 18-year court session, the Friant Central Valley Project (CVP) contractors entered into the San Joaquin River Restoration (SJRR) settlement agreement. The agreement increases flows to the River to benefit fisheries, resulting in a significant reduction in water deliveries to the Friant contractors.

The SJRRP is scoping out costs of Phase 2B projects, at the time of the 2025 update. Restoration water supply impacts to the Friant contractors were estimated by Provost & Pritchard (P&P)(2009) including a water delivery impact to Merced Irrigation District as a reduction of about 27,500 AF annually. However, the impacts are not expected to be fully realized until 2025 or later. In a critically dry year, it is not required that restoration flows be left in the River.

Several mitigation programs were established as part of the restoration settlement intended to partially reduce the water supply impacts from the river restoration program, and include the following:

1. Recirculated Water: Some restoration flows could be recaptured in the Lower San Joaquin River or Delta for use by the Friant contractors. These waters will either be sold, exchanged for other water supplies, or, when feasible, delivered directly back to some Friant contractors.
2. Part 3 Water (formerly Title 3 or T3 water): Part 3 water is generated from the facilities and programs built to increase groundwater recharge and recovery using the $50 million authorized as part of Title 3 of the San Joaquin River Restoration Act.
3. 16(b) Water (also known as $10 water): This program allows the impacted parties to buy floodwater at $10/AF to the extent they have been impacted. This is less than the cost of purchasing other floodwaters from the San Joaquin River.
4. Unreleased Restoration Flows: Designated restoration flows that are not used will be sold to the Friant contractors, who can use them directly for irrigation or domestic use. Restoration flows may not be used for a variety of reasons, including operational limitations, flood control releases, facility maintenance and construction, etc.

The Friant contractors have no control over the implementation of the SJRRP; however, they can use the mitigation programs as much as feasible. These programs will only partially compensate for the water losses, so Friant contractors may attempt to develop new water supplies through water transfers, recharge, recycling, reuse, and conservation to make up for the reduced water deliveries. The construction of new storage projects, including the Temperance Flat reservoir on the Upper San Joaquin River, can help to mitigate the impacts of the river restoration and restore some operational flexibility.

2.2.3 Conjunctive Use Programs

Regulation Requirement:

§354.8(e) A description of conjunctive use programs in the basin.

Conjunctive use is the coordinated and planned management of both surface and groundwater resources to maximize efficient use. Conjunctive use is a strategy to improve water supply reliability and environmental conditions, reduce groundwater overdraft and land subsidence, and protect water quality.

It includes balancing the use of surface water when it is available with the use of groundwater in order to sustainably meet the needs of beneficial users. Conjunctive use also includes cyclic storage where groundwater is recharged during wet years using surplus surface water to offset the groundwater pumped during dry periods. This strategy should also include a robust monitoring program to help prevent negative impacts and verify the quantity of water in storage.

The NSWD does not have a current conjunctive use program since they rely primarily on groundwater. Although they have a right to the water from the Bypass when it flows, the District's system is undersized to handle the full amount of water for which they have a right. It should be noted that the Madera and Chowchilla subbasins are used conjunctively, meaning that groundwater and surface water are used collectively for municipal and agricultural purposes. The groundwater basin can be viewed as a storage reservoir during wet years, less groundwater pumping is required, and recharge is practiced so that excess surface water supplies can be added to belowground storage. In dry years, less surface water is available, more groundwater is pumped to meet demands, and groundwater levels decline. Because of this variable use, it is expected that water levels will rise and fall, but in a balanced groundwater basin those levels will be relatively stable over a long period (P&P, 2014).

2.3 Relation to General Plans

2.3.1 Summary of General Plans/Other Land Use Plans

Regulation Requirement:

§354.8(f) A plain language description of the land use elements or topic categories of applicable general plans that include the following:

1) A summary of general plans and other land use plans governing the basin.

Land use planning activities in unincorporated areas of Madera County are performed by the Madera County Planning Department and overseen by the Madera County Planning Commission. NSWD does not have land use planning authority; therefore, regional and local land use planning activities will remain with the appropriate agencies. However, when appropriate, NSWD will comment on proposed land use plans that may impact the local groundwater quantity or quality.

California Government Code (§65350-65362) requires that each county and city in the state develop and adopt a general plan. The General Plan consists of a statement of development policies and includes diagrams and text setting forth objectives, principles, standards, and plan proposals. It is a comprehensive long-term plan for the physical development of the county or city. In this sense, it is a "blueprint" for development.

The General Plan must contain seven state-mandated elements. It may also contain any other elements that the legislative body of the county or city wishes to adopt. The seven mandated elements are: Land Use, Open Space, Conservation, Housing, Circulation, Noise, and Safety. The General Plan may be adopted in any form deemed appropriate or convenient by the legislative body of the county or city, including the combining of elements. The General Plan document materials for Madera County can be accessed by element at the following web page:

https://www.maderacounty.com/government/community-economic-development-department/divisions/planning-division/planning-forms-and-documents/-folder-269

The General Plan Policy Document for Madera County was adopted on October 24, 1995. Other elements and updates or amendments have been added since then.

2.3.2 Impact of the Madera General Plan on Water Demands

Regulation Requirement:

§354.8(f) (2) A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects.

The countywide General Plan consists of two documents: *Background Report* and the *Policy Document*. In addition, the adopted Housing Element addresses housing issues on a countywide basis. The Background Report inventories and analyzes existing conditions and trends in Madera County. It provides the formal supporting documentation for general plan policy, addressing ten subject areas: land use; population; economic conditions and fiscal considerations; transportation and circulation; public facilities; public services; recreational and cultural resources; natural resources; safety; and noise.

The County General Plan was adopted prior to the development of the GSA and SGMA; however, updates have been made since then and land use in the District area may change. The land use plan makes assumptions for urban development, and this GSP uses the same land use change assumptions identified in the general plans for forecasting the anticipated water budget, described later in this GSP.

2.3.3 Impact of GSP on Land Use Plan Assumptions

Regulation Requirement:

§354.8(f) (3) A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.

Several County General Plan sections that cover water supply are summarized below. As noted, the Plan was developed prior to the development of the GSP.

The Public Facilities and Services, Section 3 of the Madera County General Plan, discuss various topics including water supply and delivery in Section 3.C. The primary goal in this Section is to ensure the availability of an adequate (i.e., sustainable) and safe water supply and the maintenance of high-quality water in water bodies and aquifers used as sources of domestic and agricultural water supply. The relevant policies for domestic supply (some of which are also agriculture water supply policies) are listed below:

- PF Policy 3.C.1 - The County shall approve new development only if an adequate water supply to serve such development is demonstrated.
- PF Policy 3.C.3 - The County shall limit development in areas identified as having severe water table depression to uses that do not have high water usage or to uses served by a surface water supply.
- PF Policy 3.C.7 - The County shall promote the use of reclaimed wastewater to offset the demand for new water supplies.
- PF Policy 3.C.8 - The County shall support opportunities for groundwater users in problem areas to convert to surface water supplies.
- PF Policy 3.C.9 - The County shall promote the use of surface water for agricultural use to reduce groundwater table reductions.

This Plan aims to support the assumptions and policies made in the Madera County General Plan by encouraging surface water use whenever available and planning for the use of recharge facilities.

2.3.4 Permitting New or Replacement Wells

Regulation Requirement:

§354.8(f) (4) A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.

The Madera County Community and Economic Development, Environmental Health Division permits new or replacement wells. They adhere to state requirements for the construction of new or replacement wells in addition to requiring that all new or replacement wells must be equipped with a flow meter and a sounding tube. The County Water Well Program details can be reviewed, and applications obtained online at: https://www.maderacounty.com/government/community-economic-development-department/divisions/environmental-health/water-well-program. Following the signing of Executive Order N-7-22, Madera County requires that GSAs review and provide a written verification for permit applications for new or alterations to agricultural wells within their jurisdiction.

2.3.5 Land Use Plans Outside the Basin

Regulation Requirement:

§354.8(f) (5) To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.

The County General Plan was amended in 2008 to include a Dairy Element (2008). Key issues to siting a new diary would include potential impacts to groundwater and surface water quality from the diary effluent. Chapter 3 of the Dairy Element discusses goals, policies, and programs for new and existing dairies, which include buffer zones between developed or development areas and avoidance of flood zones and wetlands, as well as high groundwater areas, etc. The County requires submittal of technical reports for new or expanding dairy operations for review and approval to ensure that environmental and other concerns are met or mitigated.

Plan Developments

No plan developments are anticipated in the NSWD GSA area.

2.4 Additional GSP Components

Regulation Requirement:

§354.8(g) A description of any of the additional Plan elements included in the Water Code Section 10727.4 that the Agency determines to be appropriate.

2.4.1 Saline Water Intrusion

Saline (or brackish) water intrusion is the induced migration of saline water into a freshwater aquifer system. Saline water intrusion is typically observed in coastal aquifers where over pumping of the freshwater aquifer causes salt water from the ocean to encroach inland, contaminating the freshwater aquifer. The distance of the GSA area from the Pacific Ocean negates the possibility of saltwater intrusion from the ocean into the freshwater aquifer.

However, groundwater with naturally occurring elevated concentrations of salts exist at larger depths in the local aquifers. The base of freshwater, or the depth at which elevated specific conductance is encountered, has been characterized as the boundary where the concentration of specific conductance is over 3,000 μS/cm (Page, 1973). The base of freshwater varies throughout the GSP area and is discussed in detail in **Section 3.1** – Hydrogeologic Conceptual Model. As wells are drilled deeper, pumping can cause upcoming (i.e., upward vertical migration) of saline water, thus increasing salinity in the freshwater aquifer.

2.4.2 Wellhead Protection

A Wellhead Protection Area (WHPA) is defined by the Safe Drinking Water Act Amendment of 1986 as "the surface and subsurface area surrounding a water well or wellfield supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The WHPA may also be the recharge area that provides the water to a well or wellfield. Unlike surface watersheds that can be easily determined from topography, WHPAs can vary in size and shape depending on subsurface geologic conditions, the direction of groundwater flow, pumping rates, and aquifer characteristics.

The Federal Wellhead Protection Program was established by Section 1428 of the Safe Drinking Water Act Amendments of 1986. The purpose of the program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. The program is based on the concept that the development and application of land use controls, usually applied at the local level, and other preventative measures can protect groundwater.

Under the Act, States are required to develop an EPA-approved Wellhead Protection Program. To date, California has no state-mandated program, but instead relies on local agencies to plan and implement programs. Wellhead Protection Programs are not regulatory in nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contaminant sources.

Contaminants from the surface can enter an improperly designed or constructed well along the outside edge of the well casing or directly through openings in the wellhead. A well is also the direct supply source to the customer, and such contaminants entering the well could then be pumped out and discharged directly into the distribution system. Therefore, essential to any wellhead protection program are proper well design, construction, and site grading to prevent intrusion of contaminants into the well from surface sources.

Wellhead protection is performed primarily during design and can include requiring annular seals at the well surface, providing adequate drainage around wells, constructing wells at high locations, and avoiding well locations that may be subject to nearby contaminated flows. Wellhead protection is required for potable water supplies and is not generally required, but is still recommended, for agricultural wells.

Municipal and agricultural wells constructed by the member agencies are designed and constructed in accordance with DWR Bulletin 74-81 and 74-90. Also, a permit is needed from the County to construct a new well. In addition, the member agencies encourage landowners to follow the same standard for privately owned wells. DWR Bulletins 74-81 and 74-90 provide specifications pertaining to wellhead protection, including:

- Methods for sealing the well from intrusion of surface contaminants
- Covering or protecting the boring at the end of each day from potential pollution sources or vandalism
- Site grading to assure drainage is away from the wellhead

2.4.3 Migration of Contaminated Groundwater

Groundwater within the GSA Area is generally of good quality for agricultural use. However, serious water quality problems in certain areas of the subbasin exist due to high concentrations of certain constituents. Information on existing contaminant plumes is limited. However, some of the main constituents of concern in the County include nitrate, Dibromo-Chloropropane (DBCP), Ethylene-Dibromide (EDB), 1,2,3-Trichloropropane (TCP) and petroleum hydrocarbons. Contamination of groundwater can result in poor drinking water quality, loss of water supply, degraded surface water systems, high cleanup costs, high costs for alternative water supplies, and/or potential health problems. Several federal laws help protect groundwater quality.

In addition, several State of California online databases provide information and data on known groundwater contamination, planned and current corrective actions, investigations into groundwater contamination, and groundwater quality from select water supply and monitoring wells. These databases are discussed below:

California Water Resources Control Board: The SWRCB maintains an online database that identifies known contamination cleanup sites, known leaky underground storage tanks, and permitted underground storage tanks. The online database contains records of investigation and actions related to site cleanup activities at: http://geotracker.waterboards.ca.gov.

The Department of Toxic Substance Control
The California DTSC provides an online database with access to detailed information on permitted hazardous waste sites, corrective action facilities, as well as existing site cleanup information. Information available through the online database includes investigation, cleanup, permitting, and/or corrective actions that are planned, being conducted, or have been completed under DTSC's oversight. The online database can be accessed at:http://www.envirostor.dtsc.ca.gov.

Groundwater Ambient Monitoring and Assessment Program
The SWRCB GAMA program collects data by testing untreated raw water for naturally occurring and man-made chemicals and compiles all of the data into a publicly accessible online database. The online database can be accessed at: http://geotracker.waterboards.ca.gov/gama/

Currently, the District is not aware of contaminant plumes in the area. The District will regularly review groundwater quality data from other sources and remain alert to the possibility of contaminated groundwater migration into NSWD.

2.4.4 Well Abandonment/Well Destruction Program

Well abandonment generally includes properly capping and locking a well that has not been used in over a year. Well destruction includes completely filling in or removing portions of a well in accordance with standard procedures. Proper well destruction and abandonment are necessary to protect groundwater resources and public safety. Improperly abandoned or destroyed wells can provide a conduit for surface or near surface contaminants to reach the groundwater. In addition, undesired mixing of water with different chemical qualities from different strata can occur in improperly destroyed wells.

The administration of a well construction, abandonment, and destruction program has been delegated to the Counties by the State legislature. Madera County requires that wells be abandoned according to State standards documented in DWR Bulletins 74-81 and 74-90. Due to staff and funding limitations, enforcement of the well abandonment policies is limited.

2.4.5 Replenishment of Groundwater Extractions

Replenishment of groundwater is an important technique in management of a groundwater supply to mitigate groundwater overdraft. Groundwater replenishment occurs naturally through rainfall and stream/river seepage and intentionally through means including deep percolation of crop and landscape irrigation, wastewater effluent percolation, and intentional recharge. The primary local water sources for groundwater replenishment include precipitation, the San Joaquin River, and the Eastside Bypass.

Currently, there is no dedicated groundwater recharge activity within the GSA. For more information, refer to **Section 2.2.3** and **Section 3.3**.

2.4.6 Well Construction Policies

Madera County has enacted and is responsible for enforcing a County Well Ordinance that regulates well construction. The California DWR also has well construction standards documented in DWR Bulletins 74-81 and 74-90. NSWD does not have its own well construction policies, but rather follows State and County standards.

2.4.7 Groundwater Projects

The NSWD is responsible for development and operation of recharge, storage, conservation, water recycling, and extraction projects. The GSA develops projects to help meet their water demands and will develop additional future projects to meet sustainability goals. Developing more groundwater recharge and banking projects is considered key to stabilizing groundwater levels. **Chapter 6** provides descriptions, estimated cost, and estimated yield for the main project focus. The role of the NSWD GSA is to promote cooperation and sharing of information and ideas between interested parties as well as implementing projects to assure sustainability.

The GSA will also support measures to identify funding and implement regional projects that help the region achieve groundwater sustainability. This can include recharge projects that take advantage of local areas conducive to recharge and areas where recharge provides the most benefits to the GSA.

2.4.8 Efficient Water Management Practices

Water conservation has been and will continue to be an important tool in water management, as well as a key strategy in achieving sustainable groundwater management. The NSWD practices water conservation by using drip irrigation for the majority of their crops.

Details of water conservation programs can be found in various documents including Urban Water Management Plans and USBR Water Management Plans. Efficient water management practices will include maximizing the beneficial uses of water along with recycled water use as it can replace potable water use in some instances. Future efforts will include an increased focus on elevating awareness on groundwater overdraft, land subsidence, and explaining the requirements of SGMA. Some or all of these conservation efforts will be necessary to achieve groundwater sustainability.

2.4.9 Relationships with State and Federal Agencies

Several member agencies receive San Joaquin River water from the Friant Division of the Central Valley Project. The Friant Dam is owned and operated by the USBR. The USBR is also the lead agency for the San Joaquin River Restoration, which has resulted in significant delivery curtailments to Friant contractors. The member agencies communicate often with USBR staff on water deliveries, water allocations, progress on the SJRRP, and the Water Management Program for the SJRRP that is intended to help mitigate water losses to Friant contractors.

Many of the member agencies receive grants from various agencies for water related projects. Grants are obtained from the California DWR, SWRCB, USBR, and others. The member agencies work closely with these State and Federal agencies to track grant programs and administer and implement grant contracts.

2.4.10 Land Use Planning

Land use policies are documented in various reports, such as General Plans, Specific Plans, and plans for proposed developments. Updating some of these plans is a multi-year process, and not all could be fully updated concurrently with the GSP development. These plans are expected to be modified gradually over time to be consistent with the goals and objectives of this GSP. Some smaller communities have no formal land use policies or rely on County policies. These smaller communities will need to develop new policies and long-term plans as part of the SGMA process.

2.4.11 Impacts on Groundwater Dependent Ecosystems

There are not any groundwater dependent ecosystems within the district. The depth of groundwater ranges from 50 to 110 feet below ground surface and there are not any impacted interconnected surface water systems throughout NSWD.

2.5 Notice and Communication

2.5.1 Description of Beneficial Uses and Users

Regulation Requirement:

§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.
(b) A list of public meetings at which the Plan was discussed or considered by the Agency.
(c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.

Pursuant to California Water Code Section 10723.2, the NSWD GSA shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing a GSP. Engagement with groundwater users occurs in the following phases of the development and implementation of the GSP:

1. Formation of the GSA
2. Development of the Draft GSP
3. Finalization of the GSP
4. Implementation of the GSP

<u>Formation of the GSA</u>
To form the NSWD GSA, stakeholders gathered over several months and subsequently prepared their Notification of Intent to become a GSA, dated December 13, 2016. The NSWD GSA continues to work in concert with the six GSAs in the subbasin and enter into a coordination agreement. NSWD has formed a technical advisory ad-hoc committee to develop and implement the GSP. Public workshops will be conducted to obtain input to finalize the GSP.

<u>Development of the Approved 2022 GSP</u>
Pursuant to California Water Code Section 1073.2, the NSWD GSA shall consider the interests of the beneficial uses and users of groundwater, as well as those responsible for implementing a GSP. To this end the NSWD GSA held public workshops and participated in workshops sponsored by the other agencies within the Subbasin that prepared a joint GSP. The NSWD GSA is composed of 100% agricultural users.

Following the receipt of public comments by individuals and other agencies, the GSA responded and made revisions to the GSP. The draft GSP was presented to the GSA on September 11, 2019, and then made available immediately thereafter. After the first attempt at submitting GSPs, in September 2022, DWR provided the Subbasin GSAs with an “inadequate” determination letter and corrective actions to address prior to approval of the Plans. The Subbasin GSAs resubmitted their coordinated GSPs in March 2023. In December 2023, DWR approved the resubmitted GSPs, determining that the GSAs took sufficient action to correct their September 2022 comments.

2.5.2 Decision-Making Process

Regulation Requirement:

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

The NSWD filed to become a GSA on December 13, 2016. They are currently working independently of other GSAs in the Madera Subbasin to develop and implement a GSP in order to comply with SGMA requirements. The DWR was notified that NSWD GSA intended to develop a GSP in a letter filed with the DWR on December 12, 2018.

The NSWD GSA continues to work in concert with the six GSAs in the basin on developing a GSP while still allowing for the development of its own GSP and entering into a coordination agreement with the other GSAs in the basin. NSWD GSA has formed a technical advisory ad-hoc committee to develop and implement the GSP. The committee will report any activity to the Board of Directors when public comments are made. Public workshops were conducted to obtain input to finalize the GSP and will be conducted to obtain input on future SGMA requirements.

2.5.3 Public Engagement / Public Outreach Plan

Regulation Requirement:

§354.10 (d)(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.

The development of the NSWD GSP required involvement with the Madera County GSAs to provide an inclusive and transparent effort and required ongoing engagement with a variety of stakeholders to allow public input and response during various stages of development. It should be recognized that this GSA has two landowners. A list of public meetings can be found in **Appendix C**.

The overarching goal is to inform, engage, and build stakeholder support for NSWD GSA GSP metrics and thresholds. Progress on implementation of this GSP will be presented at public meetings and through the NSWD GSA website.

2.5.4 Encouraging Active Involvement

Regulation Requirement:

§354.10 (d) 3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of 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.

NSWD GSA has and will continue to initiate outreach activities and produce outreach materials to encourage active engagement by all stakeholders in GSP development. This Plan will guide the Board to implement consistent and coordinated public involvement and outreach. NSWD GSA seeks to actively solicit information, feedback, and opinions from stakeholders and beneficial users to inform program implementation decisions. To meet this objective, NSWD GSA will engage with stakeholders in new and existing venues.

3 Basin Setting

3.1 Hydrogeologic Conceptual Model

3.1.1 Introduction

Regulation Requirement:

§354.14(a) Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.

The purpose of a Hydrogeologic Conceptual Model (HCM) is 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 principal aquitards in the basin setting. Once developed, an HCM is useful in providing the context to develop water budgets, monitoring networks, and identification of data gaps.

An HCM is not a numerical groundwater model or a water budget model. An HCM is rather a written and graphical description of the hydrologic and hydrogeologic conditions that lay the foundation for future water budget models. Refer to Section 3.3 for information on the GSA's water budget.

This HCM has been written by adhering to the requirements set forth in the California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 5, Subarticle 2 (§354.14). Several topics are touched on in the HCM, including groundwater quality, groundwater flow, and groundwater budget which are discussed in greater detail in Groundwater Conditions (Section 3.2) and Water Budget (Section 3.3).

The narrative HCM description provided in this chapter is accompanied by graphical representations of the New Stone Water District Groundwater Sustainability Agency's (NSWD GSA or District) portion of the Madera Subbasin that have attempted to clearly portray the geographic setting, regional geology, basin geometry, and general water quality. This HCM has been prepared utilizing published studies and resources and will be periodically updated as data gaps are addressed, and new information becomes available.

In 2024, the HCM was updated to respond to DWR's Recommended Corrective Action 5 in their December 21, 2023, letter to the Subbasin. The HCM section was updated to discuss uncertainty concerning the HCM and describe data gaps. Uncertainty in the HCM is related to limitations on the amount of available data (e.g., lithologic logs, borehole geophysical logs), reliability of those available data, and the reliability of correlations made from the available data. Uncertainties in the following Sustainability Indicators are discussed in more detail in the Joint GSP: Groundwater Levels and Storage, Groundwater Quality, Land Subsidence.

3.1.2 Lateral Basin Boundaries

Regulation Requirement:

§354.14(b)(2) The hydrogeologic conceptual model shall be summarized in a written description that includes lateral basin boundaries, including major geologic features that significantly affect groundwater flow.

As shown in **Figure 3-1** and **Figure 3-2** , NSWD GSA is in the western portion of the Madera Groundwater Subbasin and is bounded to the north by Avenue 14 and to the west by Road 9, coincident with the southern boundary of the Chowchilla Groundwater Subbasin. To the east, the NSWD GSA is bounded by the Chowchilla Bypass. The County of Madera GSA borders NSWD GSA around the southern portion. The Madera Groundwater Subbasin is bordered by the Kings Groundwater Subbasin to the south and southeast, with the San Joaquin River serving as the boundary between the two.

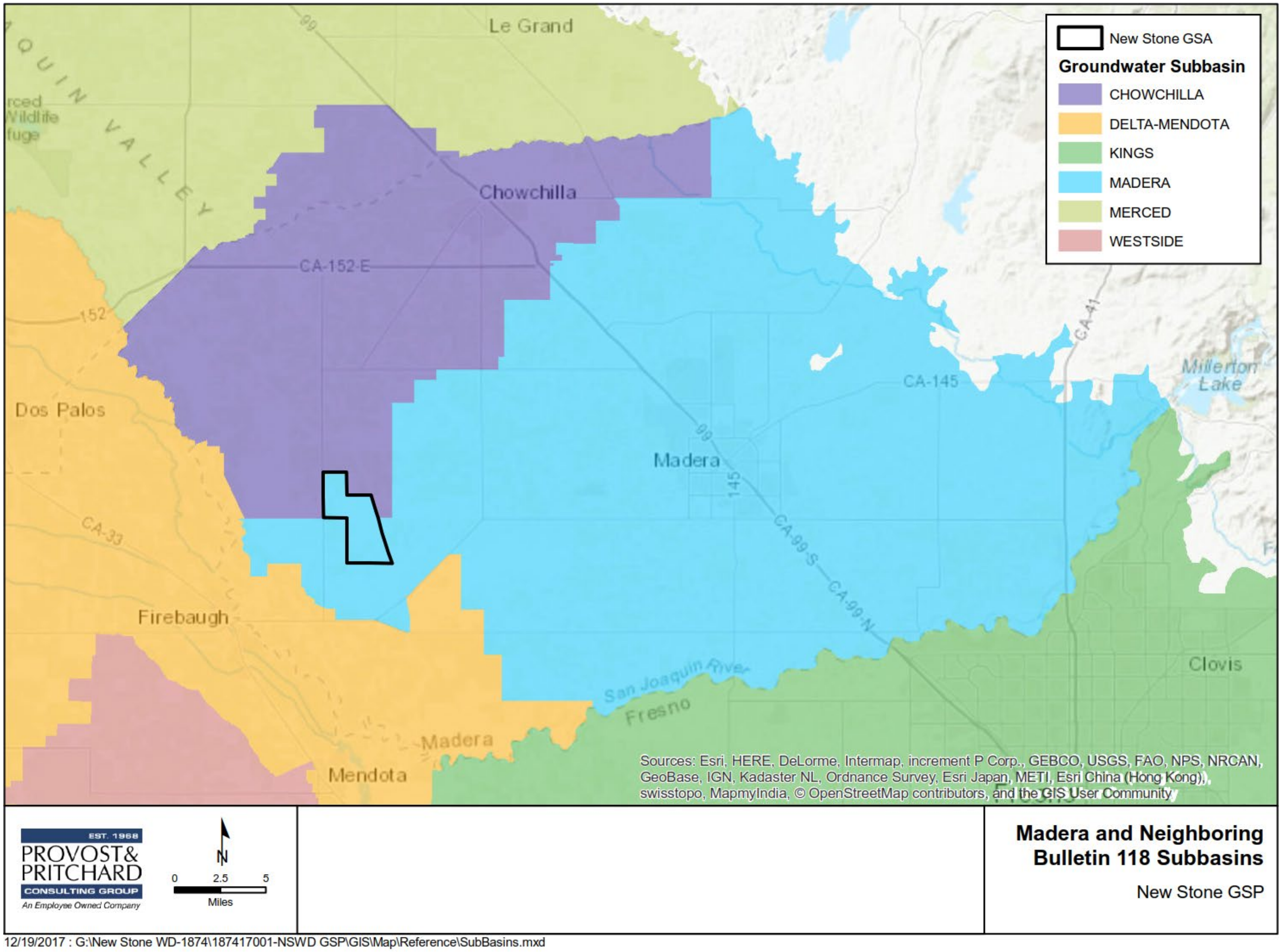


Figure 3-1 Madera and Neighboring Bulletin 118 Subbasins

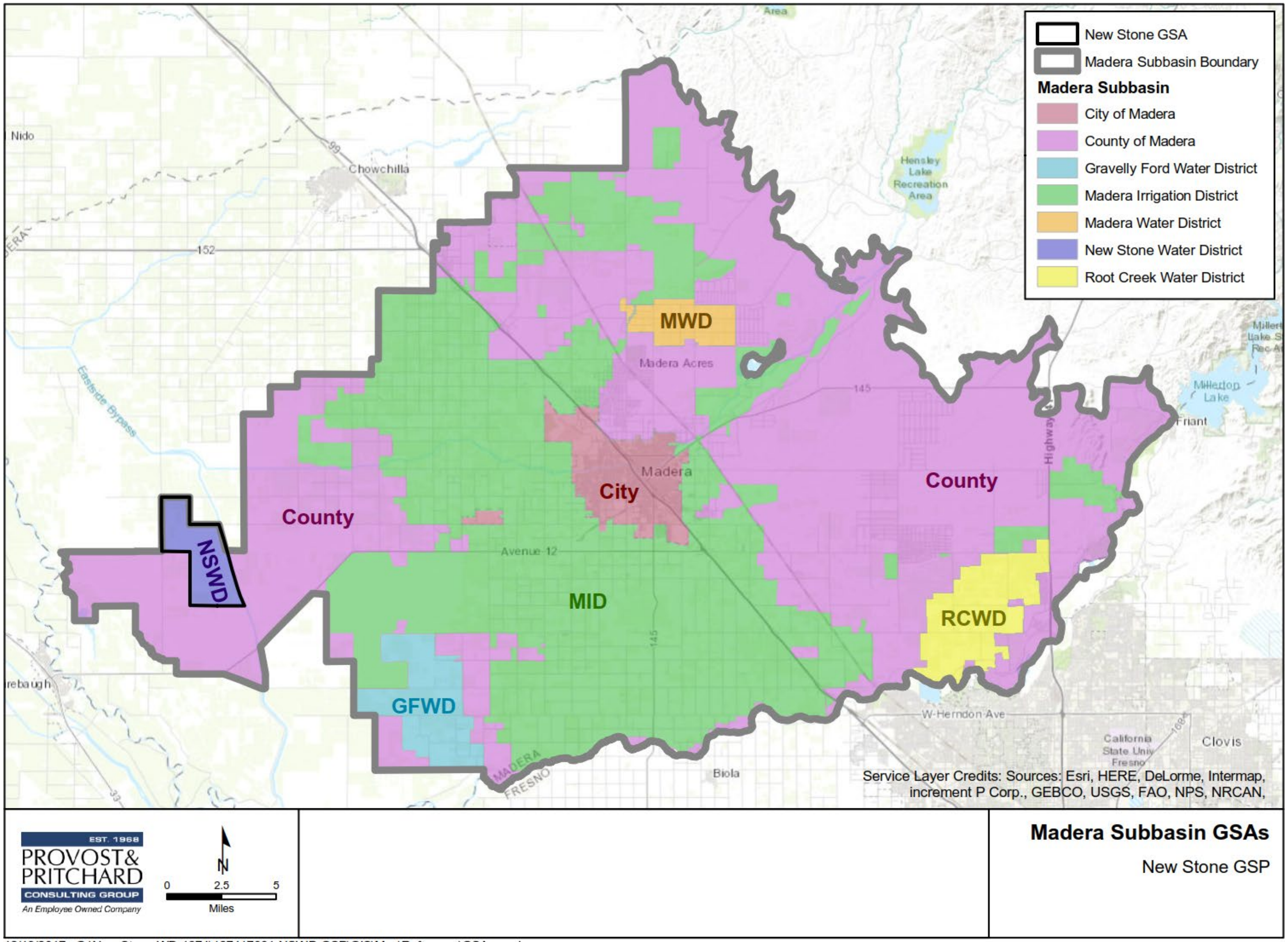


Figure 3-2 Madera Subbasin Groundwater Sustainability Agencies

The Delta-Mendota Groundwater Subbasin is located to the southwest, and the Chowchilla Groundwater Subbasin is to the northwest. The boundaries between Madera Subbasin and the adjacent subbasins primarily coincide with water agency boundaries. The foothills of the Sierra Nevada form the Madera Subbasin's eastern boundary (**Figure 3-1**).

The major features that affect groundwater flow in the Madera Subbasin are the San Joaquin River and the basement complex of the Sierra Nevada Mountains (i.e., bedrock). Significant amounts of seepage, termed stream depletion, occur along the San Joaquin River and cause groundwater to flow away from the recharge of the River (DWR, 2006). These river losses are gains to the area's groundwater aquifers. According to DWR (2006), groundwater flow in the Madera Subbasin is generally southwestward in the eastern portion and northwestward in the southern portion and there do not appear to be horizontal barriers to groundwater flow within the subbasin. However, the A- and E-clays are barriers to vertical flow where present.

3.1.3 Regional Geologic and Structural Setting

Regulation Requirement:

§354.14(b)(1) The hydrogeologic conceptual model shall be summarized in a written description that includes the regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.

The Madera Groundwater Subbasin lies within the San Joaquin Valley which comprises the southern portion of the Great Central Valley of California. The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide. It is filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding mountains, respectively. Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley edges toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes, which mark the current and historic axis of surface drainage in the San Joaquin Valley (DWR, 2006). **Figure 3-3** is a regional cross-section schematic across the San Joaquin Valley perpendicular to the trough illustrating topography and subsurface features (from Faunt, 2009).

Geologic units in the region consist of consolidated rocks and unconsolidated deposits. The consolidated rocks are comprised of a pre-Tertiary age basement complex, and marine and continental sedimentary rocks of Cretaceous (145 to 66 million years ago) and Tertiary (66 to 2.6 million years ago) age. The unconsolidated deposits are of both Tertiary and Quaternary age (2.6 million years ago to the present).

The Madera Groundwater Subbasin has been extensively studied by Mitten, LeBlanc, and Bertoldi (Mitten et al., 1970) as part of a larger study area. As shown on **Figure 3-4** the basement complex in Madera County (pTb) crops out along the eastern boundary of the 1970 Mitten study. The current basin boundary along the foothills has a long strip of basement complex mapped within the basin. The basement complex comprises a large portion of the Sierra Nevada and other regional mountain ranges that is composed of a mass of plutonic and metamorphic rocks commonly referred to as the Sierra Nevada batholith. The basement complex surface slopes gently to the southwest from the foothills to beneath the valley floor.

The U.S. Geological Survey (Mitten et al., 1970) identified the consolidated basement rock materials beneath NSWD GSA as metamorphic (schistose) and igneous (granitic) rocks that can be observed in outcrop in the foothills of the Sierra Nevada near the eastern boundary of the Madera Subbasin. Depth to basement rock in the western boundary of the Madera Subbasin, near NSWD GSA, occurs at a depth in excess of 10,000 feet (Mitten et al., 1970). Contact between the basement rocks and the overlying sediments slope steeply

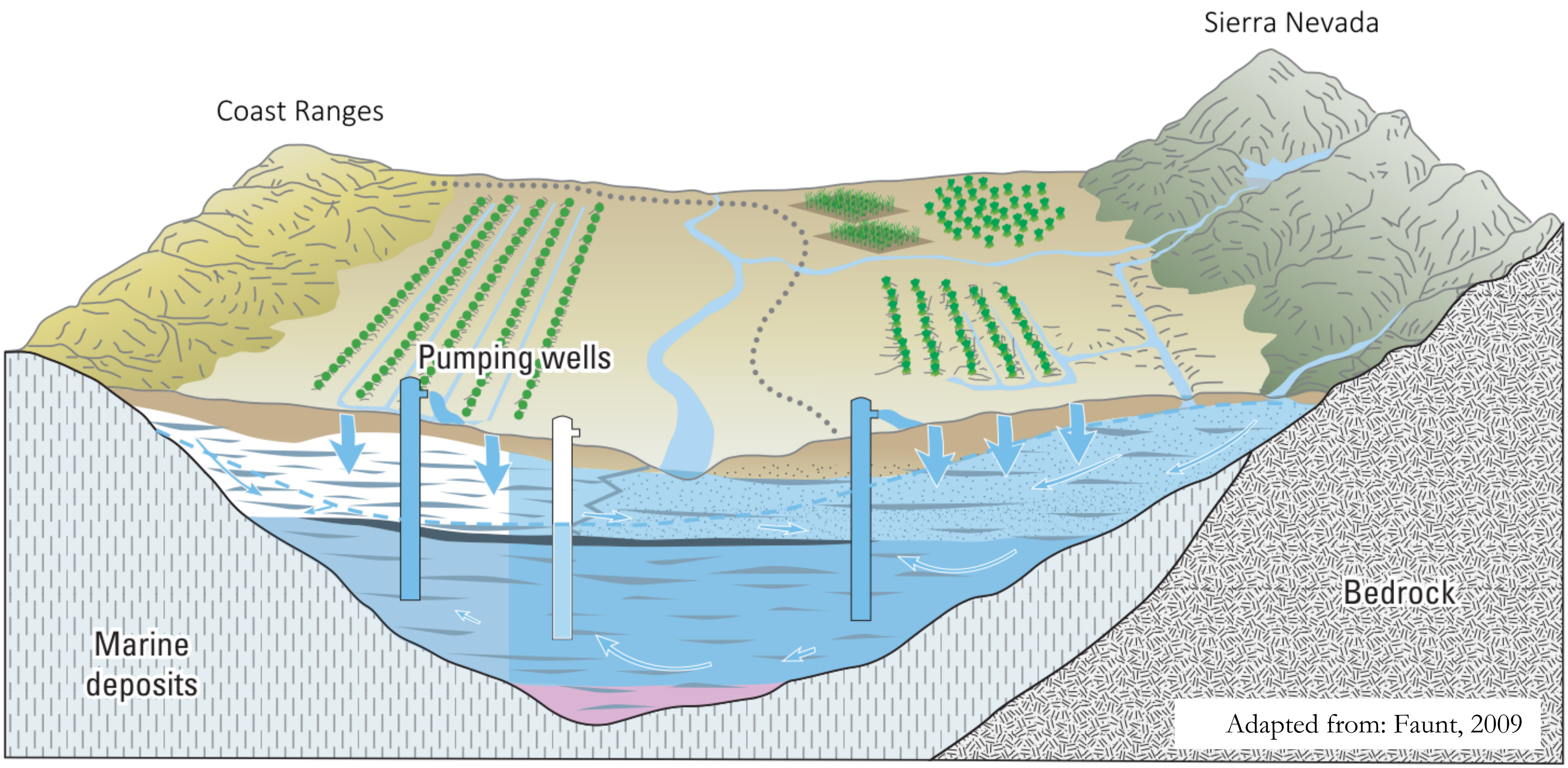


Figure 3-3 Generalized Cross-section of the San Joaquin Valley

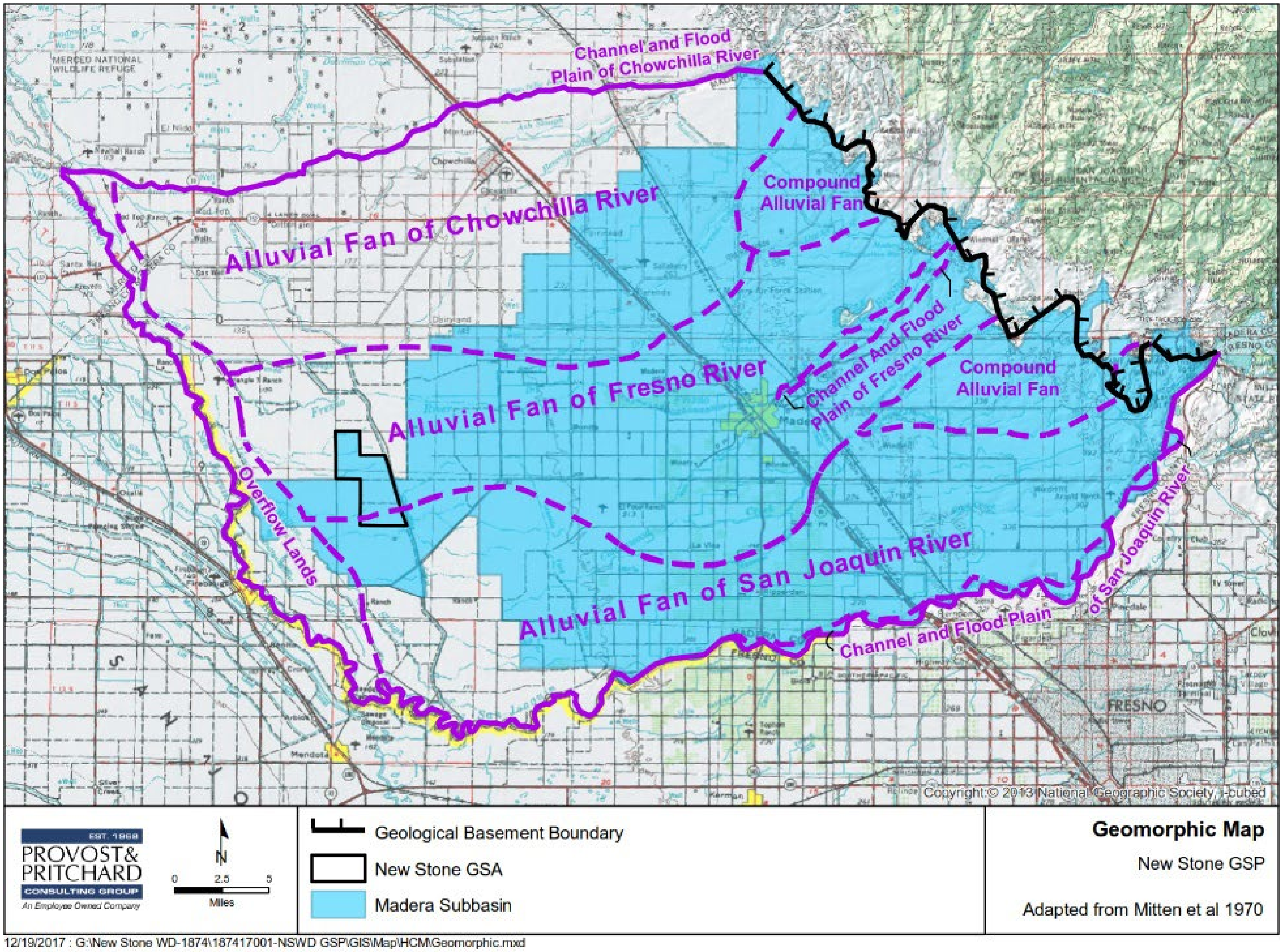


Figure 3-4 Geomorphic Features Map

southwestward from the Sierra Nevada beneath the marine rocks. Because they are largely impermeable, the rocks of the basement complex are of little importance as a source of water supply (Davis et al., 1959).

Marine sedimentary rocks, where present, overlie the crystalline basement complex. The marine rocks do not crop out in the Madera Subbasin and wedge out in the subsurface to the east where unconsolidated sediments lie directly upon the basement rocks (Mitten et al., 1970). The marine rocks generally have low yields of saline connate water which is unsuitable for most uses (Page, 1986). The base of the aquifer in the NSWD GSA area is the top of the marine rocks. The marine rocks occur at a depth of about 2,500 feet beneath NSWD GSA (as interpolated from Plate 3 of Page, 1986).

Two kinds of sedimentary deposits are present in the region of the NSWD GSA area overlying the basement complex rocks. The first is deep, marine sediments deposited on the basement described above. The second consists of continental deposits primarily formed by very large alluvial fans bordering both sides of the valley and flood basin deposits formed primarily along the axis of the valley. The fans are coalescing with distinctive deposits in the fan and interfan areas. The fans are characterized by a mass of generally coarse, permeable deposits in the upper portions of the fan, and consist largely of tongues and lenses of sand and gravel that extend to near the topographic trough of the valley. Near the trough of the valley, the fan sediments are finer grained with fewer thick and extensive permeable riverbed sands present.

The alluvial sediments are typically silty sands with a moderate permeability. The soils formed in the axis of the valley near the toe of the interfan area were formed by the Fresno River and the San Joaquin River. A few miles west of NSWD GSA are flood basin deposits (Overflow Lands described by Mitten et al., 1970). These formed fine-grained deposits and overflow lands, resulting in somewhat different soil characteristics.

Lake and marsh deposits formed in low areas that are isolated and discontinuous areas within the fan and are identified as clayey and silty sediments on driller's logs. The geologic environment in which these sediments formed is one of interfingering layers of silty sands, sands, and clays/silts. Such an environment is not conducive to the development of aerially extensive aquifers or aquicludes/aquitards. This is demonstrated by a review of the available well logs for the area. Although successions of silt, sand, clay, and gravel are noted on the logs, they do not correlate well between logs, and construction of cross-sections displaying continuous sedimentary units with laterally continuous characteristics is difficult.

A sedimentary layer of both regional and local importance is the Corcoran Clay. The lake in which the clays formed was known as Lake Corcoran or Lake Clyde. It was widely extensive, ranging from 10 to 40 miles wide and more than 200 miles long, covering much of the valley floor. The Corcoran Clay is essentially an impermeable barrier and creates a confined aquifer where it is present and has created one of the primary sources of water in the area. Groundwater flow beneath the Corcoran Clay is both from the west towards the axis of the valley and from the east also towards the axis of the valley. Regionally, groundwater flow beneath the Corcoran Clay is both from the west and east towards the axis of the valley. The Coast Range groundwater passes through sediments derived from marine source rocks and contains a higher quantity of salts and other mineral matter sometimes deleterious to crop growth. Wells drilled beneath the Corcoran Clay located in areas closer to the axis of the valley show a stronger influence from the Coast Ranges, with the water being of much lower quality. Eight wells within NSWD GSA have been completed to depths below 350 feet bgs and may encounter sub-Corcoran water.

3.1.4 Topographic Information

Regulation Requirement:

§354.14(d)(1) Physical characteristics of the basin shall be represented on one or more maps that depict topographic information derived from the U.S. Geological Survey or another reliable source.

Geomorphic features of the NSWD area and surrounding areas in the Madera Groundwater Subbasin were mapped by Mitton et al. (Plate 1, 1970). As shown in **Figure 3-4**, the landscape of this area is dominated by overlapping alluvial fans of the Chowchilla, Fresno, and San Joaquin Rivers and the compound alluvial fans of the intermittent streams between the major rivers. In general terms, alluvial fans are fan or cone-shaped deposits of sediment deposited by streams. Alluvial fans are narrower at the head than at the toe, and slope with decreasing gradient from head to toe. The area east of the NSWD consists of foothills and mountains of the Sierra Nevada, which provide the source of the sediment for the alluvial fan deposits.

A topographic map of the Madera Subbasin area is presented as **Figure 3-5**. The highest points in the basin are in the east along the boundary of the of the Sierra Nevada foothills where elevations are as high as 790 feet above mean sea level (msl). The lowest elevations (approximately 140 feet above msl) are found in the western portion of the basin. Relatively steep slopes exist in the subbasin adjacent to the eastern boundary; however, the overall topography of the greater subbasin slopes gently to the southwest.

NSWD GSA lies within the Poso Farm and Firebaugh NE quadrangles, shown in **Figure 3-6**. The topography of the NSWD GSA is relatively flat and ranges between approximately 150 to 160 feet above msl.

3.1.5 Surficial Geology

Regulation Requirement:

§354.14(d)(2) Physical characteristics of the basin shall be represented on one or more maps that depict surficial geology derived from a qualified map including the locations of cross-sections required by this Section.

Within the NSWD GSA area, surface materials are comprised solely of Quaternary age deposits which have been categorized by Mitten et al. (1970) as Quaternary Older Alluvium (Qoa). The subbasin consists mostly of Quaternary Older Alluvium, Quaternary Younger Alluvium (Qya), and Flood Basin Deposits (Qb). Quaternary alluvium within the subbasin is a result of erosion of the Sierra Nevada range to the east and subsequent deposition on the valley floor. Qoa covers the largest area within the subbasin. Thin bands of Qya are located adjacent to modern day stream channels and rivers (i.e., San Joaquin River, Fresno River, and Chowchilla River, and the small intermittent creeks that drain the foothills). Large deposits of Qya formed in the southwest paths of the aforementioned rivers. The western boundary of Madera County is composed of flood basin deposits. However, only a minor portion of the Madera Subbasin is located within an area that includes flood basin deposits. Also shown on **Figure 3-7** are several minor subsurface geologic features of significance including Ione Formations (Ti) and Terrace Deposits (Qt)

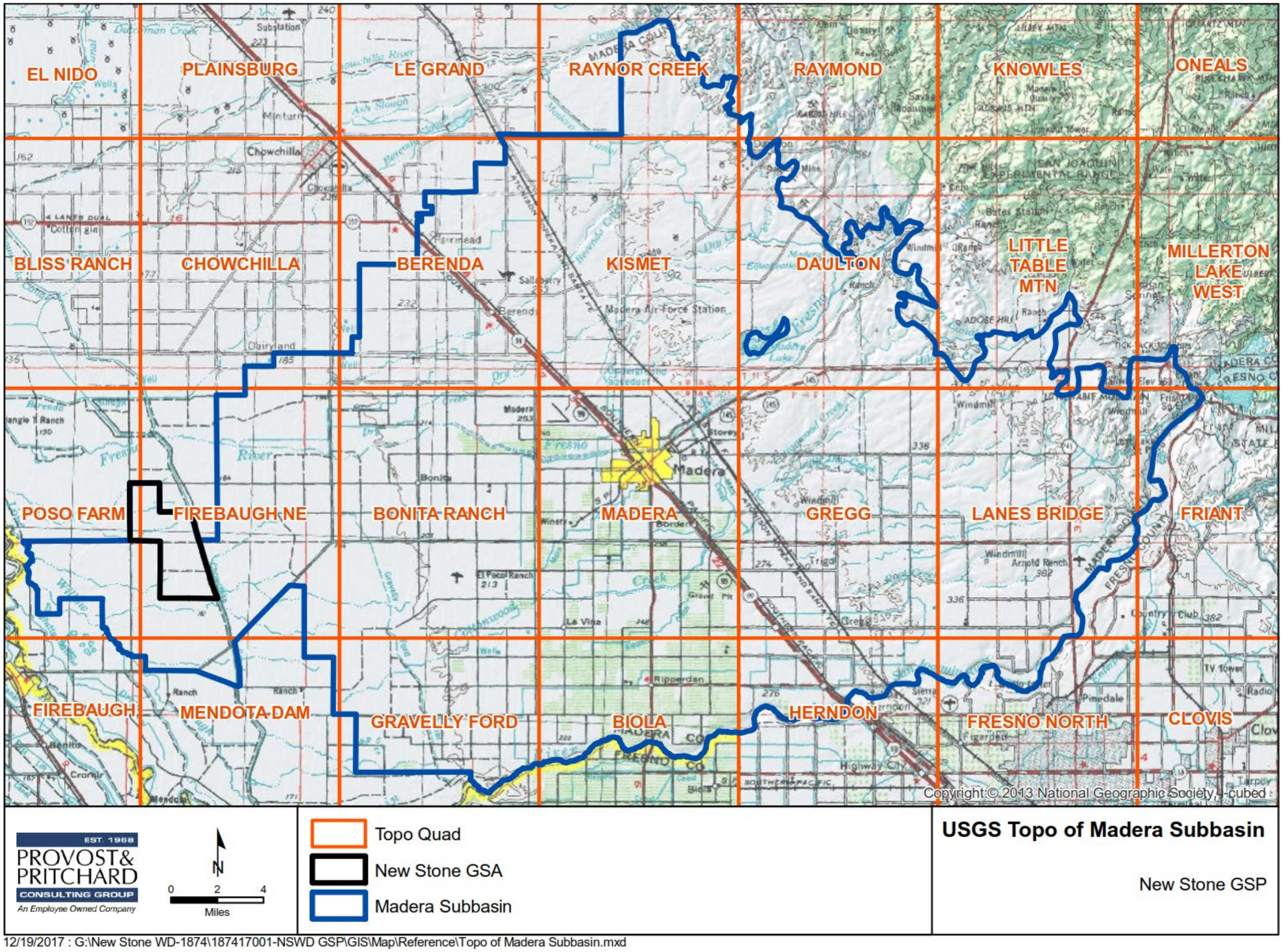


Figure 3-5 Madera Subbasin Topography

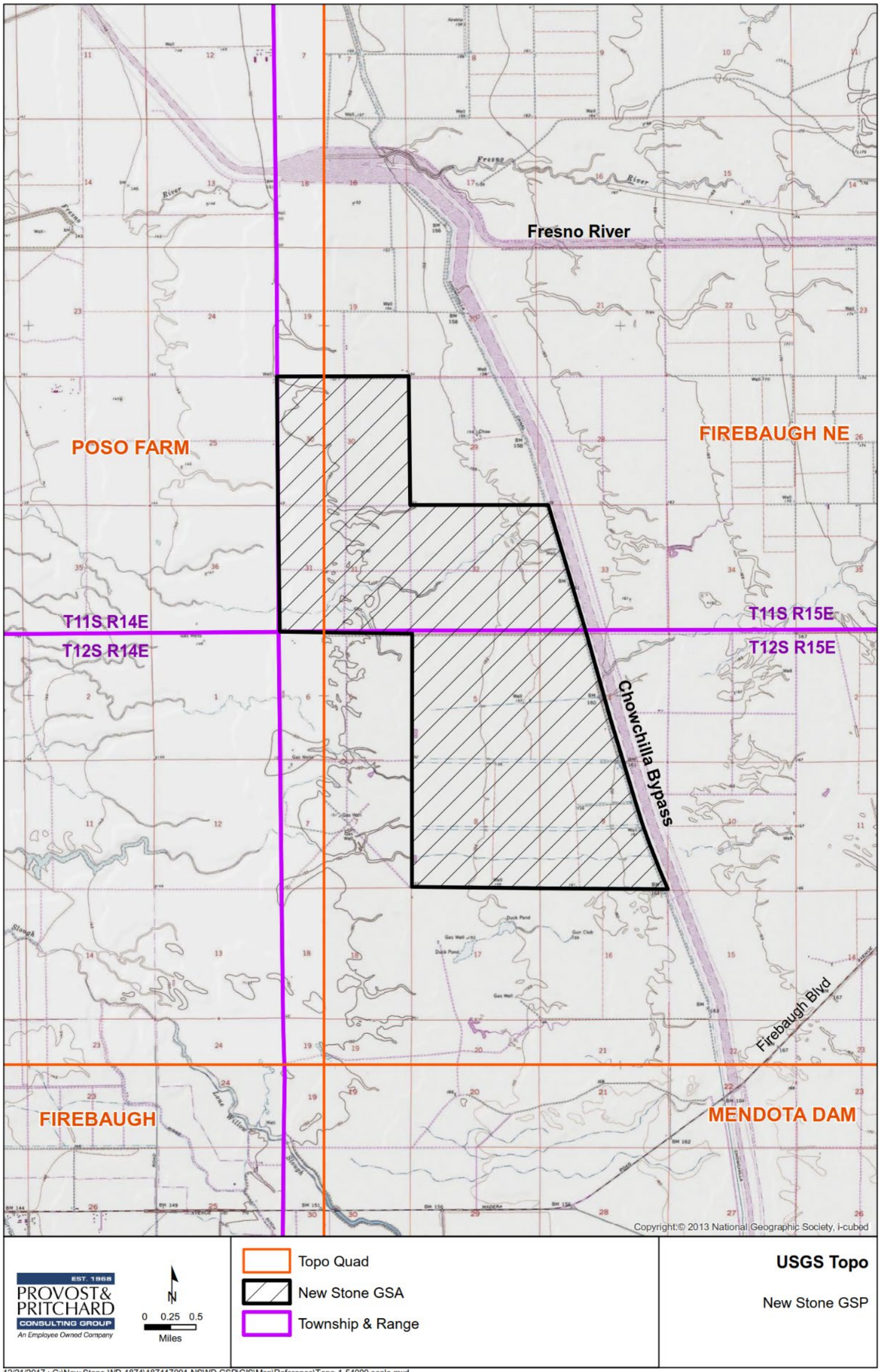


Figure 3-6 NSWD GSA Topography

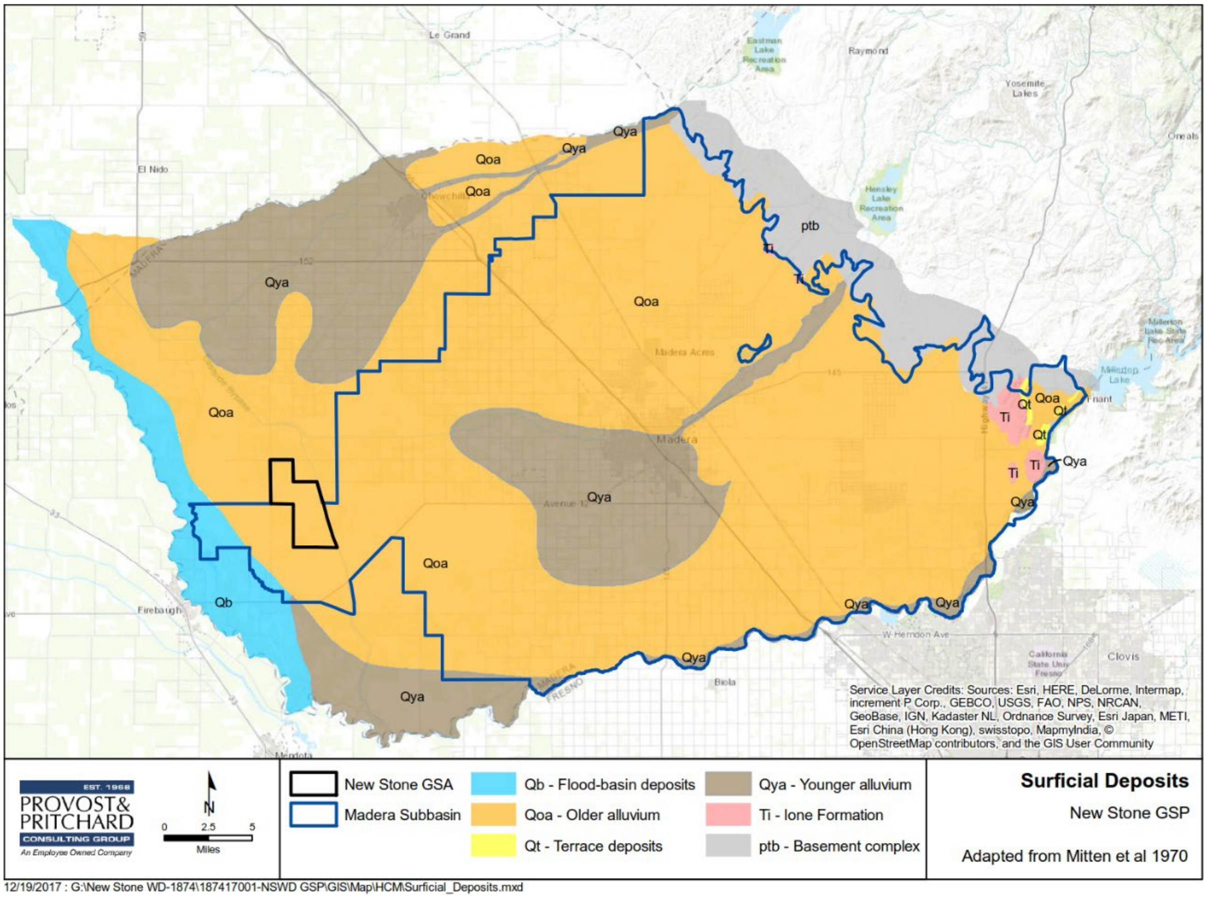


Figure 3-7 Surficial Deposits

3.1.6 Soil Characteristics

Regulation Requirement:

§354.14(d)(3) Physical characteristics of the basin shall be represented on one or more maps that depict soil characteristics as described by the appropriate Natural Resource Conservation Service soil survey or other applicable studies.

A topsoil map based on Natural Resource Conservation Service (NRCS) soil textural classes is presented as **Figure 3-8**. For the NSWD GSA area, the NRCS has generally described soils to depths of five to seven feet. In general the dominant soil textural class is fine sandy loam. The northern portion of the NSWD GSA, between Avenue 12 and Avenue 14, is mostly composed of fine sandy loam with small bands of clay loam and a small lobe of sandy loam in the northeast corner. South of Avenue 12, soil textures in the NSWD GSA vary more and include large bands of loam and clay loam which extend from east to west. There are also small pockets of loamy sand and sandy loam.

Saturated hydraulic conductivity (Ksat) classes refer to the ease with which pores in a saturated soil transmit water. NRCS categorizes Ksat into six classes from very low in fine grained soils to very high in coarse grained soils. The soil textures mapped in NSWD GSA are rated as moderately high, with the exception of the areas mapped as loamy sand which are rated as high.

Based on NRCS soil descriptions, restrictive layers (i.e., any abrupt structural or textural change) in the soil column less than six feet in depth have also been identified. Approximately 85% of NSWD GSA soils have a restrictive layer less than 1.5 foot deep. Areas shown on **Figure 3-8** as clay loam and a few areas of loam do not have a restrictive layer above six feet. The restrictive layers are chiefly comprised of duripan soil horizons (i.e., hardpan), which for the purposes of this document are assumed to have largely been broken up through deep tillage related to historic agricultural operations throughout the area.

These soil characteristics can be useful for initial screening of potential recharge and groundwater banking sites, but the information should be confirmed with on-site investigations before projects are pursued.

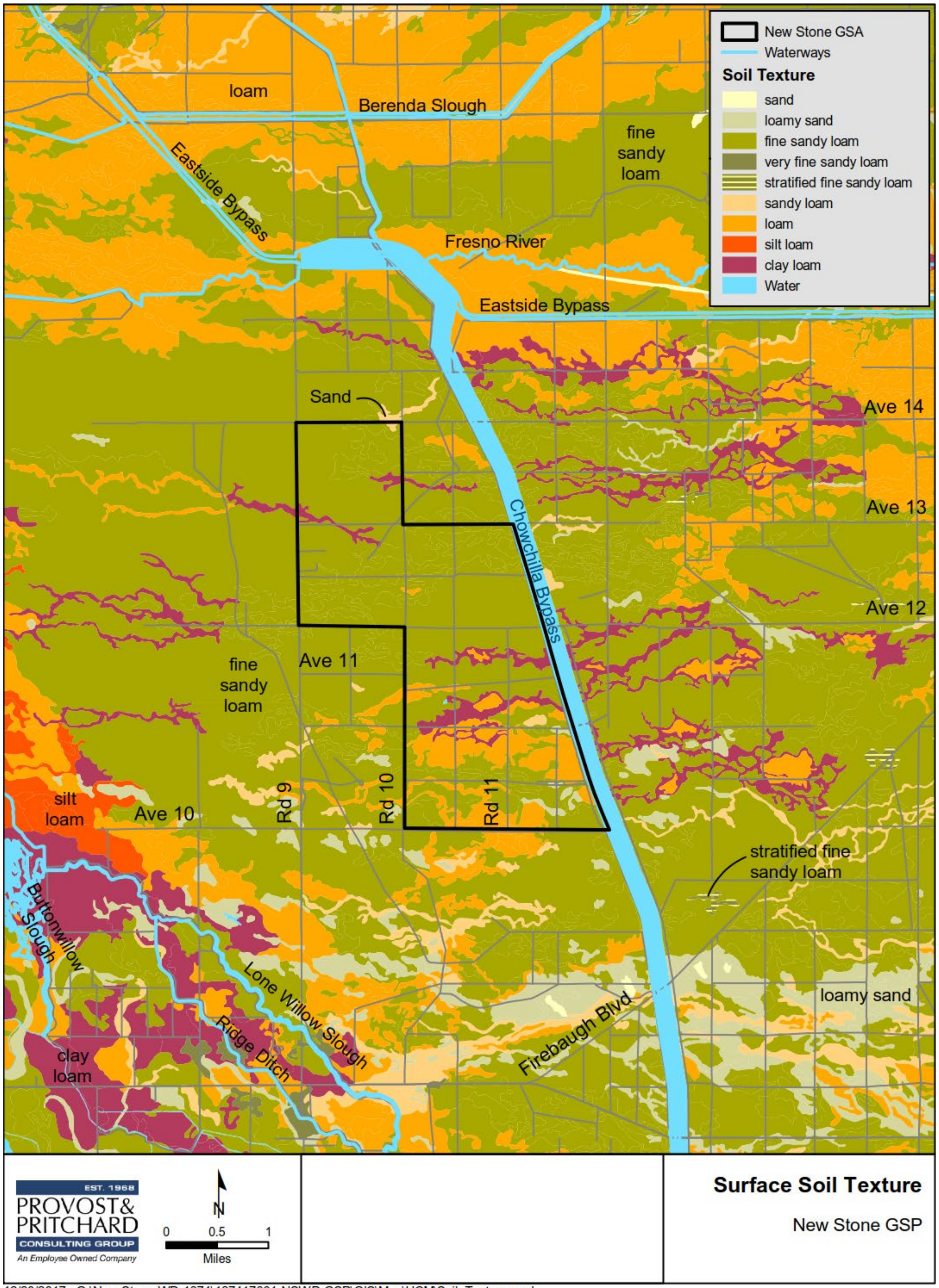


Figure 3-8 Surface Soil Texture

3.1.7 Cross-Sections

Regulation Requirement:

§354.14(c) The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.

Cross sections by Mitten et al. (1970) that transverse the NSWD GSA area are located on **Figure 3-9**. The cross sections are included to provide comparison of depths to the different units and are presented as **Figure 3-10** through **Figure 3-13**.

Regional cross-sections D-D' and E-E' transverse northwest-southeast through Madera County and are shown in **Figure 3-12** and **Figure 3-13** . Cross-section D-D' passes along the southwestern corner of the NSWD GSA. Regional cross-sections A-A', B-B' and C-C' transverse northeast-southwest through Madera County. Cross-section A-A' is not addressed outside the Madera Groundwater Subbasin. Cross-section B-B' bisects the NSWD GSA along the southern section. The regional cross-sections presented herein represent only a portion of the original regional cross sections, to more prominently display the subsurface conditions within Madera County.

As shown on the regional cross section B-B' (**Figure 3-10**), the Qoa is inferred from limited data to exist from the surface near Madera Canal in the east to a depth of approximately 500 feet below msl at the Lone Willow Slough, in the midwestern section of the study area. Qya lies along the surface of the cross-section where it crosses the Fresno River and is present approximately three miles to the southwest. The western-most portion of the cross-section shows Qb beginning near the Lone Willow Slough and terminating approximately five miles to the southwest at the San Joaquin River in the town of Firebaugh. The surficial geology directly beneath the NSWD GSA is shown as Qoa to a depth of approximately 400 feet below msl, with a discontinuous clay iron pan ranging from approximately 200 to 600 feet below msl. The Corcoran Clay confining layer is at a depth of nearly 200 feet below msl.

In cross-section D-D' (**Figure 3-12**) from where it bisects cross-section B-B' to the Chowchilla Bypass, Qoa is shown from the ground surface (approximately 150 feet above msl) to more than 400 feet below msl. The Quaternary and Tertiary age continental deposits (QTc) lie beneath Qoa at depths ranging from 400 to 800 feet and are shown to depths of at least 1,400 feet. The cross-section shows flood basin deposits in the northwestern portion located within the San Joaquin River flood plain. Qya exists at the southernmost location of the D-D' cross-section, where it again intersects the San Joaquin River as the cross-section traverses to the southeast. The D-D' cross-section passes through the southwestern corner of the NSWD GSA showing Qoa at a depth of up to 600 feet below msl and the Corcoran Clay from approximately 150 to 200 feet below msl.

As shown on regional cross-section C-C' **(Figure 3-11**) located at the southern end of the Madera Subbasin outside the boundary of the NSWD GSA, the Qoa extends to a depth of approximately 900 feet in the southwest and gradually thins out to the northeast where basement complex crops out along the eastern boundary. Quaternary and Tertiary age QTc lie below the Qoa to depths of at least 1,400 feet with basement complex lying 800 feet below the QTc east of Highway 41. The Corcoran Clay lies approximately 200 feet below msl at the west end of C-C' near the San Joaquin River and gradually thins until it terminates near Highway 145, approximately 15 miles from the river.

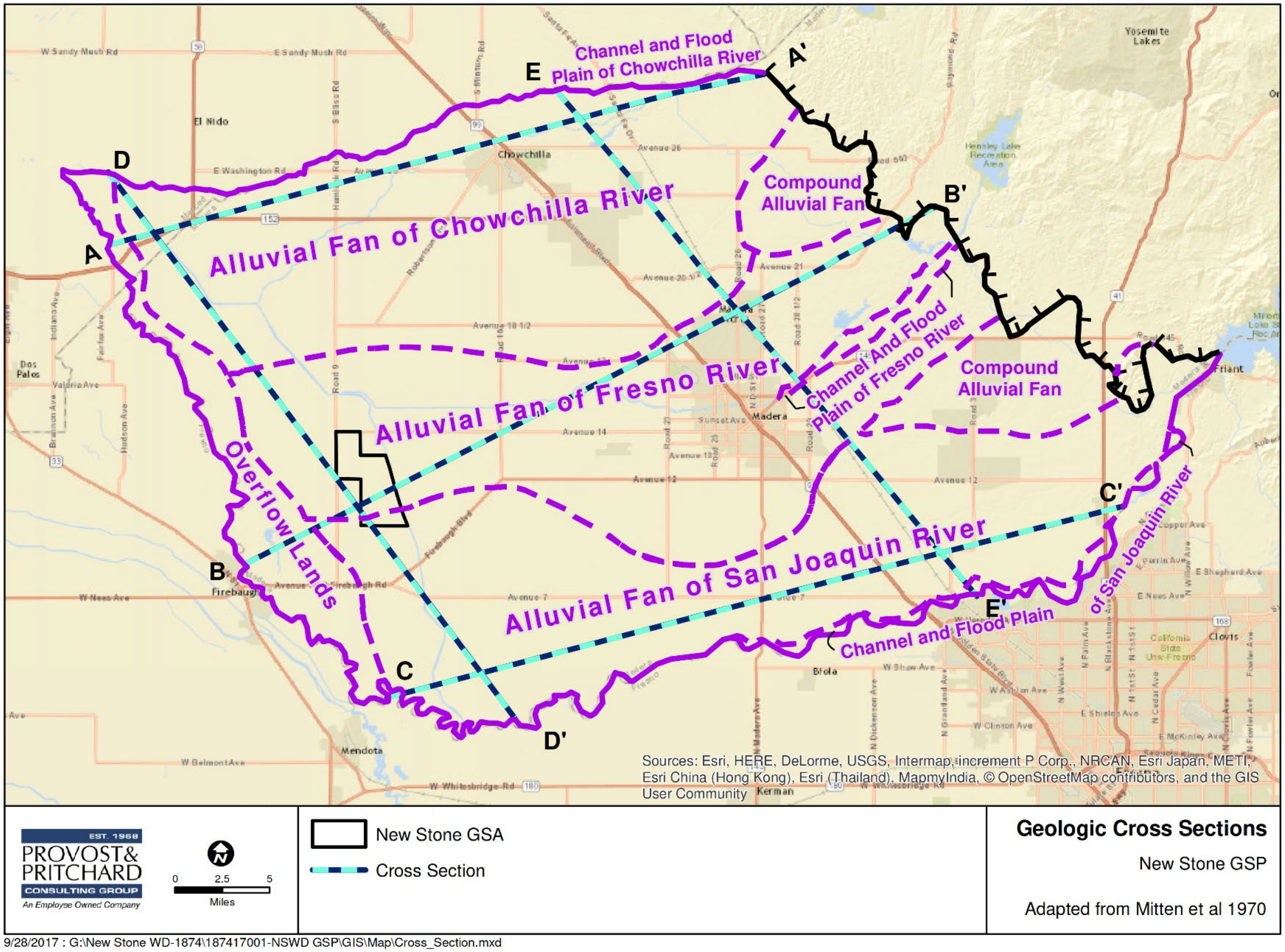
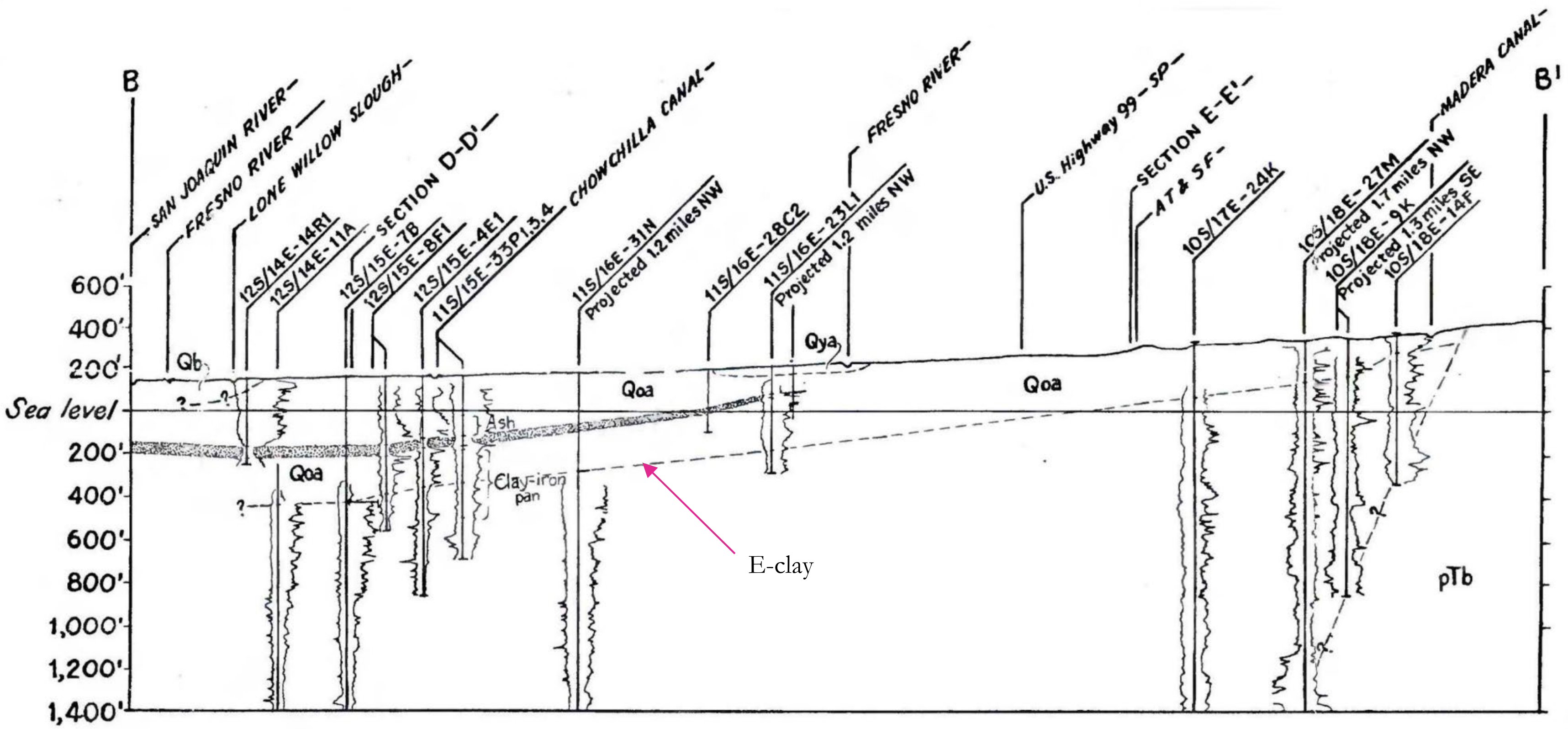


Figure 3-9 Regional Geologic Cross-section Traverses



Source: Mitten, 1970

Figure 3-10 Regional Cross-Section B-B'

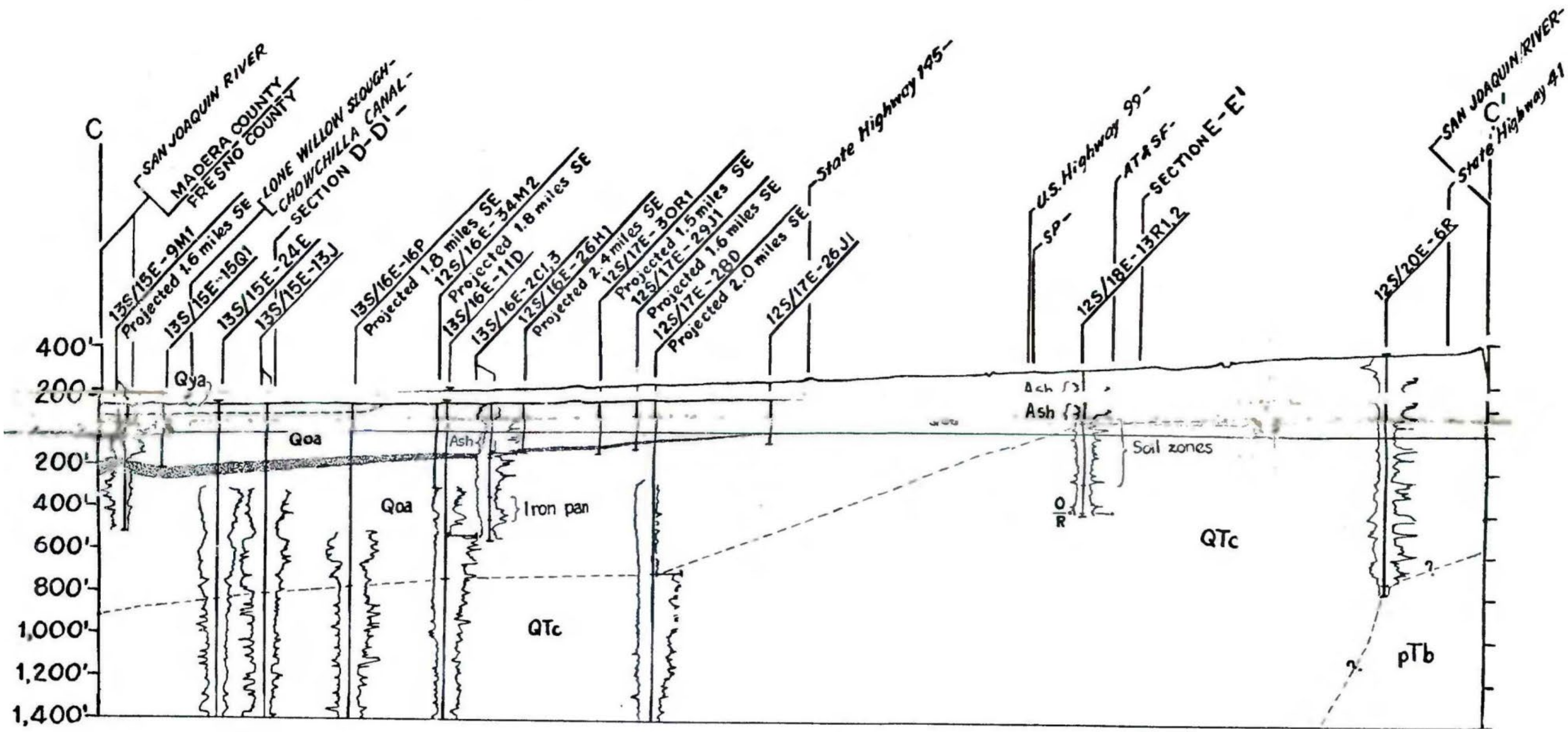
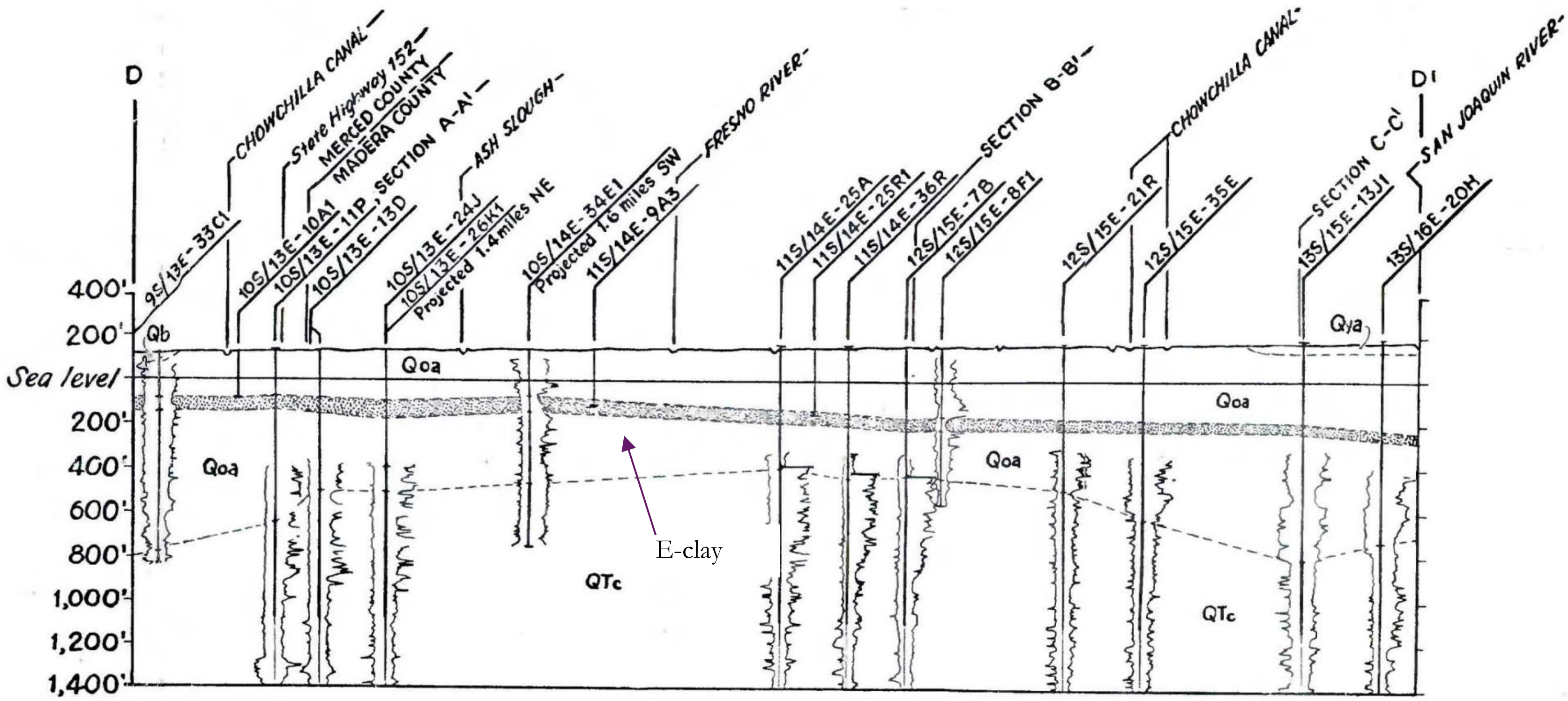


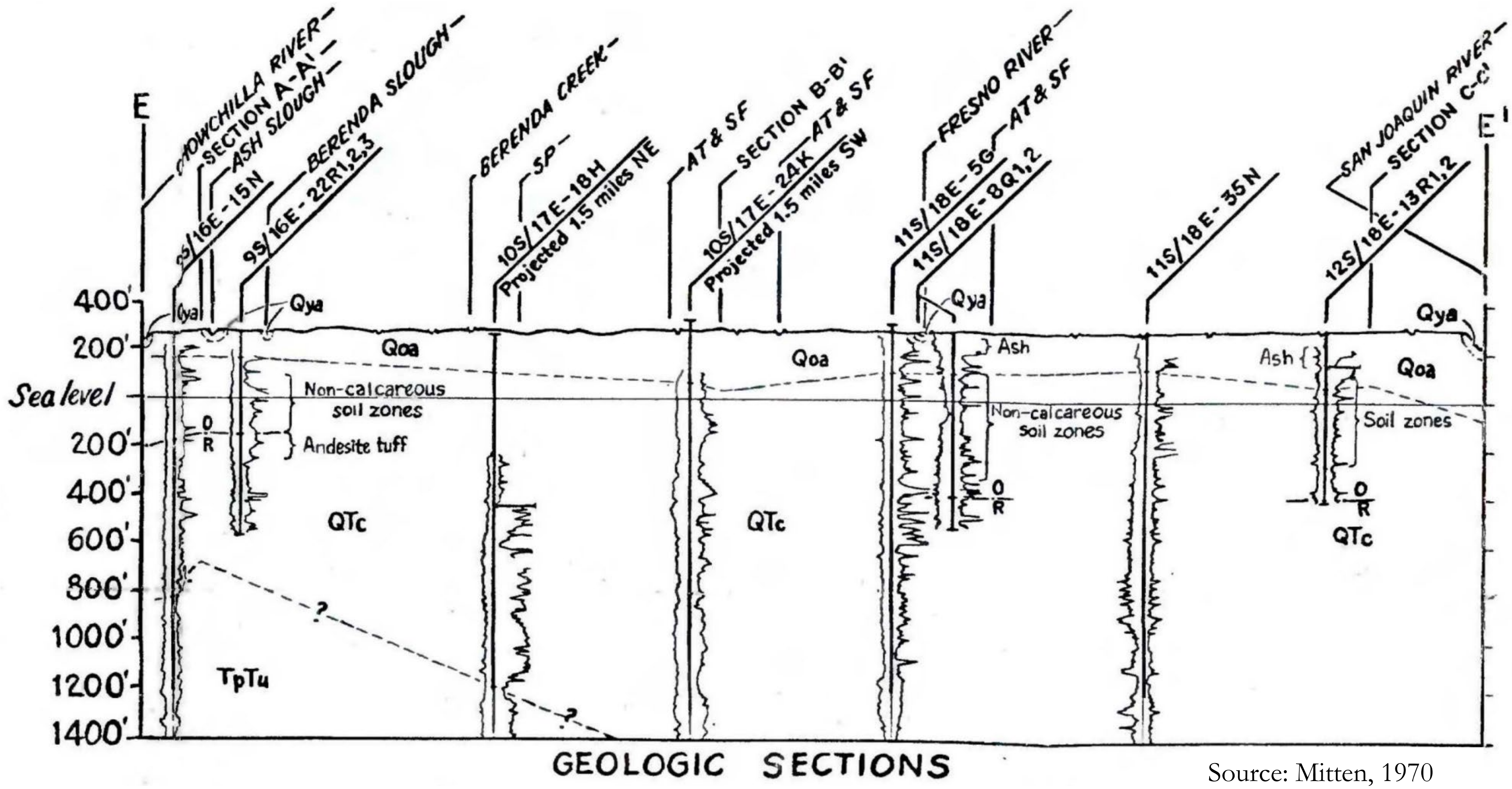
Figure 3-11 Regional Cross-Section C-C'

Source: Mitten, 1970



Source: Mitten, 1970

Figure 3-12 Regional Cross-Section D-D'



Source: Mitten, 1970

Figure 3-13 Regional Cross-Section E-E'

Cross-section E-E' is approximately parallel to and east of Highway 99, several miles to the east of the NSWD GSA. It shows shallow bands of Qoa ranging from a depth of approximately 250 feet below msl where it intersects with the San Joaquin River in the south, to approximately 200 feet above ground surface to the north near the Chowchilla River. Small bands of Qya lie along cross-section E-E' where it intersects the Ash Slough, Berenda Slough, Fresno River, and the San Joaquin River. QTc directly underlies Qoa along cross-section E-E' and typically remains above sea level.

3.1.8 Aquifer System

Regulation Requirement:

§354.14(b)(4) The hydrogeologic conceptual model shall be summarized in a written description that includes the principal aquifers and aquitards.

§354.14(b)(4)(c) Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.

The NSWD GSA encompasses a small portion of the western-most Madera Groundwater Subbasin. The subbasin aquifer system consists of unconsolidated continental deposits of older series Tertiary (66 to 2.6 million years ago) and Quaternary (2.6 million years ago to the present) age sediments overlain by younger series deposits of Quaternary age. The Quaternary age deposits are divided into Qoa, lacustrine (lake) and marsh deposits, terrace deposits, Qya, and flood-basin deposits (Mitten et al., 1970). Lacustrine and marsh deposits do not crop out in the Madera Groundwater Subbasin but tend to underlie the western portion of the subbasin (DWR, 2006).

Mitten, et al. (1970) states that subsurface water-bearing characteristics of the Qoa deposits are highly variable due to changes in lithology. These deposits consist mostly of interbedded layers of silts, silty/sandy clays, clay lenses, clayey and silty sands, sands, gravels, and cobbles. It contains much of the water that occurs in the unconfined aquifers in the Madera Subbasin.

A fine-grained lacustrine and marsh deposit, known as the E-clay or Corcoran Clay, acts as a confining layer separating the upper unconfined aquifer from the lower confined aquifer for much of the subbasin. The Corcoran Clay is approximately 100 feet below msl at the northeastern portion of the Madera Groundwater Subbasin and gradually gets deeper as it traverses south-southwest to the San Joaquin River and thicker as it traverses west-southwest. The Corcoran Clay confining layer is shown by cross-section D-D' to exist at a depth of approximately 150 to 200 feet below msl along the western section of the Madera Groundwater Subbasin. Cross-sections B-B' and C-C' show the Corcoran Clay as it crosses the Madera Subbasin from east to west. To the north, cross-section B-B' shows the Corcoran Clay at the San Joaquin River to the west at a depth of approximately 150 feet below msl and 50 feet thick. The Corcoran Clay layer thins to approximately 20 feet and appears to terminate approximately 100 feet above msl (100 feet bgs) to the east, a few miles before the cross-section bisects the Fresno River. Cross-section C-C' lies further south of cross-section B-B' and extends from west to east becoming gradually shallower and thinner as it reaches sea level. The Corcoran Clay from C-C' begins approximately 200 feet below msl and is approximately 50 feet thick. It terminates approximately 25 miles to the east near Highway 145.

The Corcoran Clay is present below the entirety of NSWD GSA. Below the NSWD GSA, the top of the Corcoran Clay lies between 200 to 350 feet bgs as shown in **Figure 3-14**. The Corcoran Clay under NSWD GSA is between 40 and 60 feet thick (Plate 5 of Page, 1986). See **Figure 3-15** for thickness of Corcoran Clay layer.

Where present, the Corcoran Clay is known to have confined groundwater conditions beneath it. It should be noted that newer supply wells are often sealed off from the quaternary alluvium and tap into confined

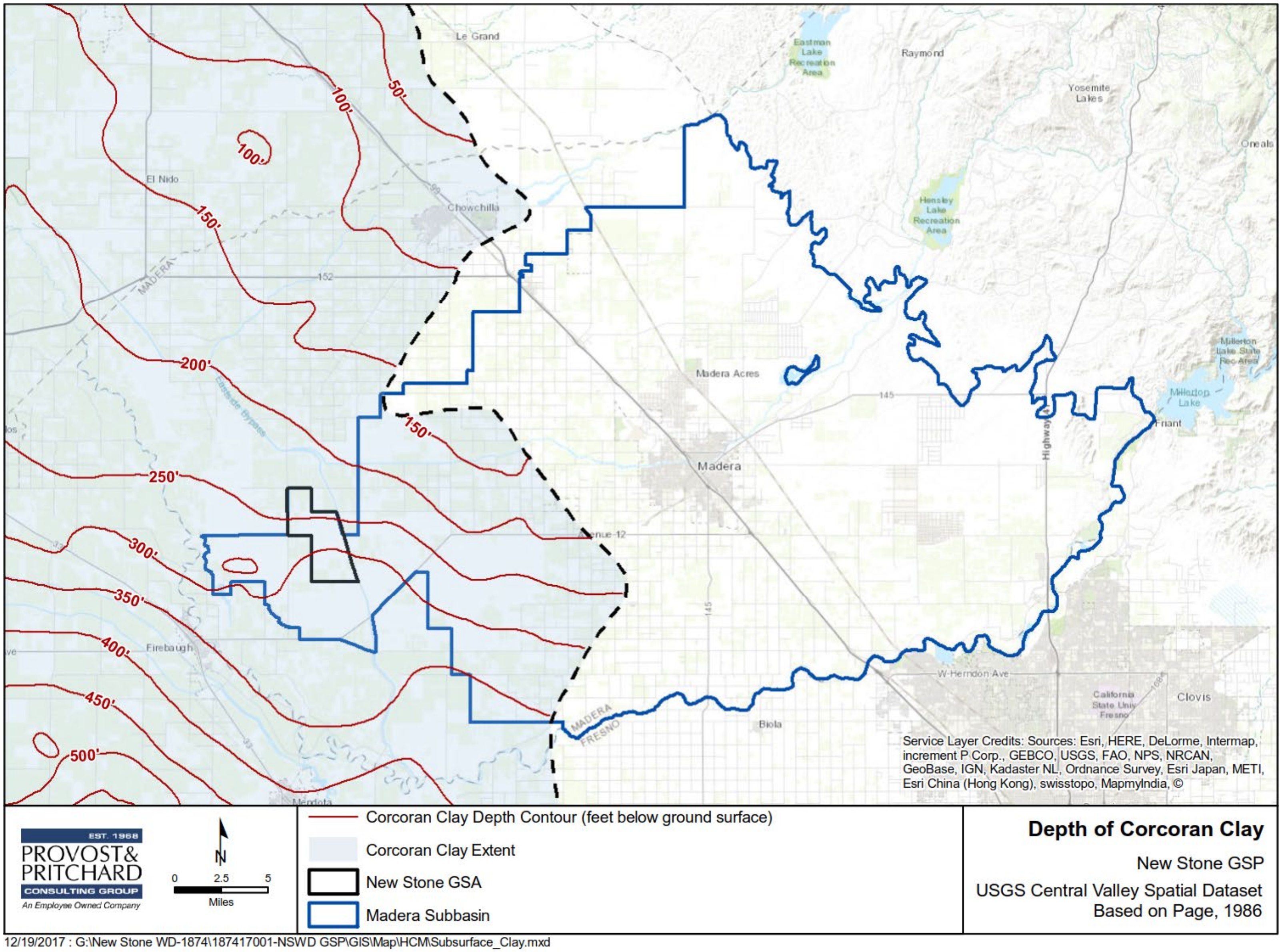


Figure 3-14 Depth of Corcoran Clay

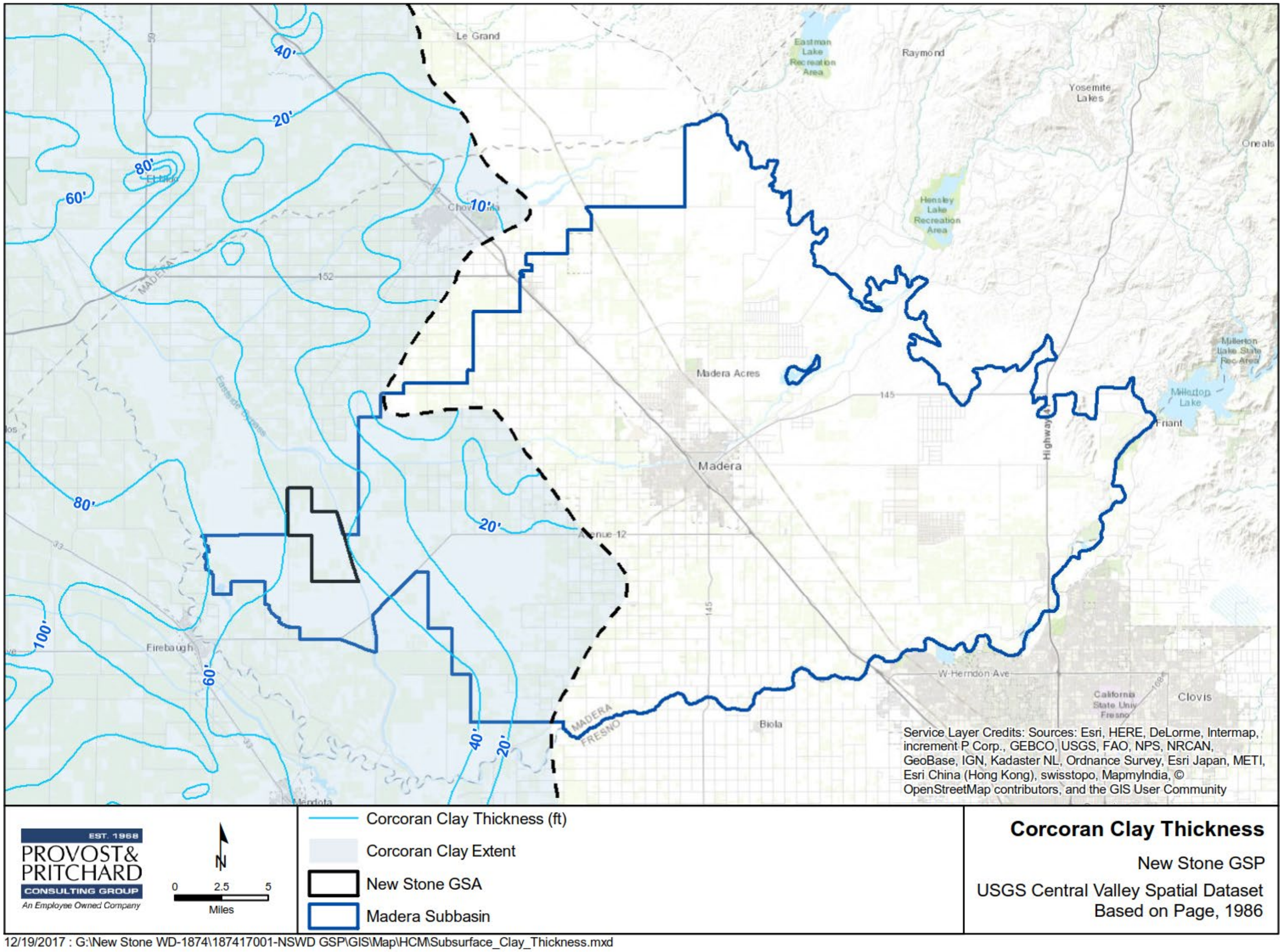


Figure 3-15 Corcoran Clay Thickness

groundwater. Within the Madera Groundwater Subbasin, less extensive confining units, known as the A-clay, exist at shallower depths; however, this confining unit is not mapped and is assumed to occur only in the southwestern portion of the subbasin. The A-clay does not extend under the NSWD GSA.

3.1.8.1 Geologic Formations

Regulation Requirement:

§354.14(b)(4)(a) Formation names, if defined.

Marchand's report (1976) contains a set of geologic maps of the Madera area. The area of NSWD GSA is mapped as Modesto Formation, primarily the lower member but with small areas of the upper member. Both the upper and lower members are described as locally derived, arkosic, alluvial sand, silt, and clay of interdistributary areas, lower fans, and flood basins that are commonly stratified (Marchand, 1976; Marchand & Allwardt, 1981). The lower member is 80 feet or thicker and is underlain by the Riverbank Formation (Marchand & Allwardt, 1981).

3.1.8.2 Aquifer Characteristics and Properties

Regulation Requirement:

§354.14(b)(3) The hydrogeologic conceptual model shall be summarized in a written description that includes the definable bottom of the basin.

§354.14(b)(4)(b) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.

<u>Vertical Extent</u>

The vertical extent (i.e., depth) of the aquifer system of the Madera Subbasin is comprised of two separate boundary types and has been mapped by Page (1973, 1986) and Mitten et al. (1970). As shown in **Figure 3-7**, the eastern most boundary of the Madera Subbasin aquifer system is defined vertically by the top of the basement complex. The depth to the basement complex is zero along foothills where valley alluvium pinches out. Cross-section B-B' shows the basement complex recedes steeply from the foothills and is approximately 350 feet below msl approximately two-miles to the west. The depth to the basement complex continues to increase until it is undetectable on the cross-section after approximately five miles from the base of the foothills.

The vertical aquifer boundary for the NSWD GSA (western portion of the Madera Subbasin) is the base of freshwater, which for the purposes of this HCM, is defined as groundwater with TDS content of less than 2,000 mg/L. As shown on **Figure 3-16**, the saltwater/freshwater interface below NSWD GSA is located at approximate depths ranging from 600 to 950 feet below msl according to Mitten et al. (1970). The base of freshwater is located below the Qoa bottom within the QTc (Mitten et al., 1970). Page (1973) includes a contour map based on EC values of 3,000 µmhos/cm, a comparable value to 2,000 mg/L for TDS. Page (1973) indicates the base of freshwater under NSWD GSA is approximately 400 to 800 feet below msl.

<u>Aquifer Characteristics</u>

Aquifer characteristics of importance to the NSWD GSA are mainly transmissivity, hydraulic conductivity, and storativity. Storativity relates to how much space is available in the aquifer system for storage of groundwater. More specifically, storativity is the volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in head (Fetter, 1994). In unconfined aquifers, the storativity is approximately equal to the specific yield. Therefore, as most of the published sources consulted for this

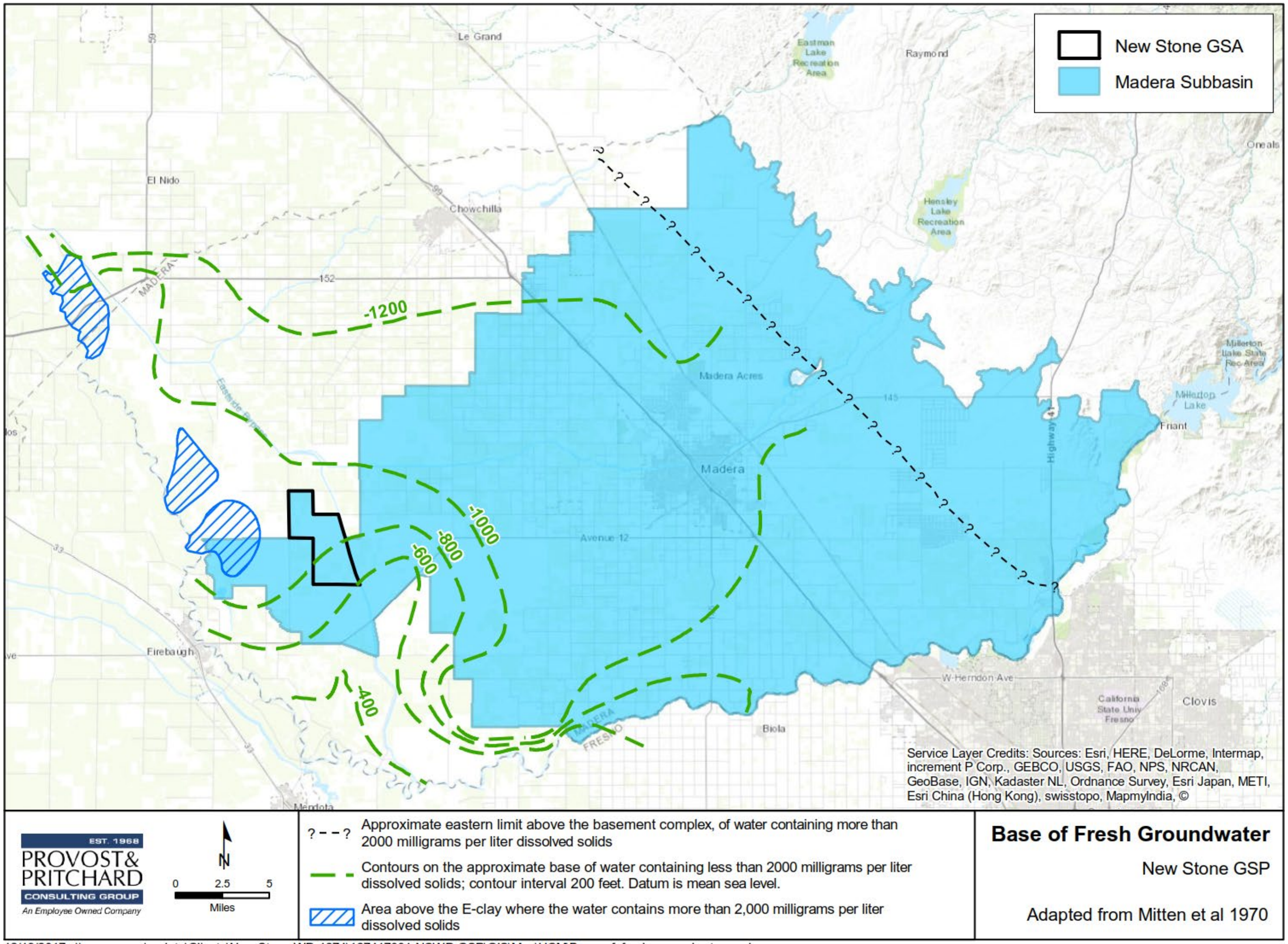


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Figure 3-16 Base of Fresh Groundwater

HCM provide information on specific yield this portion of the report discusses specific yield as a close approximation of storativity in the unconfined aquifer.

Hydraulic conductivity is the rate at which water can move through a permeable medium, and the transmissivity is the amount of water that can be transmitted horizontally by the full saturated thickness of the aquifer under a hydraulic gradient of one. These two properties are related in that transmissivity is the hydraulic conductivity multiplied by saturated aquifer thickness, thus the following discussion focuses on transmissivity values alone as a representation of both these characteristics.

Specific Yield of the Deposits

The water storage capacity or specific yield in the Madera Subbasin area are related to soil textures which are determined by geomorphic units. Davis et al. (1959), DWR (2006), and Mitten et al. (1970) provide estimates of specific yields in the Madera area based on texture of the deposits. These estimates of specific yield are based on deposit descriptions (texture), electric logs, laboratory analysis of soils samples, and a relatively simple and transparent methodology.

Davis et al. (1959) sorted classification of materials from drillers logs into five major groups and assigned specific yields to each based on results of previous studies conducted on samples collected in California. The assigned specific yield values range from 3% for clay deposits to 25% for medium to coarse sand and gravel deposits. For the San Joaquin River storage unit, including the San Joaquin River alluvial plain and the valley plain west of Madera, the average specific yield from 10 to 200 feet bgs is 11.9% (Davis et al., 1959). Davis et al. (1959) also includes a table of estimated groundwater storage capacity units, by township subunits, sorted by depths of 10 to 50, 50 to 100, and 100 to 200 feet. NSWD GSA spans two townships: T11S R15E and T12S R15E. From shallow to deep, both townships have specific yields of 8.3%, 13.3% and 14.8% listed. These values are summarized in **Table 3-1**.

Mitten et al. (1970) report water bearing properties based on USGS laboratory analyses of surface samples of both older and younger alluvium in their Madera study area. The results show that specific yields are highly variable in the older alluvium and the younger alluvium is more permeable. Specific yields for older alluvium ranged from 0.5% to 22.4% in silts and 14.0% to 23.4% in sands. In the younger alluvium specific yields were higher, ranging from 18.8% to 32.8% in silts and 17.7% to 39.0% in sands. DWR (2006) estimates the average specific yield of the Madera Groundwater Subbasin is 10.4%. Davis et al. (1959) estimated specific yield for three depths by Township, which for the District area (Townships T11S and 12S, Range 15E). Williamson et al. (1989) also estimated specific yield for deeper than 150 feet to greater than 600 feet. From his study specific yield for the District area for a depth range of 200 feet to 300 feet can be estimated at 11.0%. Specific yield values at the depths of groundwater fluctuation in the NSWD are as summarized in **Table 3-1**.

Table 3-1 Summary of Specific Yield Estimates from Davis et al. (1959) & Williamson et al. (1989)

Township	Estimated Specific Yield (percent)				
	10-50 feet	50-100 feet	100-200 feet	200-300 feet	All zones
T11S R15E	8.3%	13.3%	14.8%	10-11%	13.0%
T12S R15E	8.3%	13.3%	14.8%		13.0%

Transmissivity

Estimates of and transmissivity are available from published sources including Davis, Lofgren and Mack (1964) and Provost & Pritchard (2008). Davis et al. (1964) provides information for numerous short-term pump tests in the area and provides specific capacity (discharge in gallons per minute (gpm) divided by drawdown) by township. Thomasson et al. (1960) developed an empirical relationship between specific capacity and transmissivity, which is also discussed by Driscoll (1986) and more recently by Abbott (2015). Transmissivity can be approximated by multiplying specific capacity by a factor of 1,500 for unconfined aquifers and 2,000 for confined aquifers. At the time that these studies were done, it is likely that most wells in the San Joaquin Valley were shallow and open bottom, and the resultant transmissivities are probably more valid for the shallower portion of the aquifer comprised of the Older Alluvium. In general, transmissivity values are higher for the older alluvium than the underlying deposits. Transmissivity values can also be high in paleo channel deposits and low in deposits dominated by floodplain clays.

Short-term pump tests performed by PG&E in the San Joaquin Valley have been compiled by the USGS (Davis et al., 1964). For the two townships NSWD GSA falls within, the average discharge rate and specific capacity for T11S/R15E was 1,176 gpm and 81 gpm per foot (gpm/ft) respectively, and for T12S/R15E the discharge was 1,813 gpm with a specific capacity of 104 gpm/ft. Using the common conversion factor of 1,500 for unconfined aquifer conditions, the aquifer transmissivities would be 121,500 gallons per day per foot (gpd/ft) and 156,000 gpd/ft for T11S/R15E and T12S/R15E, respectively. These are likely pump tests of wells screened above the Corcoran Clay. These are relatively high numbers commonly found in the better portions of the aquifers of the San Joaquin Valley.

Pump tests conducted on wells within NSWD GSA were used to produce specific capacity and transmissivity values (Provost & Pritchard, 2008). With 26 wells tested, specific capacities ranged from 15 to 123 gpm/ft with an average of 41 gpm/ft. Transmissivity values ranged from 22,500 to 184,400 gpd/ft with an average of 44,000 gpd/ft. The wells are generally screened above the Corcoran Clay in the Older Alluvium. Summaries of the characteristics of the wells analyzed by Provost & Pritchard (2008) are in **Table 3-2** and estimated transmissivities in **Table 3-3.**

Table 3-2 NSWD GSA Well Characteristics and Pump Test Results (Provost & Pritchard, 2008)

Description	Units	Range	Average
Groundwater Depth	feet	51 - 110	76
Well Depth	feet	210 - 597	365
Well Diameter	inches	14 - 16	16
Pump Depth	feet	120 - 242	181
Pump Power	horse power	40 - 125	78
Specific Capacity	gpm/ft	15 - 123	41
Transmissivity	gpd/ft	22,500 - 184,400	44,000

Table 3-3 Summary of Transmissivity Estimates

Publication	Estimate of Transmissivity (gpd/ft)	Description/Notes
Davis et al. (1964)	121,500 156,000	Averages for T11S/R15E and T12S/R15E, respectively.
Provost & Pritchard (2008)	44,000	Average based on pump tests conducted on NSWD GSA wells.

3.1.8.3 Aquifer Uses

Regulation Requirement:

§354.14(b)(4)(e) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.

The aquifers in the NSWD GSA are used primarily for irrigation purposes. Groundwater pumping for agriculture is not measured, with the amount pumped varying based on the crop demand. The estimated amounts of pumping are described in **Chapter 3.3** - Water Budget.

3.1.9 General Groundwater Quality

Regulation Requirement:

§354.14(b)(4)(d) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.

The discussion presented below is intended to present a generalized view of groundwater quality in the Madera Subbasin and NSWD GSA area. A more detailed discussion on groundwater quality is included in Groundwater Conditions, Section 3.2.5 and updated information will be provided in future Annual Reports.

General groundwater quality of the Madera Subbasin is described by Mitten et al. (1970) and Provost & Pritchard (2014). Nitrate is an important constituent of concern in the area and specific conductance is a general indicator of water quality. The following discussion will focus on these two constituents.

Provost & Pritchard (2014) describes the Madera regional groundwater quality as generally good but further divides the study area into sub-areas. NSWD GSA is near the center of the Westerly Undistricted Sub-Area, where the only data available is for specific conductance and nitrate as nitrogen (NO_3). In the center of the sub-area, specific conductance has been documented above 1,600 micromhos per centimeter (µmhos/cm) and NO_3 appears to be above the primary MCL of 45 milligrams per liter (mg/L) (Provost & Pritchard, 2014).

Mitten et al. (1970) generalizes the groundwater above and east of the Corcoran Clay as predominately calcium sodium bicarbonate and sodium calcium bicarbonate type water. In the western area of the Madera Subbasin which encompasses NSWD GSA, the groundwater is a chloride type that contains more dissolved solids. Chemical analytical data is presented sorted by township. In the two townships within NSWD GSA, the average specific conductance is 650 µmhos/cm which is below the secondary MCL of 900 µmhos/cm and average NO_3 is well below the MCL at 5.3 mg/L (Mitten et al., 1970).

Water quality analytical data was collected from wells within the NSWD GSA for agronomic purposes. The data returns averages of 840 µmhos/cm and 5.6 mg/L of specific conductance and nitrate, respectively, are below their respective MCLs.

3.1.10 Surface Water Features

§354.14(d)(5) Physical characteristics of the basin shall be represented on one or more maps that depict surface water bodies that are significant to the management of the basin.

The only surface water feature in NSWD GSA is the Bypass, which exists along the eastern edge of the NSWD GSA. The Chowchilla Bypass is a designated floodway into which water is diverted from the San Joaquin River only in relatively wet years. The Bypass is the only existing conveyance facility that delivers surface water to NSWD GSA lands.

New Stone Water District owns gates and a diversion pipeline at the Bypass at Avenue 12 which can pass an estimated 30,000 gpm according to the District. The District has a canal along the west side of the Bypass up to the southern end of NSWD GSA. NSWD formerly used Bypass water to irrigate crops; however, when a drip system was installed, the water could no longer be used. As a result, a canal adjacent to the Bypass was backfilled to make more room for grape vines.

3.1.11 Source and Point of Delivery of Imported Water

Regulation Requirement:

§354.14(d)(6) Physical characteristics of the basin shall be represented on one or more maps that depict the source and point of delivery for imported water supplies.

Water is not imported into NSWD GSA, except for water from the Chowchilla Bypass during flood releases. These releases occur approximately once every three years (Provost & Pritchard, 2008).

3.1.12 Recharge and Discharge Areas

Regulation Requirement:

§354.14(d)(4) Physical characteristics of the basin shall be represented on one or more maps that depict delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.

This section discusses existing and potential groundwater recharge areas and areas of groundwater discharge. The information is presented on a regional scale and provides a general assessment of the GSA's recharge potential. This information would need to be supplemented with local information for developing site-specific groundwater recharge projects.

Existing Recharge Areas

The NSWD GSA includes natural recharge areas but does not have intentional recharge from constructed recharge basins. Natural recharge in the area occurs from seepage along the San Joaquin River, Chowchilla Bypass (when water is present), intermittent streams, and reservoirs. Deep percolation of agricultural irrigation also makes significant contributions to groundwater recharge. Natural recharge from percolation of precipitation is considered minor.

Potential Recharge Areas

Potential recharge areas can be identified using the soil and geologic maps described below. These maps provide a regional assessment of recharge potential and can be useful for initial screening. It should also be recognized that land availability is generally a limiting factor in the selection of recharge areas.

Soils

A soils map based on NRCS soil textural classes is presented as **Figure 3-8.** This map generally represents soils in the upper five to seven feet of the soil profile. The NSWD GSA is primarily mapped as fine sandy loam with fingers of finer loam and clay loam oriented in an east-west direction, mostly in the southern half of the GSA. The majority of NSWD GSA surface soils have a Ksat rating of moderately high and a restrictive soil feature less than 1.5 feet deep. Refer to **Section 3.1.6** for further discussions on the soils. However, deeper conditions (7 to 50 feet in depth) are also important in the control of surface water infiltration. Based on these soil characteristics, areas within NSWD GSA could potentially produce moderate rates of groundwater recharge.

Soil Agricultural Groundwater Banking Index

The Soil Agricultural Groundwater Banking Index (SAGBI) is a composite evaluation of the feasibility of groundwater recharge on agricultural land (also called irrigation field flooding). Irrigation field flooding could have significant potential for groundwater recharge due to the large areas of irrigated agriculture in the GSA. The Index was developed by University of California, Davis, and the University of California Division of Agriculture and Natural Resources.

The Index incorporates the following five parameters:

1. Deep percolation is dependent upon the saturated hydraulic conductivity of the limiting layer.
2. Root zone residence time estimates drainage within the root zone shortly after water application.
3. Topography is scored according to slope classes based on ranges of slope percent.
4. Chemical limitations are quantified using the electrical conductivity (EC) of the soil.
5. Soil surface condition is identified by the soil erosion factor and the sodium adsorption ratio.

Proximity to a water conveyance system is not a factor considered in the SAGBI composite evaluation. Each factor was scored on a range, rather than discreetly, and weighted according to significance. Adjustments were then made to reflect soil modification by deep tillage (i.e., shallow hard pan is assumed to have been removed by historic farming activities). **Figure 3-17** illustrates the SAGBI Index for the NSWD GSA. Ultimately, SAGBI seeks to categorize recharge potential according to risk of crop damage at the recharge site. Usefulness of the index is diminished when evaluating locations for dedicated recharge basins. In these cases, a soil profile illustrating deep percolation potential may prove to be more useful. As is the case with any model, the SAGBI is best applied in conjunction with other available data and on-site evaluation.

Discharge Areas

There are currently no known groundwater discharges (springs, seeps, etc.) in the NSWD GSA area. Springs and artesian wells were common decades ago; however, groundwater levels have declined such that these features are no longer found in the region. Groundwater levels are further discussed in **Chapter 3.2**.

Wetland Areas

Wetland areas from the U.S. Forest service, National Wetland Inventory are shown on **Figure 3-18**. Most wetlands in the figure are around the Chowchilla Bypass and the small tributaries flowing west to the San Joaquin River.

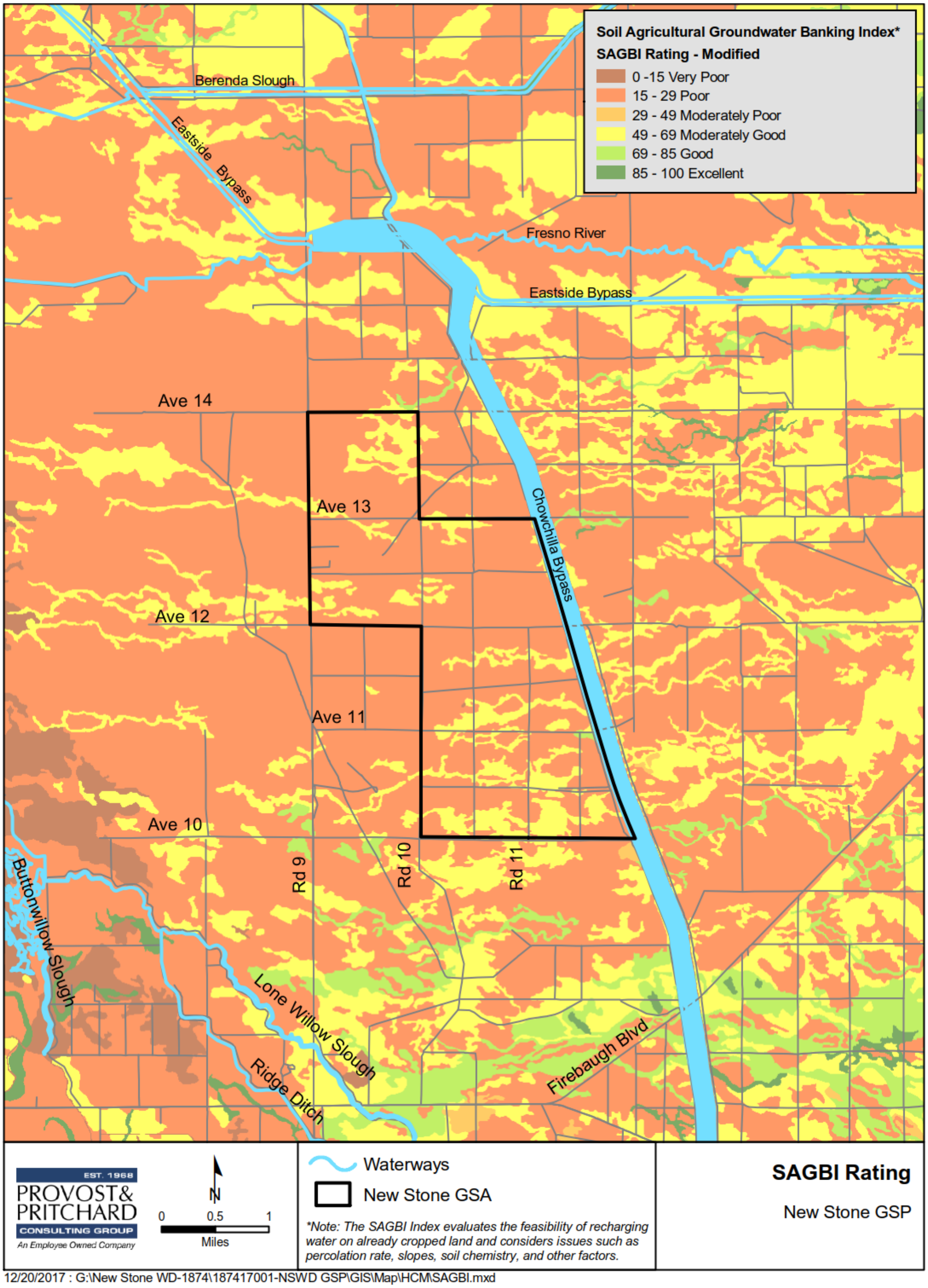

Figure 3-17 Modified Soil Agricultural Groundwater Banking Index (SAGBI) Rating

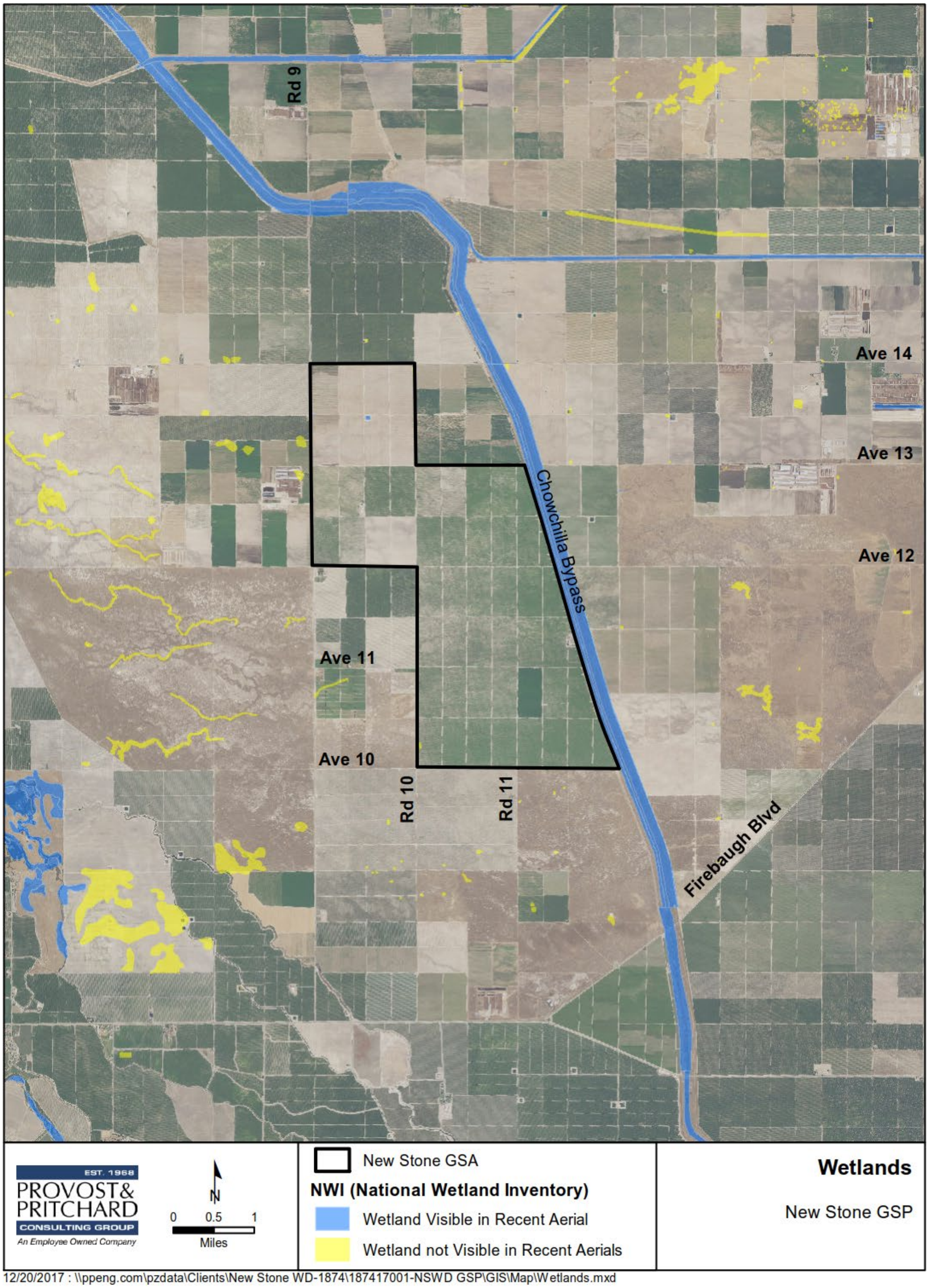

Figure 3-18 Wetlands Map

3.1.13 Identification of Data Gaps in HCM

§354.14 (b)(5) The hydrogeologic conceptual model shall be summarized in a written description that includes identification of data gaps and uncertainty within the hydrogeologic conceptual model.

The HCM, for the Madera Subbasin, has been described in the preceding paragraphs. The NSWD GSA has been working collaboratively with the Davids/Luhdorf and Scalmanini consultant team on updates to the HCM. Uncertainty in the HCM is related to limitations on the amount of available data (e.g., lithologic logs, borehole geophysical logs), reliability of those available data, and the reliability of correlations made from the available data. The amount of available data has been increasing over time and, in particular, several dedicated multi-completion (nested) monitoring wells have been drilled and installed since 2019 with plans to install additional wells in the future. These GSA efforts result in very reliable data being collected in that lithologic logs are compiled by geologists using both drill cuttings samples and downhole geophysical logs. Additional data being collected over time includes lithologic logs included in water well reports prepared by drillers, although these logs are somewhat less reliable in that they generally do not benefit from incorporation of downhole geophysical logs and detailed logging by a geologist. The uncertainty in the HCM is expected to decrease in the future as such data are collected and incorporated into HCM updates. For example, drilling of dedicated monitoring wells since 2019 has already resulted in some refinement of the extent of the Corcoran Clay which has also been incorporated into the recent MCSim Model update.

3.2 Current and Historical Groundwater Conditions

Regulation Requirement:

§354.16 Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

This section includes a description of the current and historical groundwater conditions within NSWD GSA. The data used in this chapter includes the most recent available information, as well as historic well data, to describe groundwater trends in NSWD GSA.

3.2.1 Groundwater Elevation Data

Regulation Requirement:

§354.16(a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including: 1. Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin. 2. Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.

Irrigation well depths in the NSWD GSA (in western Madera County) can be as shallow as approximately 200 feet and as deep as nearly 600 feet. Limited well logs, construction data, and monitoring provide some uncertainty about the actual depth and structure of both the wells and lithologic column. On average, the District's well depths within the GSA are about 350 feet. Many districts nearby, and other well users within the County, have drilled deeper wells in recent decades. Existing wells have been deepened or drilled for several reasons including water level declines and water quality issues.

Wells in the GSA and within approximately two miles of the GSA boundary were identified using the State's CASGEM and Water Data Library programs. Representative wells were selected based on the amount of historical and current water level data to properly display the groundwater conditions in the District. Hydrographs showing modeled and observed water surface elevations for representative wells in the GSA are shown in Chapter 4.2. Some hydrographs in the area have a relatively long period of record (starting in the 1940s, 1950s, and 1960s), include regular measurements, and are for wells geographically distributed across the area. It is the intent of NSWD GSA that data from these wells are used for setting sustainable management criteria and that data continues to be collected and will remain a key component of the monitoring network. Data from these hydrographs provides a good indication of historical groundwater levels in the basin. Groundwater levels fluctuate seasonally and in response to wet or dry periods; however, the long-term water level trend is decreasing. With few exceptions, the lowest groundwater levels occurred during the recent drought period with low points around 2015 and 2016.

Water table levels range from approximately 140 to 160 feet above sea level from the 1940s through the 1960s. Water levels peak in the 80s and late 90s between 120 and 100 feet above sea level. With less frequent groundwater level monitoring, current average water levels may be less reliable. Groundwater elevation data from about 2000 to present show an average water level between 40 and 60 feet above sea level.

As stated in Section 3.1, the Corcoran Clay is a major confining layer in the GSA. The B-B' cross-section shown in Figure 3-10, which bisects the GSA, shows the Corcoran Clay to be approximately 200 feet below msl. Cross-section D-D' (**Figure 3-12**), which traverses along the western border of the GSA, shows the Corcoran Clay at 150 to 200 feet below msl. Privately owned wells, although not currently monitored, will provide additional information on groundwater conditions below NSWD GSA. As the groundwater monitoring program is developed and implemented, water level data will be gathered and used to differentiate upper aquifer monitoring and lower aquifer monitoring. The monitoring program will utilize information from the CASGEM monitoring wells to track groundwater conditions surrounding the GSA.

3.2.2 Groundwater Movement

Groundwater flow paths have changed over time. Historically, groundwater in the Subbasin flowed southwest toward the Valley trough (Mitten et al, 1970). Heavy irrigation pumping in western Madera County has caused significant changes in ground surface and groundwater elevations. This, in turn, has caused groundwater cones of depression in the Red Top Area and white area to the north of New Stone Water District GSA and redirected groundwater flow in the GSA to the northwest, as shown in groundwater elevation contour maps. Additionally, many of the natural waterways have been diverted, altering historic flow patterns. The Fresno River is one example of a waterway that has been diverted from its natural course. Often it only flows during wet water years.

Groundwater contour maps were developed from spring groundwater levels for the hydrologically average period, determined to be from 2003-2012. Maps were selected to represent the average (2003), wet (2006), and dry (2012) water years and are included as **Figure 3-19, Figure 3-20**, and **Figure 3-21**, respectively. Each figure shows groundwater flowing toward the north/northwest, as does the water from the San Joaquin River. Groundwater depressions and areas of subsidence are located north/northeast of the GSA. There is a groundwater mound northwest of the GSA and, although the water flows away from this area locally, the overall trend for groundwater flow in the subbasin remains to the northwest. Groundwater elevation contour maps will be updated and provided with future Annual Reports.

There is only one consistently monitored groundwater elevation data point within the NSWD GSA. This prevents the GSA from calculating changes in gradient, and thus groundwater flow, across the District. Due to the size of the GSA and the relative uniformity of the land, groundwater inflow and outflow is assumed to be equal. As the monitoring plan is implemented groundwater inflow and outflow can be monitored more effectively.

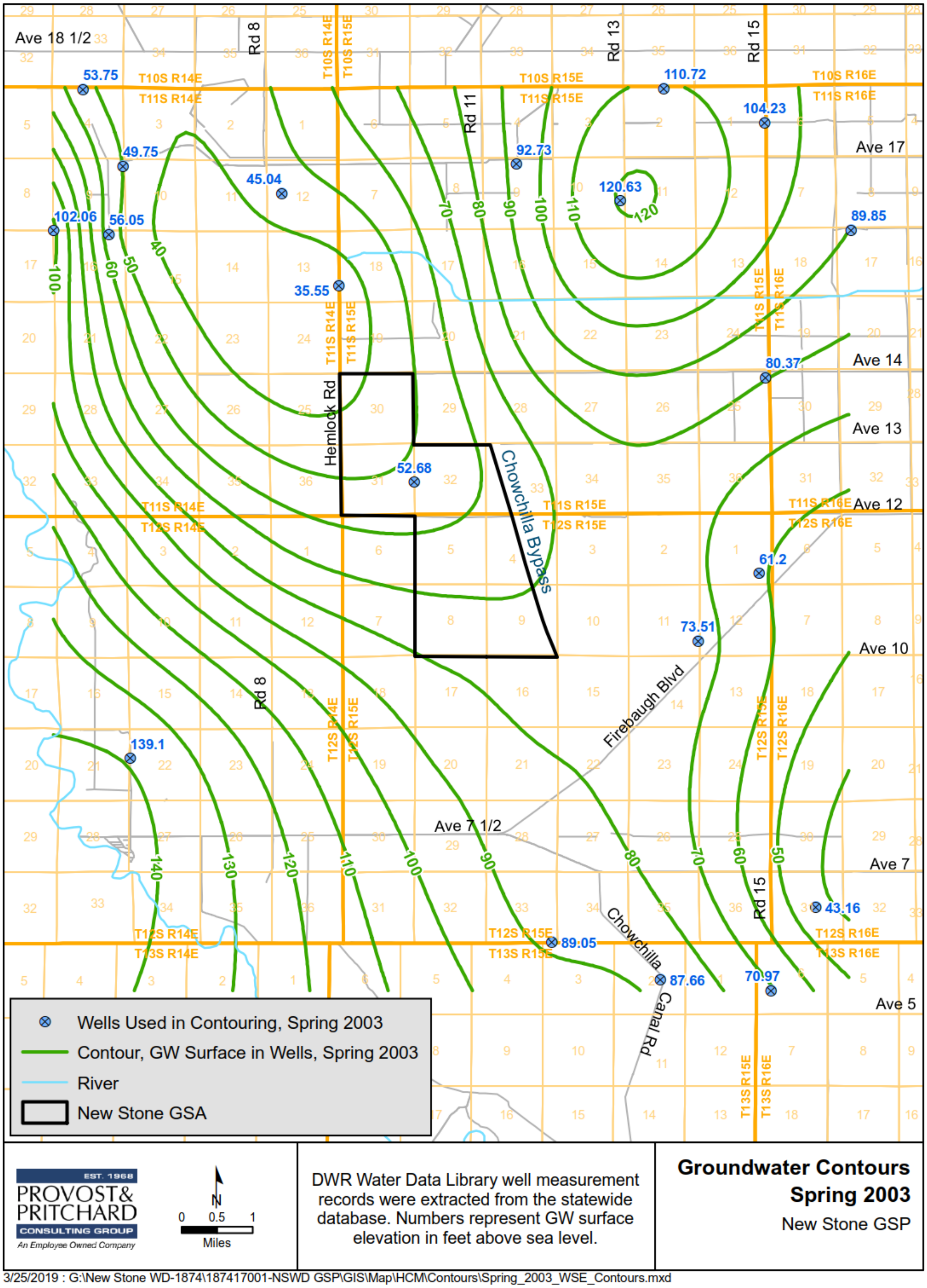

Figure 3-19 Average-Year Contour Map

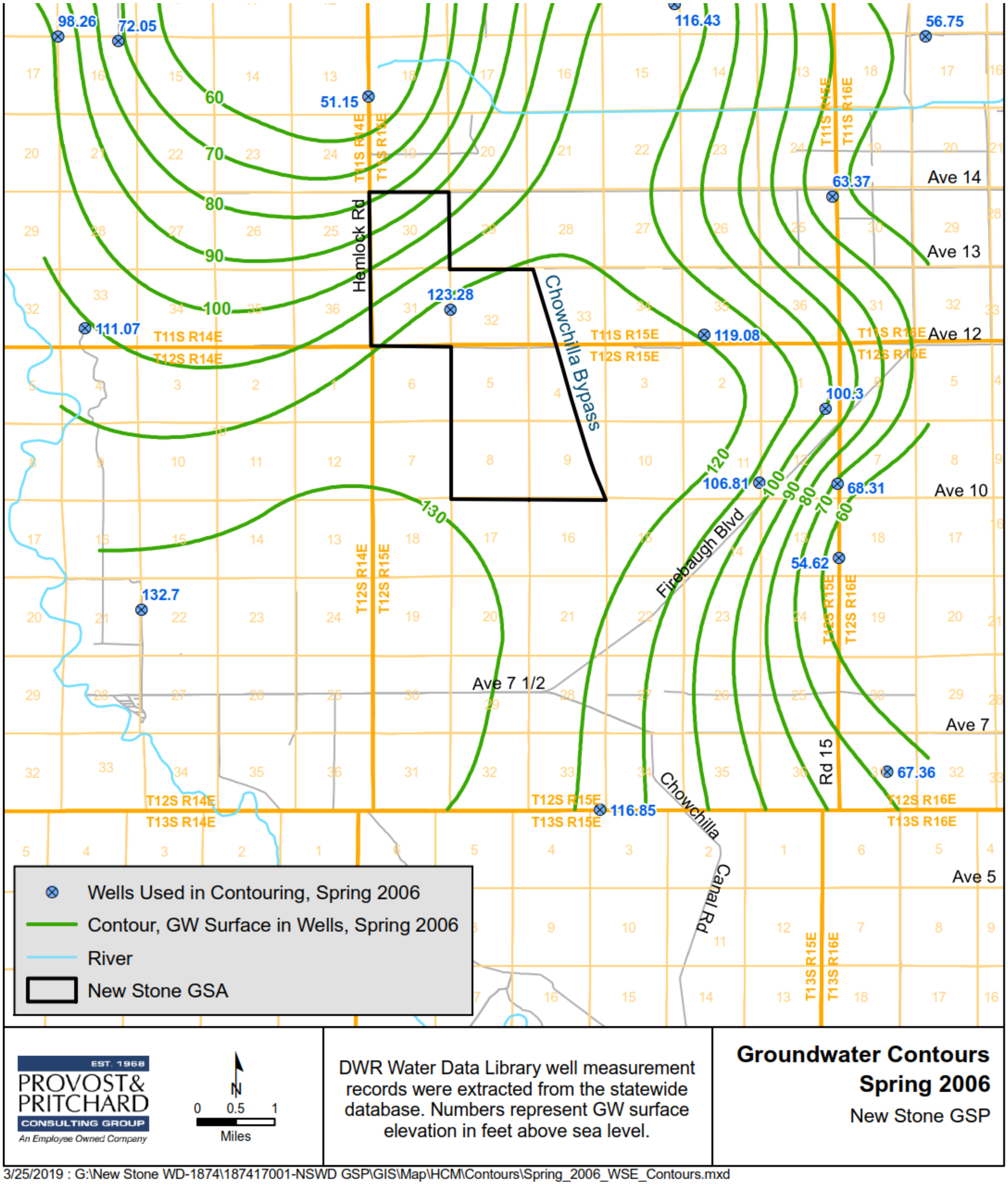

Figure 3-20 Wet-Year Contour Map

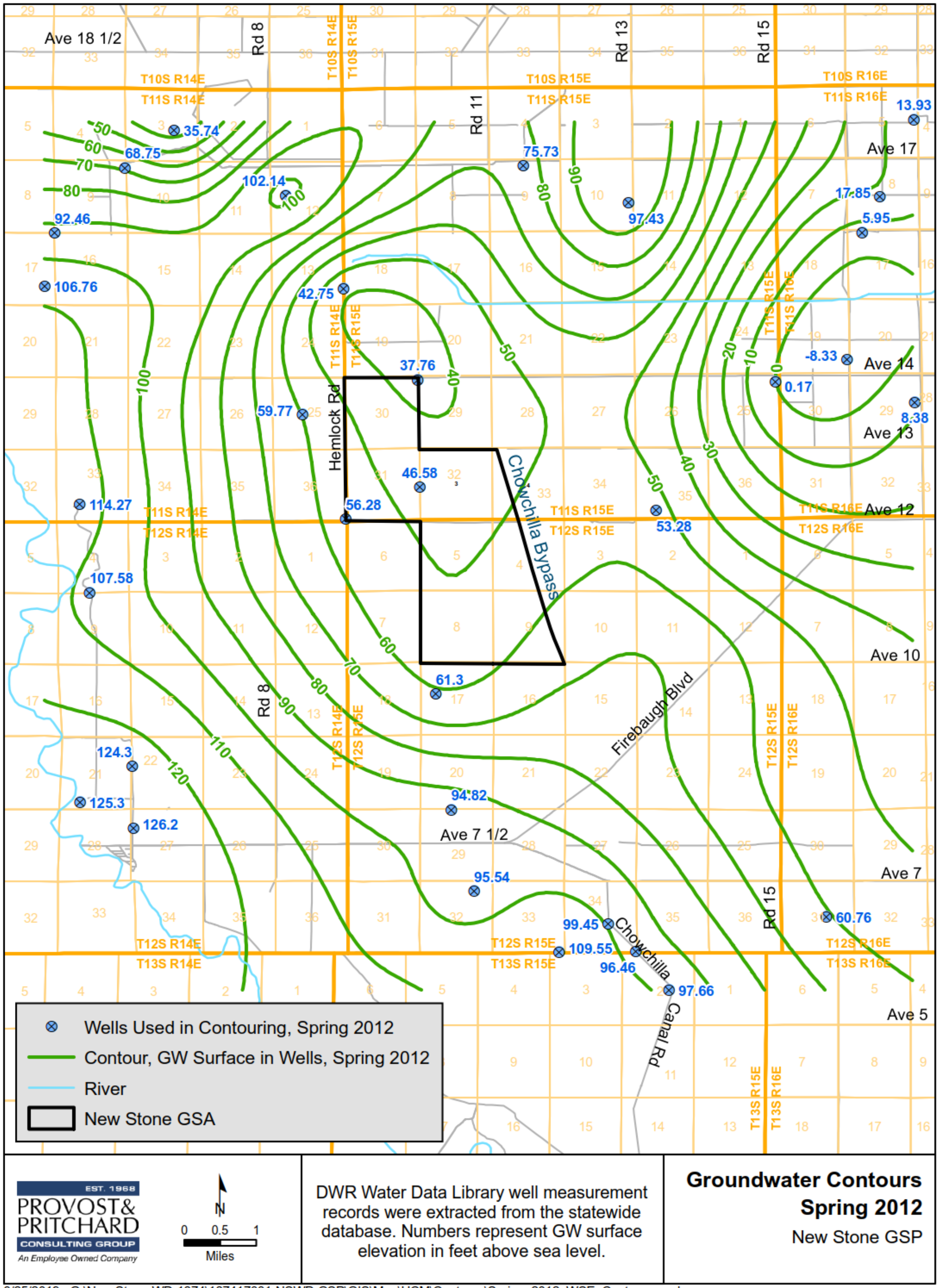

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Figure 3-21 Dry-Year Contour Map

3.2.3 Estimate of Groundwater Storage

Regulation Requirement:

§354.16(b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.

Groundwater storage was determined using multiple methods. For each method, specific yields for each subarea (predominantly by Township) were identified for varying depths: 0 to 50, 50 to 100, and 100 to 200 feet below the ground surface (Davis et al., 1959). Each method also used depths to groundwater and groundwater surface elevations in specific wells monitored and recorded in the CASGEM and Water Data Library databases to calculate changes in water level for each year.

Method one used the water budget analytical model or the checkbook balance method. It uses inputs from all water sources, consumptive uses, and losses to determine groundwater surplus or overdraft over a hydrologically average period. The second method used average specific yield, basin area, and average change in groundwater levels to determine change in storage over the hydrological average period. The final method used GIS mapping tools to calculate the difference in volume between contour maps for each year in the hydrological average period.

Due to data gaps, there is a range of values for change in groundwater storage. See **Table 3-4** for a summary of values. Future changes in groundwater storage will be evaluated and presented in future Periodic Evaluations and/or Annual Reports.

Table 3-4 Change in Storage Results

Method 1			Analytical
Water Budget Annual Change in Groundwater Storage		**(1,600 AF)**	
GW Recharge	8,100		
GW Pumping	(9,700)		
GW Outflow	0		
Method 2			Measured
Calculated Annual Change in Groundwater Storage		***(1,615 AF)***	
Average water level change during period	(3.00)	feet/year	
District size	4,141	Acres	
Assumed specific yield	0.13		

3.2.4 Seawater Intrusion

Regulation Requirement:

§354.16(c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.

Seawater intrusion conditions do not exist in the Madera Subbasin.

3.2.5 Groundwater Quality

Regulation Requirement:

§354.16(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.

Available water quality data in Madera County and the Madera Groundwater Subbasin is voluminous and, therefore, only briefly summarized in this Plan. On the contrary, groundwater quality data for NSWD GSA is sparse and outdated thus not representative of trends or average conditions.

Key groundwater quality constituents in the Subbasin discussed below include nitrate, TDS, and arsenic. These constituents have greater potential for presenting broader regional groundwater quality concerns extending beyond localized or site-specific contamination cases and are likely to reflect a range of potential contamination sources. Nitrate is one of the most common groundwater contaminants and is generally the water quality constituent of greatest concern in agricultural areas where application of fertilizers containing nitrogen can lead to elevated nitrate levels in groundwater. Additionally, nitrate is a constituent of concern in groundwater near dairy or other large-scale livestock operations. Natural concentrations of nitrate in groundwater are generally low, and elevated levels usually indicate impacts from land use activities. Nitrate presents health concerns at high concentrations and is regulated in public drinking water systems. The U.S. EPA has established a MCL for nitrate (as nitrogen) of 10 mg/L under its National Primary Drinking Water Regulations; this MCL standard is established for public health reasons and is a requirement of all public drinking water systems. TDS is a general measure of salinity and overall water quality. Elevated salinity in groundwater can be a result of land use activities, but can also be naturally occurring, especially in western parts of the San Joaquin Valley where subsurface geologic materials are derived from marine sediments. Arsenic is a naturally occurring chemical found in groundwater and has a primary MCL of 10 micrograms/liter (μg/L).

<u>Total Dissolved Solids (TDS)</u>

Regional groundwater quality mapping of TDS concentrations was conducted for the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) project (LSCE and LWA, 2016). These analyses for the upper zone (of the Upper Aquifer) showed generally increasing TDS from east to west across Madera Subbasin. TDS concentrations ranged from less than 250 mg/L in the east to greater than 1,000 mg/L in the southwestern corner of the Subbasin. Analyses of the lower zone (of the Upper Aquifer) showed a similar pattern of increasing TDS from east to west, but with a smaller area of high TDS groundwater.

<u>Nitrate</u>

A large percentage of the wells, throughout the Madera Subbasin, with nitrate data have maximum historical concentrations below 7.5 mg/L and many have concentrations below 5 mg/L. However, a number of areas of locally high maximum nitrate concentrations above 7.5 mg/L or above 10 mg/L are apparent across the Subbasin. The higher concentrations appear to be more common in the more western parts of the Subbasin. One particular area with a high density of wells with maximum nitrate concentrations above the MCL of 10 mg/L (as N) is located in the western part of the Subbasin along Highway 145, directly south of where Dry Creek joins the Fresno River.

Regional mapping of nitrate concentrations in groundwater were also performed as part of the CV-SALTS project (LSCE and LWA, 2016). Maps of nitrate concentrations in the upper zone (of the Upper Aquifer) showed a small area exceeding the MCL of 10 mg/L (as N) in the northwestern part of the Subbasin, while nitrate in the lower zone (of the Upper Aquifer) was indicated to exceed 10 mg/L in a similar but somewhat larger area in (compared to upper zone of Upper Aquifer) the northwest portion of the Subbasin.

<u>Arsenic</u>

Although there are wells with high arsenic concentrations scattered throughout the Subbasin, they are more common in the eastern part of the Subbasin. Most of the wells with maximum arsenic concentrations above the MCL of 10 μg/L are located northeast of Highway 99. Although a number of wells exhibit maximum concentrations above the MCL, the dominant fraction of wells with maximum arsenic concentrations are below 5 μg/L with many or most of these wells having concentrations below 2.5 μg/L. Few wells known to be screened in the Upper Aquifer have elevated concentrations and a higher number of wells known to be constructed in the Lower Aquifer have maximum concentrations above the MCL, although most wells of the identified Lower Aquifer wells have maximum concentrations below 5 μg/L.

Below is a summary of important groundwater quality data sources applicable to NSWD GSA.

Geology, Hydrology, and Water Quality in the Madera Area, San Joaquin Valley, California
Mitten et al. (1970) generalizes the groundwater above and east of the Corcoran Clay as predominately calcium sodium bicarbonate and sodium calcium bicarbonate type water. In the western area of the Madera Subbasin where NSWD GSA lies, the groundwater is a chloride type that contains more dissolved solids. DWR (2006) reports that TDS ranges from 100 to 6,400 mg/L with a typical range of 200 to 400 mg/L and conductance ranges from 180 to 600 μmhos/cm with an average of 251 μmhos/cm in the Madera Subbasin. As of 2006, public supply well monitoring indicated that one well had reported concentrations over the MCL for nitrate, three are over the MCL for pesticides, and none are reported over the MCL for inorganics, radiological, or volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) (DWR, 2006).

Chemical analytical data is sorted by township in Mitten et al. (1970). In the two townships within NSWD GSA between 1964 and 1966 the average in the unconfined wells of each constituent reported was below the applicable primary or secondary MCL. One well in the confined aquifer was reported and was also below applicable MCLs. Mitten et al. (1970) includes maps of salinity and sodium hazards (for agricultural use), nitrate and chloride concentrations, and hardness in unconfined groundwater between 1960 and 1966 (Mitten's Figures 13 to 16). In the NSWD GSA the salinity hazard was mapped as medium to high and the sodium hazard as low to medium. Nitrate concentrations were mapped as 1-10 mg/L with higher concentrations mapped immediately north and west. Chloride concentrations mapped in the NSWD GSA area ranged from 20 to 40 mg/L to greater than 250 mg/L with the highest concentrations in the southern part of the GSA and lowest concentrations in the center. Hardness mapped in NSWD GSA ranged from moderately hard to very hard.

Madera Regional Groundwater Management Plan
Provost & Pritchard (2014) describes the Madera regional groundwater quality as generally good for domestic supply and agricultural use in the Madera Regional Groundwater Management Plan (GMP). The GMP further breaks down the study area into sub-areas. NSWD GSA falls near the center of the Westerly Undistricted Sub-Area. The only data available for this sub-area is specific conductance and nitrate (as NO_3). In the center of the sub-area, specific conductance has been documented above 1,600 μmhos/cm and generally increases in concentration towards the southwest portion of the sub-area. NO_3 concentrations appear to be above the MCL near the central portion of the sub-area in the shallow aquifer. The northwestern portion of the sub-area has elevated concentrations of NO_3 between 30 and 45 mg/L, near or at the MCL. For the rest of the sub-area, concentrations are below the MCL (Provost & Pritchard, 2014).

Region 5: Updated Groundwater Quality Analysis and High-Resolution Mapping for Central Valley Salt and Nitrate Management Plan
An update of the groundwater quality for the CV-SALTS program was produced by Luhdorff and Scalmanini Consulting Engineers (LSCE, 2016). In the Ambient Conditions figures of the report water quality is generally good in eastern Madera Subbasin, but moderate to high concentrations of nitrate and TDS exist on the west side of the subbasin where NSWD GSA is located. In the western portion of the subbasin, concentrations are generally mapped above 5.0 mg/L of nitrate and above 500 mg/L of TDS.

East San Joaquin Water Quality Coalition Groundwater Quality Assessment Report
The ESJWQC Groundwater Quality Assessment Report by Luhdorff & Scalmanini Consulting Engineers (LSCE, 2014) shows groundwater quality sampling from various data sources in the ESJWQC area, which

includes the Madera Subbasin. Maps of the most recent sampling data show that few samples in the NSWD GSA area have been collected since the 1970s. The most recent nitrate concentrations in the vicinity of NSWD GSA are less than 10 mg/L in shallow wells and vary from less than 2.5 to greater than 20 mg/L in deep wells. The most recent TDS concentrations near NSWD GSA are between 500 and 999.9 mg/L in shallow wells and between 250 and 499.9 mg/L in deep wells. The LSCE (2014) figures also reveal that 1 or 2 wells near NSWD GSA have had pesticides detected between 1979 and 2011; however, concentrations do not surpass regulatory concentrations.

Groundwater Ambient Monitoring and Assessment

The GAMA Program is California's comprehensive groundwater quality monitoring program that was created by the SWRCB and expanded by the Groundwater Quality Monitoring Act of 2001. Groundwater quality data is available from the program on the GAMA database website (http://geotracker.waterboards.ca.gov/gama/). One well in the database, MADCHOW-26, is on the boundary of NSWD GSA. Other wells near NSWD GSA with data in the database within the last 20 years are S3-Mack-M02, S3-Mack-M03, S3-Mack-M04, MADCHOW-20, MADCHOW-25, MADCHOW-30. MADCHOW-26 was analyzed in May 2008 and reported concentrations include 3 mg/L nitrate, 1310 µmhos/cm specific conductance, and 854 mg/L TDS. MADCHOW-25 and S3-Mack-M03 are east of the northern part of NSWD GSA on the east side of the Chowchilla Bypass and were sampled in May 2008 and April 2014, respectively. They were reported to have elevated specific conductance of 1650 and 2110 µmhos/cm and nitrate concentrations of 38.6 and 51 mg/L, respectively. The remainder of the wells have nitrate concentrations less than or equal to 6 mg/L, specific conductance below 950 µmhos/cm, and TDS below 650 mg/L.

The data reported by GAMA from the MADCHOW wells was used in a 2008 USGS study of the groundwater quality in the Madera and Chowchilla Subbasins (Shelton, Fram, and Belitz, 2009). The study found that concentrations exceeded the MCL for nitrate in 7% of wells, arsenic and uranium in 13% of wells, low-level DBCP in 10% of wells, and low-level EDB in 3% of wells analyzed in the Subbasins (Shelton et al., 2009). Secondary MCLs for chloride, TDS, or manganese were exceeded in 20% of the sampled wells (Shelton et al., 2009). Other compounds detected in the study area were generally below regulatory thresholds (Shelton et al., 2009).

EnviroStor & GeoTracker

According to their website (http://www.envirostor.dtsc.ca.gov/public/), EnviroStor is the Department of Toxic Substances Control's (DTSC) data management system for tracking cleanup, permitting, enforcement, and investigation efforts at hazardous waste facilities and sites with known contamination or sites where there may be reasons to investigate further. A review of the EnviroStor website shows that there are no sites listed within 5 miles of NSWD GSA. Similarly, GeoTracker is the SWRCB data management system for sites that impact or have the potential to impact water quality in California with emphasis on groundwater. The GeoTracker website (http://geotracker.waterboards.ca.gov/) lists one closed oil and gas site near the boundary of NSWD GSA and one closed leaking underground storage tank site approximately 2.5 miles south. No active sites are listed within 4 miles of NSWD GSA.

3.2.6 Land Subsidence Conditions

Regulation Requirement:

§354.16(e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or best available information.

Subsidence is the sinking of the ground surface resulting in a change in ground surface elevation. Five types of subsidence have been found in California and the San Joaquin Valley, including: oxidation of peat deposits in the river/delta areas, deep subsidence resulting from falling groundwater levels caused by overdraft, shallow subsidence caused by hydrocompaction of collapsible soil layers, tectonic subsidence resulting from earthquakes and ground deformation, and subsidence caused by fluid withdrawal from oil and gas fields. The main form of inelastic subsidence in the NSWD GSA area is deep subsidence from declining groundwater levels in the lower aquifer exceeding pre-consolidation heads. Excessive groundwater pumping can contribute to deep subsidence across a broad area, resulting in aquifer compaction, loss of storage capacity, and adverse effects to surface features, such as bridges, canals, flood control systems, and water supply pipelines which rely on gravity flow.

Two types of subsidence can occur as a result of groundwater pumping: elastic and inelastic as shown in **Figure 3-22**. Elastic subsidence can be reversed as the water table recovers, while inelastic subsidence is permanent. Elastic subsidence generally occurs in the unconfined portions of the aquifer. Although there are several causes of inelastic land subsidence, the compression of clay as a result of groundwater extraction from confined aquifers is the cause of the vast majority of subsidence documented in the San Joaquin Valley. This results in compaction of fine-grained confining beds (clays) above and within the confined aquifer system as water is removed from pore spaces between the grains of the sediments. Once water is squeezed out of the compressible clay, the clay compacts, resulting in the lowering of the overlying land surface. The compressed clays, in which the clay particles have been re-arranged, can no longer re-absorb water, thus the subsidence in these areas cannot be reversed. This process is known as aquifer system compaction. The Corcoran Clay Member of the Tulare Formation has been mapped beneath much of the western side of the San Joaquin Valley and the aquifer beneath it is confined. Permanent subsidence in the San Joaquin Valley has historically been correlated to overdraft in the confined aquifer below the Corcoran Clay. However, with increased reliance on groundwater to meet demands, land subsidence is currently occurring in areas outside of the Corcoran clay. Even though subsidence is now occurring in areas outside of the Corcoran clay, the relative amount is less than the historical subsidence in areas underlain by the Corcoran Clay.

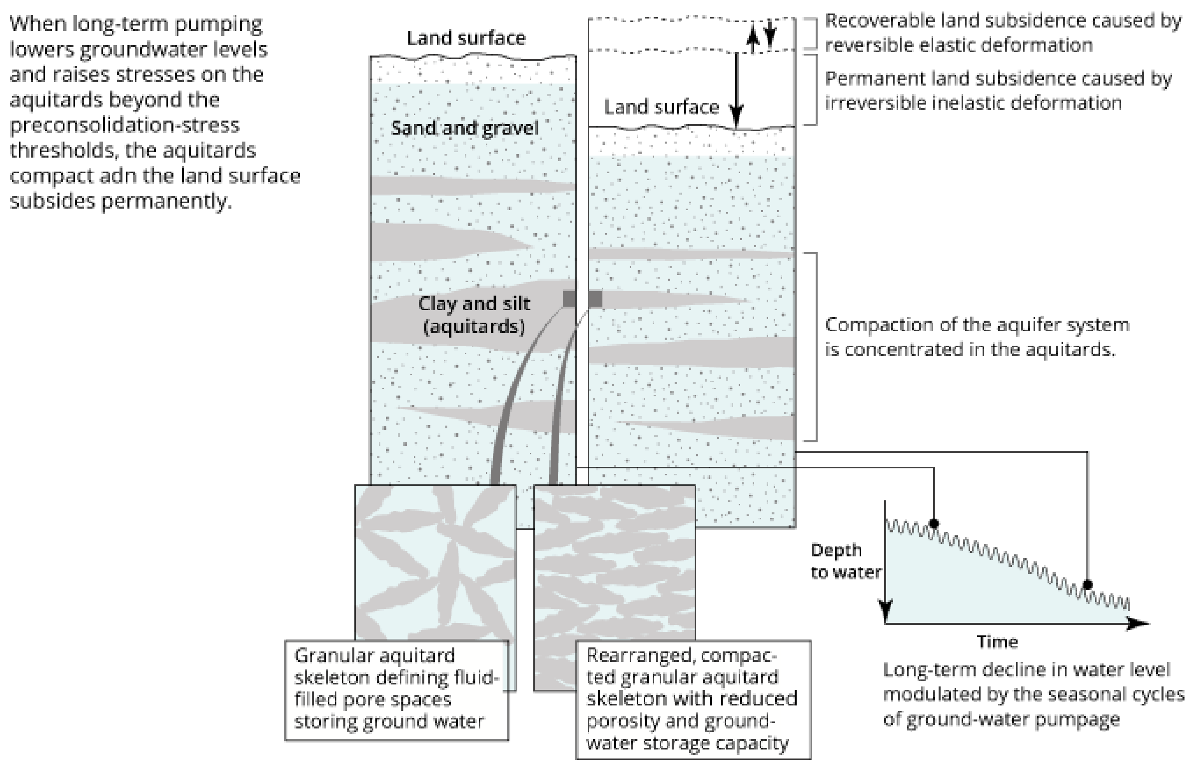

Figure 3-22 Aquifer compaction due to groundwater pumping as identified by USGS

(https://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.htm)

3.2.6.1 Review of Existing Data

Available land subsidence data was reviewed to determine what information exists and to assist in establishing a monitoring network. The review included examination of the Hydrogeologic Conceptual Model (**Section 3.1**), historic groundwater levels, historic infrastructure impacts, and on-going subsidence monitoring programs, which use various methods to track subsidence via surveys, remote sensing data, and geospatial imagery. A discussion of existing data is provided below.

Generally, areas with the most significant land subsidence are underlain by the Corcoran Clay member of the Tulare Formation. As shown on **Figure 3-14** in the HCM, the Corcoran Clay extends into the western portion of the Madera Subbasin and the entirety of NSWD GSA. Comparison of **Figure 3-23** and **Figure 3-24** show land subsidence is minor in the Madera Subbasin where the Corcoran Clay is not present. In addition to the presence of the Corcoran Clay, aquifer compaction and the resultant land subsidence are also dependent on over-extraction of groundwater from the confined aquifer. As discussed in **Section 3.2.1**, the long-term trend of water levels in the area has been downward due to groundwater extraction.

Nearby areas within the subbasin have experienced significant complications due to subsidence. Land subsidence in the Central Valley of California has caused serious operational, maintenance, and construction-design problems for adjacent water-delivery and flood-control canals in the San Joaquin Valley, such as the Chowchilla and Eastside Bypasses for the San Joaquin River. Several canals used for both irrigation and flood control have had reduced freeboard and structural damages. Wells, pipelines, roads, and bridges have also suffered damage due to subsidence. Combating subsidence in the County and adjacent districts has already required millions of dollars of repairs, and more repairs are expected in the future.

Subsidence Monitoring Program Results

Land subsidence has impacted the west side of the San Joaquin Valley for decades. Land subsidence was first monitored in the 1920s when there was less access to surface water. From the 1920s to 1970s, subsidence rates were at a historical high with rates around one foot per year in some areas. Subsidence rates and monitoring efforts decreased after the 1970s as surface water became more available due to the canals and water storage projects completed in California. This resulted in less reliance on groundwater to meet demands. Land subsidence monitoring increased in the 2000s due to drought conditions and environmental regulations that reduced surface water allocations, which resulted in local farmers and cities relying more heavily on groundwater. Data sources for the following discussion include the USBR, SJRRP, and UNAVCO data.

Figure 3-23 shows land subsidence rates based on the USBR SJRRP monitoring data from December 2011 to December 2017. Figure 3-24 shows SJRRP land subsidence monitoring locations and results from December 2016 to December 2017. The NSWD GSA area is shown to have land subsidence rates between -0.15 feet (-1.8 inches) and -0.6 feet (-7.2 inches) annually. Subsidence rates are higher in the northeastern portion of the GSA.

USBR monitoring point 123 is located on the Chowchilla Bypass just northeast of NSWD GSA. Since December 2011, observed subsidence rates at this point have been between 0.18 and 0.68 feet per year, with the highest annual rate measured from July 2016 to July 2017. The subsidence rate at this monitoring point from December 2011 to December 2018 is 0.52 feet per year. USBR monitoring point 1007R is located on the western boundary of NSWD GSA. At this monitoring point annual subsidence rates have ranged from 0.09 to 0.60 feet per year since December 2011. The highest annual rate at this monitoring point occurred from December 2012 through July 2014. Overall, since the program began the subsidence rate at 1007R from December 2012 to December 2018 is 0.39 feet per year. **Figure 3-25** graphs the annual subsidence rates measured by the SJRRP program from December to December and July to July.

Due to subsidence rates north of NSWD GSA, the Chowchilla Bypass that runs along the east side of the District is experiencing a change in design operation. The SJRRP with DWR has conducted a hydraulic analysis to study the effects of subsidence on the Chowchilla and Eastside Bypasses and Reach 4A of the San Joaquin River, including the Sand Slough Connector Chanel (DWR, 2018). The study was conducted for the years 2011 and 2016, and projected into 2026 using DWR land subsidence data and Hydrologic Engineering Center's River Analysis System (HEC-RAS) software for modeling flow.

The greatest subsidence appears to be occurring between Road 9 and the Sand Slough control structure. In turn, the bypass channel slope upstream of Road 9 and the Fresno River confluence is steepening. This increase in slope results in an increase in freeboard (more channel capacity). In the segment from Road 4 to Sand Slough, the channel slope flattens out causing an increase in water depth, resulting in reduced freeboard. Channel design capacity along with estimated channel capacity results are shown in **Table 3-5**.

Table 3-5 Estimated Flow Capacity in Reach 4A and the Chowchilla and Eastside Bypasses based on Freeboard Criteria (in cfs) (DWR, 2018)

Channel Segment	Flood Design Flow[a]	2008[b]	2011[b]	2016	2026
Chowchilla Bypass					
Bifurcation Structure to Fresno River	5,500	>5,500	>5,500	>5,500	>5,500
Eastside Bypass					
Fresno River to Berenda Slough	10,000	>10,000	>10,000	>10,000	>10,000
Berenda Slough to Ash Slough	12,000	>12,000	>12,000	>12,000	>12,000
Ash Slough to Sand Slough	17,500	9,500[c] – 12,500	7,500[c] – 11,500	5,700[c] – 9,500	3,400[c] - 7,500
Sand Slough to Mariposa Bypass[d]	16,500	16,000	14,500	12,500	9,800
San Joaquin River					
Reach 4A	4,500	ND	ND	3,700[e] – 4,300	2,500[e] – 3,800
Sand Slough Connector Channel	ND	ND	ND	2,100[e] – > 4,500	0[e] – > 4,500

Notes: cfs = cubic feet per second, ND = not determined as part of this study
[a] Referenced from the Lower San Joaquin River Flood Control Project Operation and Maintenance Manual.
[b] Results obtained from a previous study done by DWR in 2013.
[c] Reduced capacity assumes contribution of 4,500 cfs from Reach 4A of the San Joaquin River (creating backwater conditions).
[d] Capacity assumes diversions into the Mariposa Bypass based on the O&M Manual operating rules.
[e] Reduced capacity assumes contribution of 12,000 cfs through the Bypass Channel (creating backwater conditions).

For reference, **Figure 3-26** displays the channel sections covered in the subsidence study. Results indicate that the Chowchilla Bypass remains operable at above design capacity; however, as part of the limitations in the study, sediment transport was not considered, which could affect the hydraulics of the canal. Furthermore, downstream canals are shown to have reduced channel capacity, which limits the volume of water that can be sent down the Chowchilla Bypass.

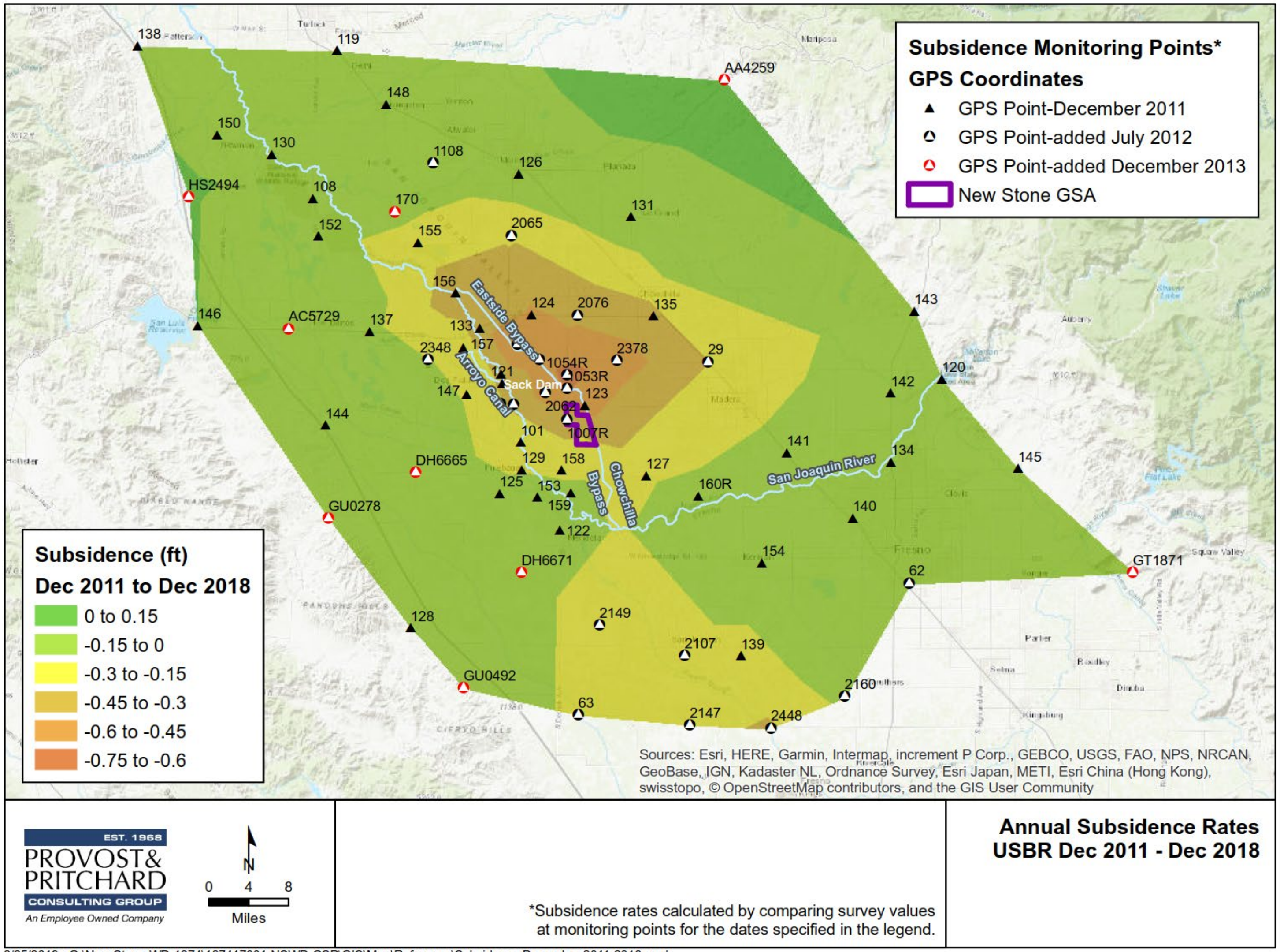

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Figure 3-23 SJRRP Subsidence Data Dec. 2011 to Dec. 2018

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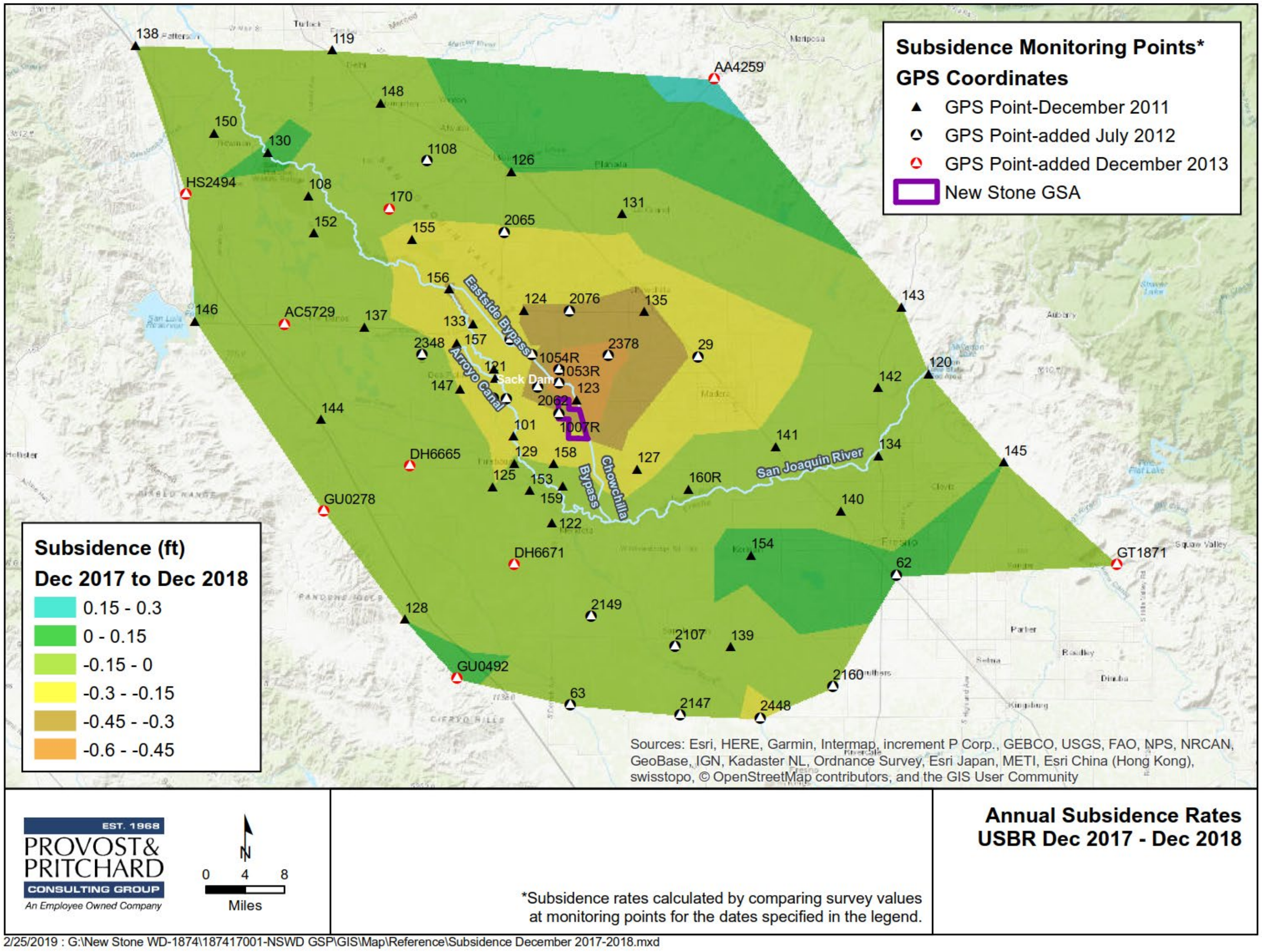


Figure 3-24 SJRRP Subsidence Data Dec. 2017 to Dec. 2018

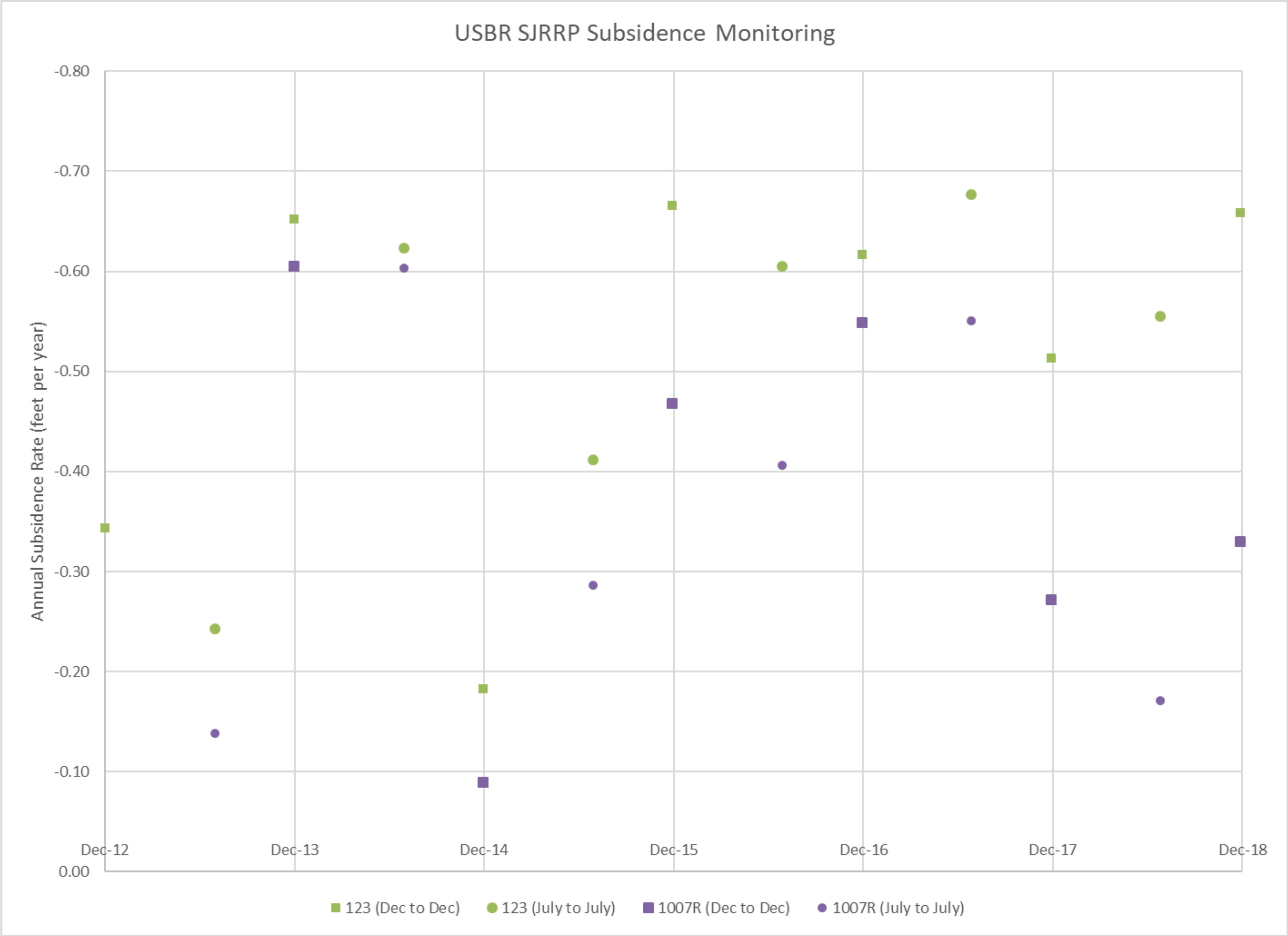


Figure 3-25 SJRRP Annual Subsidence Rates

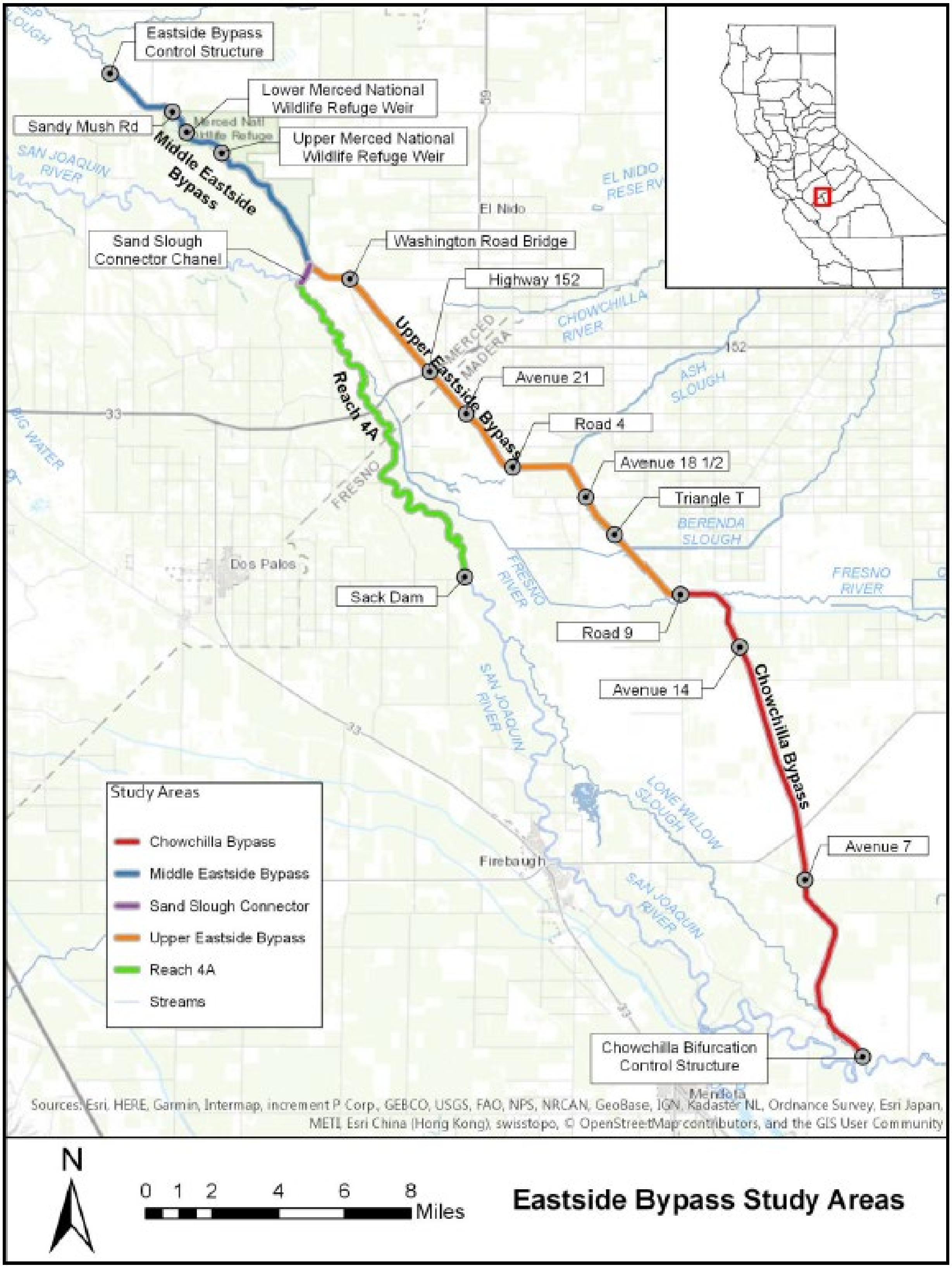


Figure 3-26 DWR (2018) Study Area

3.2.7 Surface Water and Groundwater Interconnections

Regulation Requirement:

§354.16(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or best available information.

Major surface water systems in the Madera Subbasin are the San Joaquin River and Fresno River. The nearest NSWD GSA boundaries are approximately 4 miles from Reach 3 of the San Joaquin River and 1 ½ miles from the confluence of the Eastside Bypass and the Fresno River. The NSWD GSA's eastern boundary is bounded by the Chowchilla Bypass flood control structure.

SGMA Regulations are concerned with the volume or rate of surface water depletion caused by groundwater pumping in basins where surface water and groundwater are interconnected. Interconnected surface water systems are defined as surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted (Modeling Best Management Practices, DWR, 2016). The purpose of this section is to identify any known areas within the NSWD GSA where groundwater pumping has caused surface water depletion. Currently, there is no evidence that active wells within the GSA are causing increased seepage loss or impacts to downstream beneficial uses.

3.2.7.1 Interconnected Surface Water Systems

Only two surface water systems are within the vicinity of NSWD GSA: the Fresno River and the Chowchilla Bypass. The Fresno River joins the Eastside Bypass approximately 1 ½ miles north of New Stone Water District GSA. The Eastside Bypass is highly regulated and is often dry during the year as water is diverted for irrigation prior to reaching NSWD GSA. Due to the long dry periods in the Fresno River, which often remain for multiple years, and the distance from the GSA, there is no interconnection between the groundwater in the NSWD GSA and the Fresno River.

The Chowchilla Bypass is a flood control structure that diverts San Joaquin River water from the upper reaches of the river to the lower reaches in Merced County. The bypass only runs once every 3.5 years on average, and there is no interconnected groundwater and surface water.

Interconnected Surface Water Working Group

The Madera Subbasin GSAs and Kings Subbasin GSAs adjacent to the San Joaquin River, the USBR, and the Friant Water Authority (FWA) established an Interconnected Surface Water Working Group outlined in a Memorandum of Understanding. This collaborative effort will assist in establishing the framework to determine the timing and magnitude of potential surface water depletions from occurring in the future.

3.2.8 Groundwater Dependent Ecosystems

Regulation Requirement:

§354.16(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or best available information.

There are no interconnected surface water systems throughout the NSWD and the depth of groundwater ranges from 50 to 110 feet below ground surface. With this depth to water there are no groundwater dependent ecosystems within the district.

3.3 Water Budget Information

Regulation Requirement:

§354.18
(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.

A water budget is defined as a complete accounting of all water flowing into and out of a defined area (e.g., a subbasin or GSA) over a specified period of time. A water budget is crucial to sustainable groundwater management by quantifying the historic and current overdraft, in turn having a goal to set demand mitigation and supply augmentation objectives. The water budget for NSWD was developed using knowledge gathered from the hydrogeologic conceptual model, precipitation data, measurements of inflows and outflows, and other various data sets described throughout this section in more detail. While the NSWD GSA performs its own water budget for internal decision making and annual report purposes, a Subbasin-wide groundwater numerical model is used in this GSP in coordination with the Subbasin.

GSP regulations stipulate the need to use the best available information and the *best available science* to quantify the water budget for the basin. Best available information is common terminology that is not defined under SGMA or the GSP Regulations. Best available science, as defined in the GSP Regulations, refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, which is consistent with scientific and engineering professional standards of practice. It is understood that initial steps to compile and quantify water budget components may be constrained by GSP timelines and limited funding and may consequently need to rely on the best available information that is obtainable at the time the GSP is developed. The best data available for the water budget was often incomplete, had to be estimated or was based on assumptions. The confidence intervals for each parameter vary from 5% to as high as 50%. As a result, the water budget presented herein is merely an approximation of the hydrologic system in the Subbasin.

The data source types in the Subbasin-wide model and NSWD GSA water budget are the same. By necessity there were some methods to process the information that caused some of the calculations to vary slightly. These differences included more specific information and knowledge on the regional scale including geography, geology, and water management practices. Despite these districts related information, the overall results of the two methods are very close and within the accuracy of the estimates. As more data are collected, and the hydrologic processes are better understood, both the NSWD GSP and the Madera Joint GSP will work towards closing these discrepancies and further improving the accuracy of the water budgets. Model calibrations and revisions to model inputs and assumptions will be evaluated for subsequent GSP updates. All revisions to the Subbasin-wide model are documented in the Madera Joint GSP, with annual outputs documented in Annual Reports.

3.3.1 Description of Groundwater Model

Regulation Requirement:

§354.18
(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.
(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.

GSP Regulations do not require the use of a model to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater. However, if a model is not used, the GSA is required to describe in the GSP an equally effective method, tool, or analytical model to evaluate projected water budget conditions. In basins with interconnected surface water systems or complex spatial and temporal variations in water budget components, quantifying and forecasting streamflow depletion and other water budget components may be extremely difficult without the use of a numerical groundwater and surface water model. NSWD has been part of a cooperative effort in the Madera Subbasin and much of the documentation for the water budget can be found in *Madera Subbasin Sustainable Groundwater Management Act Basin Boundary Water Budget* by Davids Engineering and Luhdorff & Scalmanini (DE & LSCE), dated February 2018. The purpose of the investigation was to develop a preliminary water budget for the subbasin as a whole according to DWR's GSP regulations for the historic, current, and future. The historical subbasin boundary water budget is based on historical data and provides insight into the magnitude of the historical imbalance (or overdraft) of the subbasin. The current and future budgets use current data as well as projected water level changes into the future based upon the projects and management actions included in this as well as the other GSP's in the Subbasin. The following discussion is a summary of the conceptual water budget model from DE & LSCE for the subbasin as a whole.

Groundwater and surface water are critical resources that support agriculture and other economic activities in the subbasin. Groundwater is particularly important because it is relied upon to a significant extent in all years and serves as the main supply source in periods when surface water supplies are limited. Thus, the sustainable management of groundwater is important to the long-term prosperity of Madera County's various communities. SGMA allows for local control of groundwater resources while requiring sustainable management.

The lateral extent of the basin is defined by the subbasin boundaries provided on DWR's groundwater website (DWR, 2017) and is discussed in Chapters 2 and 3.1 of this GSP. The vertical boundaries of the subbasin are the land surface and the base of fresh water in the underlying aquifer (Page, 1973), as discussed in the basin-wide HCM developed during previous data collection and analysis efforts conducted by DE and LSCE (2017). The vertical extent of the basin is subdivided into a surface water system (SWS) and the underlying groundwater system (GWS) with separate but related water budgets prepared for each that together represent the overall subbasin water budget.

In accordance with GSP regulations, a base period must be selected so that the analysis of sustainable yield is performed for a representative period with minimal bias that might result from the selection of an overly wet or dry period, while recognizing changes in other conditions including land use and water demands. The base period should be selected considering the following criteria: long-term mean annual water supply; inclusion of both wet and dry periods, antecedent dry conditions, adequate data availability; and inclusion of current hydrologic, cultural, and water management conditions in the basin. To develop a preliminary base period for sustainability analyses of the Madera Subbasin during GSP development, only historical precipitation records for the area were evaluated.

Precipitation provides an indication of the long-term mean water supply and potential for natural groundwater recharge. Monthly precipitation records acquired from the Western Regional Climate Center for a station in Madera (Station 045233) were analyzed to determine the hydrologic base period defined in the Madera Joint GSP. It was determined that the period is a relatively balanced climatic period with a similar number of wet and dry years and some prolonged periods of wet, dry, and average conditions and represents a reasonable base period for conducting sustainability analyses. Analyses and visuals associated with assigning this base period are provided in the Madera Joint GSP.

3.3.2 Description of Inflows, Outflows, and Change in Storage

Regulation Requirement:

§354.18(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:

(1) Total surface water entering and leaving a basin by water source type.

(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.

(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

Subbasin boundary inflows and outflows must be quantified according to Section §354.18(b) of the GSP Regulations. Quantification of inflows and outflows is necessary for estimating the overdraft on an average annual basis. Some variables were estimated based on best available information due to a lack of measured data. For the water budget, water supply and demand has been broken down by water source type and use. A summary of the Madera Subbasin water budget flows from DE & LSCE (2018) is provided below. A summary of the updated model for the 2025 plan amendment can be found in the Madera Joint GSP.

Madera Subbasin Water Budget Conceptual Model

While this section provides an overview of the Madera Subbasin Conceptual Model, which is being used collectively by the Subbasin GSAs to interpret groundwater conditions on a Subbasin-wide scale, the NSWD GSA acknowledges that the Madera Joint GSP and Annual Reports will provide more detailed updates on model inputs, calibration, and outputs.

A conceptual representation of the Madera Subbasin boundary water budget is simplified and presented in **Figure 3-27.** Boundary inflows include precipitation, surface water inflows (in various canals and streams), boundary watercourse seepage, and groundwater inflows from adjoining subbasins. Outflows include ET, surface water outflows (in various canals and streams), and groundwater outflows. Also represented in **Figure 3-27** are groundwater recharge and extraction, which are "internal" flows between the SWS and GWS. Subbasin boundary inflows and outflows were quantified on a monthly time step for the base period, including accounting for changes in storage within each time step, such as changes in water stored in the root zone. Surface water inflows and outflows for Madera Subbasin are shown in **Figure 3-28**.

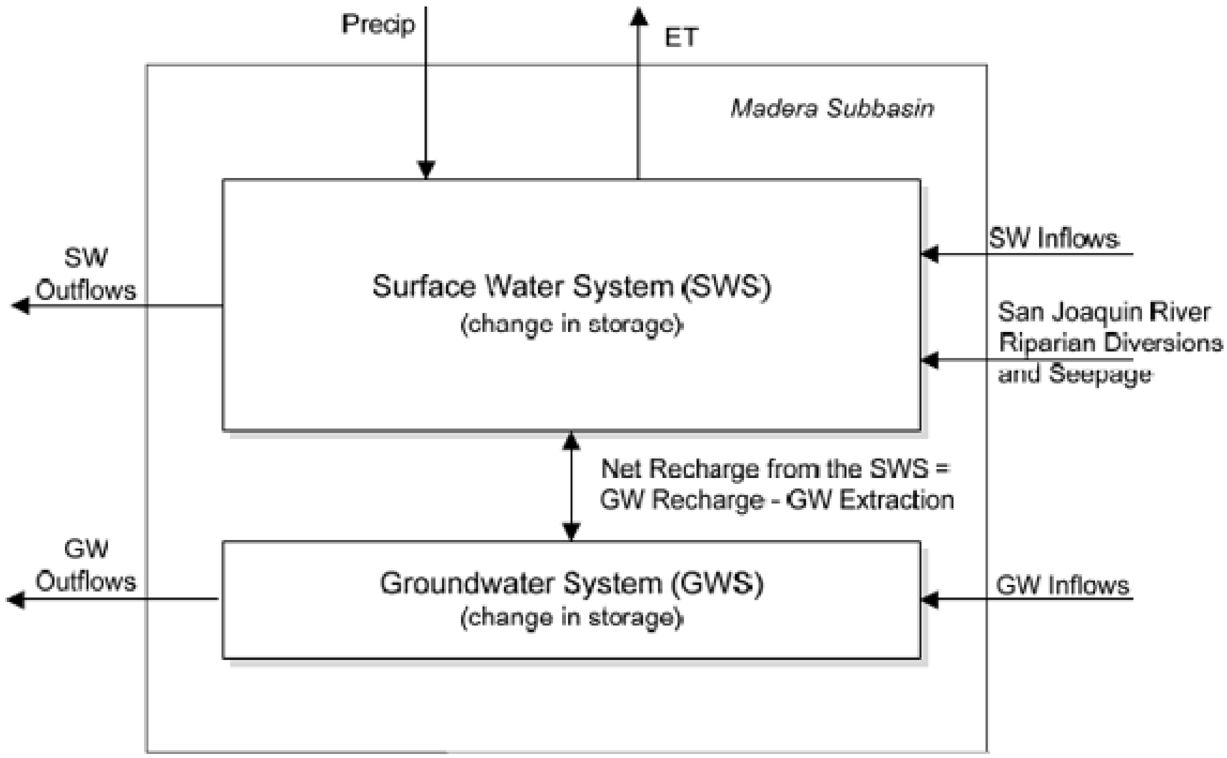


Figure 3-27 Preliminary Basin Water Budget Diagram (Davids Engineering and Luhdorff & Scalmanini, 2018)

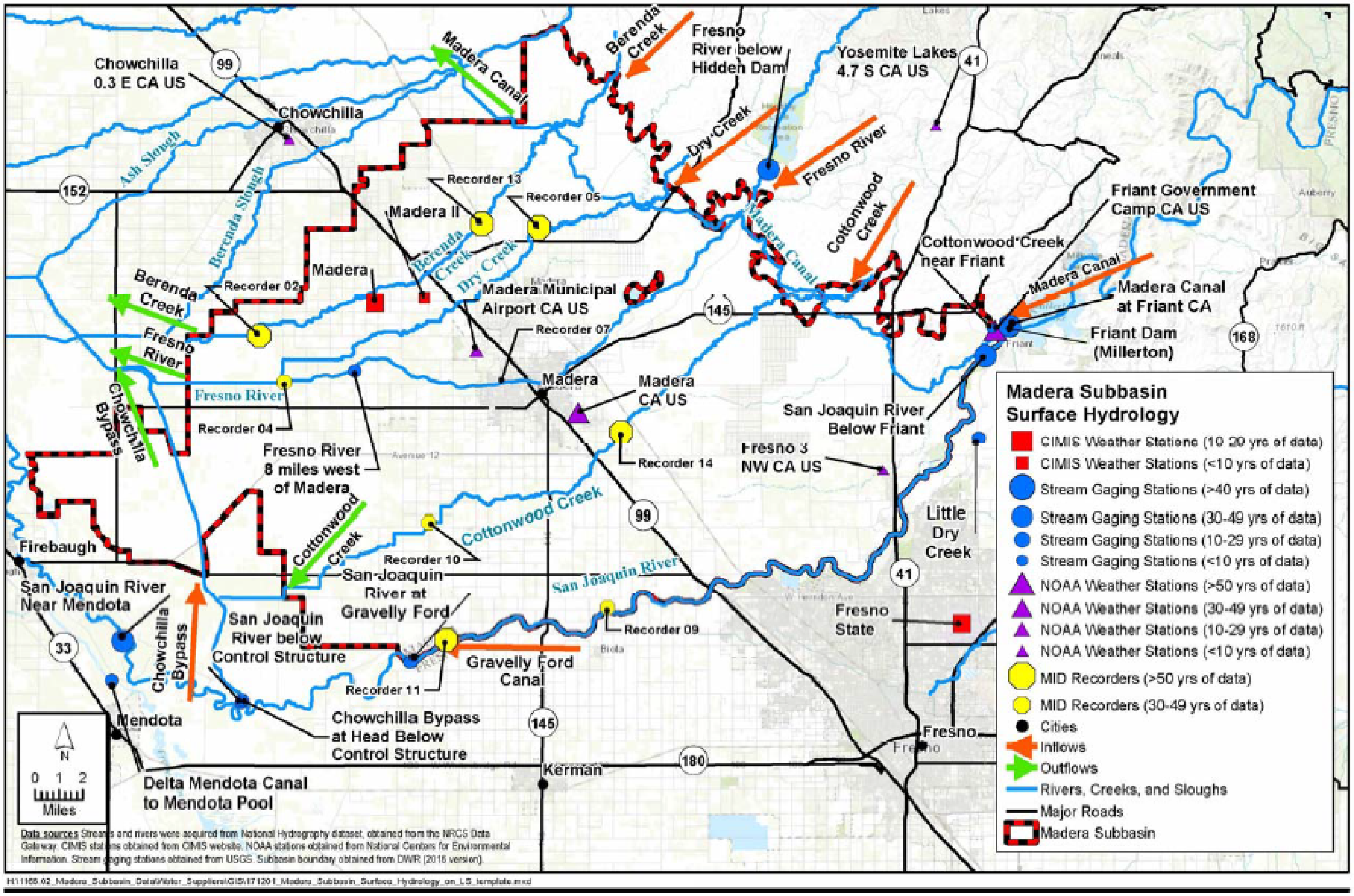


Figure 3-28 Preliminary Madera Subbasin Inflows and Outflows (Davids Engineering and Luhdorff & Scalmanini, 2018)

The SWS represents the land surface down to the bottom of plant root zone, within the lateral boundaries of the basin. The GWS extends from the bottom of the root zone to the definable bottom of the subbasin, within the lateral boundaries of the basin. The SWS basin boundary water budget was completed on a monthly time step and by calendar year. Inflows and outflows may cross the subbasin boundary or may represent exchanges of water between the SWS and the underlying GWS. **Figure 3-29** shows the conceptual water budget flows including various inflows and outflows comprising recharge, extraction, and discharge from the GWS. Net recharge from the SWS to the GWS is defined as groundwater recharge minus groundwater extraction and is useful for understanding and analyzing the combined effects of land surface processes on the underlying GWS. Basin boundary inflows and outflows for Madera Subbasin were quantified on a monthly basis and any changes in storage were included, such as changes in water stored in the root zone.

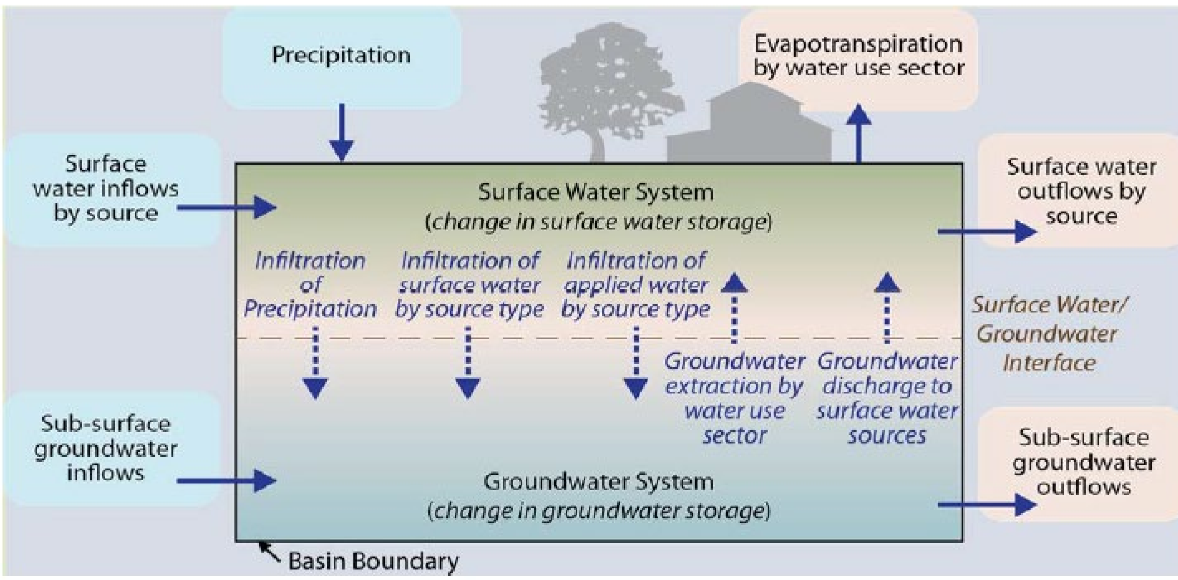


Figure 3-29 Preliminary Basin Boundary Water Budget (DWR Water Budget BMP, 2016)

The SWS is further subdivided into water use sectors identified in the GSP regulations. Water use sectors are defined in the GSP Regulations as "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 budgets for each water use sector in the subbasin will be added to the water budget during GSP development.

Preliminary estimates of subbasin overdraft derived from the SWS and GWS water budgets are briefly described in the following sections. Note: the report estimates an initial Preliminary Sustainable Yield across the entire Madera Subbasin and does not quantify local variability, including the variability between the different GSAs. The preliminary sustainable yield for the overall Madera Subbasin is documented in the Madera Joint GSP.

Sustainable yield is defined as the maximum quantity of water, calculated over a base period representative of long-term conditions in the subbasin that can be withdrawn annually from a groundwater supply without causing an undesirable result (CA Water Code 10721). This includes accounting for any temporary water surpluses.

New Stone Water District Water Budget Model

To review and compare with the Subbasin model results against NSWD-specific conditions, a complete water budget including historical, current, and projected, for NSWD was created using information from the basin setting discussed earlier in this chapter along with data from sources such as CIMIS, NOAA, DWR, ITRC, etc. The period of record chosen to analyze the historical data was 2003-2012. This period was chosen because it represents 100% of the long-term calculated natural flow (1901-2016) in the San Joaquin River and it closely reflects current management practices and facilities available to the District. Also, this period includes a mix of dry, normal, and wet years. The following discussion outlines the data and methodologies used to estimate inflow and outflow components for the NSWD GSA. The water budget components were estimated using the best available data during initial GSP development. Yearly updates to these estimates, using the same methodologies described below, are represented in the District's annual reporting efforts.

Inflows

Surface Water for Irrigation

NSWD has limited access to surface water. During high flow years, water is diverted from the San Joaquin River (SJR) to the Chowchilla Bypass flood control structure. The District has an appropriative water right along the Chowchilla Bypass (referred to as Eastside Bypass/Chowchilla Canal in permit) of 15,700 acre-feet/year (permit number 19615). Currently, NSWD only has one turnout on the Bypass to serve the District. Due to the location of the turnout and the infrastructure within the District, NSWD has not always exercised their water right in the past years. As for projecting into the future, the District plans to use their water right to its full potential.

Surface Water for M&I

There are no municipal surface water systems in the area.

Spill Inflows

There are no spill inflows in NSWD.

Precipitation

During initial GSP development, monthly precipitation data was collected from the National Climactic Data Center (NCDC) for the period of record. The closest weather station to New Stone WD with the available data is the Madera Station (045233); therefore, this station was utilized to represent the District. Also, this station had historic data that dates back more than 50 years. The Madera Station has records of precipitation from 1928-to current. It should be noted that the District lies directly between the Madera Station and the Firebaugh CIMIS station. It may be prudent in the future to take precipitation from the Firebaugh CIMIS station into account to more accurately estimate precipitation in the NSGSA.

Averages were calculated for the entire recorded period, the most recent 50-year period, and the hydrologically average period (2003-2012). The averages were compared to ensure that the historical average period does not vary too much from the 50-year and total historic averages. There is a less than 10% difference in the calculated average precipitation for each of the periods.

The historic water budget considers the water years from 2003-2012 to calculate an average annual precipitation of 9.60 inches, while the projected budget assumes the average annual precipitation over the last 50 years of 10.8 inches will continue into the future.

Deep Percolation

Deep percolation occurs in NSWD from precipitation and applied irrigation water. When precipitation or irrigation causes the soil to reach field capacity (become saturated), water begins to move downward through the soil due to gravity. When it passes the root zone, it is considered part of the groundwater system. Deep percolation of precipitation is calculated using **Equation 3-1** (Williamson, Prudic, & Swain, 1989):

Equation 3-1 Deep Percolation of Precipitation

$$DP = 0.64 * P - 6.2$$

Where:
DP = Deep Percolation (inches)
P = Annual Precipitation (inches)

Deep percolation of irrigation water is estimated by assuming that any water applied in excess of evapotranspiration requirements, due to irrigation efficiency, trickles through the root zone and reenters the groundwater system. With an average irrigation efficiency of 81% in NSWD (based on NRCS efficiency tables), approximately 1,800 AF of water is recharged through deep percolation of irrigation water. Deep percolation of precipitation was assumed to be 5% for the 10-year precipitation average which equates to 200 AF.

Surface Water Seepage
A potentially large source of groundwater recharge occurs through seepage of unlined canals, streams, lakes, and reservoirs. For the purposes of this GSP, seepage is considered an inflow of surface water from the perspective of groundwater. Water infiltrates through the soil below unlined canals, reservoirs, and ponds leaving the surface water system and entering the groundwater system. NSWD does not currently contain any large reservoirs for the banking of water nor does it have much in the way of surface water distribution.

River and Local Stream Recharge
The Chowchilla Bypass runs along the eastern edge of the District and contributes a substantial amount of seepage to the groundwater system when it runs. The channel has a design capacity of 5,500 cubic feet per second (cfs), however at times flows to can exceed 8,000 cfs at the head gate. Varying flows lead to varying top widths of the channel, due to the cross-section of the channel which includes a smaller pilot channel. An illustration of the cross section can be seen in **Figure 3-30**. The recharge volume varies depending on the wetted area.

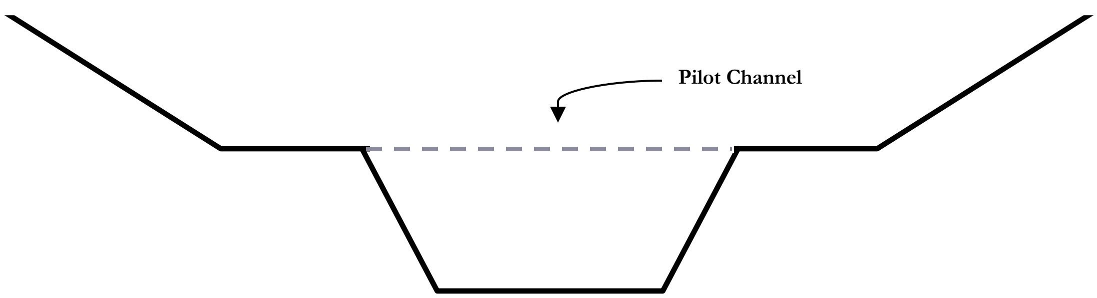


Figure 3-30 An Example of a Cross Section Representative of the Chowchilla Bypass

California Data Exchange Center (CDEC) data is available for water flowing into the Chowchilla Bypass gauging station (CBP). It was determined that the pilot channel is exceeded at around 4,300 cfs. Along the 3.25 miles of the Bypass along the NSWD GSA border, the top width of the pilot channel was found to be about 160-feet wide, and the full width of the bypass was found to be about 580-feet wide.

For the period of record (2003 – 2012), the average annual days per year that water was available in the Bypass was 38 days. The average annual days per year with more than 4,300 CFS for the same time period was 11.3 days and 26.7 days with less than 4,300 CFS. Based on the seepage rate of 0.748 ft/day (weighted average of Soil Survey Geographic Database (SSURGO) seepage rate data provided by Davids Engineering based on soil type along the NSWD GSA border). This value was then divided by 2 to represent that NSWD only borders one-side of the Bypass. The total estimated annual average seepage for NSWD GSA from the Bypass is therefore approximately 1,600 acre-feet. This calculated historic seepage is expected to remain the same into the future, as it is assumed that flood flows will continue to flow in the Chowchilla Bypass at the same frequency.

Urban Stormwater Recharge
There is no urban stormwater recharge in NSWD.

Intentional Groundwater Recharge
Historically, NSWD has not used intentional groundwater recharge as a method for banking water. Water for recharge is only available during high flow years when the Bypass is running. When averaged over the 10-year average period, recharge equals 1,600 AF. Looking into the future, recharge ponds will be built to better capture the high flow water in the Bypass.

Groundwater Inflow
Water movement occurs due to hydraulic and pressure gradients, which is true above ground or below. Calculation of groundwater movement is done using transmissivity values based on soil type, groundwater level contours, and cross boundary flow directions. Transmissivity changes with depth due to variations in soil types; however, an average transmissivity value was used for each boundary line for the depth of the aquifer. The largest inflow of groundwater into NSWD is through subsurface flows of approximately 4,500 AF/year. The projected budget into 2040 assumes the same subsurface flow.

Outflows
Evaporation and Runoff of Precipitation
Evaporation and runoff of precipitation is a surface outflow. It is calculated as the volume of precipitation that has not been attributed to deep percolation or effective precipitation. It has a negligible effect on groundwater storage changes. This value is calculated to be 1,500 AF for NSWD.

Groundwater Pumping for Irrigation
Groundwater pumping for irrigation of crops is usually an unknown factor due to the lack of historic regulation and monitoring of pumping. However, private groundwater pumping can be estimated with land use cropping data, ET data, and effective precipitation. Effective precipitation is the amount of rainfall that is beneficially used by the crops and is calculated for each year in the hydrologic period using the set of three equations seen below (MacGillivray, 1989).

Equation 3-2: Effective Precipitation

$$Nov - Feb = -0.54 + (0.94 * P)$$
$$Mar = -1.07 + (0.837 * P)$$
$$Oct = -0.06 + (0.635 * P)$$

Where:
P = Precipitation for the months listed (inches)

The average annual effective precipitation over the base period is subtracted from the crop ET values, obtained from the ITRC, for a typical year to get applied water demand.

The average effective precipitation is subtracted from the average consumptive use of crops (crop ET) for the hydrologic period. Land use data from DWR surveys and the United States Department of Agriculture's (USDA) CropScape database was used along with ET values from the ITRC. This value is known as crop water demand, or the amount of water that needs to be beneficially applied to the crop, typically given in acre-feet per acre (af/ac). To capture the most recent land use, 2015 data from the Agricultural Commissioner of Madera County was used as the base for estimating private groundwater pumping for the current and projected budget. Average annual crop water demand and annual demand were calculated. Total effective precipitation was applied to crop ET supplementing pumping requirements.

Not all water that reaches the field is beneficially used by the crop due to irrigation inefficiencies. Thus, irrigation efficiency was considered in estimating groundwater pumping for irrigation. Irrigation techniques were assigned to various crops based on available DWR data, which indicated the most popular irrigation system for various crops. System efficiency was assumed based on NRCS efficiency tables and was found to be 81%. An average irrigation efficiency was applied to the total crop water demand to calculate the volume of water that will need to be applied as irrigation. As mentioned before, the volume of water applied that exceeds crop water demand is assumed to percolate back into the groundwater system.

Lastly, to get to the estimated volume of pumped groundwater, surface supplies and transportation losses must be considered. Known surface water diversions from the Chowchilla Bypass minus losses were taken out of the applied groundwater demand.

Using the method described above, the total groundwater pumping used for irrigation within NSWD for the period of record was found to be 9,700 AF/year.

Groundwater Pumping for Municipal and Industrial Use
There are no municipal or industrial agency wells in the area.

Evapotranspiration
Evaporation and evapotranspiration are not direct sources of groundwater outflow as pumping is; however, they are the main nonrecoverable losses, other than groundwater outflow. Some of the water pumped for irrigation purposes goes back into the system through deep percolation, while the majority permanently leaves the system through evapotranspiration, known as a consumptive use. This occurs to water used for irrigation of crops or municipal water used for irrigation of landscaping, so a portion of both water-use sectors contribute to nonrecoverable loss of groundwater. The evapotranspiration of the District was broken down into the evapotranspiration of applied water, effective precipitation, and municipal and industrial.

Evapotranspiration of applied water was determined by using data from the Cal Poly's ITRC, which provides average pan evaporation and crop ET for regions in the State of California. NSWD lies within ITRC Region 15. Only monthly average pan evaporation data was used from ITRC, which was combined with crop coefficient (k_c) values to calculate crop ET. It was determined that the evapotranspiration of applied water for NSWD was 7,900 AF/year.

To calculate evapotranspiration of effective precipitation, it was assumed that half of all annual precipitation is effective precipitation. An effective annual precipitation of 1,600 AF/year was determined for the District.

Municipal and industrial water use is assumed negligible due to the minimal agencies within the District.

Groundwater Outflow
Based on groundwater contours and operations within the District, groundwater outflows were assumed to be negligible.

3.3.3 Quantification of Overdraft

Regulation Requirement:

§354.18(b) The water budget shall quantify the following, either through direct measurements or estimates based on data: (4) The change in the annual volume of groundwater in storage between seasonal high conditions. (5) If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions. (6) The water year type associated with the annual supply, demand, and change in groundwater stored. (7) An estimate of sustainable yield for the basin.

Madera Subbasin

Current estimates of Subbasin overdraft and change in storage over the base period are documented in the Madera Subbasin Joint GSP. NSWD-specific change in storage values are presented in the NSWD GSA Annual Reports.

New Stone Water District GSA

Quantification of groundwater overdraft was calculated using the following simple **Equation 3-3**:

Equation 3-3: Groundwater Overdraft

$$\Delta\, Storage = Inflows - Outflows$$

Where:
Inflows = Subsurface inflow, deep percolation of irrigation water and precipitation, and seepage from the Chowchilla Bypass
Outflows = Groundwater pumping for irrigation demand (AF/year)

The above parameters are quantified and summarized in tables in the following section. The change in storage based on the above equation was compared to the calculated annual change in groundwater storage based on average annual water level decline and specific yield. During the initial GSP development, the assumed specific yield for NSWD is 0.13 (Davis et al., 1959) and average annual water level decline across the district is 3.0 feet per year. Current estimates are included in the NSWD GSA Annual Reports. The method for calculating annual change in groundwater uses **Equation 3-4**:

Equation 3-4: Groundwater Storage Change (Specific Yield Method)

$$\Delta\, Storage = SY * \,\Delta WL * A$$

Where:
SY = Specific Yield (%)
ΔWL = Change in Water Level (feet/year)
A = Area of GSA (acres)

The overdraft for the District was calculated to be about 1,600 AF/year.

3.3.4 Current, Historical, and Projected Water Budget

Regulation Requirement:

§354.18
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.
(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:
(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.
(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.
(C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.
(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:
(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.
(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.
(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.
(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:
(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.
(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.
(3) Projected water budget information for population, population growth, climate change, and sea level rise.

New Stone Water District

Table 3-6 summarizes the historic, current, and projected water budget parameters and estimates. NSWD GSA Annual Reports provide yearly updates to water budget components in the NSWD GSA.

Table 3-6 NSWD Historical, Current, and Projected Water Budgets

		Volume (AF)		
	Description	**Historic**	**Current (2017)**	**Projected (2040)**
Supply				
1)	Surface Water for Irrigation	0	270	2,600
2)	Surface Water for M&I	0	0	0
3)	Groundwater Pumping for Irrigation (Private Wells)	9,700	9,400	7,000
4)	Groundwater Pumping for M&I (Agency Wells)	0	0	0
5)	Precipitation	3,300	3,600	3,600
6)	Other Supply:	0	0	0
	Total Supply	**13,000**	**13,270**	**13,200**
Demand				
7)	Evapotranspiration Crop Requirement	7,900	7,900	7,200
8)	Evapotranspiration met by Effective Precipitation	1,600	1,900	1,400
9)	Evapotranspiration of M&I	0	0	0
	Consumptive Subtotal	**9,500**	**9,800**	**8,600**
Groundwater Recharge				
10)	Groundwater Inflow	4,500	4,500	4,500
11)	Deep Percolation of Irrigation Water	1,800	2,100	1,600
12)	Deep Percolation of Precipitation	200	400	400
13)	Deep Percolation of M&I Water	0	0	0
14)	Seepage of Channels & Pipelines	0	0	0
15)	Urban Stormwater - Recharge	0	0	0
16)	Local Streams/Rivers - Recharge	1,600	1,600	1,600
17)	Groundwater - Intentional Recharge	0	0	0
18)	Other Recharge:	0	0	0
	GW Recharge Subtotal	**8,100**	**8,600**	**8,100**
Nonrecoverable Losses				
19)	Groundwater - Outflow	0	0	0
20)	Evaporation - Recharge Basins	0	0	0
21)	Precipitation - Evaporation and Runoff	1,500	1,500	1,500
22)	Other Losses:	0	0	0
	Nonrecoverable Subtotal	**1,500**	**1,500**	**1,500**
	Estimated Annual Change in Groundwater Storage	**(1,600)**	**(800)**	**4,600**
	GW Recharge - #10 thru #18	8,100	8,600	8,100
	GW Pumping - #3 and #4	(9,700)	(9,400)	(7,000)
	GW Outflow - #19	0	0	0

Historic Water Budget

As previously mentioned, the historic water budget for the NSWD GSA to compare against the Subbasin-wide model was prepared using data from 2003-2012, which represents a typical hydrologic period for the District. This period mostly came into play when calculating various aspects of precipitation data, such as effective precipitation and deep percolation. Groundwater water inflow in terms of seepage from the Chowchilla Bypass were assumed to be constant at an average annual value. As discussed earlier in the chapter, the District is primarily made up of farmland, which means high water demand for irrigation. Total water demand has remained fairly constant over the years while surface supplies are variable. Historically, water year type has a limited effect on groundwater overdraft on a year-to-year basis. The District is mainly groundwater dependent; however; seepage from the Chowchilla Bypass has kept water levels stable. New Stone's historic overdraft is estimated to be 1,600 AF/year.

Current Water Budget

The current year (2017) water budget was designated as a wet year. This wet year hydrology was utilized with the historic ET demand and bypass channel deliveries.

Projected Water Budget

The goal of a projected water budget is to estimate future baseline conditions in response to GSP implementation. The projected water budget must include 50 years of historical precipitation, evapotranspiration and streamflow, while using the most recent land use and water supply information as the baseline condition. In formulating future baseline conditions, the effects of climate change on water availability and use must be considered.

Historical precipitation, evapotranspiration, and streamflow were not continuously recorded within the district for any 50-year period which necessitated using modeled climate data to project future conditions. The GSA does not have surface water allocations, so the effects of climate change on streamflow were not quantified. Instead, water rights off the Chowchilla Bypass, which on average has been available every four years, were considered a source of surface water that would be diverted for recharge. This period was kept in place for the projected water budget, diversions up to 15,700 AF was used.

Monthly time-series precipitation and minimum and maximum temperature data was obtained from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) historical datasets. PRISM is a gridded monthly dataset that includes monthly temperature maximum and minimum and precipitation accumulation. All PRISM grid cells that are either fully or partially within the GSA boundaries were used for the period of interest. The segmented maximum temperature, minimum temperature, and precipitation values were averaged for each parameter by month in the period.

Historical evapotranspiration measurements are not available for the GSA before the mid-1980s implementation of CIMIS. Thus, monthly evapotranspiration was calculated with PRISM temperature data using the Hargreaves-Samani equation, shown below as **Equation 3-5**, from the DWR California Simulation of Evapotranspiration of Applied Water (Cal-SIMETAW) model. This equation provides a monthly reference ET estimate derived from mean temperature and long-term average radiation for a centroid of the GSA. This model was used to calculate monthly reference ET values.

Equation 3-5: Hargreaves-Samani Equation

$$ETo = 0.0023\ (T_{mean} + 17.8) * \sqrt{T_{max} - T_{min}} * R_a$$

where: *ETo* is reference monthly evapotranspiration
T is monthly temperature
Ra is the monthly average extraterrestrial radiation at the given latitude

DWR provided a dataset containing factors to apply to historical data to estimate future climate. This method, known as climate period analysis, preserves the historical variability while dampening or amplifying the magnitude of events based upon projected changes in precipitation and temperature. The provided climate change factors for two future 30-year periods, centered on 2030 and 2070, were derived from statistical analysis of an ensemble of 20 global climate model projections.

Using the same method as with the PRISM grid, the monthly climate change factors provided by DWR were averaged over the spatial extent of the GSA. The monthly change factors were then applied to the PRISM derived monthly precipitation and ET and then summed by water year. The 2030 climate change factors, which are applicable to the climate period of 2016-2045, were used for projected years through 2045. For the projected years of 2046-2070, the 2070 climate change factors were used.

A yearly sequence was chosen to line up historical data to projected years from 2020 to 2070. This sequence was developed by the Basin Technical Committee and Davids Engineering. **Table 3-7** shows the matching surrogate years for this period.

Table 3-7 Water Year Type

Year	Equivalent Water Year	Water Year Type
2020	1967	W
2021	1968	D
2022	1969	W
2023	1970	AN
2024	1971	BN
2025	1972	D
2026	1973	AN
2027	1974	W
2028	1975	W
2029	1976	C
2030	1977	C
2031	1978	W
2032	1979	AN
2033	1980	W
2034	1981	D
2035	1982	W
2036	1983	W
2037	1984	AN
2038	1985	D
2039	1986	W
2040	1987	C
2041	1988	C
2042	1989	C
2043	1990	C
2044	1991	C
2045	1992	C
2046	1993	W
2047	1994	C
2048	1995	W
2049	1996	W
2050	1997	W
2051	1998	W
2052	1999	AN
2053	2000	AN
2054	2001	D
2055	2002	D
2056	2003	BN
2057	2004	D
2058	2005	W
2059	2006	W
2060	2007	C
2061	2008	C
2062	2009	BN
2063	2010	AN
2064	2011	W
2065	2012	D
2066	2013	C
2067	2014	C
2068	2015	C
2069	1965	W
2070	1966	BN
Average (00-15)	100%	
Source	CDEC Data (MIL Full Natural Flow)	

Note: Water Year Type is based on DWR Water Year Index. Wet = Wet(W), Normal = Above Average(AN) & Below Average(BN), Dry = Dry(D) & Critical(C)

A simplified model was used to calculate the projected water budget for 2020-2070. This method was based on selecting three basic water year types that were identified based upon historical indices of the Dry, Normal, and Wet water year types were kept the same for projected years and not recalculated based upon climate change (note on **Table 3-7**: Dry has Dry and Critical, and Normal has Above Average and Below Average). For each one of these year types, water budget components had specified volumes, which were applied to the projected year that climate was derived from. The values of these components were derived from representative years, included from the historical water budget. The water budget was computed for each year individually, so inter-year trends and variability did not affect water budget components.

In addition to the uncertainties of changes in climate and land use, weaknesses exist to this approach. The lack of inter-year variability led to compounding effects of wet or dry years. No change in land use was considered, so effects of drought and water shortage beyond the conditions of the origin years were not considered. Crop coefficients to determine ET were held at the most recent calculation, so changes in growing seasons brought by climate change and variations in future crop management were not taken into account.

3.3.5 Surface Water Supply Available for Recharge

At this time, NSWD anticipates using its water right of surface water from the Chowchilla Bypass for direct recharge in the future. This water will be stored in recharge basins as well as be used to flood the fields when the crops are dormant to promote deep percolation throughout the District. The District will also deliver the surface water directly crops when available during the growing season.

4 Sustainable Management Criteria

Regulation Requirement:

§354.22 This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.

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 NSWD GSA plan (DWR, 2017).

Indicators for the sustainable management of groundwater were determined by SGMA based on properties that are 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 including groundwater levels, groundwater storage volume, land subsidence, water quality, interconnected surface water, and seawater intrusion. This chapter will describe the indicators and why they are significant and will define the management thresholds.

The Sustainable Management Criteria described herein were prepared following the requirements set forth in the California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 5, Subarticle 3 (§354.22 through §354.30).

4.1 Sustainability Goal

Regulation Requirement:

§354.24 Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

"GSAs must develop a sustainability goal that is applicable to the entire basin. If multiple GSPs are developed for a single basin, the sustainability goal must be presented in the basin wide coordination agreement. Unlike the other sustainable management criteria, the sustainability goal is not quantitative. Rather, it is supported by the locally defined minimum thresholds and undesirable results. Demonstration of the absence of undesirable results supports determination that the basin is operating within its sustainable yield and, thus, that the sustainability goal has been achieved." (DWR, 2017)

Goal Description

The sustainability goal for the Madera Subbasin is to implement a package of projects and management actions that will, by 2040, balance long-term groundwater system inflows with outflows based on a 50-year period representative of average historical hydrologic conditions. The six sustainability indicators, establish measurable objectives, and minimum thresholds that will ensure no undesirable results of significant and unreasonable economic, social, or environmental impacts occur as a result of GSP activities, as defined based on local values expressed in this GSP. Efforts will be taken to address and mitigate undesirable results if they do occur during the implementation of this GSP. To achieve this Subbasin-wide goal, the GSPs provide the GSAs with a tool for managing groundwater, basin-wide, on a long-term basis and to meet measurable objectives for each indicator by maintaining a sustainable yield, thus avoiding undesirable results. The participants in the Madera Subbasin will work collectively to manage groundwater resources in the basin, importation of water supplies to the basin, develop recharge projects, and implement programs to stabilize water levels. Information laid out in **Chapter 3** has provided insight to current and historical groundwater conditions, including a water budget to quantify overdraft. This knowledge was used to determine a sustainable yield, which will stabilize groundwater levels at a lower level than experienced today based upon a recognition that it will take time, money, and regulatory approvals to develop the programs that are needed to overcome the shortfall currently experienced. This will be done in a manner that is open to the public and stakeholders such that the local citizenry has a voice in the outcome and development of the programs.

Discussion of Measures

In order to achieve the goals outlined in the GSP, a combination of projects and management actions will be implemented over the course of the 20-year implementation period. Surface water supply and infrastructure projects will be crucial for supplementing the use of groundwater and providing space for recharge. Management actions will be implemented to help mitigate overdraft on the demand side. Projects and management actions are discussed in further detail in Chapter 6 and the NSWD GSA's Annual Reports, including a general timeline on when implementation will take place. When combined with consistent monitoring practices for each of the sustainability indicators, NSWD GSA will ensure that the District operates within its sustainable yield on an average annual basis.

Explanation of how the goal will be achieved in 20 years

The water budget, described in **Section 3.3**, accounts for historical water supplies and water demands by water use sector and quantifies the average annual overdraft. This value gives the basin and the GSA a goal by which to either improve supply or mitigate demand. NSWD GSA proposes to develop surface water supply projects, including recharge basins to augment groundwater supply, as well as implementing demand reduction programs. Areas sensitive or vulnerable to reaching an undesirable result will be given first consideration to groundwater recharge. To ensure that the goal will be achieved in the 20-year timeframe, interim goals for every 5 years have been established. Understanding that projects and programs take time and money to implement, the interim goals have considered exponential mitigation rates. Funding for projects, management actions, and monitoring will be secured by grant applications and NSWD GSA.

Designated monitoring networks have been chosen for keeping track of groundwater levels, change in storage volume, land subsidence, and water quality. The monitoring networks, described in detail in **Chapter 5**, will allow the GSA to evaluate the success of the plan and make changes accordingly throughout the implementation process.

This NSWD GSA GSP was developed in coordination with the other Madera Subbasin GSAs to ensure consistent explanations of data and methodologies. In the event that interim milestones (IMs) described in this section are exceeded in the subbasin during the implementation period, or MTs are exceeded after 2040, leading to undesirable results, the NSWD GSA will participate in Subbasin-wide coordinated efforts to investigate the cause of those exceedances. The NSWD GSA will also coordinate on identified adaptive management actions to address those exceedances and will implement actions within the NSWD GSA, to the extent they are identified. However, the NSWD GSA does not anticipate implementing adaptive management actions for exceedances outside of the NSWD GSA. Additionally, the NSWD GSA will not be financially responsible for efforts to evaluate exceedances occurring outside of its jurisdiction or implementing actions to address those exceedances. The NSWD GSA will focus on managing the IMs and MTs within its boundaries. Annual Reports and future Periodic Evaluations will provide updates on the progress in achieving the established IMs and MTs for the NSWD GSA.

4.2 Groundwater Levels

Groundwater depths across the GSA currently vary from approximately 100 to 200 feet below ground surface. A cone of depression, or an area of high pumping, occurs just north of the district boundary causing groundwater to flow mostly north; however, historically this was not the case. Significant groundwater pumping has caused levels to drop drastically, which has created higher energy costs and the need for well deepening.

As noted in the Basin Setting chapter of the Madera Joint GSP, and as referenced in this document, a numerical groundwater model has been developed for the Subbasin that utilized a historic water budget and estimated current and future budgets. Also included in the model were estimates of sustainable management indicators including projected water levels and subsidence. From review of the model results for past, present, and future conditions, there appears to be good calibration in the majority of the Subbasin. However, in some portions of the Subbasin, the model results are not calibrating closely and are offset from actual data. While this offset may seem concerning, lack of correlation between actual data and modeled results is not uncommon. Future efforts will be made to improve model accuracy and will be documented in the Madera Joint GSP and Annual Reports. It is the intent of this GSP to use the model projections but is also clear that actual measurements take precedence over model projections. To this end, more discussion is included in later sections on how the measured data is used in conjunction with the model projections to determine Sustainable Management Criteria.

In order to avoid undesirable results as identified in the Madera Subbasin Joint GSP and discussed further in sections below:

- Minimum thresholds were set using observed historic low groundwater level conditions in fall 2015 if available.
- Measurable objectives were set using observed fall 2010 groundwater levels if available.
- Interim milestones were set using the Subbasin model in coordination with the effort and methodologies employed throughout the Subbasin. Offsets between historically observed and modeled data were accounted for, as needed, based on fall observed and modeled groundwater levels.

4.2.1 Undesirable Results

4.2.1.1 Criteria to Define Undesirable Results

Regulation Requirement:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

If groundwater levels continue to deteriorate to a significant and unreasonable level, it will be considered an undesirable result. The GSP regulations provide that the "minimum thresholds for chronic lowering of groundwater levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results." Chronic lowering of groundwater levels in the Subbasin cause significant and unreasonable declines if they are sufficient in magnitude to lower the rate of production of pre-existing groundwater wells below that necessary to meet the minimum required to support overlying beneficial uses and users where alternative means of obtaining sufficient groundwater resources are not technically or financially feasible.

As of 2015 and the enactment of the Sustainable Groundwater Management Act, water levels in the Subbasin have been on an ongoing downward trend. It is recognized that it will take time, energy and financial resources to correct this trend. As such, even with the adoption and implementation of this plan, it will take a number of years to reverse this trend. The GSAs recognize that groundwater levels are anticipated to fall below 2015 levels during the GSP implementation period. With this understanding, interim milestones were set below the fall 2015 levels using observed and modeled projections with the goal of returning levels to above fall 2015 levels, as projects and management actions are implemented. The minimum thresholds have been designated with these considerations in mind. It should be noted that groundwater level MTs and MOs were set based on seasonal low, fall groundwater levels, which are more protective of domestic wells than using Spring groundwater levels. An undesirable result is defined to occur after 2040, when projects and management actions have been implemented through the implementation period, when the same 30 percent of wells within the Subbasin are below MTs for two consecutive fall measurements.

Since the submission of the initial 2020 GSP, the Subbasin has experienced undesirable results related to groundwater levels. Stakeholders within the Subbasin have experienced wells that have gone dry. With groundwater levels anticipated to decline further during the Implementation Period as PMAs are implemented and demand reduction programs expand, and in response to present conditions, affected GSAs in the Madera Subbasin have expressed support of a Domestic Well Mitigation Program to provide assistance to domestic well owners adversely impacted by groundwater level declines.

Additional information about the Domestic Well Mitigation Program is provided in the following section. The alternative of specifying higher MTs that avoid any additional groundwater level declines (to avoid the need for a Domestic Well Mitigation Program) would require immediate and substantial cutbacks in groundwater pumping (i.e., immediate demand reduction) that would result in major impacts to the local economy and all Subbasin stakeholders, including domestic well owners. These analyses considered the impacts of immediate demand reduction only on agricultural net return, but in reality, the economic impacts would spread to other county businesses and industries, significantly increasing the net effect on all beneficial uses and users of groundwater in the Madera Subbasin, including domestic well owners. With these considerations in mind, the GSAs will mitigate potential impacts to domestic wells caused by temporary further declines in groundwater levels during the implementation period.

4.2.1.2 Domestic Wells

Based on DWR's Groundwater Live Domestic Wells dashboard[6] there are only three domestic wells located within the NSWD GSA area (**Table 4-1**). All domestic wells have total completed depths that are deeper than established minimum thresholds and interim milestones for groundwater levels (i.e., water levels at the minimum thresholds and interim milestones are set above the bottom perforations at all domestic wells within NSWD GSA). Consequently, impacts to domestic wells would not be significant within the NSWD GSA. While there are a large number of agricultural wells in the NSWD GSA area, these wells tend to be deeper and are not expected to be affected or go dry.
A domestic well mitigation plan will be developed cooperatively by the Madera Subbasin GSAs having affected domestic wells.

Table 4-1 Summary of Domestic Wells Within the NSWD GSA per DWR's Groundwater Live Domestic Wells Dashboard

OID	Well Completion Report Number	Total Completed Depth (ft)
188	WCR0240007	293
654	WCR0088554	364
697	WCR2019-001296	340

4.2.1.3 A domestic well mitigation plan will be developed cooperatively by the Madera Subbasin GSAs having affected domestic wells. Evaluation of Multiple Minimum Thresholds

Regulation Requirement:

[6] https://storymaps.arcgis.com/stories/f2b252d15a0d4e49887ba94ac17cc4bb

> **§354.26** (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Due to variation in monitoring site locations in the GSA, each representative monitoring site may have a different minimum threshold and measurable objective based on the most sensitive sustainability indicator in the area. Four wells were chosen for setting minimum thresholds and measurable objectives for the chronic lowering of groundwater levels. An undesirable result is defined to occur after the implementation period (2040), giving time for projects in the Subbasin and neighboring subbasins to return water levels, when more than 30% of wells in the Subbasin exceed groundwater level MTs for two consecutive fall readings. In addition to MTs being set with consideration of protecting domestic wells, the MTs for groundwater levels are also intended to protect against significant and unreasonable impacts to groundwater storage volumes, land subsidence, and groundwater quality concerns. Subbasin GSAs have determined that the approach towards defining the minimum thresholds for the chronic lowering of groundwater levels sustainability indicator, along with a temporary Domestic Well Mitigation Program developed by the Madera Subbasin GSAs having affected domestic wells, will help avoid undesirable results by reducing the likelihood that access to adequate water resources for beneficial users within the Subbasin will be compromised.

4.2.2 Minimum Thresholds

Regulation Requirement:

> **§354.28** (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.
> (d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

4.2.2.1 Description of Minimum Thresholds

Regulation Requirement:

> **§354.28** (b) The description of minimum thresholds shall include the following:
> (1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.
> (2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.
> (3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
> (4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.
> (5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.
> (6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Minimum thresholds have been set at each of the representative monitoring sites for the necessary sustainability indicators at a level that will avoid undesirable results. When monitoring sites are not meeting minimum threshold requirements, more strict pumping regulations may be enforced to reverse the trend in the area and avoid undesirable results.

The GSP regulations provide that the "MTs for chronic lowering of groundwater levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results." (354.28.c.1). In developing sustainability goals for NSWD GSA, the Subbasin model was used. At the site of each of the proposed Representative Monitor Wells, modeled hydrographs were developed. Since the wells were constructed across multiple model zones (defined zones of the aquifer system) the model results were shown for both zones. Once the hydrographs were developed, the measured data was added to the hydrographs to compare measured data with both projected, present, and future projections. The trends in the modeled results are considered useful and were used to develop SMCs.

The overall approach used to set the Minimum Thresholds in the Subbasin included using observed fall 2015 data and modeled data if necessary. The methodology to develop MTs for groundwater levels was based on discussion with GSA staff and technical representatives to establish a coordinated methodology across the Subbasin. The coordinated methodology of groundwater level MTs is as follows:

1) Review available wells with regard to several variables/criteria (e.g., is well in CASGEM program, known well construction details, preference for wells with relatively long history of observed water levels, availability of recent water level data, good spatial distribution) and select appropriate representative monitoring sites.
2) For each selected representative monitoring site, review/evaluate the fluctuation of observed vs. modeled historical groundwater levels and projected future with PMAs model results.
3) Set the groundwater level MT equal to the fall 2015 measurement, if this observed data point is available at a given Representative Monitoring Site (RMS).
4) If no fall 2015 groundwater level measurement is available, utilize groundwater model results to determine the estimated fall 2015 groundwater level, with MT adjustments up or down to account for offset between historical observed and modeled data, if necessary.
5) Adjust groundwater level minimum threshold to address other sustainability indicators.

The consideration of the offset between observed and modeled data is intended to reflect cases where observed data are either consistently above or below modeled water levels, or situations where observed water levels occasionally spike below seasonal low modeled water levels. Overall, the purpose of adjusting for differences between observed and modeled data is to obtain the most representative value for the estimated fall 2015 measurement.

The decisions to set MTs for chronic lowering of groundwater levels at fall 2015 levels were made with the following understandings:

- That it takes time and money to implement projects and management actions that increase groundwater recharge and decrease net groundwater extraction.
- To balance and protect the water supply needs of all beneficial uses and users of groundwater through an approach that is both sustainable and economically reasoned.
- Maintaining some level of operational flexibility in the Subbasin under projected future conditions. With this understanding, it is likely that recent historical pumping trends will continue for up to ten years.

4.2.2.2 Relationship for Each Sustainability Indicator

Regulation Requirement:

> **§354.28** (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
> (1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:
> (A) The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.
> (B) Potential effects on other sustainability indicators.

Groundwater levels can be directly related to groundwater storage change and, in many cases, groundwater quality. Lowering of groundwater levels also has a direct impact on land subsidence when it is caused by pumping water from below a confining clay layer. Each of the sustainability indicators must be monitored to watch for minimum thresholds; whichever indicator is most sensitive to groundwater level reduction may be the controlling factor in the surrounding area. Groundwater levels will serve and be used as the indicator for groundwater storage change and MTs were set with consideration for land subsidence. The groundwater elevation minimum thresholds were set (in combination with the domestic well mitigation program) to avoid undesirable results for other sustainability indicators as described below.

1. **Reduction in groundwater storage** –. A significant and unreasonable condition for change in groundwater storage is pumping groundwater in excess of the sustainable yield for an extended period of years during the Sustainability Period. Pumping at or less than the sustainable yield will maintain or raise average groundwater elevations in the Plan area. The groundwater elevation minimum thresholds are set at Fall 2015 groundwater elevations, consistent with avoiding long-term declines in groundwater storage. Therefore, the groundwater elevation minimum thresholds established for this GSP will not result in long term significant or unreasonable change in groundwater storage.
2. **Subsidence** – A significant and unreasonable condition for land subsidence is measurable permanent (inelastic) subsidence that significantly damages existing infrastructure. Inelastic subsidence is caused by reduction in pore pressure and compaction of clay-rich sediments in response to declining groundwater levels. There have been small amounts of land surface elevation fluctuation/subsidence that have been recorded across the Plan area; however, these levels of recent historical fluctuation/subsidence have not yet resulted in any known significant impacts to infrastructure. Nonetheless, a zero MT for subsidence has been set for the Subbasin to avoid potential future subsidence impacts as well. The groundwater level MT set equal to Fall 2015 groundwater levels is consistent with the subsidence MT established for the Subbasin. In order to achieve the subsidence MTs for NSWD GSA, effective implementation of projects and management actions in the eastern portion of the Subbasin, along with areas outside of the Subbasin, is required.
3. **Degraded water quality** – Protecting groundwater quality is critically important to all who depend upon the groundwater resource, particularly drinking water and agricultural uses. A significant and unreasonable condition of degraded water quality is exceeding regulatory limits for constituents of concern in wells due to actions proposed in the GSP. Water quality could be affected through three processes:

    a. Low groundwater elevations in an area could cause deeper, poor-quality groundwater to flow upward into existing wells. Groundwater elevation MTs are generally set well above depths to reduced sediments that may provide poorer quality water with respect to naturally occurring constituents (e.g., arsenic), thereby minimizing opportunities for poor quality groundwater flowing into wells. To the extent that temporary declines during the Implementation Period may result in domestic wells previously below the arsenic MCL to be above the MCL as a direct result of declining groundwater levels after 2020, a proposed temporary domestic well mitigation program would address this issue. Therefore, the combination of the groundwater elevation minimum thresholds and domestic well mitigation program will avoid poor-quality water (resulting directly from GSP actions) from impacting existing wells.

    b. Changes in groundwater elevation as a result of projects and management actions implemented to achieve sustainability could change groundwater gradients, which could cause poor quality groundwater (i.e., contaminant plumes) from documented contaminant sites to flow towards wells that would not have otherwise been impacted. These groundwater gradients, however, are dependent on differences between groundwater elevations, not in the groundwater elevations themselves. Therefore, the minimum thresholds for groundwater elevations do not directly lead to significant and unreasonable degradation of groundwater quality in wells. Although distributed areas of degraded groundwater quality from non-point source contamination exist in the Plan area (most notably elevated nitrate concentrations), there are no current documented large-scale contaminant plumes of concern in the regional groundwater aquifers. Smaller localized and shallow contaminant site plumes have been documented in parts of the Plan area, although these contaminants are generally restricted to very shallow depths above the regional aquifer system. RWQCB files for existing and potential new documented contaminant site plumes will be reviewed every five years for potential changes in contaminant movement that may be related to GSP projects and management actions, and adaptive management implemented as necessary.

c. GSP projects and management actions include a number of recharge basins and Flood-Managed Aquifer Recharge (Flood-MAR) programs that will recharge surface water available in wet years through the vadose zone (unsaturated zone about the regional water table) to the water table. Such projects have the potential to flush existing constituents of concern (i.e., TDS, nitrates) from the vadose zone to the water table. While such flushing has been occurring and will continue to occur naturally (e.g., via rainfall recharge, excess irrigation recharge) without such GSP projects, it may be the case that GSP projects temporarily increase the rate of vadose zone flushing and result in temporarily higher constituent concentrations in groundwater prior to eventual dilution (due to recharge of higher quality water) and a reduction in these constituent concentrations. Overall, it is anticipated that there will likely be an overall net benefit to groundwater quality from GSP projects; however, the overall groundwater monitoring program developed for this GSP plus additional site-specific monitoring if determined to be needed (e.g., additional groundwater or potentially soil sampling), will be utilized to evaluate the need for adaptive management related to GSP recharge projects.

4. **Depletion of interconnected surface waters** – The assessment of surface water flows and groundwater levels indicate that there are likely time periods with interconnected surface waters in the Plan area. Interim sustainable management criteria for interconnected surface waters (ISW) have been established for the San Joaquin River based on the percent of time historical groundwater elevations at key Upper Aquifer RMS wells near the San Joaquin River reflect direct connection between groundwater and the San Joaquin River. The interim MT for interconnected surface water requires that the future percentage of time with connection between surface water and shallow groundwater be maintained. Therefore, the MT for interconnected surface water is consistent with the groundwater elevation minimum thresholds being equal to historical Fall 2015 groundwater elevations. Select Madera Subbasin GSAs and Kings Subbasin GSAs adjacent to the San Joaquin River have undertaken efforts to review ISW along the San Joaquin River from Millerton to the Mendota Pool. These efforts include implementation of ISW Work Plans and data sharing, along with coordination with FWA and SJRR studies.

4.2.2.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Minimum thresholds are set as a precursor to reaching an undesirable result defined earlier as either wells going dry or water levels dropping below historic low, potentially causing subsidence within the Subbasin.

The minimum threshold will be applied to the four groundwater level monitoring wells, consisting of three confined aquifer wells and one unconfined aquifer wells, in the District that are spatially distributed. Two of the previous three unconfined aquifer wells in the Representative Monitoring Network were removed due to one being destroyed and the other being monitored by an adjacent GSA in the Subbasin. **Table 4-2** lists the minimum thresholds for the representative monitoring sites.

Table 4-2 Minimum Thresholds for the Chronic Lowering of Groundwater Levels

Site	Minimum Threshold*
NSWD 10	8
NSWD 34	-14

NSWD 37	-4
11S15E30A001M	-5

(*Water level elevation – feet above mean sea-level)

4.2.2.4 Impact of Minimum Thresholds on Water Uses and Users

Groundwater level minimum thresholds are likely to have several effects on beneficial uses, users, land use, and property owners. Those expected to be impacted within the NSWD GSA include agricultural land use and users. Overall agricultural land use and users will be significantly impacted in terms of increased costs to design and construct recharge projects and in terms of reduced crop yields from required reductions in consumptive use for irrigation. There are no municipal areas in the NSWD GSA region that will need to take water conservation efforts compared to other GSAs in the Subbasin. Due to the nature of infrastructure development and program implementation, water levels will continue to drop during the Implementation Period, followed by stabilization of water levels during the latter portion of the Implementation Period and some potential recovery in groundwater levels after 2040. Lowering groundwater levels are not anticipated to have a significant impact on domestic wells within the NSWD GSA other than the cost of increased energy for pumping. Declining groundwater levels during the initial part of the Implementation Period will cause adverse impacts to domestic wells, which are expected to be addressed through a temporary domestic well mitigation program currently under consideration by Subbasin GSAs.

The Chowchilla Bypass, adjacent to the NSWD GSA boundary, is a flood control structure and is not viewed as a potential Groundwater-Dependent Ecosystem (GDE). The closest potential ecological impacts are limited to the Fresno River Riparian potential GDE unit outside and north of the NSWD GSA region composed of vegetation which may access shallow groundwater within approximately 30 feet of the surface. For more information on this potential GDE, refer to the Minimum Thresholds Impact on Beneficial Uses and Users subchapter of the Chronic Lowering of Groundwater Level Minimum Thresholds chapter in the Madera Joint GSP. Overall, sustainable groundwater management in the Madera Subbasin is expected to maintain the health and resiliency of the vegetation communities composing the potential GDE units and adverse impacts are not expected.

The potential for impacts on adjacent subbasins will primarily be a function of average water levels in the Plan area during the Sustainability Period, average water level in adjacent subbasins during the Sustainability Period, natural groundwater flow conditions that would be expected to occur along subbasin boundaries (e.g., pre-development groundwater flow conditions), and the ability for the Madera Subbasin and adjacent subbasins to successfully implement projects and management actions. The average groundwater levels expected for the Plan area are reflected in the MOs described in the following section and provide a good basis for evaluation of anticipated impacts on adjacent subbasins through the implementation of the Subbasin GSPs. The MOs are higher than minimum thresholds. Modeled groundwater levels imply that net subsurface inflow to the Plan area from surrounding subbasins will be greatly reduced after 2040 compared to historical net subsurface inflow. Therefore, the projects and management actions implemented for this GSP are expected to benefit adjacent subbasins (compared to historical conditions) and not hinder the ability of adjacent subbasins to be sustainable.

4.2.2.1 Impact of Minimum Thresholds on Adjacent Basins

The potential for impacts on adjacent subbasins will primarily be a function of average water levels in the Plan Area during the sustainability period, average water level in adjacent subbasins during the sustainability period, and natural groundwater flow conditions that would be expected to occur along subbasin boundaries (e.g., pre-development groundwater flow conditions). The average groundwater levels expected for the Plan Area are reflected in the MOs. Therefore, the impact to adjacent subbasins is primarily described under the section on MOs. With regard to MTs, the Madera Subbasin set MTs at Fall 2015 groundwater levels, which is consistent with proposed groundwater level MTs in Chowchilla and Delta-Mendota Subbasins. Kings Subbasin was approved by DWR with groundwater level MTs lower than Fall 2015 groundwater levels. Thus, Madera

Subbasin MTs are consistent with or beneficial to adjacent subbasins and will not hinder their ability to achieve their own MTs.

4.2.2.2 Measurement of Minimum Thresholds

Measurement of groundwater levels will be done through the sounding tube twice a year to obtain seasonal high (spring) and seasonal low (fall) values in each of the monitoring wells. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the SGMA regulations. For more information on the monitoring of water levels see **Chapter 5** – Monitoring Network.

4.2.3 Measurable Objectives

Regulation Requirement:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.
(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.
(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for finding of inadequacy of the Plan.

4.2.3.1 Description of measurable objectives

The MOs represent the expected operating conditions for the Subbasin. If the Subbasin GSAs successfully operate to the measurable objectives described, the Subbasin will be operating sustainably. Sustainable operation is dependent on the effective implementation of projects and management actions in the Subbasin and surrounding subbasins. Measurable objectives and interim milestones are detailed below. The DWR Water Data Library was used to find wells within the District that have decent water level data covering the last 20 years or so. Four wells spatially distributed, as seen in **Figure 4-1**, were discovered in or adjacent to the District and can provide enough historical data to create trend lines and project water levels into the planning and implementation horizon.

Setting measurable objectives for groundwater levels was done considering both annual (year to year) and seasonal) winter/spring to summer/fall) variability

MOs were set based upon observed fall 2010 groundwater levels when available. Fall 2010 data were used because that time period represents basin conditions prior to the pre-2012 to 2015 drought period, which are considered a reasonable expectation for the level at which Fall groundwater levels will fluctuate around under sustainable conditions after 2040. If observed data were not available, the Fall 2010 groundwater level was based on modeled results, modified, if necessary, to account for offset between historically observed and modeled groundwater levels. **Figure 4-2** through **Figure 4-5** graphically display how the MTs along with MOs and interim milestones (IMs) were set for each of the four wells. As shown in the figures, there are some potential fluctuations in future years and the MO was established to allow for the basin to be able to pump significant groundwater quantities in multiple dry year scenarios. Measurable objectives for groundwater levels for each RMS for water levels are summarized in **Table 4-3**.

Table 4-3 Measurable Objectives for the Chronic Lowering of Water Levels

Site	Measurable Objectives*
NSWD 10	17
NSWD 34	1
NSWD 37	7
11S15E30A001M	19

(*Water level elevation – feet above mean sea-level)

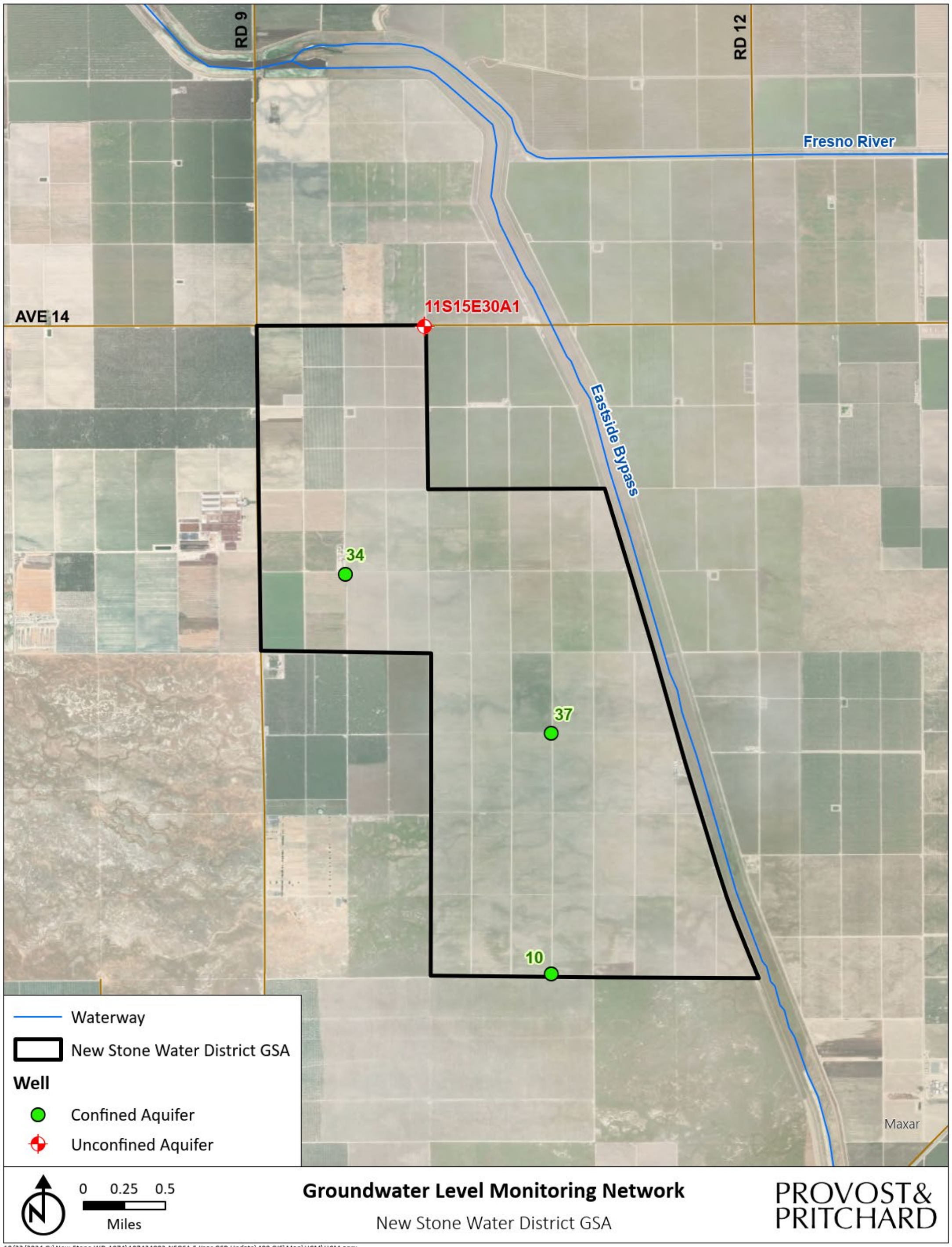


Figure 4-1 Location of Wells with Groundwater Level SMCs

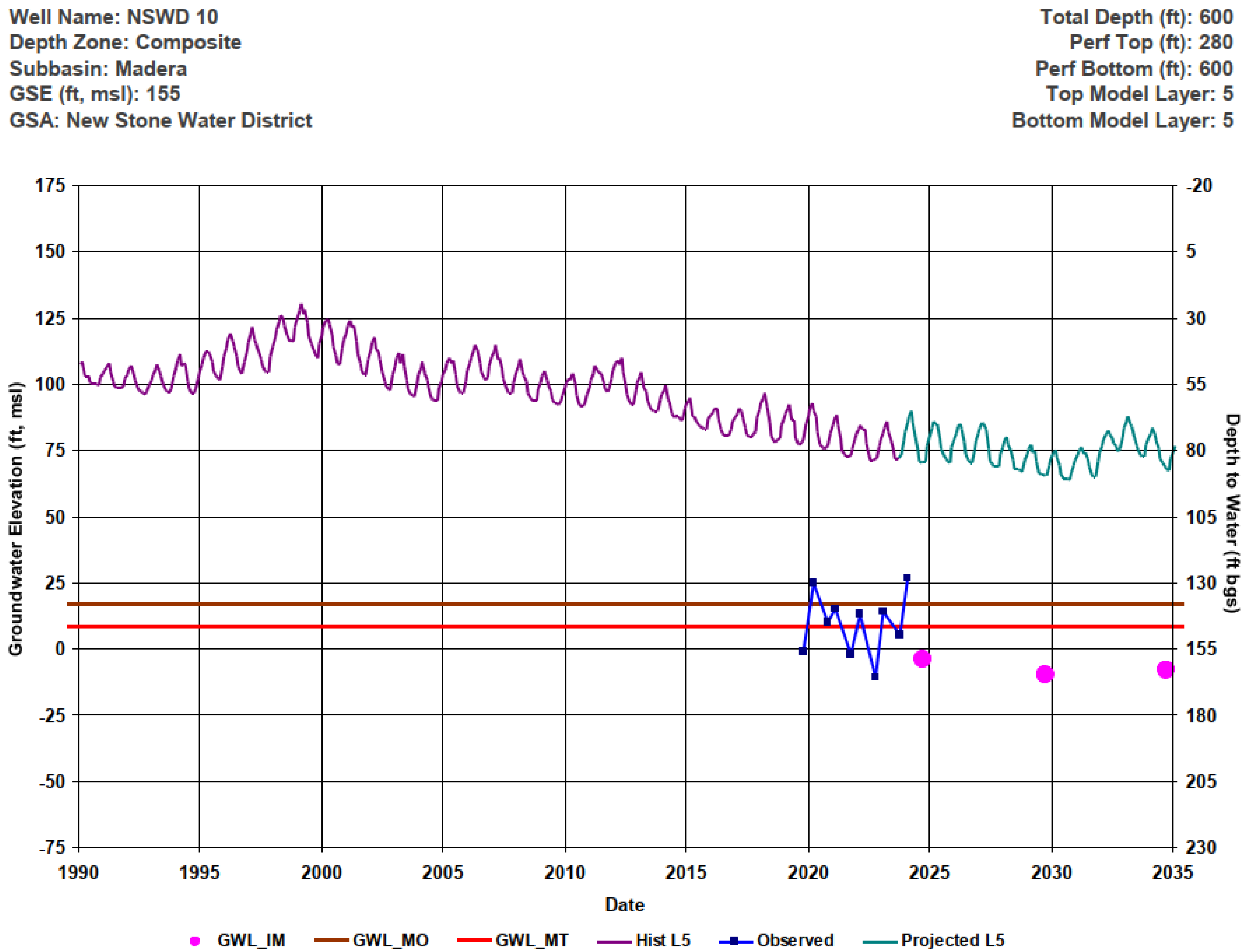


Figure 4-2 Modeled and Observed Groundwater Elevation Hydrograph for Well NSWD 10

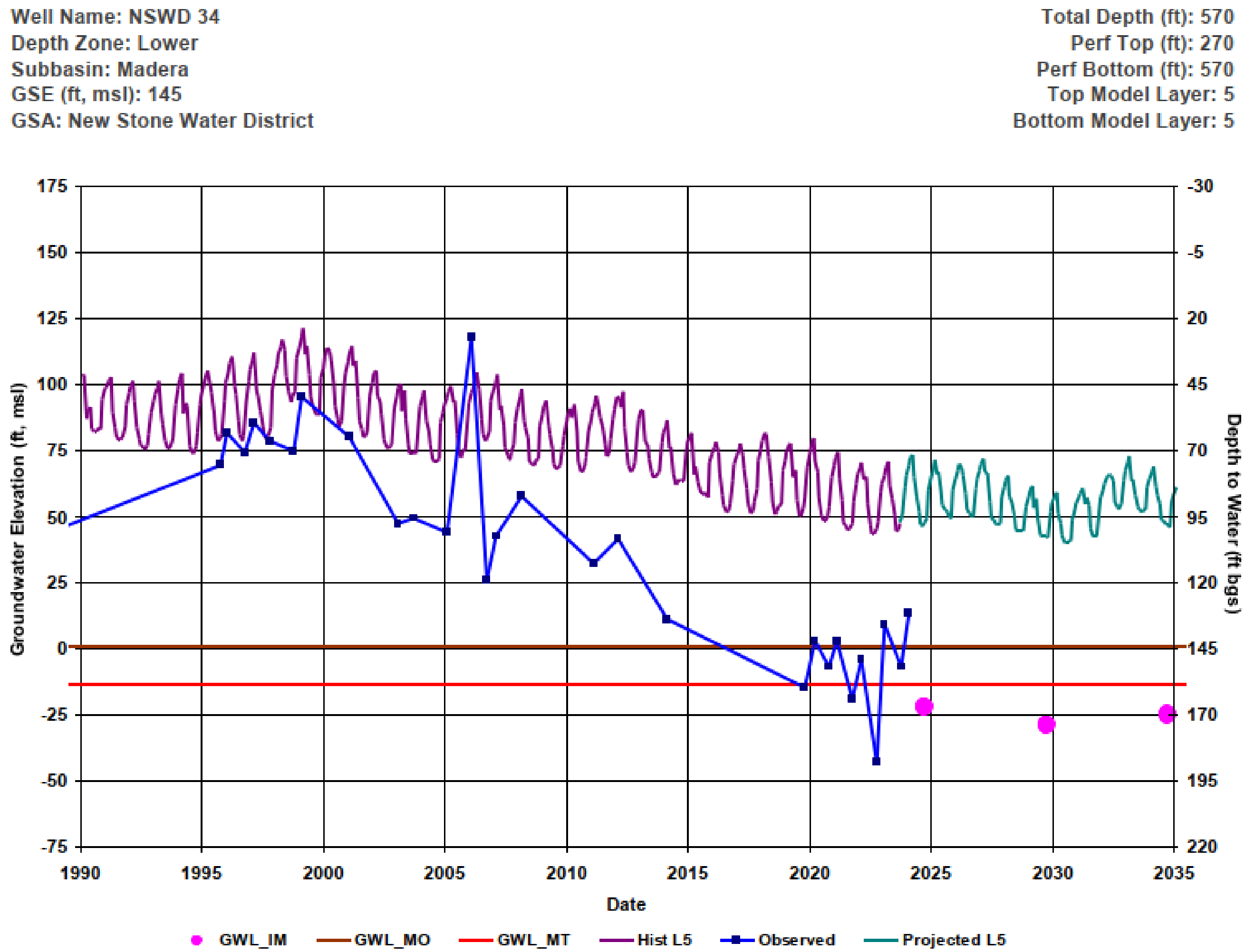


Figure 4-3 Modeled and Observed Groundwater Elevation Hydrograph for Well NSWD 34

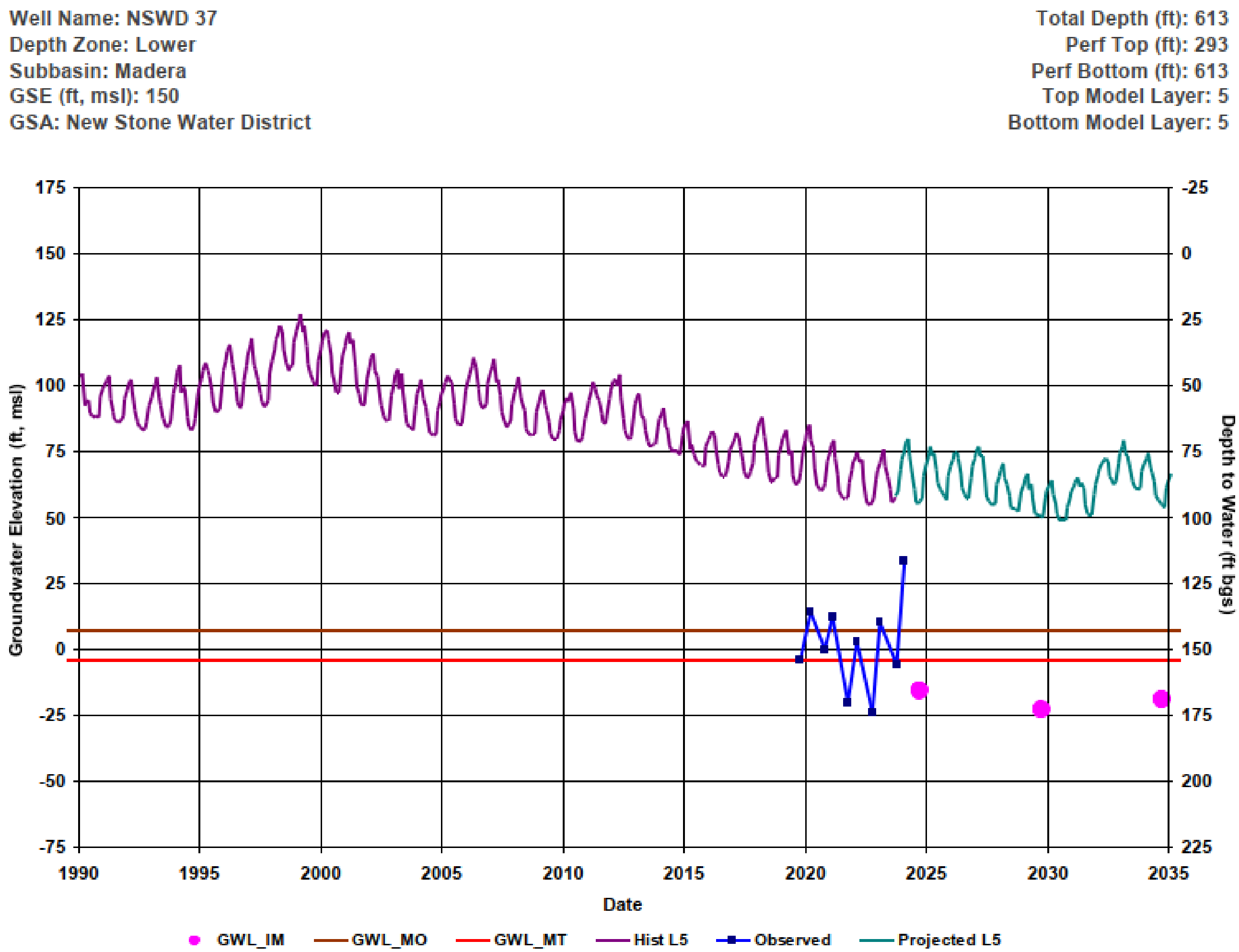


Figure 4-4 Modeled and Observed Groundwater Elevation Hydrograph for Well NSWD 37

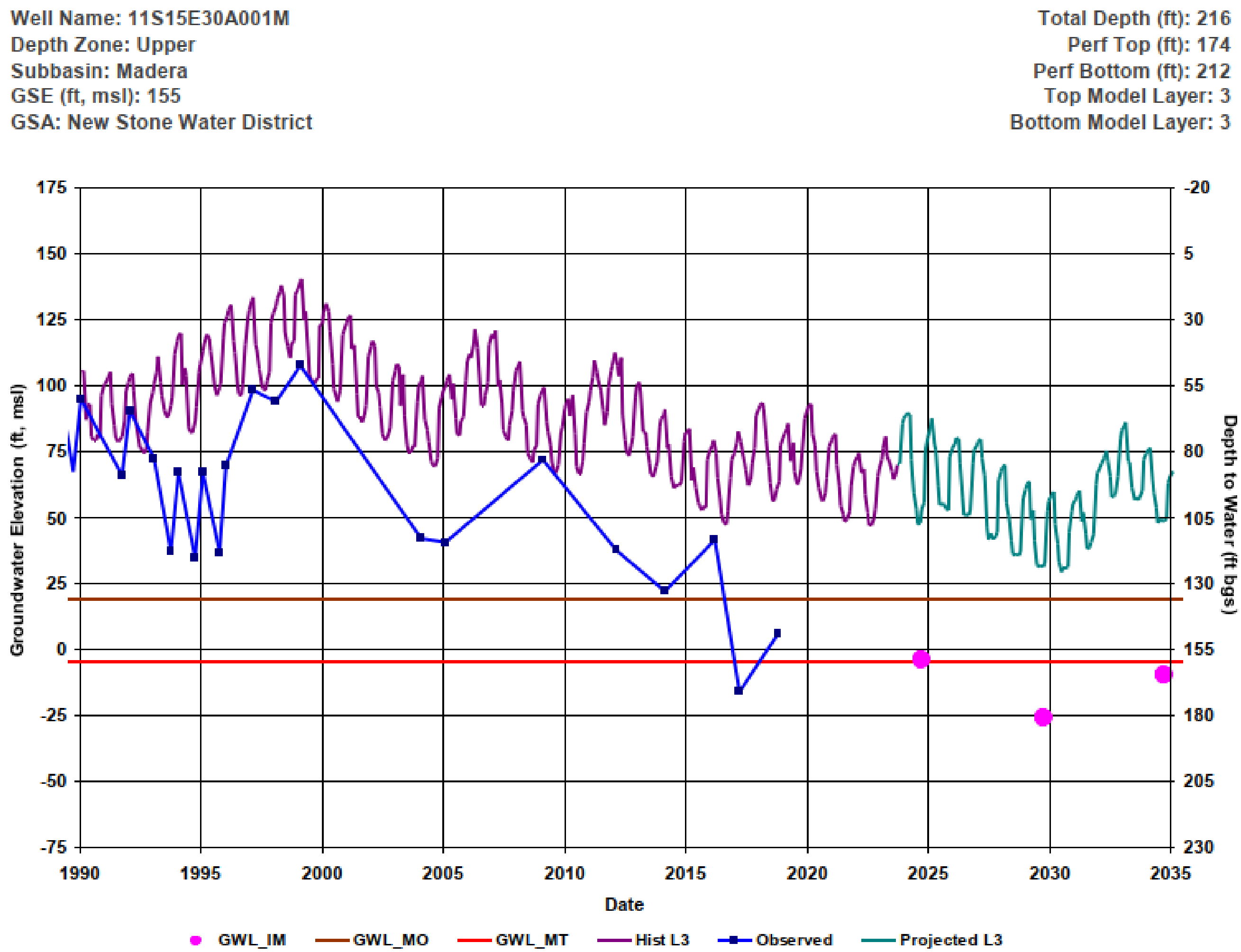


Figure 4-5 Modeled and Observed Groundwater Elevation Hydrograph for Well 11S15E30A001M

4.2.3.2 Operational Flexibility

Operational flexibility is considered the difference between the measurable objective and the minimum threshold. It allows for variation in groundwater levels due to seasonal and yearly variations. Drought years may cause pumping to increase, but wet years may bring enough opportunity to recharge what was lost. The operational flexibility for each well in the District will vary based on current groundwater levels and rate of decline. Most areas in the GSA will have plenty of operational flexibility during drought years; however, due to heavy pumping on the north side of the district, groundwater levels decline at a faster rate.

4.2.3.3 Path to achieve Measurable Objectives

Current groundwater elevations will be compared to the sustainable management criteria for each representative monitoring well to determine if the Plan is successful. To achieve the goals laid out for groundwater levels in the Subbasin, NSWD, and all GSAs must effectively implement projects and management actions. The measurable objective for each of the wells was set with interim milestones in mind for every 5 years over the Implementation Period from 2020 to 2035, at years 2025, 2030, and 2035, through review and evaluation of measured groundwater level data and future projected fluctuations in groundwater levels utilizing the numerical groundwater model, which simulated implementation of projects and management actions.

4.2.4 Interim Milestones

Interim milestones for groundwater levels were established at five-year intervals over the Implementation Period from 2020 to 2035, at years 2025, 2030, and 2035, through review and evaluation of measured groundwater level data and future projected fluctuations in groundwater levels utilizing the numerical groundwater model, which simulated implementation of projects and management actions. IMs were set at the Fall 2024, 2029, and 2034 simulated water levels for 2025, 2030, and 2035, respectively. Offsets between historically observed and modeled data were accounted for, as needed, based on Fall observed and modeled groundwater levels. Offsets between historically observed and modeled data were accounted for, as needed, based on Fall observed and modeled groundwater levels. Interim milestones for groundwater levels for each representative monitoring well are summarized in **Table 4-4**, along with the MTs and MOs. In all cases, the Interim Milestones gradually increase over time (i.e., higher groundwater elevations).

Table 4-4 Summary of Water Level SMCs

Well ID	*Minimum Threshold*	*Measurable Objective*	Interim Milestones		
	Water Elevation (msl)	*Water Elevation (msl)*	2025	2030	2035
10	8	17	-4	-10	-8
34	-14	1	-22	-29	-25
37	-4	7	-16	-23	-19
11S15E30A001M	--5	19	-4	-26	-10

4.2.4.1 Impact of Groundwater Level IM on Groundwater Quality

The relationship between changes in groundwater levels and groundwater quality is difficult to quantify due to the many additional variables that may be involved and may affect historical trends between levels and quality (e.g., variability in recharge quantities, land surface management activities). However, some studies have been conducted that document investigations into how TDS, nitrate, and arsenic may be affected by fluctuations in groundwater levels and are summarized in the following paragraphs.

TDS: A study of a project area in Poland (Blaszyk and Gorski, 1981) suggests that TDS increases can occur via introduction of oxygen to the hydrogeochemical environment during pumping, which oxidizes sulfur compounds to produce acid the increases solubility of various chemical compounds, thereby leading to potential for increases in TDS. A USGS (2018) study concluded that TDS concentrations in the San Joaquin Valley have increased by an average of about 100 mg/L in the last 100 years. This increase in TDS was attributed primarily to irrigated agricultural activities at the land surface and associated recharge of irrigation water. While the primary cause of overall increases in TDS was attributed to land surface activities (and not changes in groundwater levels), the study concluded that declining groundwater levels from municipal and agricultural pumping served to cause shallow groundwater with higher TDS to migrate vertically downward. The study further concluded that continued municipal and agricultural pumping will likely lead to higher TDS concentrations in deeper groundwater in the future.

Nitrate: A USGS study (Levy et.al., 2021) indicated the detection frequency of high nitrate (defined as greater than 5 mg/L as N in the study) in the San Joaquin Valley that was episodically higher during droughts and superimposed on a long-term upwards trend. Wells with long-term nitrate records indicate a tendency for lower concentrations during wet periods such as 1993-1999, 2010-2011, and 2016-2017. The study goes on to suggest that drought/overdraft conditions with declining groundwater levels may cause higher concentrations of nitrate in the shallower zone to migrate vertically downward to enter well screens in deeper zones, thereby resulting in overall contribution of a higher proportion of modern high nitrate groundwater to wells as groundwater levels decline.

Arsenic: A Stanford study (Smith et.al., 2018) suggests higher arsenic concentrations residing in clay layers within aquifers (interbeds) may be released in association with groundwater pumping that causes compaction of clay layers. Another USGS study (Haugen, et.al., 2021) found both increasing and decreasing trends in arsenic: decreasing arsenic trends associated with groundwater pumping contributing younger more toxic groundwater, and increasing arsenic trends associated with higher pH and more reduced groundwater. More reduced groundwater tended to be associated with deeper wells along the San Joaquin Valley trough where aquifer materials are more fine-grained (favoring reducing conditions). A study by USGS and CDC (Lombard et.al., 2021) for domestic wells across the U.S. found an inverse relationship between precipitation and arsenic concentrations (decreasing precipitation tends to correlate with increasing arsenic concentrations) but a positive relationship between groundwater recharge and arsenic concentrations (i.e., increasing recharge correlates to increasing arsenic concentrations). The inverse relationship between precipitation and arsenic concentrations was interpreted to be related to climate regimes and pattern of higher arsenic concentrations in arid regions. They suggested the positive relationship of recharge and arsenic concentrations may be a function of reductive desorption and/or dissolution of arsenic from iron oxides, and/or a flushing of arsenic into groundwater with increased recharge. Regardless of the physical mechanism, the association of increased rainfall with increased recharge would tend to mean these two variables act in opposition to each other.

4.2.4.2 Impact of Groundwater Level IM on Subsidence

The total subsidence that may occur in the future is a combination of active subsidence caused by groundwater level declines to new lows and residual subsidence that may occur due to previous groundwater level declines from undeveloped (no pumping) conditions. The portion of total subsidence that occurs with any further groundwater level declines during the GSP implementation period prior to groundwater level stabilization and potential recovery with attainment of sustainable conditions would generally be associated with the active subsidence component.

4.2.4.3 Impact of Selected Measurable Objectives on Adjacent Basins

The MOs established for Subbasin provide a good basis for evaluation of anticipated impacts on adjacent subbasins from implementation of the GSP. This is because MOs are set to reflect the expected average groundwater levels to be maintained during the sustainability period. Ultimately, the potential for impacts on adjacent subbasins will be primarily a function of average water levels in the Madera Subbasin during the sustainability period, average water levels in adjacent subbasins during the sustainability period, and natural groundwater flow conditions that would be expected to occur at subbasin boundaries (e.g., pre-development groundwater flow conditions). The average groundwater levels expected for the Plan Area are reflected in the MOs. The MOs are higher than the MTs in the Madera Subbasin. MOs set for Madera Subbasin are based on Fall 2010 groundwater elevations, which is consistent with proposed Chowchilla Subbasin MOs and generally higher than MOs proposed in Delta-Mendota Subbasin and higher than DWR approved MOs in Kings Subbasin. In addition, groundwater model results indicate that the anticipated groundwater levels after 2040 will result in greatly reduced net subsurface inflow to the Plan Area from surrounding subbasins compared to historical net subsurface inflow. Therefore, the projects and management actions implemented for this GSP are expected to benefit adjacent subbasins (compared to historical conditions) and not hinder the ability of adjacent subbasins to be sustainable.

4.3 Groundwater Storage

4.3.1 Undesirable Results

4.3.1.1 Criteria to Define Undesirable Results

Regulation Requirement:

> **§354.26** (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

The chronic depletion of groundwater storage volume to a significant and unreasonable level is considered an undesirable result. The terms "significant and unreasonable" are not defined by regulations, rather the conditions leading to this classification are determined by the GSA, beneficial users, and the basin they are a part of. The process used to develop criteria for determining undesirable results began with the review of DWR well construction records for choosing monitoring wells and through discussions with stakeholders and landowners.

For NSWD GSA, the depletion of groundwater storage is considered significant and unreasonable. A calculation of the storage change necessary to cause an undesirable result has been done. However, large depletion of storage volume from a localized area may cause an undesirable result to occur at a lower storage change. Due to lack of well construction information throughout the basin, it is difficult to quantify storage change for undesirable results at such a localized scale. When more data becomes available during the implementation phase of this plan, undesirable results may be updated.

4.3.1.2 Evaluation of Multiple Minimum Thresholds

Regulation Requirement:

> **§354.26** (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Change in groundwater storage has been calculated using data and SMCs from the same four wells used for groundwater levels. A surface has been created across the GSA using GIS software in order to consider variation in groundwater elevation when calculating the minimum threshold of storage change.

4.3.2 Minimum Thresholds

Regulation Requirement:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.
(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Information and criteria used to determine a minimum threshold for groundwater storage includes the most recent available groundwater elevation data at the time of initial GSP development, specific yield data, and a GSA determined minimum threshold elevation. The groundwater level minimum threshold was determined to avoid undesirable results. Groundwater elevation data has been collected using DWR Water Data Library, and GIS software has been used to create surfaces for minimum thresholds and current levels. Specific yield data was analyzed for the water budget to determine historical storage change and safe yield. Refer to Section 3.3 for more information on specific yield data that was gathered.

4.3.2.1 Description of Minimum Thresholds

Regulation Requirement:

§354.28 (b) The description of minimum thresholds shall include the following:
(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.
(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.
§354.28 (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
(2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.

The minimum threshold for storage volume change was calculated by using the most recent available groundwater elevation contours at the time of initial GSP development (Spring 2012) and groundwater level minimum thresholds. The volume of groundwater storage depletion allowed before reaching the minimum threshold is approximately 132,000 AF. Since groundwater volume storage change is directly related to groundwater levels, depletion of storage volume to the minimum threshold will not cause an undesirable result to occur with regards to groundwater levels. From a groundwater storage perspective, it is reasonable to use the minimum threshold value set for groundwater level decline considering the total volume of storage in the aquifer below NSWD GSA boundaries is 440,000 AF. If storage declines to the minimum thresholds set for groundwater levels, less than 30% percent of total storage will have been depleted.

4.3.2.2 Selection of Minimum Thresholds to Avoid Undesirable Results

By using criteria set for groundwater levels to calculate thresholds for storage change, undesirable results will be avoided. The potential for undesirable results arises if all storage change is coming from a localized area, in which case wells may go dry.

4.3.2.3 Impact of Minimum Thresholds on Water Uses and Users

Due to the nature of infrastructure development and program implementation, groundwater storage will continue to decrease at current rates in the next few years before programs have an effect on the stabilization of levels. Decrease in groundwater storage will continue to increase the cost of energy for pumping. If minimum threshold levels are reached, there will be some wells that go dry and will require deepening to reach the water table.

4.3.2.4 Measurement of Minimum Thresholds

Measurement of groundwater storage change will continue to be through the use of groundwater elevation contours created from a network of monitoring wells with available data. Storage change will be calculated on an annual basis using the seasonal high (spring) measurements and the specific yield. Annual estimates are presented in the NSWD GSA Annual Reports. For more information regarding the wells in the monitoring network, refer to **Chapter 5**.

4.3.3 Measurable Objectives

Regulation Requirement:

> **§354.30** (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.
> (b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
> (c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
> (d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.
> (e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
> (f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
> (g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for finding of inadequacy of the Plan.

4.3.3.1 Description of Measurable Objectives

The measurable objective for change in groundwater storage volume is to become stable by the end of the 20-year implementation phase. After 2040, the District should see a net zero change in groundwater storage on a 10-year rolling average basis. The total volume of storage depletion between available water levels (Spring 2012) and 2040 measurable objectives was calculated similarly to minimum thresholds. Using surfaces created by GIS software, the difference between current levels and 2040 measurable objectives was calculated and multiplied by the specific yield. The volume of storage depletion allowed before reaching the measurable objective is approximately 20,000 AF.

4.3.3.2 Operational Flexibility

Operational flexibility is the difference between the measurable objective and minimum threshold. As previously mentioned, the success of meeting the objective is based on a rolling average, allowing room for expected overdraft in dry years as long as wet years allow for recharge. There is approximately 42,000 AF of allowable storage change between the measurable objective and minimum threshold.

4.3.3.3 Path to Achieve Measurable Objectives

The measurable objective for groundwater storage change was set with interim milestones in mind for every 5 years. It is the intent of the GSA to mitigate the rate of groundwater level decline by 10 percent in 2025 and an additional 30 percent at each of the following five-year intervals (2030, 2035, and 2040). The same interim goals apply to storage change as well. Mitigation of decline will be achieved through implementation of projects to bring in additional water supply and programs that will decrease water demand. Programs may be adjusted over the implementation period in response to conditions and whether or not Plan goals are being met.

4.3.4 Interim Milestones

Groundwater levels are being used as a proxy for groundwater storage; therefore, the interim milestones for reduction in groundwater storage are based on the interim milestones for chronic lowering of groundwater levels.

4.4 Groundwater Quality

4.4.1 Sustainability Goal

Regulation Requirements:

§354.24 Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

The groundwater quality sustainability goal is to maintain the overall groundwater quality within the NSWD GSA at its general current state or to improve it. Contaminant plumes in groundwater can also be a significant factor in groundwater usage and no known plumes have been identified within the GSA, and the GSA is unaware of any activities, nor point sources that may have the potential to degrade water quality conditions within the GSA.

4.4.2 Undesirable Results

4.4.2.1 Criteria to Define Undesirable Results

Regulation Requirement:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

An undesirable result for degraded groundwater quality in the Subbasin is defined as 10 percent of wells in the Subbasin above the minimum threshold for the same constituent due to projects and/or management actions and overall groundwater extraction, based on the average of the most recent three-year period. Subbasin groundwater conditions that would result in significant and unreasonable degraded water quality is from implementation of a GSP project or management action or groundwater extraction that causes concentrations of key groundwater quality constituents to exceed MTs, which are set at the MCLs for drinking water for identified key constituents (10 mg/L for nitrate as nitrogen; 500 mg/L for TDS; 10 µg/L for arsenic). When existing or historical concentrations for the key constituents already exceed the MCL, the MT is set at the baseline concentration plus 20 percent.

Although distributed areas of degraded groundwater quality from non-point source contamination exist in the Plan Area (most notably elevated nitrate concentrations), there are no current documented large-scale contaminant plumes in the regional groundwater aquifers. Municipal and domestic supply (MUN) is a designated beneficial use for groundwater in the Subbasin, outside of the NSWD GSA Plan Area; therefore, groundwater quality degradation resulting from a GSP project or management action or overall groundwater extraction is considered significant and unreasonable based on adverse impacts to this beneficial use. Locally defined significant and unreasonable conditions were determined based on discussion with GSA staff and technical representatives, and input received from interested stakeholders and the public through public meetings and through individual stakeholder input to various GSA representatives. Significant and unreasonable degradation of water quality occurs when beneficial uses for groundwater are adversely impacted by constituent concentrations increasing to levels above the drinking water MCLs for one of the key constituents (nitrate, arsenic, TDS) previously identified in **Chapter 3** (Basin Setting) of the GSP at indicator wells in the representative groundwater quality monitoring network due to implementation of a GSP project or management action or overall groundwater extraction. When existing or historical concentrations for the key constituents already exceed the MCL, the MT is set at the baseline concentration plus 20 percent.

4.4.2.2 Causes of Groundwater Conditions That Could Lead to Undesirable Results

Regulation Requirements:

> **§354.26** (b) The description of undesirable results shall include the following:
> (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.
> (2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.
> (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

Causes of groundwater conditions that could lead to Undesirable Results include:

- Adverse impacts resulting from a GSP Project or Management Action;
- Groundwater extraction;
- The accumulated effects of nutrient application and other farming practices;
- One-time releases from sources of chemical contamination such as from fuel storage tanks;
- The accumulated effects of regulated and unregulated waste discharge streams from wastewater treatment facilities, septic systems, and food processors; and
- DBCP, EDB, and Trichloroethylene (TCE) are legacy contaminants and thus no future degradation from them is foreseen, rather efforts include managing current contamination.

No known information exists that suggests there are current groundwater conditions that will lead to undesirable results within the GSA.

4.4.2.3 Evaluation of Multiple Minimum Thresholds

Regulation Requirement:

§354.26 (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Multiple Minimum thresholds are not appropriate at this time.

4.4.3 Minimum Thresholds

Regulation Requirement:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.
(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Currently, NSWD GSA is not experiencing any water quality conditions causing crop yield to be noticeably affected by groundwater management practices. Data will continue to be gathered for determining current nutrient concentrations based on groundwater depth and location. Findings will be discussed in NSWD GSA Annual Reports. As discussed in **Section 3.2.5**, a couple of samples in or near the District have shown elevated concentrations of nitrates and electrical conductivity, but the majority of the region is generally below MCLs. Depth to water containing elevated concentrations of constituents is difficult to determine and will be monitored more thoroughly moving forward.

The MTs for Degraded Water Quality across the Subbasin are set at the following MCLs for drinking water for the identified key constituents of nitrate as nitrogen, TDS, and arsenic.

- Nitrate as nitrogen = 10 mg/L, or baseline concentration plus 20%
- TDS = 500 mg/L, or baseline concentration plus 20%
- Arsenic = 10 μg/L, or baseline concentration plus 20%

When existing or historical concentrations for the key constituents already exceed the MCL, the MT is set at the baseline concentration plus 20 percent. When current or historical water quality for the key constituents has not been measured, the MT will be set as the MCL and will be adjusted if needed.

Table 4-5 Summary of Groundwater Quality Minimum Thresholds for Representative Monitoring Sites

Well ID	Well Type	MT Arsenic Concentration (µg/L)	MT Nitrate Concentration (mg/L)	MT TDS Concentration (mg/L)
NSWD 10	Production	10†	10†	500†
NSWD 34	Production	10†	10†	500†
NSWD 37	Production	10†	10†	500†
11S15E30A001	Production	10†	10†	500†

†Values will be confirmed and/or adjusted as needed once enough data are collected

4.4.3.1 Description of Minimum Thresholds

Regulation Requirement:

§354.28 (b) The description of minimum thresholds shall include the following:
(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.
(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.
§354.28 (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be used on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

The methodology to develop MTs for nitrate, arsenic, and TDS is based on the objective of protecting all designated beneficial uses from significant and unreasonable adverse impacts from implementation of GSP PMAs or overall groundwater extraction. In accordance with the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (RWQCB, 2018), groundwater in the Subbasin is considered suitable or potentially suitable for municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply beneficial uses. From a groundwater quality standpoint, the municipal and domestic supply beneficial use is the most restrictive with the RWQCB (2018) water quality objectives linked to drinking water MCLs. As a result, the MTs for groundwater quality set for each of the three identified key water quality constituents (nitrate, arsenic, TDS) are the respective MCL values, except for cases where existing or historical concentrations for these constituents already exceed the MCL. When existing or historical concentrations for the key constituents already exceed the MCL, the MT is set at the baseline concentration plus 20 percent. When current or historical water quality for the key constituents has not been measured, the MT will be set as the MCL and will be adjusted if needed.

A review of literature described in the Joint GSP identified that it is reasonable and justified to set the MT by adding 20% to groundwater quality RMS with existing or baseline concentrations above the MCL. This methodology provides a relatively conservative and narrow range to account for the uncertainties in several variables that may affect lab reported concentrations for a key constituent. Using this methodology will help avoid the occurrence of false positives in which expected variability in sample collection and/or lab analyses results in developing a conclusion that undesirable results have occurred when there is actually no (or a very minimal) increase in concentrations. In addition, a 20% increase when baseline concentrations exceed the MCL (e.g., baseline of 15 mg/L increases to between 15 and 18 mg/L for nitrate) represents a relatively small net increase that would not be expected to have significant and unreasonable effects. Finally, the selection of the greater of the MCL or 20% increase is intended to avoid more false positives that could easily result when a baseline concentration is very close to but less than the MCL (e.g., a baseline arsenic concentration at 9.8 ug/L only needs to have sample results that increase by 3% to exceed the MCL).

Water quality characteristics can have varying effects on agricultural practices depending on soil type, irrigation method, and crop type. Land in the GSA is almost solely used for agriculture, thus agricultural water quality standards will also be considered in the GSA as agriculture is the primary focus and beneficial use. Furthermore, grapes are the main crop grown in the GSA. According to Ayers & Westcot (1985), grapes are sensitive to excess nitrogen in irrigation water which may cause late maturity with lower yields and a lower sugar content. In Libya, no fruiting occurred in grapes when water containing greater than 50 mg/L of nitrogen was applied; however, greater than 30 mg/L can cause severe effects on crop growth as well. In general, grapes are also moderately sensitive to salinity, having only approximately 75 percent of their yield potential when using irrigation water with an EC of 2.7 dS/m (2,700 µmhos/cm).

Based on the information discussed above, and in the interest of growers within the GSA, water quality minimum thresholds have been set as follows:

Agricultural Water Quality:

- *Nitrate as Nitrogen (NO3-N):* Concentration levels should not exceed 45 mg/L for applied irrigation water.
- *Electrical Conductivity:* Concentration levels should not exceed levels causing an electrical conductivity of 2,700 µmhos/cm for applied water.

4.4.3.2 Relationship for Each Sustainability Indicator

Regulation Requirements:

> **§354.28** (d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Groundwater quality thresholds have the potential to be impacted by undesirable results in other sustainability indicators. For example, low groundwater elevation could cause poor quality groundwater to flow upwards towards wells. Similarly, the projects and management actions intended to address other sustainability indicators may have both positive and negative impacts on groundwater quality. Recharge projects have the potential to flush constituents of concern from the vadose zone to the water table, thus impacting water quality. However, recharge also has the potential to dilute the concentrations of these constituents, providing a net positive benefit. Ongoing monitoring of groundwater quality will help determine if adaptive management strategies are necessary for project implementation.

Protecting groundwater quality is critically important to all who depend upon the groundwater resource, particularly drinking water and agricultural uses. A significant and unreasonable condition of degraded water quality is exceeding regulatory limits for constituents of concern in wells due to actions proposed in the GSP. Water quality could be affected through three processes:

a. Low groundwater elevations in an area could cause deeper, poor-quality groundwater to flow upward into existing wells. Groundwater elevation MTs are generally set well above depths to reduced sediments that may provide poorer quality water with respect to naturally occurring constituents (e.g., arsenic), thereby minimizing opportunities for poor quality groundwater flowing into wells. The combination of the groundwater elevation MTs and Subbasin Domestic Well Mitigation Program will avoid poor-quality water (resulting directly from GSP actions) from impacting existing wells.
b. Changes in groundwater elevation as a result of PMAs implemented to achieve sustainability could change groundwater gradients, which could cause poor quality groundwater (i.e., contaminant plumes) from documented contaminant sites to flow towards wells that would not have otherwise been impacted. These groundwater gradients, however, are dependent on differences between groundwater elevations, not in the groundwater elevations themselves. Therefore, the MT for groundwater elevations do not directly lead to significant and unreasonable degradation of groundwater quality in wells. There are no known point source contaminates in the GSA. Smaller localized and shallow contaminant site plumes have been documented in parts of the Subbasin.

Subbasin GSP PMAs include a number of recharge basins and Flood-MAR programs that will recharge surface water available in wet years through the vadose zone (unsaturated zone about the regional water table) to the water table. Such PMAs have the potential to flush existing constituents of concern (i.e., TDS, nitrates) from the vadose zone to the water table. While such flushing has been occurring and will continue to occur naturally (e.g., via rainfall recharge, excess irrigation recharge) without such GSP PMAs, it may be the case that GSP PMAs temporarily increase the rate of vadose zone flushing and result in temporarily higher constituent concentrations in groundwater prior to eventual dilution (due to recharge of higher quality water) and a reduction in these constituent concentrations. Overall, it is anticipated that there will likely be an overall net benefit to groundwater quality from GSP PMAs; however, the overall groundwater monitoring program developed for this GSP plus additional site-specific monitoring if determined to be needed (e.g., additional groundwater or potentially soil sampling), will be utilized to evaluate need for adaptive management related to GSP recharge projects.

4.4.3.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Minimum thresholds were selected to protect crop production for farmers and to prevent the necessity of paying for water treatment. If water quality is maintained at or above minimum threshold standards, then significant and unreasonable decline in crop yield will be avoided. Keep in mind that the concentration levels listed above are only meant to be short term. If minimum thresholds have been reached, it is highly recommended that action is taken to reverse the trend and reach the measurable objective.

4.4.3.4 Impact of Minimum Thresholds on Water Uses and Users

If water quality is allowed to deteriorate to levels set by minimum thresholds, growers may experience a decrease in crop yield and/or crop quality. Poor water quality would cause a buildup of salts and nitrates in the surface layers of soil.

The methodology to develop minimum thresholds for groundwater quality is based on the objective of protecting all designated beneficial uses from significant and unreasonable adverse impacts from implementation of GSP projects and/or management actions or overall groundwater extraction. From a groundwater quality standpoint, the municipal and domestic supply beneficial use is the most restrictive with

Basin Plan water quality objectives linked to drinking water MCLs. As a result, the MTs for groundwater quality set for each of the three identified key water quality constituents (nitrate, arsenic, TDS) are the respective MCL values, except for cases where existing or historical concentrations for these constituents already exceed the MCL. When existing or historical concentrations for the key constituents already exceed the MCL, the MT is set at the baseline concentration plus 20 percent.

4.4.3.5 Measurement of Minimum Thresholds

Water quality data will be monitored and sampled for analysis according to the monitoring network, as discussed in **Chapter 5**. This includes sampling every year for analysis of arsenic, nitrate as nitrogen, and total dissolved solids. Samples will be taken during the summer pumping season.

4.4.4 Measurable Objectives

Regulation Requirement:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.
(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.
(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for finding of inadequacy of the Plan.

4.4.4.1 Description of Measurable Objectives

Measurable Objectives for water quality will be based on a baseline constituent concentration that will be defined during the 2025 Periodic Evaluation. NSWD GSA is coordinating with the other Madera Subbasin GSAs to determine a standard approach to defining this baseline. Measurable Objectives will be defined for the RMWs in the NSWD GSA.

4.4.4.2 Operational Flexibility.

The operational flexibility is considered the difference between the minimum threshold and the measurable objective.

4.4.4.3 Path to Achieve Measurable Objectives

As mentioned, there is a lack of current and historical data on groundwater quality in the District. However, the data available shows that NSWD GSA is currently not impacting agricultural yield. The path to remain operating within objectives includes a monitoring network for collecting data on a yearly basis and adjusting management strategies as needed at each five-year milestone. Being a part of the East San Joaquin Water Quality Coalition, which exists to help growers monitor and manage nutrient pollution, will aid NSWD GSA in achieving water quality goals. Water quality data will be evaluated and provided with future Annual Reports and measurable objectives and minimum thresholds will be considered for relevance with each Periodic Evaluation.

4.4.5 Interim Milestones

The interim milestones for the groundwater quality sustainability indicator are the same as the MOs and include ensuring that during the implementation period, GSP PMAs and overall groundwater extraction do not lead to degradation of existing groundwater quality conditions that would make groundwater unsuitable for the most restrictive beneficial use of municipal and domestic supply.

4.5 Land Subsidence

4.5.1 Undesirable Results

If land subsidence occurs to significant and unreasonable levels, it will be considered an undesirable result. The terms "significant and unreasonable" are not defined by regulations, rather the conditions leading to this classification are determined by the GSA, beneficial users, and the basin they are a part of. An undesirable result in the Subbasin is defined as occurring when the average subsidence across greater than 25 percent of representative monitoring sites in the Subbasin exceed the minimum threshold for two consecutive years. Conditions that may lead to an undesirable result are excessive overall average annual groundwater pumping, especially below where the Corcoran Clay exists, extensive drought, and other outflows from the Subbasin that exceed average annual inflows. Critical infrastructure in the New Stone Water District GSP Region includes the Chowchilla Bypass and Eastside Bypass, or distribution systems, wells, and pumps. Critical infrastructure in the Madera Subbasin is further discussed in Chapter 3 of the Madera Subbasin Joint GSP. The process used to develop criteria for determining undesirable results in the Subbasin began with discussions with stakeholders and landowners.

Conditions that lead to an undesirable result of a significant and unreasonable amount for land subsidence have historically occurred during periods with groundwater pumping in excess of sustainable yield in areas where critical infrastructure exists. This is of particular concern in the Lower Aquifer where the Corcoran Clay exists. Conditions that may lead to an undesirable result of a significant and unreasonable amount of land subsidence include the following:

- Localized pumping. Even if regional pumping is maintained within the sustainable yield, a cluster (or pumping centers) of high-capacity wells pumping below the Corcoran Clay may cause excessive localized drawdowns that lead to undesirable results in specific areas.
- Extensive, unanticipated drought. MTs were established to avoid causing and observing subsidence after 2040. However, extensive, unanticipated droughts may lead to increased groundwater extraction due to limited surface water supply. This may result in lowered groundwater elevations and potential subsidence.

The SGMA regulations state that the subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. Significant continued subsidence that impacts infrastructure in the Subbasin is unacceptable. Historical water level data and modeling results indicate that a significant shift within the

Subbasin in pumping from the Lower Aquifer to the Upper Aquifer will be necessary to achieve land subsidence MT thresholds. In addition, several successful recharge projects and overall demand reduction (as described elsewhere in this GSP) in this Subbasin and neighboring subbasins will also be needed to meet subsidence MTs.

Land subsidence SMCs and the significant and unreasonable impacts of land subsidence were re-evaluated by the Subbasin GSAs in 2024 with input from interested stakeholders and members of the public. Agencies with critical infrastructure in the Subbasin were interviewed in Summer 2024 to confirm identification of their critical infrastructure, further document observed and possible impacts attributable to land subsidence and assess the potential future impacts of land subsidence. **Table 4-6** lists the agencies contacted, the identified critical infrastructure, and reported or possible impacts.

The Madera Subbasin GSAs, with support from the agencies interviewed, are proposing to establish a Subbasin Critical Infrastructure Operator Group. Although discussions are ongoing, the Critical Infrastructure Operator Group is planning to meet annually to provide updates on any potential critical infrastructure impacts related to subsidence, coordinate ongoing PMA implementation, and to discuss any potential critical infrastructure mitigation concerns.

Table 4-6 Summary of Results from Critical Infrastructure and Subsidence Interviews

Agency	Identified Critical Infrastructure in Madera Subbasin	Reported Impacts in the Madera Subbasin	Possible Impacts	Interview Date
Madera Irrigation District	Supply canals, pipelines, diversion infrastructure.	None.	None.	6/19/2024
Madera Water District	Pipelines, diversion infrastructure.	None.	None.	6/19/2024
City of Madera (Public Works)	Potable water system, groundwater wells, wastewater system, roads, stormwater/floodwater control infrastructure, Madera Municipal Airport.	None.	None.	6/25/2024
County of Madera (Public Works)	Roads, bridges, stormwater/floodwater control infrastructure, potable water system, sewer water system, wells.	Protrusion of urban wells out of the ground.	Collapsed urban well casings.	7/8/2024
Central Valley Flood Protection Board	Control structures, Drop structures, and Levees within the Chowchilla Bypass, San Joaquin River, Fresno River, Ash Slough, and Berenda Slough	Washouts and scouring, loss of freeboard, impacts to control structures and drop structures.	Loss of freeboard, loss of capacity to move flood flows.	6/26/2024
San Joaquin River Restoration Program	Wells, fish bypasses/ladders	None.	Change in water stage and velocities.	7/2/2024
Lower San Joaquin Levee District	Control structures, Drop structures, and Levees within the San Joaquin River, and Chowchilla Bypass,	Impacts to drop structures, washouts and scouring.	Impacts to drop structures on Fresno River and Ash Slough, worsening scouring on the Chowchilla Bypass.	6/24/2024
New Stone Water District	Chowchilla Bypass, Eastside Bypass, distribution systems, wells, pumps.	None.	Damage to wells and pipelines, loss of conveyance in Chowchilla Bypass and Eastside Bypass.	8/20/2024
Root Creek Water District	San Joaquin River	None.	None.	6/10/2024
Gravelly Ford Water District	Agricultural wells, San Joaquin River lift pump station, Gravelly Ford Canal, road crossings, San Joaquin River.	None.	Damage to wells, damage to pump stations, reduction in canal capacity, pipeline failure.	7/24/2024

4.5.1.1 Criteria to Define Undesirable Results

Regulation Requirement:

> **§354.26** (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

In the Madera Subbasin, land subsidence is considered significant and unreasonable when critical infrastructure, such as the Chowchilla Bypass in NSWD GSA, or distribution systems, wells, and pumps begin to fail or take critical damage. This land subsidence within the Subbasin is a result of excessive overall average annual groundwater pumping and other outflows from the Plan area that exceed average annual inflows. As discussed in Section 3.2.6., land subsidence in the Madera Subbasin and neighboring subbasins has caused adjacent water-delivery and flood-control canals such as the Chowchilla and Eastside Bypasses to have reduced freeboard and structural damages, requiring millions of dollars in repairs. Even though the hydraulic analysis on the Chowchilla Bypass determined that the capacity of the channel would remain above design capacity if subsidence were to continue into 2026, to avoid more costs and repairs in the future, the Subbasin has set minimum thresholds at 0 feet/year after 2040 to prevent undesirable results.

4.5.1.2 Evaluation of Multiple Minimum Thresholds

Regulation Requirement:

> **§354.26** (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Monitoring for land subsidence will be done by evaluating data released twice a year from USBR SJRRP stations and the continuous GPS station by UNAVCO. Subsidence rates will be compared to the interim milestones, measurable objectives, and minimum thresholds set across the Subbasin. Monitoring sites for these programs may or may not be within NSWD GSA boundaries; however, the data is adequate for covering the District using contouring and interpolation techniques.

4.5.2 Minimum Thresholds

Regulation Requirement:

> **§354.28** (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.
> (d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

The cause of Subbasin groundwater conditions that would result in significant and unreasonable land subsidence is excessive overall average annual groundwater pumping and other outflows from the Subbasin, primarily from the Lower Aquifer, that exceed average annual inflows.

Significant and unreasonable conditions were determined based on discussions with GSAs and through individual stakeholder outreach. These subsidence interviews resulted in a coordinated MT of no additional inelastic land subsidence, or 0 feet/year, after 2040 (subject to subsidence station uncertainty of +/- 0.16 feet/year), consistent across the Subbasin.

Undesirable results for land subsidence are significant and unreasonable adverse impacts from land subsidence on critical surface infrastructure that impair the operation and function of the infrastructure. Critical infrastructure previously identified include the Chowchilla Bypass and Eastside Bypass. According to the hydraulic analysis on the Chowchilla Bypass, if subsidence is to continue into 2026 as it has, the capacity of this channel would remain above design capacity due to the steepening slope. Despite this determination, MTs for land subsidence are set at 0 feet/year after 2040 and were established to reduce pumping from the Lower Aquifer with the goal of mitigating subsidence and preventing adverse impacts to surrounding critical infrastructure. It should be recognized that land subsidence within the Subbasin can also be attributed to actions in neighboring subbasins. The ability to meet the minimum threshold and interim milestones in the Subbasin is dependent on effective implementation of projects and management actions in the Subbasin and neighboring subbasins.

4.5.2.1 Description of Minimum Thresholds

Regulation Requirement:

§354.28 (b) The description of minimum thresholds shall include the following:
(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.
(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.
§354.28 (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
(5) Land Subsidence. 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. Minimum thresholds for land subsidence shall be supported by the following:
(A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including and explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.
(B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

In the Madera Subbasin, Land subsidence MTs were set to prevent undesirable results and minimize inelastic land subsidence attributable to groundwater extraction, with no additional subsidence after 2040. The MTs were set recognizing that land subsidence within the Madera Subbasin is also contributed to by actions in neighboring subbasins. The land subsidence MT is set at a rate of 0 feet/year. However, due to uncertainty in land subsidence measurement accuracy, the SJRRP has reported that these data have a vertical accuracy of ±2.5 cm (Reclamation, 2011). Since the Subbasin is using rates to establish sustainable management criteria for subsidence, there is an approximate error of ±5 cm/year, or ±0.16 feet/year. Therefore, a rate of subsidence less than -0.16 feet/year (less negative) is considered in compliance with the MT of 0 feet/year, as this rate is within the uncertainty of the measurements. The most significant subsidence is occurring directly to the north of NSWD GSA outside of the GSA. The Eastside Bypass and Sand Slough are experiencing decreased design capacity due to this subsidence; however, the Chowchilla Bypass maintains its capacity. **Figure 4-6** displays the recent historical land subsidence that was used in setting the minimum thresholds.

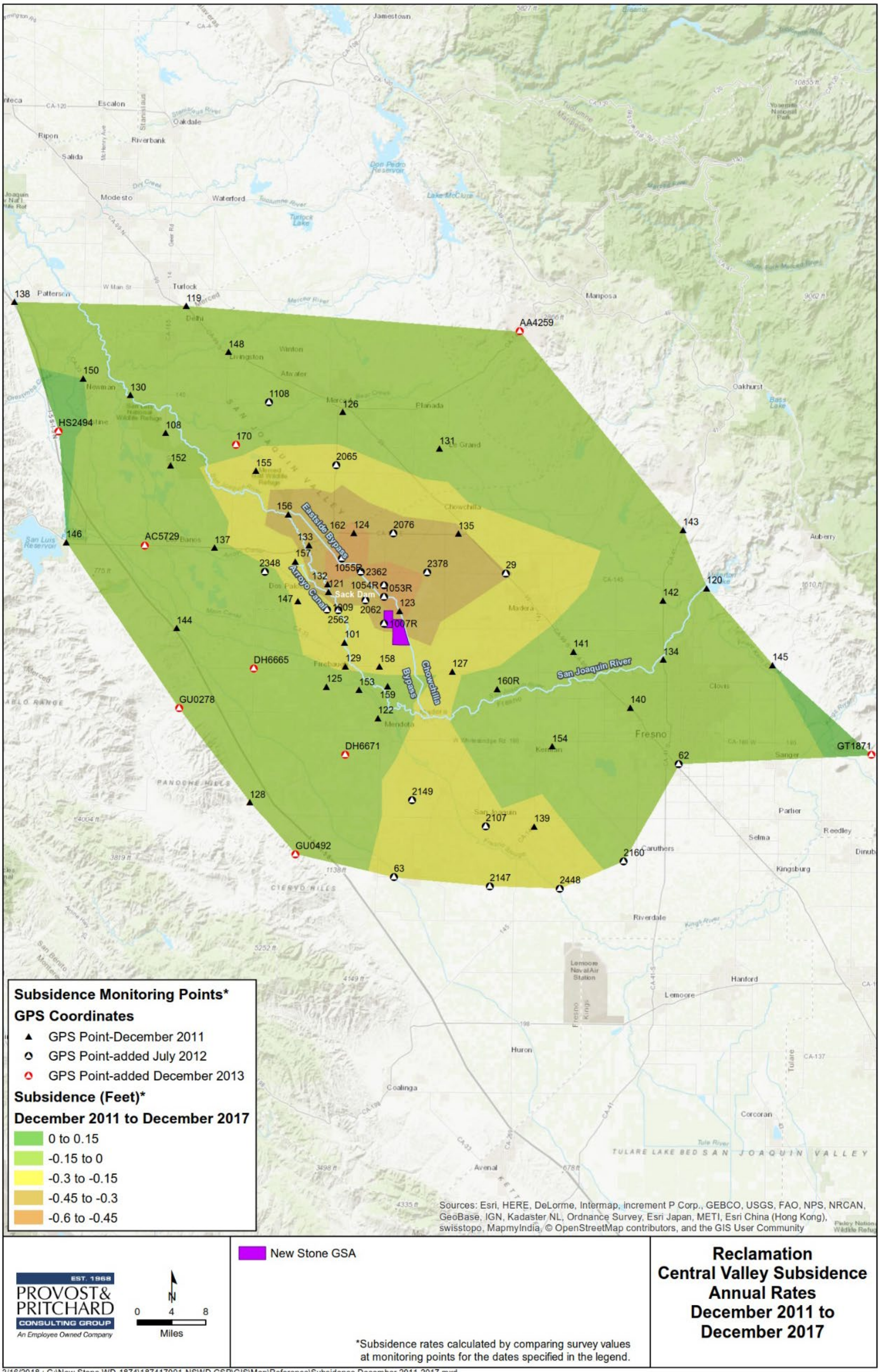


Figure 4-6 Land Subsidence Rates from 2011 to 2017 for Setting Minimum Thresholds

4.5.2.2 Methodology

The land subsidence MT is set at a rate of 0 feet/year to prevent undesirable results after 2040. However, compliance with this threshold will take into consideration the level of uncertainty associated with survey measurements. SJRRP has reported that survey measurements have a vertical accuracy of +/-2.5 centimeters (Reclamation, 2011). With two measurements necessary to calculate a rate (before and after), the total uncertainty in the subsidence rate value is 5 centimeters, or approximately -0.16 feet/year. Therefore, a rate of subsidence of less than -0.16 feet/year (values that are less negative) are considered to be within the uncertainty of the measurement and would be considered compliant with the MT of 0 feet/year. This is not meant to allow for a continued rate of 0.16 feet/year of subsidence in the Subbasin. Rather, this is an acknowledgement that there may be instances where measurement error will indicate a rate of subsidence greater than the MT. The definition of undesirable results will govern, and exceedances of the undesirable result will trigger further management actions within the Subbasin.

The MT for land subsidence is set recognizing that land subsidence within the Subbasin is tied to actions in neighboring subbasins, and the ability to meet these interim milestones is influenced by the successful implementation of projects and management actions in neighboring subbasins. It should also be noted that while groundwater level MTs and MOs are a separate sustainability indicator and are not specifically tied to subsidence thresholds, they are consistent with the objective to limit the potential for future subsidence. The MT may require modification in the future if subsidence continues to be seen approaching the end of the 20-year GSP implementation period.

4.5.2.2 Relationship to Other Sustainability Indicators

The MT of 0 feet/year of subsidence after 2040 does not conflict with other sustainability indicators. However, it should be noted that while sustainable management criteria for the chronic lowering of groundwater levels are not directly tied to subsidence thresholds, they are consistent with the Subbasin's effort to limit future subsidence by setting MTs at observed fall 2015 historical low water levels. Projects and management actions will limit the potential for future subsidence by stabilizing, possibly raising, preventing the chronic lowering of groundwater levels, and ultimately maintaining the health of drinking water supply wells.

4.5.2.3 Impact of Selected Minimum Thresholds to Adjacent Basins

The minimum threshold for land subsidence is set to prevent significant and unreasonable impacts to infrastructure and are therefore not likely to impact adjacent subbasins or their ability to achieve sustainability.

4.5.2.4 Minimum Thresholds Impact on Beneficial Uses and Users

Given that no significant impacts to infrastructure have been noted to date in the Plan area, minimum thresholds set to prevent any future impacts will not have any impacts on beneficial uses or users.

4.5.2.5 Comparison between Minimum Thresholds and Relevant State, Federal or Local Standards

There are no Federal, State, or local standards that exist for land subsidence.

4.5.2.6 Minimum Thresholds Measurement Method

Subsidence will continue to be monitored twice a year at SJRRP survey benchmarks by the UBSR and daily at the continuous GPS station by UNAVCO. Subsidence minimum thresholds will be evaluated on an annual (December to December) basis.

4.5.2.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Subsidence MTs were set to prevent undesirable results and minimize inelastic land subsidence attributable to groundwater extraction, with no additional subsidence after 2040. The MTs were set recognizing that land subsidence within the Madera Subbasin is tied to actions in neighboring subbasins. The land subsidence MT is set at a rate of 0 feet/year after 2040. However, due to uncertainty in land subsidence measurement accuracy, the SJRRP has reported that these data have a vertical accuracy of ±2.5 cm (Reclamation, 2011). Since the Subbasin is using rates to establish sustainable management criteria for subsidence, there is an approximate error of ±5 cm/year, or ±0.16 feet/year. Therefore, a rate of subsidence less than -0.16 feet/year (less negative) is considered in compliance with the MT of 0 feet/year, as this rate is within the uncertainty of the measurements. If residual subsidence continues to occur near the end of the 20-year implementation period, the MT may require modification. If subsidence stays at the minimum threshold and no additional subsidence is observed, critical damage to the Bypass and other critical infrastructure in the Subbasin will be avoided.

4.5.2.4 Impact of Minimum Thresholds on Water Uses and Users

If subsidence rates stay at the minimum threshold and no additional subsidence is caused or observed, the impact on water uses and water users should be minimal. However, the groundwater level MTs that were established using fall 2015 water levels will significantly reduce the amount of groundwater that can be pumped for the beneficial uses and users. The effective implementation of projects and management actions in NSWD GSA and neighboring agencies will improve decreasing water levels. Since there has been no major damage reported on private property, it is assumed there will be no future impact if conditions are held above established MTs. It should be noted that while sustainable management criteria for the chronic lowering of groundwater levels are not directly tied to subsidence thresholds, they are consistent with the Subbasin's effort to limit future subsidence by setting MTs at observed fall 2015 historical low water levels. It is well understood that water levels are directly related to subsidence and as water levels go below historical groundwater levels, the potential for subsidence increases. Projects and management actions will limit the potential for future subsidence by stabilizing, possibly raising, preventing the chronic lowering of groundwater levels, and ultimately maintaining the health of drinking water supply wells Measurement of Minimum Thresholds

Measurement of land subsidence data is taken twice a year by the USBR SJRRP and daily at the continuous GPS station by UNAVCO. Subsidence rates will be evaluated on an annual (December to December) basis to gauge progress towards Subbasin sustainability. The monitoring network is of adequate density and frequency, with measurements occurring annually. If data from these programs becomes unavailable, a new monitoring network will be formed. For more information on the monitoring network, refer to **Section 5.6.3**.

4.5.3 Measurable Objectives

Regulation Requirement:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.
(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.
(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for finding of inadequacy of the Plan.

Land subsidence sustainability criteria were developed to avoid significant and unreasonable impacts from occurring in the future within the Subbasin and to not cause or observe subsidence after 2040. An MO for subsidence of 0 feet/year was established with the goal of long-term avoidance of land subsidence. Achieving this MO will take into consideration the level of uncertainty associated with survey measurements. SJRRP has reported that survey measurements have a vertical accuracy of +/-2.5 centimeters (Reclamation, 2011). With two measurements necessary to calculate a rate (before and after), the total uncertainty in the subsidence rate value is 5 centimeters, or approximately -0.16 feet/year. Therefore, a rate of subsidence of less than -0.16 feet/year (values that are less negative) are considered to be within the uncertainty of the measurement and would be considered compliant with the MO of 0 feet/year. This is not meant to allow for a continued rate of 0.16 feet/year of subsidence in the Subbasin. Rather, this is an acknowledgement that there may be instances where measurement error will indicate a rate of subsidence greater than the MO. The definition of undesirable results will govern, and should an IM be triggered or an undesirable result occur, a subsidence working group will be formed to define areas of the basin subject to taking additional actions to eliminate subsidence.

Information on historical subsidence in the Subbasin is presented in the HCM. The MO for land subsidence is set recognizing that land subsidence within the Subbasin is tied to actions in neighboring subbasins, and the ability to meet this MO is dependent on the successful implementation of PMAs in neighboring subbasins. It should also be noted that while groundwater level MTs and MOs are not specifically tied to subsidence thresholds, they are consistent with the objective to limit the potential for future subsidence.

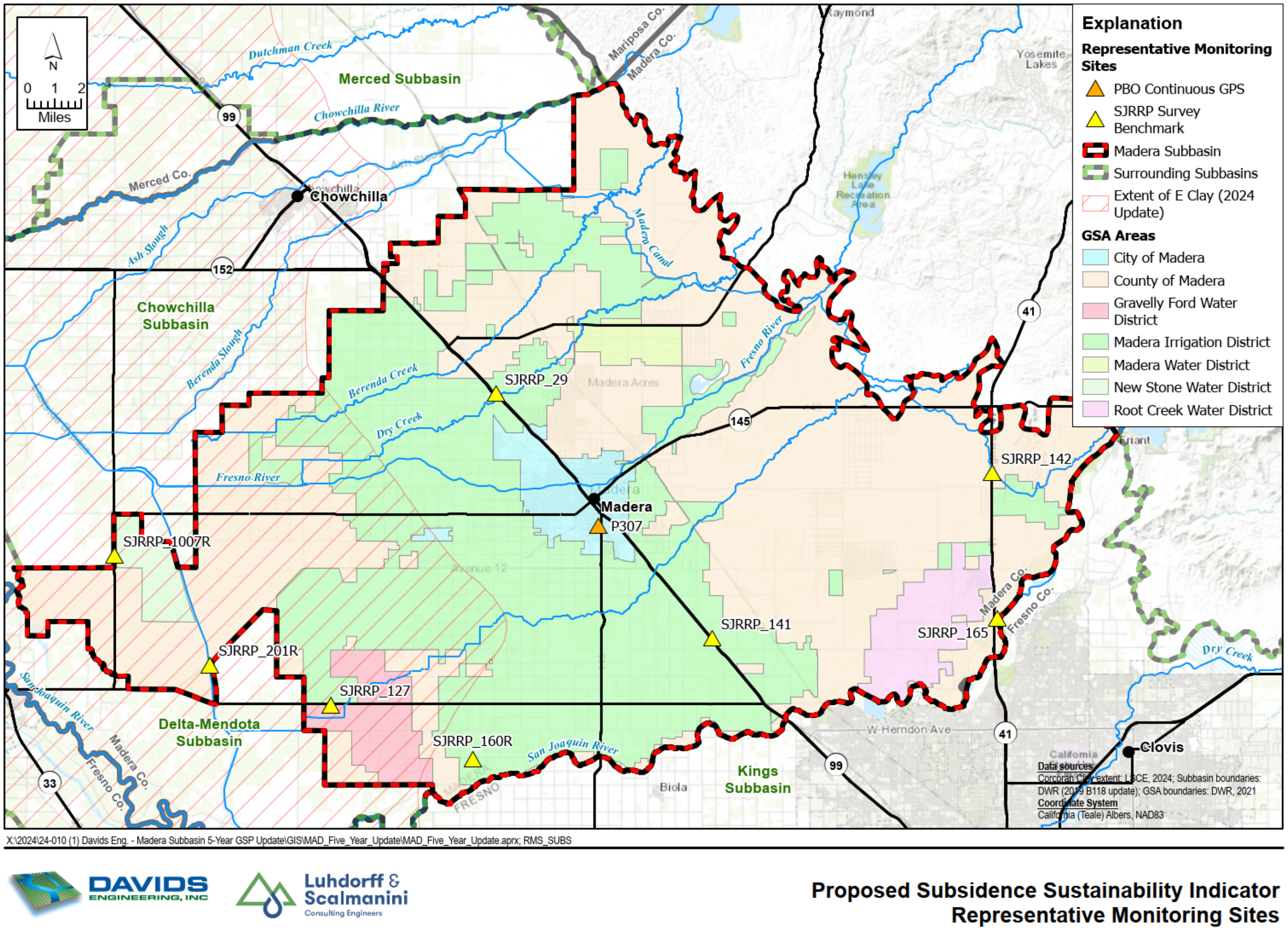


Figure 4-7 Madera Subbasin Subsidence Representative Monitoring Sites

4.5.4 Interim Milestones

Interim milestones for land subsidence were established at five-year intervals over the GSP implementation period from 2020 to 2040, at years 2025, 2030, and 2035. Interim milestones were informed by a detailed infrastructure sensitivity assessment and recent interviews with agency personnel and stakeholders. The established IM also have capacity to accommodate some residual subsidence that may continue to occur due to historical cycles of lower groundwater levels and subsidence, while providing time for GSAs to implement PMAs. A combination of eight survey benchmarks monitored by the USBR on a semi-annual basis as part of the SJRRP and one continuous GPS station monitored daily as part of the UNAVCO Plate Boundary Observatory (PBO) project have been selected as part of the land subsidence RMS network.

A detailed Infrastructure Assessment has been conducted and describes critical infrastructure in the Subbasin (e.g., highways, bridges, waterways, wells, etc.) and the historical and potential future impacts from subsidence. The infrastructure assessment was based on a combination of review/assessment of discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, through individual stakeholder input to various GSA representatives, review of historical subsidence, and in meetings with all technical representatives from all GSAs in the Subbasin regarding existing and potential impacts of subsidence across the subbasin on critical infrastructure (e.g., waterways, wells). In addition, GSP consultants recently (2024) conducted interviews with local, state, and federal agencies to better understand subsidence concerns and how the potential for future subsidence may be accounted for in agency maintenance of critical infrastructure within the Subbasin. The results of this infrastructure assessment indicated a certain amount of tolerance for some impacts (e.g., growers willing to accept costs for some replacement wells to account for agricultural well collapse), a neutral to beneficial impact from subsidence on some impacts (e.g., southwest flowing waterways where channel gradients steepened, thereby increasing flow capacity), and/or a degree of planning/design to accommodate future subsidence (e.g., 2.5 to 5 feet by SJRRP). While the GSAs recognize the importance of reducing the rates of active subsidence across the Subbasin as quickly as possible, it should be recognized that residual subsidence will occur regardless of future actions due to the lag time associated with historical low groundwater elevations.

Based on the updated Infrastructure Assessment, it has been determined that the maximum allowable additional cumulative subsidence within the subbasin should be set at two feet between December 2023 and January 2040 in order to be further protective of critical infrastructure. This amount of tolerable cumulative subsidence is less than the 2.5 to 5 feet of additional subsidence in the planning criteria for the SJRRP and two feet is consistent with the tolerable additional subsidence proposed in the recent Public Draft GSP for adjacent Delta Mendota Subbasin. IMs were established for additional cumulative subsidence between now (December 2023) and January 2025, and at five-year intervals for 2025 to 2030, 2030 to 2035, and 2035 to 2040 to ensure a ramp down to the zero subsidence MT by 2040. An IM for average annual rate of subsidence has also been set for each five-year interval in order to evaluate annual progress toward meeting the cumulative subsidence IMs.

Review of critical infrastructure and historical subsidence impacts indicates there is likely greater tolerance for additional subsidence in the southern portion of the subbasin compared to the central/northern portions of the Subbasin based on the generally lower amounts of historical subsidence along the San Joaquin River. However, it has been determined that the maximum allowable additional cumulative subsidence in all the areas of the subbasin should be set at two feet between December 2023 and January 2040. IMs were established for five-year intervals through 2040 to ensure a ramp down to the zero subsidence MT by 2040 (**Table 4-7**). An IM for average annual rate of subsidence has also been set for each five-year interval in order to evaluate annual progress toward meeting the cumulative subsidence IMs.

Table 4-7 Preliminary Interim Milestones for Land Subsidence Objectives

5-Year Interval	Maximum Average Annual Rate of Subsidence (feet/year)	Maximum 5-Year Cumulative Subsidence (feet) [7]
2020-2025		1.5
2025-2030	0.2	1.0
2030-2035	0.1	0.5
2035-2040	0.05	0.25
Note: Due to the uncertainty in land subsidence measurement accuracy of +/- 0.16 feet/year, there may be instances where measurement error will indicate a rate of subsidence greater than the IMs. Undesirable results will trigger further management actions within the Subbasin.		

Achievement of these IMs will take into consideration the level of uncertainty associated with survey measurements (+/- 0.16 feet/year, assuming two measurements per year). However, this uncertainty is not intended to allow for 0.16 feet of subsidence per year on an ongoing basis, but rather that an amount of subsidence within this range for a given year should be considered as potentially within the uncertainty of that year's measurements.

The IMs for land subsidence are set recognizing that land subsidence within the Subbasin is tied to actions in neighboring subbasins, and the ability to meet these IMs is dependent on the successful implementation of projects and management actions in neighboring subbasins.

The Subbasin GSAs will continue to prioritize implementation of projects and management actions, to the extent feasible, in those areas of the Subbasin where subsidence rates have historically been greatest to ensure that sustainable groundwater conditions are reached by 2040. Ultimately, progress toward achieving IMs for the most constraining sustainability indicator will govern the determination of whether the Subbasin is on track toward achieving sustainability. Progress toward implementation of projects and management actions will be reported in Annual Reports.

4.5.4.1 Achieving and Maintaining Sustainability

The combination of IMs and the MO reflect how the basin will achieve and maintain sustainability. The land subsidence IMs and MOs are set at values reflecting gradual reductions in the rate of subsidence over the Implementation Period with the intent of limiting future subsidence and achieving a long-term rate of zero subsidence by 2040. It is important to consider that land subsidence within Subbasin is tied to actions in neighboring subbasins, and the ability to meet these interim milestones is dependent on the successful implementation of PMAs within the Madera Subbasin and in neighboring subbasins. To keep up to date on impacts to critical infrastructure and the progress to meeting IMs within the Subbasin, the GSAs, with support from the agencies interviewed, are proposing to establish a Subbasin Critical Infrastructure Operator Group. Although discussions are ongoing, the Critical Infrastructure Operator Group is planning to meet annually to provide updates on any potential critical infrastructure impacts related to subsidence, coordinate ongoing PMA implementation, and to discuss any potential critical infrastructure mitigation concerns. All agencies interviewed expressed a strong interest in participating in the Subbasin Critical Infrastructure Operator Group.

[7] A cumulative total of up to 1.0 feet of subsidence has already occurred in some portions of the subbasin between December 2019 and December 2023. Therefore, the maximum allowable cumulative subsidence of 1.5 feet as of December 2024 requires annual subsidence in 2024 to be less than 0.5 feet. Subsequent years after 2024 have significantly lower allowable annual rates of subsidence.

4.6 Seawater Intrusion

Regulation Requirement:

§354.26 (d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

§354.28 (e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

By definition, seawater intrusion occurs when saline water from the ocean infiltrates the groundwater system and begins to flow into areas of freshwater due to pressure differentials, in many cases caused by groundwater pumping. The Madera Subbasin and NSWD GSA do not need to account for seawater intrusion since they are not located adjacent to the coast.

4.7 Interconnected Surface Water and Groundwater

Regulation Requirement:

§354.26 (d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

§354.28 (e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

As discussed in Groundwater Conditions, **Section 3.2.7**, NSWD GSA does not contain interconnected surface and groundwater systems. The Chowchilla Bypass is the only surface water system that exists within or on the GSA boundaries. It only runs during wet years when flood flows are released, thus it is most frequently dry. Depth to water table along the Bypass ranges from approximately 46 to 67 feet above sea level, which is 80 to 100 feet below the ground surface elevation. Due to the lack of connected water systems, interconnected surface water will not be monitored or considered when making management decisions in the NSWD GSA region. The Madera Subbasin GSAs adjacent to the San Joaquin River plan to collaboratively develop SMCs for ISW, in conjunction with efforts by applicable Kings Subbasin GSAs, the SJRRP, and the FWA. Applicable Madera Subbasin GSAs and neighboring Kings Subbasin GSAs along the San Joaquin River have established the framework of an Interconnected Surface Water Working Group outlined in a Memorandum of Understanding (MOU). The MOU will establish a collaborative scope of work for further investigation of possible ISW along the San Joaquin River from Reach 1a to Mendota Pool. This investigation will help the GSAs better understand the timing and magnitude of potential surface water depletions from the San Joaquin River from groundwater pumping. This MOU and associated Working Group also includes the involvement from the USBR and FWA. The same applicable GSAs plan to review the additional ISW guidance by DWR that was released in September 2024. In February 2024, DWR release the 1st of 3 papers on ISW. Papers 2 and 3 were released in late September of 2024. In addition to the aforementioned papers, the GSAs understand that DWR plans to release an ISW guidance document in December 2024. During subsequent Plan Amendments, the GSAs may consider revisions to the current ISW SMC based on information gleaned from the collaborative work with USBR and FWA, in addition to the additional papers and guidance document issues by DWR.

4.8 Causes of Groundwater Conditions That Could Lead to Undesirable Results

Regulation Requirement:

> **§354.26** (b) The description of undesirable results shall include the following:
> (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.
> (2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.
> (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

The following factors have the potential to cause changes leading to undesirable effects:

1. **Climate Change**
    a. Some information developed by the State of California Department of Water Resources (DWR, 2018) suggests that warmer conditions could lead to more rain and less snowpack. This would lead to more runoff earlier on and less reliability in water source.
    b. The same studies indicate that increased temperatures could result in higher evapotranspiration rates which would increase demand.
    c. Some studies suggest more variability in water year types with dry years becoming more dry and wet years becoming more wet, which could lead to more flooding in wet years and worse droughts in dry years.
2. **Changing Crop Patterns**. Alfalfa, corn and grapes are grown within NSWD GSA with vineyards making up the majority of the acreage. A change in cropping to include more nuts such as almonds or pistachios would increase crop demand.
3. **Lack of Access to Surface Supply**. NSWD currently relies almost completely on groundwater; therefore, to meet sustainability goals set forth in the GSP, surface water will be required to use for recharge or in-lieu of groundwater.
4. **Excess Nutrient application**. The accumulated effects of nutrient application and other farming practices could lead to higher concentrations of nitrogen or TDS.

Change in water levels is the most important indicator in this Subbasin. The monitoring network will be used to gather the data to evaluate the groundwater levels. Minimum thresholds will be set at different levels throughout the District using the Subbasin numerical groundwater model. The model developed utilized the best data and information that was available at the time of model development. Additional sites may be added where there is a specific concern, where levels have changed significantly and historically and/or where there is a concern expressed by a local entity.

5 Monitoring Network

Regulation Requirement:

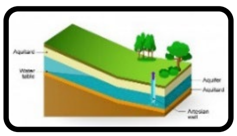
§354.32 This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.

Monitoring is a fundamental component of a groundwater management program and is needed to measure progress of reaching measurable objectives and the goal of groundwater sustainability. **Table 5-1** includes the monitoring programs of sustainability indicators needed to comply with SGMA monitoring and reporting requirements.

Table 5-1 Monitoring Requirements

Groundwater Levels

- Monitoring of static groundwater levels each spring and fall

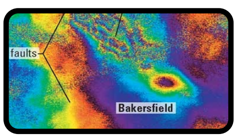


Groundwater Storage

- Measurement of the annual change in groundwater storage

Water Quality

- Monitoring for water quality degradation that could impact available groundwater supplies

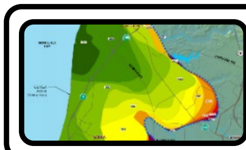


Land Subsidence

- Surface land subsidence caused by groundwater extraction

Depletion of Interconnected Surface Water

- Loss of permanent connections between surface water and groundwater



Seawater Intrusion

- Intrusion of seawater into local aquifers. This is not applicable to the NSWD GSA

Monitoring programs for these indicators are described below including the history of the monitoring programs, proposed monitoring to comply with SGMA, and the adequacy and scientific rationale for each monitoring network. Monitoring of groundwater pumping, groundwater recharge and surface water deliveries is discussed in **Section 3.3**– Water Budget Information.

5.1 Introduction

Regulation Requirement:

§354.34(a) Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan Implementation.

§354.34(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

This chapter describes the current and developing monitoring networks in the NSWD GSA that will collect data to determine short-term, seasonal, and long-term trends in groundwater and related surface conditions. Those data collected from the monitoring networks will yield information necessary to support the implementation of this Plan, evaluation of the effectiveness of this Plan, and guide decision making by the NSWD GSA management. Information and data from historical monitoring efforts can be found in **Section 3.2** – Current and Historical Groundwater Conditions. **Figure 5-1** and **Figure 5-2** show the monitoring network site locations.

5.1.1 Monitoring Network Objectives

§354.34(b) Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:
1) Demonstrate progress toward achieving 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.

The objectives of the various monitoring programs include the following:

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 to Madera Subbasin Coordinator for reporting to DWR.
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.

5.1.2 Sustainability Indicator Monitoring Networks

Regulation Requirement:

> **§354.34(c)** Each monitoring network shall be designed to accomplish the following for each sustainability indicator: [§354.34(c)(1) through §354.34(c)(6) are individually listed below]

> **§354.34(d)** The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.

> **§354.34(g)(3)** For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

> **§354.38(a)** Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

The following **Sections 5.2** through **5.7** include descriptions of the GSA's monitoring networks designed to meet criteria for the six sustainability indicators: groundwater levels, groundwater storage, seawater intrusion, water quality, land subsidence, and depletion of interconnected surface water. For each sustainability indicator, the adequacy of the monitoring network is discussed, as well as the quantitative values for the minimum thresholds, measurable objectives, and interim milestones. The sections also include a review of each monitoring network for monitoring frequency and density, identification of data gaps, plans to fill data gaps, and future site selection. This information will be reviewed and evaluated during each five-year assessment.

There are three general types of data gaps to consider for monitoring networks:

1. **Temporal**: Insufficient frequency of monitoring. For instance, data may be available from a well only in the fall since it is rarely idle in the spring. In addition, a privately owned well may have sporadic access due to locked security fencing, roaming dogs, change in ownership, etc.
2. **Spatial**: Insufficient number or density of monitoring sites in a specific area.
3. **Insufficient quality of data**: Data may be available but be of poor or questionable accuracy. Poor data may at times be worse than no data, since it could lead to incorrect assumptions or biases. The data may not appear consistent with other data in the area or with past readings at the monitoring site. The monitoring site may not meet all the desired criteria to provide reliable data, such as having information on perforation depth, etc. Past experiences have shown that well location information on Well Construction Reports is often poor, making it difficult or impossible to match wells with their well logs.

New monitoring networks will be developed, and existing networks enhanced when necessary, using the DQO process, which follows the U.S. EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The DQO process is also outlined in the DWR's Best Management Practices for monitoring networks (2016a) and monitoring protocols (2016b). The DQO process helps to ensure a repeatable and robust approach to collecting data with a specific goal in mind.

5.2 Groundwater Levels

Regulation Requirement:

§354.34(c)(1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:

A. A sufficient density of monitor wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.

B. Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.

5.2.1 Monitoring Network Description

The CASGEM program was created by SBx7 6, Groundwater Monitoring, a part of the 2009 Comprehensive Water Package. Groundwater levels have been regularly monitored in wells within or on the border of the GSA for the CASGEM program. CASGEM wells that will be included in the monitoring network have state well IDs 11S14E36R001, 11S15E30A001, and 12S15E16A001. Water depths have been measured in these wells by the U.S. Bureau of Reclamation on a bi-annual basis since the late 1950s or early 1960s. Once these wells were selected as representative wells, the NSWD GSA began collecting data for these wells on a bi-annual basis to capture spring and fall groundwater conditions. A well log with construction information is not available for 12S15E16A001; however, it is believed to be perforated in the unconfined aquifer, as the other two wells' construction information shows. This well is also being monitored by the County of Madera GSA and utilized in their RMN for water level as a collaborative effort.

Three District wells that are not part of CASGEM will also be included in the monitoring network. Unique CASGEM or state well IDs will be assigned to the wells. These three wells are perforated in the confined aquifer.

5.2.2 Quantitative Values

Minimum thresholds, measurable objectives, and interim milestones for groundwater levels are discussed in **Section 4.2**. The minimum threshold, measurable objectives and interim milestones set in **Section 4.2** are shown in **Table 5-2**.

Table 5-2 Groundwater Level Interim Goals, Measurable Objectives, and Minimum Thresholds (msl)

Well Number	Interim Milestones			Measurable Objective	Minimum Threshold
	2025	2030	2035		
NSWD 10	-4	-10	-8	17	8
NSWD 34	-22	-29	-25	1	-14
NSWD 37	-16	-23	-19	7	-4
11S15E30A001M	-4	-26	-10	19	-5
Note: Criteria reported in Elevation (MSL) – feet above mean sea-level					

5.2.2.1 Monitoring Frequency and Density

Regulation Requirement:

§354.34(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:

1) Amount of current and projected groundwater use.
2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.
3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.
4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.

The Monitoring Networks and Identification of Data Gaps Best Management Practices (DWR, 2016) estimates the density of wells needed is 10 wells per principal aquifer per 100 square miles (Heath, 1976). For the NSWD GSA, which is less than 7 square miles in area, this estimate would require 0.7 wells be monitored in the GSA. The wells in each aquifer included in the monitoring network exceed this density. Modifications to this density may be needed if professional judgement determines and will be described in future Annual Reports.

Some of the wells are not considered "High Quality Monitoring Points." Such wells are defined as wells with reliable access each spring and fall, information on the well depth and perforated interval, and sufficient depth to accommodate seasonal fluctuations. Wells that do not meet these guidelines will be maintained in the network, as they can still provide useful information. Well construction information on the monitored wells may be obtained in the future, and it is desired to keep wells that have a long period of record. During development of groundwater contours, those wells with and without well construction information will be labeled to assist with the analysis.

Groundwater levels will be monitored in the spring (March) and fall (October) of each year. Spring measurements are designed to capture the recovery of the groundwater levels after an extended period of minimal agricultural and landscape irrigation demand, assuming a normal rainfall. The fall measurement would capture a period after peak irrigation and summertime urban demands have ceased, thereby showing the cumulative impacts on the groundwater basin before any natural recovery has taken place.

5.2.2.2 Identification of Data Gaps

§354.38(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.
§354.38(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

1) The location and reason for data gaps in the monitoring network.
2) Local issues and circumstances that limit or prevent monitoring.

The existing groundwater level monitoring network has provided adequate data to prepare groundwater contour maps and identify groundwater level trends. The density of the groundwater level monitoring network is adequate.

Well construction information, including the depth and perforated interval is required according to SGMA guidelines. While this represents a data quality gap as of initial GSP development, the GSA plans to collect construction information on all new and existing wells to improve the use of those data in annual reports.

5.2.2.3 Plans to Fill Data Gaps

Regulation Requirement:

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

The data quality gap in the groundwater level network can be filled using the four alternatives below. Any updates to the GSA's efforts to fill data gaps are described in the Annual Reports.

- **Collect well completion reports.** Well Completion Reports will provide the needed information. These could be collected from the landowner or Department of Water Resources; however, several challenges exist. First, landowners may not have the report or may not be willing to provide them. The GSA has found it very difficult to match up Well Completion Reports from DWR with actual wells, since so many have been drilled in the area, and location maps in the reports are often poor or erroneous, or wells have since been destroyed.
- **Perform a video inspection of each well to obtain construction information.** A video inspection can be performed on desired wells to determine the total depth and perforated interval. The cost of each inspection is about $1,500 (2017), but up to $15,000 may also be needed to lift a pump to provide access. Additional costs would also be incurred for administration and outreach to landowners. Permission would be needed from the well owner; however, they may agree since they would obtain a free well assessment.
- **Replace monitoring point with a dedicated monitor well.** Dedicated monitor wells could be installed and used in place of private wells. The construction information would be known and there would be no access issues. Dedicated monitor wells are expensive to construct, and their installation will depend on available funding.
- **Replace monitor point with another private well.** Private wells without construction information could be replaced with another private well that has well construction information. This may be simpler and less costly than a video inspection. However, replacing monitor well locations is not always desirable, since it is preferred to continue measurements in wells that have a long period of record (i.e., long hydrograph).

5.2.2.4 Site Selection

Regulation Requirement:

§354.34(g) Each Plan shall describe the following information about the monitoring network: **(1)** Scientific rationale for the monitoring site selection process.

The rationale for the groundwater level monitoring network includes the following:

- The monitoring points contribute to the minimum density of wells per aquifer in the GSA.
- The monitoring point has performed adequately in providing information for annual reporting, groundwater contour maps, and estimation of storage change.
- Many existing wells have a significant period of record (i.e., greater than 20 years) and are useful for long-term evaluations.

The following scientific rationale will be used to add new wells to the groundwater level monitoring network:

- Add wells whenever necessary to maintain minimum monitor well density (3 wells in the GSA).
- Avoid wells perforated across multiple aquifers.
- Select dedicated monitor wells over production wells where feasible.
- Select wells with available construction information (i.e., depth, perforated interval).

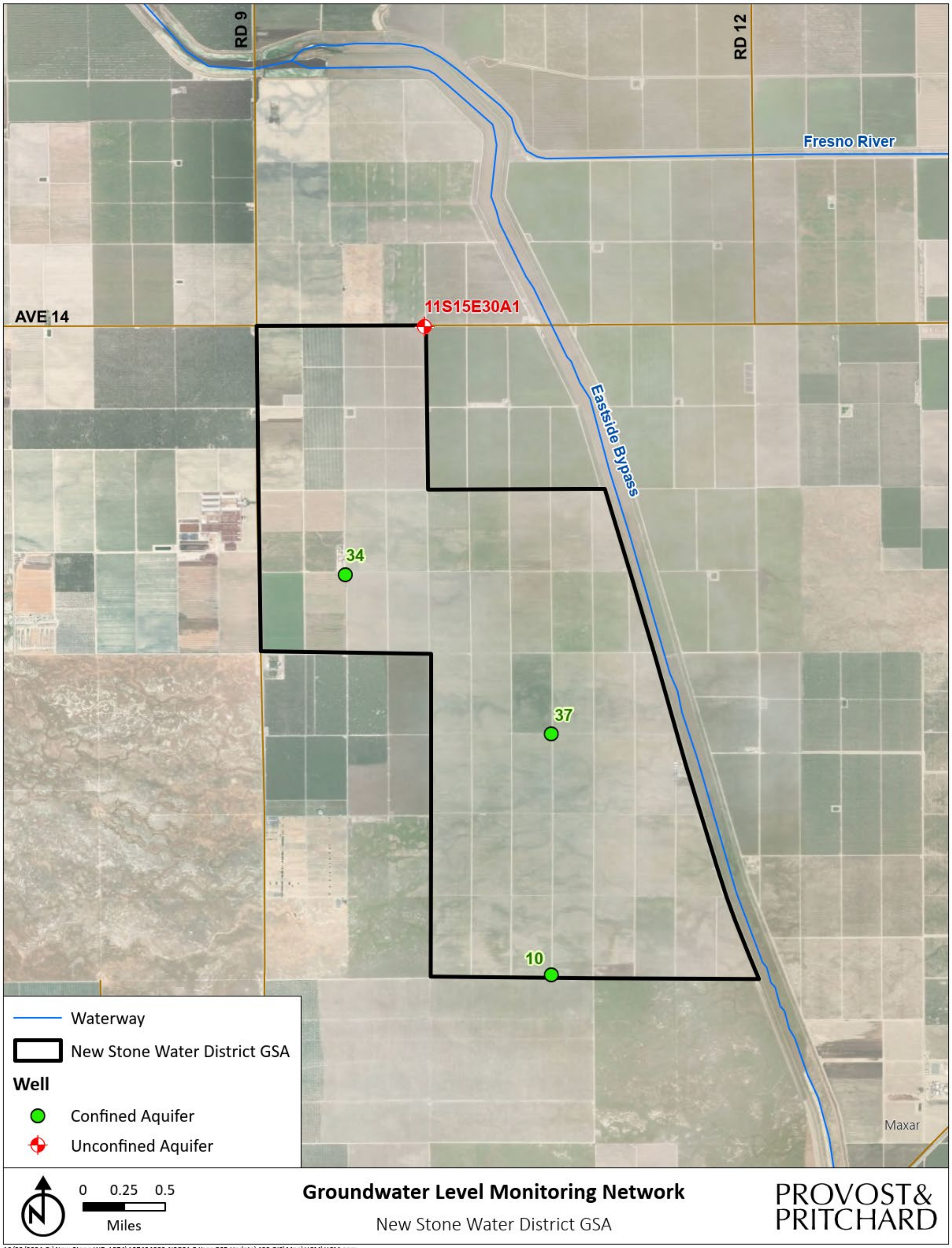


Figure 5-1 Groundwater Level Monitoring Network

5.3 Groundwater Storage

Regulation Requirement:

§354.34(c)(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.

5.3.1 Monitoring Network Description

Groundwater storage was determined using multiple methods in **Chapter 3.2** – Current and Historical Groundwater Conditions, **Section 3.2.3**. Method one used the water budget analytical model or the checkbook balance method. It uses inputs from all water sources, consumptive uses, and losses to determine groundwater surplus or overdraft over a hydrologically average period. The second method used average specific yield, basin area, and average change in groundwater levels to determine change in storage over the hydrological average period. The final method used GIS mapping tools to calculate the difference in volume between contour maps for each year in the hydrological average period. The general methodology used in those efforts will continue to be used by the GSA. Groundwater storage calculations are largely dependent on the groundwater level network and will consist of the same wells in the groundwater level monitoring network (**Figure 5-1**).

5.3.2 Quantitative Values

Minimum thresholds, measurable objectives, and interim milestones for groundwater storage are discussed in **Section 4.3**. The groundwater storage minimum thresholds are the same as the thresholds for groundwater levels shown in **Figure 5-2**. Measurable objectives for groundwater storage have a net zero change in groundwater storage on a 10-year rolling average basis after 2040. Specific interim milestones are not set for groundwater storage but are inherent in the groundwater level milestones.

5.3.3 Review and Evaluation of Monitoring Network

5.3.3.1 Monitoring Frequency and Density

Groundwater storage change will be estimated annually, based on spring groundwater levels. Groundwater storage changes will be based largely on the geographic availability of specific yield data (see **Section 3.1.8**). The areas used are considered reasonable, since overdraft is typically estimated on a regional scale; estimating overdraft on a very small or local scale may provide misleading results. Only wells with reasonable and reliable data will be used to develop groundwater contours and estimate storage change.

5.3.3.2 Identification of Data Gaps

Data gaps were identified in the groundwater storage network are the same as the groundwater level gaps described above, since storage change is dependent on groundwater level readings.

5.3.3.3 Plans to Fill Data Gaps

The steps to fill data gaps are the same as the groundwater level network. Collection of well attribute information described above will benefit groundwater storage monitoring. The program would be enhanced with refined specific yield values.

5.3.3.4 Site Selection

Change in groundwater storage is based on a calculation involving the specific yield and change in groundwater levels. Site selection for the groundwater level monitoring network is discussed in **Section 5.3.3.4**.

5.4 Seawater Intrusion

Regulation Requirement:

§354.34(c)(3) Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.

The GSA is approximately 80 miles from the ocean, separated by the Coast Range and, therefore, seawater intrusion is not feasible. In addition, there are no saline water lakes in or near the GSA. As a result, seawater intrusion is not discussed hereafter in this chapter as allowed by §354.34(j). Saline water intrusion from up-coning of deep saline groundwater is a potential problem and will be monitored as part of general water quality monitoring.

5.5 Water Quality

Regulation Requirement:

§354.34(c)(4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.

5.5.1 Monitoring Network Description

Water quality monitoring is an important aspect of groundwater management in the area and serves the following purposes:

- Spatially characterize water quality according to soil types, soil salinity, geology, surface water quality, and land use;
- Compare constituent levels at a specific well over time (i.e., years and decades);
- Determine the extent of groundwater quality problems in specific areas;
- Identify groundwater quality protection and enhancement needs;
- Determine water treatment needs;
- Identify impacts of recharge and surface water use on water quality;
- Identify suitable crop types that are compatible with the water characteristics; and
- Monitor the migration of contaminant plumes (such as nitrate).

A discussion on groundwater quality in the NSWD GSA is in **Section 3.2.5** – Groundwater Quality. Several agencies are involved in the monitoring and mitigation of groundwater quality in the surrounding area. These agencies include the County of Madera, SWRCB, and RWQCB, USGS, and California DTSC. Data from these sources indicate that common constituents of concern in NSWD GSA and the region are nitrate and TDS. Data available within and near the GSA show that levels of these constituents are generally below respective regulatory levels for drinking water (see **Section 3.2.5** for details). Contaminant plumes, nor point sources, are unknown within the GSA.

Though water quality has been periodically analyzed within the GSA for irrigation suitability, a monitoring program is not in place with defined temporal and spatial distribution. The wells in the groundwater quality network will be analyzed once a year for nitrogen and EC. **Figure 5-1** shows the NSWD wells selected for water quality monitoring.

5.5.2 Quantitative Values

To summarize the Sustainable Management Criteria set in **Chapter 4**, Minimum Thresholds are defined by the MCLs for three key constituents, TDS, Nitrate, and Arsenic, and where the existing concentration at a monitoring well exceeds the MCL is the MCL plus 20%.

5.5.3 Review and Evaluation of Monitoring Network

5.5.3.1 Monitoring Frequency and Density

Water quality sampling will occur annually. The sampling will be conducted during the summer pumping to get a good representation of the water quality. Because there are no known contaminant plumes, nor point sources, to be monitored in the GSA, this sampling interval will be sufficient to determine if water quality is being degraded.

Similar to the groundwater level monitoring network, a minimum of three water quality data points is required to define spatial trends. Three wells have been selected for water quality monitoring in the confined aquifer.

5.5.3.2 Identification of Data Gaps

Though water quality has been periodically analyzed within the GSA for irrigation suitability, a groundwater quality monitoring program is not in place with defined temporal and spatial distribution. The water quality monitoring network described above that will be implemented does not contain temporal data gaps.

Spatial gaps are present in that no wells in the unconfined aquifer have been identified for monitoring. Wells owned by NSWD landowners that have construction information do not include wells exclusively screened in the unconfined aquifer.

Data quality gaps will be avoided by following the monitoring protocols discussed in **Section 5.9**.

5.5.3.3 Plans to Fill Data Gaps

Spatial data gaps will be filled by:

- Collecting well construction information for additional wells in NSWD as described in **Section 5.3.3.3** to identify wells in the unconfined aquifer, or
- Obtaining permission from the owners of CASGEM wells in the groundwater level monitoring network to collect water quality samples.

5.5.3.4 Site Selection

The scientific rationale for selecting water quality monitoring sites includes:

- Select dedicated monitor wells over production wells where feasible.
- Lateral distribution is such that water quality can be defined across the GSA.
- Select wells with available construction information (i.e., depth, perforated interval).
- Avoid wells perforated across multiple aquifers.
- Select site so that each aquifer is represented (vertical distribution).

5.6 Land Subsidence

Regulation Requirement:

§354.34(c)(5) Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.

5.6.1 Monitoring Network Description

Land subsidence is discussed in detail in **Section 3.2.6** – Land Subsidence Conditions. The GSA is included in areas monitored by UNAVCO and the USBR SJRRP. **Figure 5-2** shows the SJRRP monitoring points surrounding the GSA. Data from these sources show that subsidence has been occurring at significant rates within and surrounding the GSA. The monitoring network for NSWD GSA will utilize the USBR SJRRP and the continuous GPS station by UNAVCO to monitor the areas of subsidence.

5.6.2 Quantitative Values

Minimum thresholds, measurable objectives, and interim milestones for land subsidence are discussed in **Section 4.5.**

5.6.3 Review and Evaluation of Monitoring Network

Land subsidence will be monitored utilizing the USBR SJRRP and the continuous GPS station by UNAVCO land subsidence surveying programs. This is considered adequate considering the high density of monitoring in the region and the small area of the NSWD GSA. If data from these sources becomes unavailable in the future, a new monitoring network will be established to monitor land subsidence.

5.6.3.1 Monitoring Frequency and Density

The subsidence monitoring network has adequate density and frequency to determine land subsidence in the NSWD GSA area annually.

5.6.3.2 Identification of Data Gaps

Data gaps were not identified in the land subsidence monitoring network for the NSWD GSA.

5.6.3.3 Plans to Fill Data Gaps

There are no plans to fill data gaps as there are no data gaps identified. The District may entertain adding a subsidence benchmark within the District to improve subsidence resolution within the District.

5.6.3.4 Site Selection

Land subsidence in the NSWD GSA area is monitored with agency and government land subsidence surveying programs. This is considered adequate, especially because the area is closely monitored due to the high subsidence rates.

If additional monitoring locations are added, the following scientific rationale will be used:

- Add sites that can be easily surveyed and tied back to a nearby monument.
- Add sites where the ground surface is unlikely to be modified by future construction and will remain undisturbed.

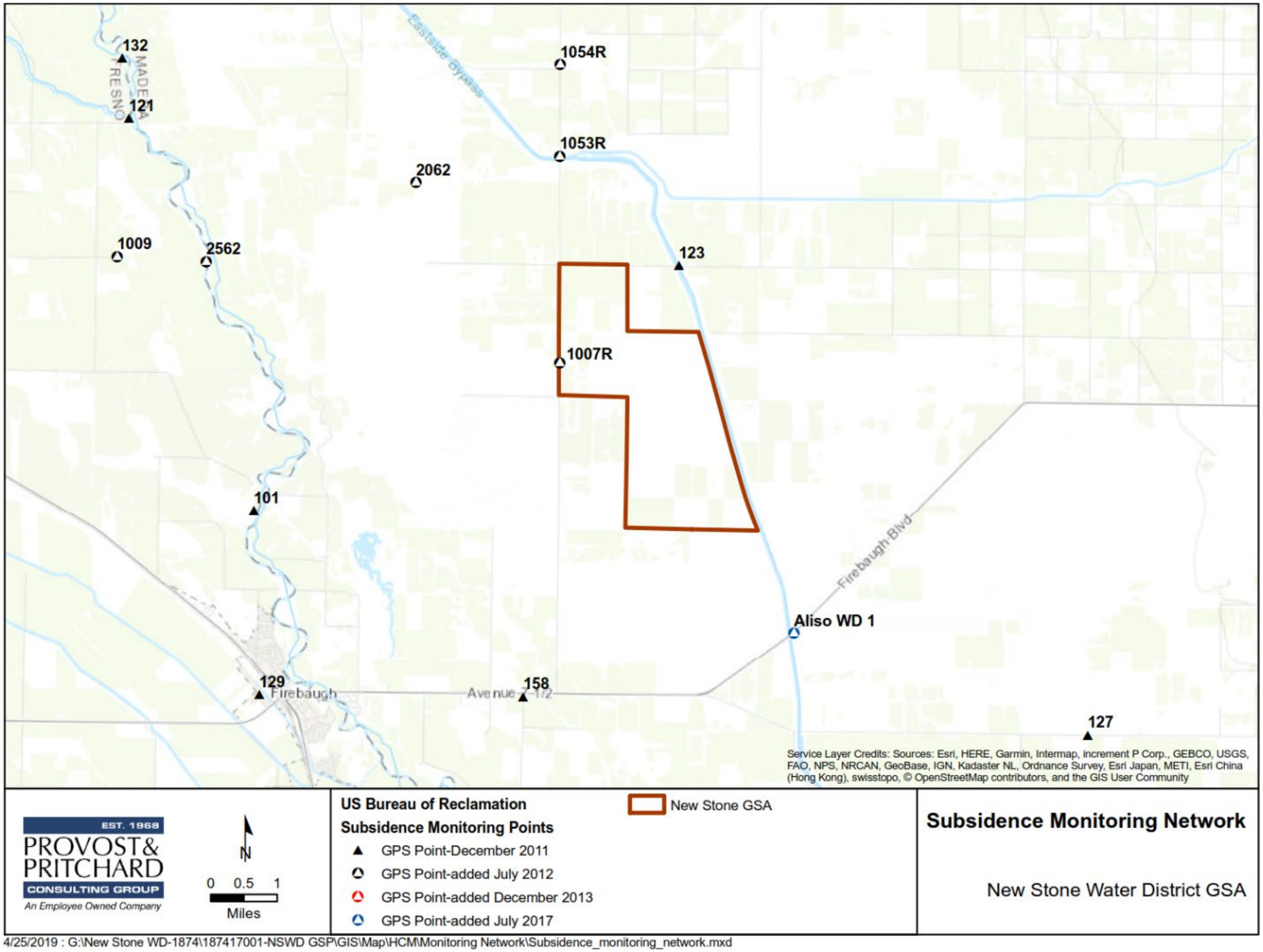


Figure 5-2 Subsidence Monitoring Network

5.7 Depletion of Interconnected Surface Water

Regulation Requirement:

§354.34(c)(6) Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following: A. Flow conditions including surface water discharge, surface water head, and baseflow contribution. B. Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable. C. Temporal change in conditions due to variations in stream discharge and regional groundwater extraction. D. Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.

There are not any interconnected surface water systems within NSWD GSA due to distance from rivers and lack of water in the adjacent Chowchilla Bypass (see **Section 3.2.7**). As a result, depletion of interconnected surface water is not discussed hereafter in this chapter as allowed by §354.34(j). A detailed explanation of the efforts outlined in Memorandum of Understanding between the applicable Madera Subbasin GSAs, Kings Subbasin GSAs adjacent to the San Joaquin River, the SJRRP, and the FWA is described in the Madera Joint GSP.

5.8 Consistency with Standards

Regulation Requirement:

§354.34(g) Each Plan shall describe the following information about the monitoring network: **(2)** Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

The data gathered through the monitoring networks is and will continue to be consistent with the standards identified in Section 352.4 of the California Code of Regulations related to Groundwater Sustainability Plans. The main topics of Section 352.4 are outlined below.

- Data reporting units and accuracy
- Monitoring site information
- Well attribute reporting
- Map standards
- Hydrograph requirements
- Groundwater and surface water models
- Availability of input and output files to DWR

5.9 Monitoring Protocols

Regulation Requirement:

§354.34(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

The DQO process will be used to develop monitoring protocols that assist in meeting the measurable objectives and sustainability goals of this GSP. The DQO process includes the following:

1. State the problem.
2. Identify the goal.

3. Identify the inputs.
4. Define the boundaries of the area/issue being studied.
5. Develop an analytical approach.
6. Specify performance or acceptance criteria.
7. Develop a plan for obtaining data.

Groundwater level, groundwater quality, and land subsidence monitoring will generally follow the protocols identified in the *Monitoring Protocols, Standards, and Sites BMP* (DWR, December 2016b). Refer to **Appendix B** for a copy of the Best Management Practices (BMP). The GSA may develop standard monitoring forms in the future.

The following comments and exceptions to the BMP should be noted:

1. SGMA regulations require that groundwater levels be measured to the nearest 0.1 feet. The BMP suggests measurements to the nearest 0.01 feet; however, this is not practical for many measurement methods. In addition, this level of accuracy would have little value since groundwater contours maps typically have 10- or 20-foot intervals, and storage calculations are based on groundwater levels rounded to the nearest foot. The accuracy of groundwater level measurements will vary based on the well type and condition. For instance, if significant oil is found in an agricultural well, then readings to the nearest foot are achievable.
2. Well sounding equipment will be decontaminated after use if used in a well with suspected or known contamination or if there are obvious signs of contamination, such as oil.
3. Wells will be surveyed to a vertical accuracy of 0.5 feet.
4. Unique well identifiers will be labeled on private wells if permission is granted by well owner.

5.10 Representative Monitoring

Regulation Requirement:

§354.36 Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:

§354.36(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.
§354.36(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following: …1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy. 2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.

Representative monitoring sites are designated in **Chapter 4** of the GSP. NSWD GSA does not plan to use groundwater elevations as a proxy for monitoring other sustainability indicators. As noted, groundwater elevations will be used as a critical component of groundwater storage estimation, but the elevation monitoring will not replace the storage change estimation.

5.11 Data Storage and Reporting

Regulation Requirement:

> **§354.40** Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

The GSA will develop and maintain a data management system for storing and reporting information for the implementation of this GSP.

The rest of this section is to be prepared later after the GSA has prepared a comprehensive Data Management System as part of the Madera Basin Coordinated Effort. DWR has also stated that they will provide further guidance on this topic, possibly in the form a Best Management Practices Report, but it has not been released as of January 2019.

6 Projects and Management Actions

Regulation Requirement:

§ 354.44. Projects and Management Actions
(a) Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.
(b) Each Plan shall include a description of the projects and management actions that include the following:
(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:
(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.
(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.
(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.
(3) A summary of the permitting and regulatory process required for each project and management action.
(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.
(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.
(6) An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.
(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.
(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.
(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.
(c) Projects and management actions shall be supported by best available information and best available science.
(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.1 Potential GSP Projects and Programs

Implementation of projects and management actions will ensure that NSWD GSA will achieve groundwater sustainability by 2040. NSWD GSA analyzed several project types and groundwater management programs during the GSP planning process, which can be summarized into the following categories:

- Groundwater Recharge Projects
- Surface Water Acquisition Projects
- Water Conservation Projects
- Management Programs

6.1.1 Groundwater Recharge Projects

Recharge Basins

When excess surface water is available, it can be diverted into recharge basins, which allow water to percolate to the groundwater table and replenish the upper aquifer. Surface water is stored underground and extracted at a later time for beneficial use. Benefits to groundwater recharge via recharge basins include stabilization of groundwater tables, improved flood risk management, reduced land subsidence, and increased subsurface storage of local or imported water for later use (especially for use in dry years). The volume of water recharged is limited by availability of and access to surface water, infiltration rates of soils, losses due to evaporation and groundwater migration, acreage of basins, constraints in existing infrastructure, and the ability to construct new infrastructure.

Water stored in recharge basins must be utilized in a timely manner or the benefits are lost. The SWRCB recognizes a first-in, first-use policy. This means the volume of water diverted for storage below ground is counted as the first water extracted during irrigation. There is little concern of losses once surface water is diverted to underground storage. For districts like New Stone that use more groundwater than they artificially recharge, water will be extracted before it can migrate out of the District. The District currently does not have any recharge basins, but a proposed recharge basin location is shown in **Figure 6-1.**

Preliminary designs and cost estimates for NSWD GSA's program for recharge have been completed. The GSA is seeking funding for the program through a Prop 218 assessment and through grants. The GSA plans to proceed as soon as funding is secured.

In-Lieu Recharge

Decreased dependence on groundwater supplies can be achieved through in-lieu recharge when excess surface water is available. When the availability of excess surface water coincides with irrigation demands primarily met through groundwater pumping, the excess surface flows can be used for irrigation in-lieu of pumping. This may create an increase in groundwater storage or reduce the rate at which stored groundwater is depleted by allowing groundwater, that would normally be used to satisfy irrigation demands, to remain in storage. The water remaining in underground storage could be extracted at a later time for beneficial use. Typical benefits of recharge basins apply to in-lieu recharge as well. Limitations of in-lieu recharge include availability of and access to surface water coinciding with irrigation demands that are primarily met with groundwater pumping as well as crop dormant seasons. It can also be limited by constraints in existing infrastructure and the possible need to construct new infrastructure to allow for surface water delivery to users who do not have existing connections to conveyance systems.

Groundwater Injection Wells

Groundwater injection wells recharge groundwater by pumping surface water into the aquifer through a well or set of wells. This type of recharge can be beneficial for recharging the lower aquifer. Typical benefits of recharge basins apply to injection wells, but the limitations are vastly different. Injection wells are not as limited by available land due to their small footprint and are not affected by evaporation losses. Injection wells also have the potential to directly recharge the confined aquifer. They are dependent on soil types for recharge rates, but not in the same way as recharge basins. Limitations unique to injection wells are potential requirements to treat surface water prior to injection to protect aquifer water quality, variations in recharge rates due to differing water quality and air content between injected water and groundwater, and additional permitting.

The NSWD GSA is studying injection techniques which may work in the District. There has been a lot of work with pilot studies that show promise. These projects would work in conjunction with the surface water distribution system for the recharge basins.

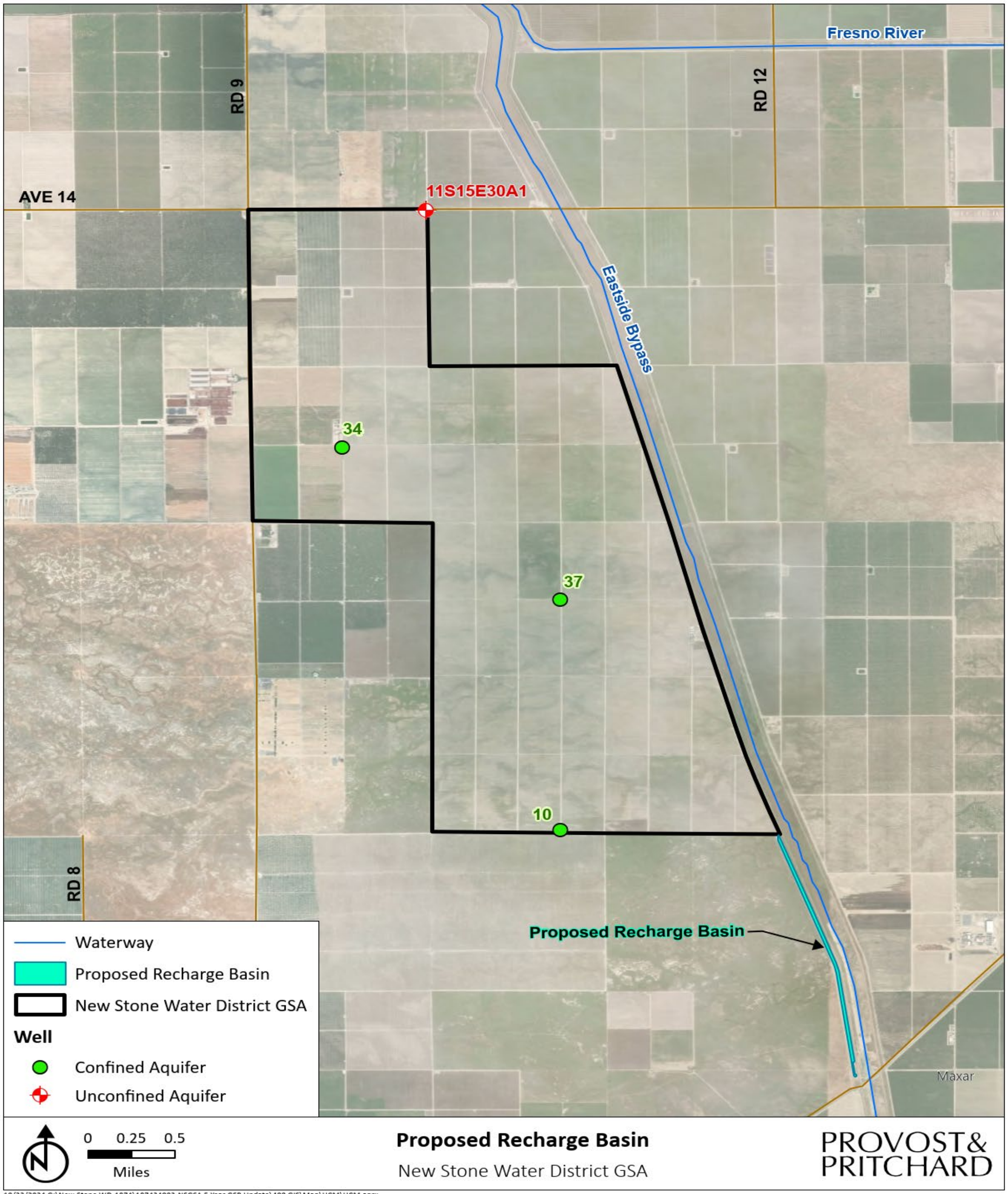


Figure 6-1 Proposed Recharge Basin

Banking Water Outside of District

There is potential to recharge water on lands outside of NSWD if suitable recharge pond locations cannot be found or acquired within the District. There are lands adjacent to NSWD that are currently not farmed and could be purchased or annexed into the District with the understanding that the lands are to be used for surface water recharge. This land would also increase the GSA's overall acreage, reducing the overdraft per acre and count toward a potential fallowing program. Currently, no adjacent landowners are willing to sell their land or agree to the District's terms for annexation.

The GSA has been exploring the possibility of working with neighboring landowners to build recharge basins. They have not had success in this effort as of WY2023 but are continuing to pursue this concept.

6.1.2 Surface Water Acquisition Programs

Acquisition of Chowchilla Bypass Flood Water

Securing new sources of surface water for import into a district/basin is a vital component of basin and groundwater sustainability. During years with significantly above average precipitation, non-contracted water sourced from high flow events is released into the San Joaquin River from Millerton Dam. If the lower reaches of the SJR are at capacity, excess flows are diverted into the Chowchilla Bypass via the bifurcation structure operated by the Lower San Joaquin Levee Control District. Acquiring water rights for surplus flows in Chowchilla Bypass will allow this previously abandoned water to be put to beneficial use and promote groundwater sustainability in the basin. Uses for this water can include, but are not limited to, groundwater banking and recharge via recharge basins, on-farm recharge, and in-lieu recharge. Excess surface flows often occur during the non-irrigation season when demands are very low or non-existent. In this case, surplus flows can be stored in basins until there is an irrigation demand or flooded on fields when the crops are dormant for in-lieu recharge. Benefits to importing new sources of surface water via water rights acquisition include stabilization of groundwater levels, reduced dependence on groundwater pumping, improved flood risk management, reductions in land subsidence, and increased storage of water underground for later use, especially in critically dry years or during extended droughts. Currently, NSWD has an appropriated water right along the Chowchilla Bypass for 15,700 AF of water.

Acquisition of USBR 215 Flood Water

Section 215 of the Reclamation Reform Act of 1982 (Public Law 97-293) defines temporary non-storable water supplies that can be released by the USBR from their facilities. The release of Section 215 water occurs during years of above-average precipitation when water levels encroach on flood-control levels. Section 215 flows are defined as unusually large temporary water supplies that cannot be stored for project purposes. Acquiring a Section 215 contract allows for these flows to be applied to lands that would otherwise not be eligible to receive Federal water. Benefits to importing new sources of surface water via a Section 215 Contract include stabilization of groundwater levels, reduced dependence on groundwater pumping, improved flood risk management, reductions in land subsidence, and increased storage of water underground for later use, especially in critically dry years or during extended droughts.

Water Exchanges/Transfers/Purchases

The GSA could exchange, transfer, or purchase water from other public or private agencies as opportunities arise. These prospects could be used within NSWD for direct or indirect recharge to help alleviate overdraft conditions and promote aquifer sustainability. If a lack of infrastructure prevents purchased water from being used within the GSA, agreements could be made with neighboring agencies to bank or recharge the water on behalf of NSWD.

6.1.3 Conservation and System Projects

Irrigation Efficiency Improvements
NSWD is approximately 4,200 acres made up of farmland and irrigated primarily by District wells. Most of the wells in the District range between 300 to 680 feet in depth. Typical irrigation methods include sprinklers, drip/micro irrigation, and surface/flood irrigation. Over the historic water budget period, it was estimated average on-farm irrigation efficiency is approximately 81%. This number may not reflect current irrigation efficiencies as irrigation techniques move from flooding to drip and micro. Implementing projects to increase on-farm efficiencies can promote aquifer sustainability by reducing or eliminating water that leaves the District via irrigation runoff, as wind and spray losses and leaks. Increasing on-farm efficiencies may not significantly impact aquifer sustainability if water is pumped from the upper aquifer because it is assumed any water applied in excess of crop evapotranspiration will percolate and return to the upper, unconfined aquifer. However, actual irrecoverable losses due to irrigation efficiency may be underestimated. Other benefits may be seen by growers as irrigation efficiency increases, such as decreased operational and pumping costs and possible increases in yield per acre-foot of water applied.

Increasing the overall District irrigation efficiency by capturing and reusing any water leaving the GSA could promote basin sustainability. Recaptured water can be used for artificial groundwater recharge or be directly used for irrigation to reduce the amount of required groundwater pumping.

Installing Well Meters
Groundwater pumping is currently the primary source of irrigation for NSWD. Installing flow meters on all irrigation wells would allow for better management of groundwater extractions by allowing the GSA to quantify pumping and its effects on groundwater storage, quality, and other sustainability indicators. Metering groundwater pumping would also allow the GSA to determine additional areas of improvement. Monitoring and collecting volumetric groundwater extraction data may be necessary if pumping restrictions are implemented in the future, where penalties are developed and implemented for over pumping. This data will also aid the District in maintaining a balanced aquifer. The GSA may decline to require existing wells be fitted with meters; however, metering is mandatory for any new wells drilled in Madera County.

6.1.4 Management Programs

Proposition 218 – Fee Assessment to Implement GSP
The proposition 218 assessment is used to develop a fee schedule for members lying within the district being assessed. The purpose is to generate income to implement the GSA's mission and keep members of the district in compliance with local, state, and federal laws. For the purposes of assessing a GSA, districts would likely consider land uses, total acreage, number of wells, groundwater pumping and overall water use, access to surface water, and existing privately-operated management programs. Fees would then be assessed and either attached to an individual's property taxes or be collected directly by the districts. This would replace voluntary assessments and prevent districts from requesting money on an as-needed basis, but it would ensure that funds were available for project implementation and GSP maintenance and updates.

As of this Revision submission, a draft Prop 218 engineers report is currently under review by the NSWD GSA Board. The capital improvement budget must be finalized and then a public hearing will be held. The schedule for implementation of the proposed assessment is the 2023-2024 tax year.

Subsidies for Surface Water Use, Groundwater Conservation Improvements, & Crop Conversions
Subsidies for surface water use, groundwater conservation improvements, and crop conversions to lower water-demand crops may be implemented by the GSA as incentives to help alleviate current overdraft conditions.

Irrigating with surface water in-lieu of groundwater pumping may increase groundwater storage or reduce the groundwater extraction rate. Subsidies could be awarded to users who utilize surface water as incentive to reduce groundwater extractions for irrigation.

Subsidies could also be awarded to users who engage in groundwater conservation improvements, such as implementing on-farm BMPs. These practices can include installing soil moisture sensors, utilizing high-efficiency irrigation methods, and metering to apply precise irrigation amounts. Increasing groundwater conservation practices can promote aquifer sustainability by decreasing extractions and overdraft.

Replacing existing crops with lower-demand crops could increase basin sustainability and reduce groundwater overdraft through a reduction in extractions for irrigation. Growers may be incentivized through subsidies for crop conversions.

Fallowing Rotation

Land fallowing is the practice of taking crops out of production, allowing the land to be used for recharge purposes or to remain bare. Removing high water demand crops from production can balance groundwater levels and increase basin stability and sustainability by reducing the demands on the aquifer, especially if the fallowed land was irrigated with composite or deep-water wells.

The GSA had been considering a land fallowing program due to the continuing drought period through WY2022. However, the recent wet cycle that is happening during WY2023 has vastly improved conditions and no fallowing will be required for 2023.

Agency Reporting

GSAs will need some amount of reporting to meet the minimum requirements of SGMA and to establish representative monitoring networks. However, internal reporting will assist GSAs in determining impacts or benefits of management actions as well as protecting GSAs if disputes should arise in neighboring basins. Reporting will also assist GSAs in identifying problems and areas of concern, potential improvements or programs to achieve sustainability, and will likely prevent internal disputes.

6.2 Project Selection to Achieve Sustainability

NSWDGSA has not dismissed any of the proposed project types. For the purposes of this GSP, only projects being considered by the District as of initial GSP development are described further. If other projects described previously become feasible in the future, they will be addressed and prioritized in subsequent Annual Reports.

6.2.1 Construct Chowchilla Bypass Turnout, New Canals, and Recharge Basins

6.2.1.1 Project Description

During extreme wet years, non-contracted water sourced from high flow events is released into the San Joaquin River. When the lower reaches of the SJR are at capacity, water is diverted from those lower reaches into the Bypass, a man-made flood control structure that runs along the east boundary of NSWD. Diversions from the SJR to the Bypass occur at the bifurcation structure operated by the Lower San Joaquin Levee Control District. The Bypass diverts flood waters from the lower reaches of the SJR to prevent flooding from Mendota northward past Highway 152 where it reconnects with the SJR. The Bypass only runs during high-flow years when the combined flows from both the SJR and the Kings River exceed the capacity of the lower SJR.

Constructing a turnout on the Chowchilla bypass ½ mile south of Avenue 12, new canals to convey the water, and up to three 80-acre recharge basins (Project) would allow NSWD GSA to implement groundwater recharge, in-lieu recharge, and flood relief projects. This project proposes to divert the District's appropriated high-flow waters from the Bypass via a new turnout owned and operated by the District. Water will be delivered from the Bypass to the proposed recharge basins and on-farm recharge areas within NSWD. Water will be applied directly to crops until land for a recharge basin can be acquired and developed. The turnout will be similar to others on the Bypass in the surrounding area and will divert water using slant mount pumps on the Bypass levee or a slide gate-controlled gravity pipeline turnout that will cut through the levee and end at sump pump on the field side of the Bypass levee. Fish screens will be required on both alternatives. The new canals will then convey the water through the District and terminate at the new recharge basins.

Additional groundwater recharge would also occur along the new canals. Excess water beyond the capacity of the proposed recharge basins could be stored in the canals, turning it into a linear recharge pond and allowing water to recharge the groundwater table. Also, turnouts to landowners can be installed along the canals so that they could use the water for irrigation purposes or flood the fields when the crops are dormant for another groundwater recharge opportunity.

Flows for the 20-year duration of available data (1997-2017) were analyzed to determine the frequency and duration of flows down the Bypass. There were significant flows in the Bypass in 1998, 2005, 2006, 2011, and 2017. The Bypass typically flows every 4 years between mid-January to mid-July (**Figure 6-2**). During high flow years (2006, 2011, 2017), the Bypass ran between 146 to 192 days. Flow rates in the Bypass are measured every 15 minutes at the California Data Exchange Center (CDEC) at the CBP station.

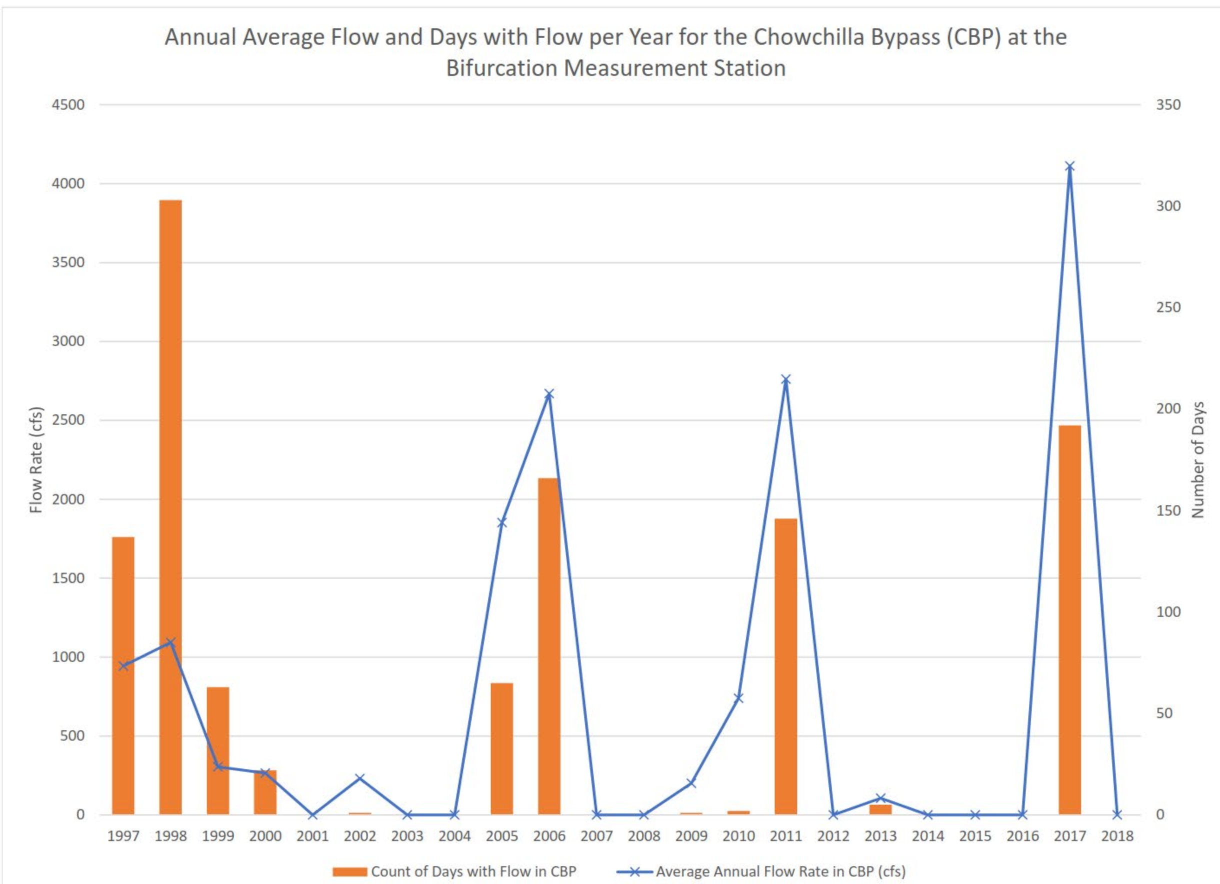


Figure 6-2 Chowchilla Bypass Historical Flow

The Bypass is operated by the Levee District. Flows for Bypass operations are measured in the SJR upstream of the Bifurcation Structure/control structure (Upstream flow SJR) and downstream of the Bifurcation Structure/control structure (Downstream flow SJR), and Chowchilla Bypass (Chowchilla Canal CCBP, CBP).

When flows exceed the 2,500 cfs capacity of the SJR below the Bifurcation Structure, water is diverted down the Bypass. The Bypass at the CBP Station has a capacity of 5,500 cfs; however, if both the capacity of the SJR below the Bifurcation Structure (2,500 cfs) and the CBP Station (5,500 cfs) are exceeded, it is at the Levee District's discretion to operate the system with the objective of minimizing damage. According to the Levee District, due to additional constraints in SJR channel capacity below the Bifurcation Structure, the Bypass operates when flows downstream are expected to exceed 1,300 cfs. Because the Bypass is operated as a flood control structure, there are many years when it does not run and there is no available water for users along the Bypass.

6.2.1.2 Measurable Objectives

The main objective of the Project is to divert the District's 15,700 AF appropriated water right during time of high flows. The GSA has an estimated annual groundwater deficit of 1,600 acre-feet per year. If NSWD GSA is able to divert 15,700 AF of water from the Bypass every 4 years, they should be able to correct their deficit and achieve sustainability. Flows will be diverted from the Bypass to the proposed recharge basins via new turnout and conveyance facilities. Using existing wells in the area, water elevations will be monitored, and water samples will be collected. This data will be used to establish baselines for groundwater elevations and quality for comparison to quantify project impacts. Surface water delivered to the recharge basins will be metered and sampled for water quality issues, although none are anticipated.

6.2.1.3 Circumstances for Implementation

NSWD GSA lies within a critically overdrafted groundwater basin, which causes basin-wide aquifer depletion, land subsidence, and unstable groundwater levels. Constructing a Bypass turnout and new recharge facilities will play a vital role in remediating basin unsustainability. Implementation will depend on the availability of land for new recharge basins and acquiring a source of funding.

6.2.1.4 Permitting and Regulatory Process

It is anticipated that approvals from the following agencies will be required:

- *Army Corps of Engineers (Army Corps), 404 Permit* – work within a Water of the US.
- *California Environmental Quality Act (CEQA)* – compliance with CEQA for project approval.
- *Central Valley Flood Protection Board (CVFPB), Encroachment Permit* – For work within a State Designated Floodway.
- *Department of Fish and Wildlife, Stream Bed Alteration Agreement* – for work within the CBP, a Water of the State.
- *Madera County, Building Permit* – for any electrical work to service facilities.
- *Mosquito Abatement* – for operation of an open body of water that could host vectors.
- *Regional Water Quality Control Board (RWQCB), Section 401 Water Quality Certification* – for compliance with the Clean Water Act in conjunction with the Army Corps 404 permit.
- *San Joaquin Valley Air Pollution Control District (SJVAPCD)* – for preparation of a Dust Control Plan for construction that disturbs a surface area of 5 acres or more.
- *State Water Resources Control Board, Stormwater Pollution Prevention Plan (SWPPP)* – for construction that disturbs more than five acres.

6.2.1.5 Project Schedule

This project is in the conceptual phase. Once project funding is secured, a comprehensive schedule including environmental review, design, permitting, and construction will be developed. Environmental review, permitting, and project agreements could be completed in 3 to 6 months, where design and construction could be completed in a year. It is anticipated that NSWD GSA will start working on securing funding prior to or within the first 5 years of GSP implementation.

6.2.1.6 Project Benefits

Groundwater is the primary water supply within NSWD, and the project will increase the reliability of the groundwater supply and basin sustainability. The benefits of this project are flood damage reduction, groundwater recharge, improving groundwater levels, and creation of a dry-year water supply. During high flows of the SJR when flows are diverted through the Bypass, redistribution of surface water mitigates the possibility of flooding to cities and lands downstream. These flood flows can then be used for groundwater recharge to alleviate chronic overdraft conditions. The amount of recharge will depend on how many acres are available for the proposed recharge facilities, the amount and duration of available water, and the infiltration rate of the recharge facilities. The removal of approximately up to 240 acres of permanent crops for the Project will also reduce pumping in the District by about 550 AF annually (assuming a District average pumping rate of 2.3 acre-feet/acre).

6.2.1.7 Project Implementation

This project will be implemented by NSWD as an integral piece of the GSA's overall effort to reach sustainability. It will be implemented, managed, and operated by the GSA. Project implementation includes the construction of recharge facilities and water conveyance systems. Benefits would begin as soon as water is applied to the constructed recharge facilities. The Project has been determined to be a high priority project based on the urgent need to correct critical overdraft.

6.2.1.8 Legal Authority

NSWD GSA would need to purchase the land necessary for the proposed groundwater recharge facilities and acquire easements for the new turnout and the conveyance systems. The project would be owned and operated by NSWD GSA. An agreement with the CVFPB and Army Corps will be required for constructing the turnout in the Bypass levee system. It is anticipated that the connection will need to be constructed outside of flood season.

6.2.1.9 Project Cost Estimate/Acre-Foot of Yield

Construction costs are based on similar projects for the conceptual level design and include permitting, the turnout, conveyance canal, and basin construction. The total cost of the project is estimated at about $7.7 million, Assuming a 3% interest rate loan, annualized over a 50-year period, the annual repayment cost is expected to be $400,000. The material required to complete this project is expected to last 50 years or more. The portion of the water cost due to capital expenditures, on an average annual basis, is expected to be about $70 per acre-foot for an annual yield of 6,000 acre-feet. Costs will be further developed once the project proceeds to a more detailed level of design. Based on being a conceptual level, a -20%/+30% contingency was presumed.

6.2.1.10 Management of Groundwater Extractions and Recharge

The project would be owned and operated by NSWD GSA as a necessary part of meeting the demands of SGMA. Management of groundwater extractions and recharge is possible by monitoring groundwater levels, recharge basin inflows, and diversions over time. Data could be reported to the GSA to make sure groundwater levels do not continue to decline beyond sustainable levels. During times of drought or in the occasion that the recharge rate is insufficient to mitigate overdraft to the measurable objective, management actions may be enacted. The severity of the situation will dictate the required actions. Priority will be given to actions that can be implemented in a relatively short amount of time and have a high benefit-to-cost ratio.

6.3 Management Actions

GSAs have a variety of tools which can be used to achieve sustainable groundwater management. The project previously identified in this chapter primarily focuses on the capture and use of surface water supplies within the GSA. Alternatively, there are other management actions which primarily focus on the reduction of groundwater demand and increase of data collection including education and outreach, regulatory policies, incentive-based programs, and enforcement actions.

If basin overdraft isn't mitigated or if sustainable thresholds are not being met after implementation of NSWD GSA and landowner projects, the management actions and other potential projects listed below may be enacted, and the priority of these projects will be increased. The severity of the situation will dictate the actions taken. Priority will be given to actions and projects that can be implemented in a relatively short amount of time and have a high benefit-to-cost ratio.

The following sections will discuss a suite of management options NSWD GSA may consider during the GSP implementation. The menu of management actions discussed below may not be implemented in a strictly linear fashion, as numbered in the GSP. It is expected that NSWD 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. NSWD GSA understands there are various levels of uncertainty with program implementation, and it is not unusual for 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.

The legal authority and basis for the management actions described in this GSP Chapter 6 are outlined in SGMA and related provisions. SGMA describes the powers and authorities, financial authority, and enforcement powers of GSAs in Chapters 5, 8, and 9 respectively. These GSA authorities include adopting regulations, regulating groundwater extractions, imposing fees, monitoring, enforcing programs, and more. Though the law grants the GSA these powers, the pursuit and implementation of the projects and management actions is the GSA's responsibility. The GSA may enforce their legal authority to the extent necessary to achieve sustainable groundwater management for all beneficial users within the GSA.

6.3.1 Groundwater Allocation

The GSA may adopt a policy which provides a finite groundwater allocation on a per acre basis. The sustainable yield and ultimate groundwater allocation may take into consideration the existing water rights holders, disadvantaged communities (DACs), GDEs, and CA Native American tribes. The GSA may determine whether an equal-, reduced-, or zero-allocation is given to lands with unexercised groundwater rights.

The GSA may adopt a policy which provides a gradual decrease to the initial groundwater allocation on a per acre basis to allow growers to adjust to the pumping restrictions over a 5-year period. The GSA may adopt a policy which states an adaptive management approach, whereby the groundwater allocation may be reviewed, changed, and reestablished every 5 years or during extreme drought as necessary to achieve long-term sustainability.

The GSA may adopt a policy to determine the method or methods to quantify the groundwater extractions. The GSA may consider a variety of methods including, but not limited to 1) aerial flyovers or remote sensing of irrigated area, 2) annual crop survey alongside aerial flyovers or remote sensing of irrigation areas including crop coefficients, 3) energy records and meter calibrations, 4) flow meter readings of pumped water, 5) remote sensing of evapotranspiration, or 6) other methods.

6.3.1.1 Measurable Objective

The goal is to ensure a fair groundwater allocation which clearly defines the acceptable groundwater extraction volume per year. The measurable objective is the volume of groundwater extraction in acre-feet.

6.3.1.2 Program Benefits

The development of a groundwater allocation per acre may be based on the GSA's current sustainable yield. The expected benefits would be mitigation of overdraft by ensuring groundwater supplies are withdrawn in a sustainable manner. To enforce this program, monitoring of groundwater extractions would be necessary, thus creating a better database for future understanding of groundwater conditions.

6.3.1.3 Program Costs

Exact costs are difficult to determine; however, qualitative costs include personnel to draft and adopt the policy as well as implementation and enforcement of the policy on a yearly basis.

6.3.1.4 Circumstances of Implementation

The policy may be considered as part of the implementation of the plan and continue indefinitely or it may only be established when measurable objectives or minimum thresholds of sustainability indicators are not being met. The policy may be adapted or changed based on current or future conditions.

6.3.2 Groundwater Market and Trading

The GSA may adopt a policy to define groundwater allocation carryover provisions and/or allowing multi-year pumping averages. The inter-annual flexibility may be useful to growers who could change cropping patterns or fallow. However, there is a risk that extreme drought may induce exceptionally high pumping in a single year.

The GSA may adopt a policy to define a groundwater banking program. The GSA must acknowledge and discuss any other existing water bank/credit systems. The GSA must approve of all replenishment projects and determine the timeframe for any banking efforts prior to banking program adoption. The GSA may consider adjusting banked credits if groundwater allocations require adjustment of safe yield. The GSA may define a "leave-behind" amount for groundwater migration and operational and evaporative losses, as well as to buffer against impacts to neighboring wells. The GSA may consider finite timelines for banked water or ongoing "leave-behind" amounts.

The GSA may adopt a policy to define a groundwater trading structure. The GSA may consider a variety of structures including, but not limited to 1) bilateral contracts or "coffee shop" markets, 2) brokerage, 3) bulletin boards, 4) auctions and reverse auctions, 5) electronic clearing-houses or "smart markets," or 6) other trade structures. Trading may be executed through short-and long-term leases, permanent transfers, inter-annual water exchanges, or dry-year option contracts. The GSA may determine physical trade limitations, such as distance, aquifer, soil conditions, or management areas.

The GSA may adopt a policy to prohibit groundwater allocation transfers outside of the GSA Management Area boundaries. The GSA may assure performance by enforcing rigid penalties for illegal actions. The GSA may approve external transfers in limited quantities for emergency situations and levy fees for metering the transferred amount.

6.3.2.1 Measurable Objectives

The goal is to provide groundwater users (excluding de minimis extractors) with more flexibility in utilizing their groundwater allocation. It may also provide groundwater users an optional banking program to fairly and responsibly bank groundwater allocations.

6.3.2.2 Program Benefits

The expected benefits may provide groundwater extractors more flexibility year to year and encourage other on-farm changes, such as crop conversion, crop rotation, deficit irrigation, and other best management practices. The method of evaluation may consider the number of participants, cost, accounting, and legal defense. This management action allows sustainable carryover allocations but may not generate a quantifiable demand reduction.

6.3.2.3 Program Costs

Exact costs are difficult to determine; however, qualitative costs include personnel to draft and adopt the policy as well as implementation and enforcement of the policy on a yearly basis.

6.3.2.4 Circumstances of Implementation

The policy may be implemented shortly after the adoption of the groundwater allocation per acre and remain indefinitely. Prerequisites of banking may include the installation of a flowmeter for participants and payment of any GSA assessments, penalties, or fees.

6.3.3 Groundwater Fees and Subsidies

The GSA may adopt a policy to levy tiered fees for pumping beyond the current groundwater allocation. The GSA may consider cease and desist orders for excessive abuse. The GSA may adopt a policy to incentivize groundwater extractors through subsidies to change crop type to one with a lower water demand.

6.3.3.1 Measurable Objective

The objective of these types of policies would be to directly decrease water demand and to enforce sustainable yield policies.

6.3.3.2 Program Benefits

The program may enforce sustainable yield allocations by imposing a tiered fee structure and would bring in additional income for the GSA. Subsidies for crop conversion would directly impact water demand, thus helping the District remain sustainably managed.

6.3.3.3 Program Costs

Exact costs are difficult to determine; however, qualitative costs include personnel to draft and adopt the policy as well as implementation and enforcement of the policy on a yearly basis.

6.3.3.4 Circumstances of Implementation

The policy may be implemented shortly after the adoption of GSP and remain indefinitely. It may instead be adopted if sustainability goals are not being met.

7 Plan Implementation

The adoption of the GSP will be the official start of the Plan Implementation for the NSWD GSA. The GSA will continue its efforts to secure the necessary funding to successfully monitor and manage groundwater resources within the District in a sustainable manner. While the GSP is being reviewed by DWR, NSWD GSA will begin the implementation of both projects and management actions.

The following chapter outlines the estimated proposed budget and implementation timeline for the suggested projects and management actions of the NSWD 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 outlined below are purely estimates and may be adapted or eliminated should the GSA board deem it necessary.

7.1 Estimate of GSP Implementation Costs

There are two main types of expenses that require funding in order to successfully implement the NSWD GSP: Ongoing Administrative Expenses and Project Costs.

Ongoing Administrative Expenses
These include but are not limited to the cost of annually operating the GSA, including the executive officer's salary, fiscal agent and staff expenses, audit, annual data collection and reporting, outreach, legal, and other administrative costs. This does not include agency specific project implementation costs but may include GSA-wide efforts, such as identification of construction information for wells in the monitoring network. Costs are estimated to be in the range of approximately $40,000 to $105,000 annually as seen in **Table 7-1**.

Table 7-1 Estimated Administrative Costs

	2020	2021	2022	2023	2024
Annual Monitoring	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000
Basin Coordination	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Five Year Plan Update					$ 65,000
	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 105,000

Table 7-1 is referring to the estimated administrative costs that may be seen on an annual basis for fulfilling typical responsibilities of the GSA. The above costs were compiled purely as an estimation and may be adapted or eliminated should the Board of Directors deem it necessary. It is impossible to accurately determine how many hours may be required on a weekly basis to complete the regular responsibilities of the GSA. The line items seen in **Table 7-1** may not accurately represent all the actions said funding would be contributed to.

Project Costs
Projects which may include infrastructure or management programs will be required to achieve groundwater sustainability. Project costs may include planning, capital, financing, and operations and maintenance of infrastructure. The project costs listed throughout this chapter are estimates and may be adapted or eliminated by the GSA Board should it be deemed necessary. Additionally, the implementation of the projects is dependent on both obtaining funding and the availability of flood water to be utilized. Further discussion regarding projects and their individual components, as well as their estimated timelines, can be found in Chapter 6 Projects and Management Actions.

Table 7-2 Estimated NSWD GSA Project Costs

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

PRELIMINARY
ENGINEER'S OPINION OF PROBABLE COST

New Stone Waste District
GSP Management Actions
July 23, 2019

Item No.	Item Description	Quantity	Unit	Unit Price	Amount
CHOWCHILLA BYPASS TURNOUT					
1-1	Chowchilla Bypass Diversion Channel Excavation	7,000	CY	$ 4	$ 28,000
1-2	F&I Fish Screen in Bypass Diversion Channel	2	EA	$ 91,000	$ 182,000
1-3	F&I Slant Pump (50 CFS, 175 HP)	2	EA	$ 150,000	$ 300,000
1-4	Site Electrical with PG&E Service	1	LS	$ 100,000	$ 100,000
1-5	Levee Crossing and Replacement - Open Trench	600	CY	$ 14	$ 8,400
1-6	F&I 42" Steel Discharge Pipes	700	LF	$ 210	$ 147,000
1-7	F&I Flow Meter	2	EA	$ 10,000	$ 20,000
1-8	F&I Rip Rap	250	TN	$ 80	$ 20,000
1-9	Construct Flashboard Check Structure at D/S End	1	LS	$ 155,000	$ 155,000
	ESTIMATED CONSTRUCTION SUBTOTAL				**$ 960,000**
DISTRIBUTION SYSTEM					
2-1	Canals	7,000	CY	$ 4	$ 28,000
2-2	Lift station	1	EA	$ 91,000	$ 91,000
2-3	Road crossings	20	EA	$ 30,000	$ 600,000
2-4	Settling Basins	40	EA	$ 20,000	$ 800,000
	ESTIMATED CONSTRUCTION SUBTOTAL				**$ 1,519,000**
RECHARGE BASINS (10,000AF/yr)					
3-1	Earthwork (3 - 80 ac basins)	200,000	CY	$ 4	$ 800,000
3-2	Interbasin structures	6	EA	$ 15,000	$ 90,000
3-3	Rip-rap	450	TON	$ 80	$ 36,000
	ESTIMATED CONSTRUCTION SUBTOTAL				**$ 926,000**
LOWER AQUIFER PUMPING REDUCTION					
4-1	New shallow wells	5	EA	$ 450,000	$ 2,250,000
4-2	Lower aquifer well rehabilitation	5	EA	$ 55,000	$ 275,000
	ESTIMATED CONSTRUCTION SUBTOTAL				**$ 2,525,000**
AQUIFER STORAGE (6,000AF/ year)					
2-1	Water treatment Equipment	8	EA	$ 250,000	$ 2,000,000
2-2	Basins	8	EA	$ 65,000	$ 520,000
2-3	Well equipment	8	EA	$ 120,000	$ 960,000
2-4	Filters	8	EA	$ 65,000	$ 520,000
	ESTIMATED CONSTRUCTION SUBTOTAL				**$ 4,000,000**

Table 7-2 lists the estimated costs for the proposed projects as seen in Chapter 6 Projects and Management Actions. The existing project list is not necessarily definite and may be altered by the GSA Board of Directors. It is the intention of the GSA Board that the proposed projects would contribute substantially to NSWD GSA sustainability goals.

Grant Funding

NSWD GSA will explore federal and state grant funding opportunities to help finance the initial steps of plan implementation.

Table 7-3 Estimated Costs for Implementing Management Actions

Implementation of Projects and Management Actions	Estimated Costs Per 5-Year Period				Total 20-Year Cost
	2020 - 2025	2025 - 2030	2030 - 2035	2035 - 2040	
Bypass Turnout	$125,000	$125,000	$125,000	$125,000	$500,000
Distribution System	$375,000	$375,000	$375,000	$375,000	$1,500,000
Recharge Basins/Canal	$200,000	$200,000	$200,000	$200,000	$800,000
New wells	$500,000	$500,000	$500,000	$500,000	$2,000,000
Aquifer Storage	$750,000	$750,000	$750,000	$750,000	$3,000,000
Total Cost	$1,950,000	$1,950,000	$1,950,000	$1,950,000	$7,800,000
Average Annual Cost	$390,000	$390,000	$390,000	$390,000	

Table 7-3 indicates the estimated costs to the GSA associated with the proposed management actions as seen in Chapter 6 Projects and Management Actions. **Table 7-3** explains the estimated costs associated with each proposed management action as it is implemented and indicates their conceivable annual costs. These estimates may be altered by the GSA Board of Directors if deemed necessary and may be additionally adjusted during the 5-year GSP review. **Table 7-3** is an estimation of these and other costs, actual values may be in exceedance of, or less than those depicted above.

7.2 Identify Funding Alternatives

The Madera Subbasin has qualified for funding for developing and pursuing planning for the development and writing of the GSP. NSWD GSA has been a part of this effort and the NSWD GSA is grateful. Hopefully, Proposition 1 grant funding will be available to offset some of the capital improvement costs. Because Proposition 3 did not pass in this last election, there is some doubt that there will be grant or low interest loan money available to help offset some of the costs.

7.3 Schedule for Implementation

The GSA's overdraft was estimated to be approximately 1,600 AF prior to the development of the GSP. It is evaluated that by 2025, the pre-existing overdraft value will have decreased by approximately 10% due to both the implementation of projects and management actions. Of that amount, approximately 75% of that change will have developed from new or existing GSP projects and 25% will come from the implementation of NSWD GSA management actions. In the year 2030 it is estimated that the implementation of both GSP projects and management actions will have decreased the amount of overdraft by an additional 30% with 50% coming from project implementation and 50% from management actions. The progress of this trend is cumulative and will continue to increase throughout the GSP's implementation until sustainability is met.

7.4 Data Management System

The GSA's data management system will be developed in cooperation with the Madera Subbasin GSAs. The expectation is that over time the system will be modified to allow easier sharing of data within the region. The logistics of data flow, timing, and individual GSA management will be further defined after GSP adoption when more specific information is available.

7.5 Annual Reporting

Regulation Requirement:

§356.2. Annual Reports
Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:

(a) General information, including an executive summary and a location map depicting the basin covered by the report.

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:

(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.

(B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.

(2) Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.

(3) Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.

(4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.

(5) Change in groundwater in storage shall include the following:

(A) Change in groundwater in storage maps for each principal aquifer in the basin.

(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.

(c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.

The GSA will annually report the result of basin operations including current groundwater levels, extraction volume, surface water use, total water use, groundwater storage change, and progress of GSP implementation in accordance with SGMA law §356.2. Annual Reports.

7.6 Periodic Evaluations

Regulation Requirement:

§356.4. Periodic Evaluation by Agency
Each Agency shall evaluate its Plan at least every five years and whenever the Plan is amended, and provide a written assessment to the Department. The assessment shall describe whether the Plan implementation, including implementation of projects and management actions, are meeting the sustainability goal in the basin, and shall include the following:

(a) A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones and minimum thresholds.

(b) A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.

(c) Elements of the Plan, including the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives, shall be reconsidered and revisions proposed, if necessary.

(d) An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the Agency's evaluation shows that the basin is experiencing overdraft conditions, the Agency shall include an assessment of measures to mitigate that overdraft.

(e) A description of the monitoring network within the basin, including whether data gaps exist, or any areas within the basin are represented by data that does not satisfy the requirements of Sections 352.4 and 354.34(c). The description shall include the following:

(1) An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of Section 354.38.

(2) If the Agency identifies data gaps, the Plan shall describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Plan.

(3) The Plan shall prioritize the installation of new data collection facilities and analysis of new data based on the needs of the basin.

(f) A description of significant new information that has been made available since Plan adoption or amendment, or the last five-year assessment. The description shall also include whether new information warrants changes to any aspect of the Plan, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.

(g) A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the Plan.

(h) Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the basin.

(i) A description of completed or proposed Plan amendments.

(j) Where appropriate, a summary of coordination that occurred between multiple Agencies in a single basin, Agencies in hydrologically connected basins, and land use agencies.

(k) Other information the Agency deems appropriate, along with any information required by the Department to conduct a periodic review as required by Water Code Section 10733.

The GSA will report, at least every five years and when the GSP is amended, the result of basin 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 network, summary of enforcement or legal actions, and agency coordination efforts in accordance with SGMA law §356.4. Periodic Evaluation by Agency.

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Appendix A - Coordination Agreement

SECOND AMENDMENT TO THE MADERA SUBBASIN COORDINATION AGREEMENT

This SECOND AMENDMENT (AMENDMENT) to the MADERA SUBBASIN COORDINATION AGREEMENT ("Agreement") is entered into the_____day of January 2025 (the "Effective Date"), by and between the Groundwater Sustainability Agencies of the COUNTY OF MADERA ("County"), the CITY OF MADERA ("City"), the MADERA IRRIGATION DISTRICT ("MID"), the ROOT CREEK WATER DISTRICT ("RCWD"), the MADERA WATER DISTRICT ("MWD"), the GRAVELLY FORD WATER DISTRICT ("GFWD"), and the NEW STONE WATER DISTRICT ("NSWD"), collectively hereinafter referred to as the "Parties," or individually as the "Party."

RECITALS

A. **WHEREAS**, groundwater and surface water resources within the Madera Subbasin of the San Joaquin Valley Groundwater Basin (DWR Bulletin 118 No. 5-22.06) (Subbasin) are vitally important resources, in that they provide the foundation to maintain and fulfill current and future environmental, agricultural, domestic, municipal, and industrial needs, and to maintain the economic viability, prosperity, and sustainable management of the Subbasin; and

B. **WHEREAS**, agriculture has been prominent in making Madera County one of the world's foremost agricultural areas and plays a major role in the economy of Madera County; and

C. **WHEREAS**, in 2014 the California Legislature passed a statewide framework for sustainable groundwater management, known as the Sustainable Groundwater Management Act, California Water Code § 10720-10737.8 (SGMA), pursuant to Senate Bill 1168, Senate Bill 1319, and Assembly Bill 1739, which was approved by the Governor on September 16, 2014. and went into effect on January 1, 2015; and

D. **WHEREAS**, the Subbasin has been designated by the California Department of Water Resources (DWR) as a high-priority subbasin in a condition of critical groundwater overdraft and is subject to the requirements of SGMA; and

E. **WHEREAS**, SGMA requires that all medium and high priority groundwater basins in California be managed by a Groundwater Sustainability Agency (GSA), or multiple GSAs, and that such management be implemented pursuant to an approved Groundwater Sustainability Plan (GSP), or multiple GSPs; and

F. **WHEREAS**, County, City, MID, and MWD have developed one GSP; RCWD has developed one GSP; GFWD has developed one GSP; and NSWD has developed one GSP, such that the Subbasin is governed by four separate GSPs unified through the Agreement; and

G. **WHEREAS**, in January 2020, the Parties submitted four GSPs to DWR; and

H. **WHEREAS**, in January 2020, the Parties entered into the Agreement; and

I. **WHEREAS**, in March 2023, the Parties executed the first amendment to the Agreement; and

J. **WHEREAS**, the Agreement was defined as remaining in effect until December 31, 2024 unless terminated earlier by the Parties.

K. **NOW, THEREFORE**, in consideration of the mutual promises, covenants and conditions contained herein and these Recitals, which are hereby incorporated herein by this reference, the Parties agree to amend the Agreement as follows:

AGREEMENT

1. **TERMINATION DATE.** The Parties agree that the Agreement shall remain in effect until December 31, 2040 unless terminated earlier by the Parties as provided in the Agreement.

2. **NOTICES**. All notices required or permitted by the AMENDMENT shall be made in writing and may be delivered in person (by hand or by courier) or may be sent regular, certified, or registered mail or U.S. Postal Service Express Mail, with postage prepaid, or by facsimile transmission, or by electronic transmission (email) and shall be deemed sufficiently given if served in a manner specified in this section. The addresses and addressees noted below are the Party's designated address and addressee for deliver or mailing notices.

To County GSA:	County of Madera Stephanie Anagnoson 200 W 4th Street, 4th Floor Madera, CA 93637
To MID GSA:	Madera Irrigation District Thomas Greci 12152 Road 28 1/4 Madera, CA 93637
To RCWD GSA:	Root Creek Water District Julia Berry PO Box 27950 Fresno, CA 93729
To GFWD GSA:	Gravelly Ford Water District Don Roberts 18811 Road 27 Madera, CA 93638

To City GSA: City of Madera
Keith Helmuth
428 East Yosemite Avenue
Madera, CA 93638

To NSWD GSA: New Stone Water District
Gabriella Lion
9500 South DeWolf Avenue
Selma, CA 93662

To MWD GSA: Madera Water District
Phil Janzen
1663 N. Schnoor Street, Suite 105
Madera, CA 93638

Any Party may, by written notice to each of the other Parties, specify a different address for notice. Any notice sent by registered or certified mail, return receipt requested, shall be deemed given on the date of delivery shown on the receipt card, or if no delivery date is shown, three days after the postmark date. If sent by regular mail, the notice shall be deemed given 48 hours after it is addressed as required in this section and mailed with postage prepaid. Notices delivered by United States Express Mail or overnight courier that guarantee next day delivery shall be deemed given 24 hours after delivery to the Postal Service or overnight courier. Notices transmitted by facsimile transmission or similar means (including email) shall be deemed delivered upon telephone or similar confirmation of delivery (conformation report from fax machine is sufficient), provided a copy is also delivered via personal delivery or mail. If notice is received after 4:00 p.m. or on a Saturday, Sunday or legal holiday, it shall be deemed received on the next business day.

IN WITNESS WHEREOF, the Parties have caused this AMENDMENT to be executed, each signatory hereto represents that he/she has been appropriately authorized to enter into this AMENDMENT on behalf of the Party for whom he/she signs.

County of Madera

_______________________________ _______________________________
Leticia Gonzales Date

Madera Irrigation District

Thomas Greci | Date

Root Creek Water District

Julia Berry | Date

Gravelly Ford Water District

Don Roberts | Date

City of Madera

Cecelia Gallegos | Date

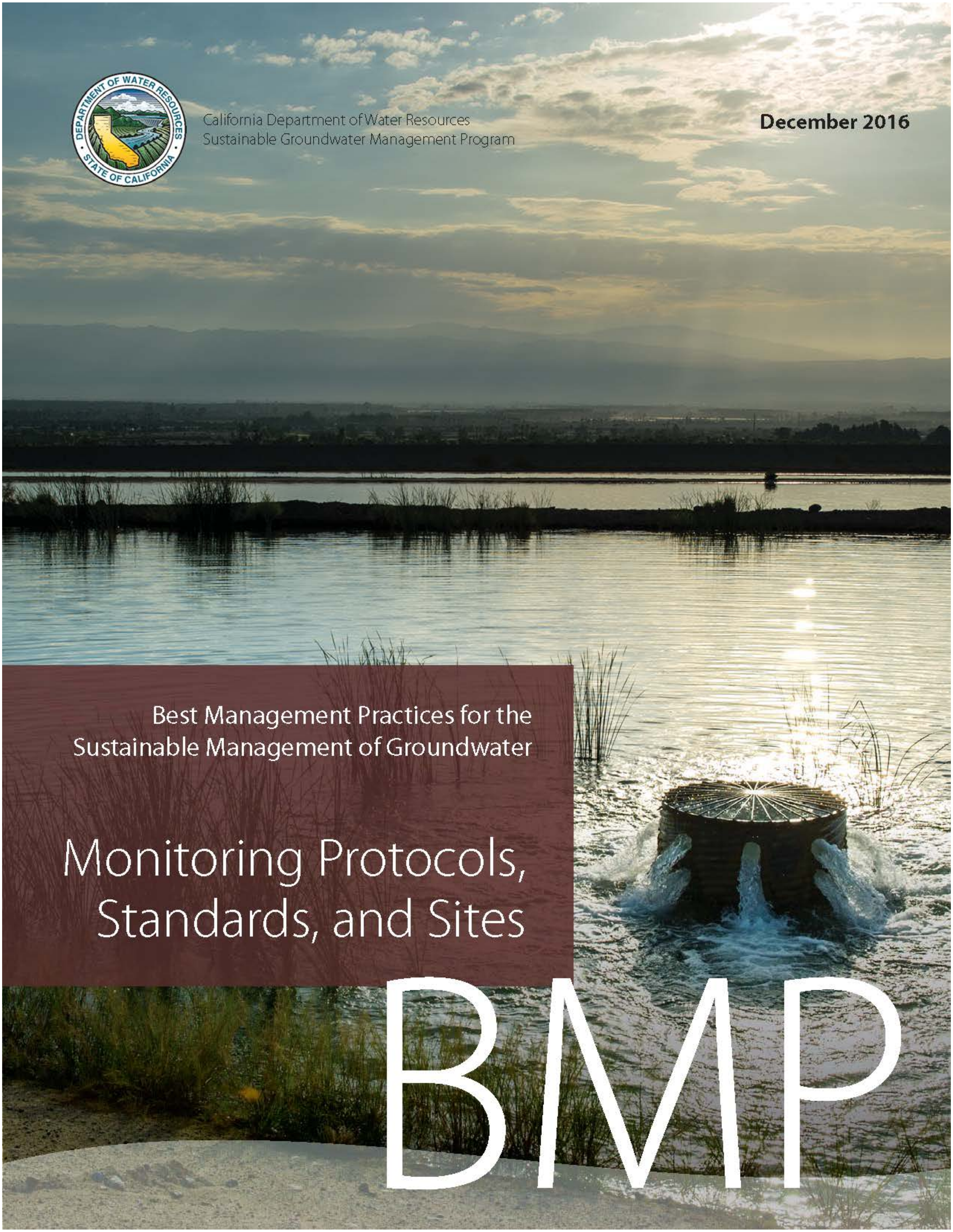
New Stone Water District

Gabriella Lion | Date

Madera Water District

Phil Janzen | Date

Appendix B – BMP



California Department of Water Resources
Sustainable Groundwater Management Program

December 2016

Best Management Practices for the
Sustainable Management of Groundwater

Monitoring Protocols, Standards, and Sites

BMP

State of California
Edmund G. Brown Jr., Governor

California Natural Resources Agency
John Laird, Secretary for Natural Resources

Department of Water Resources
Mark W. Cowin, Director

Carl A. Torgersen, Chief Deputy Director

Office of the Chief Counsel
Spencer Kenner

Public Affairs Office
Ed Wilson

Government and Community Liaison
Anecita S. Agustinez

Office of Workforce Equality
Stephanie Varrelman

Policy Advisor
Waiman Yip

Legislative Affairs Office
Kasey Schimke, Ass't Dir.

Deputy Directors

Gary Bardini **Integrated Water Management**

William Croyle **Statewide Emergency Preparedness and Security**

Mark Anderson **State Water Project**

John Pacheco (Acting) **California Energy Resources Scheduling**

Kathie Kishaba **Business Operations**

Taryn Ravazzini **Special Initiatives**

Division of Integrated Regional Water Management

Arthur Hinojosa Jr., Chief

Prepared under the direction of:

David Gutierrez, Sustainable Groundwater Management Program Manager
Rich Juricich, Sustainable Groundwater Management Branch

Prepared by:

Trevor Joseph, BMP Project Manager

Timothy Godwin
Dan McManus
Mark Nordberg
Heather Shannon
Steven Springhorn

With assistance from:

DWR Region Office Staff

Groundwater Monitoring Protocols, Standards, and Sites Best Management Practice

1. Objective

The objective of this *Best Management Practice* (BMP) is to assist in the development of Monitoring Protocols. The California Department of Water Resources (the Department or DWR) has developed this document as part of the obligation in the Technical Assistance chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater *basins*. Information provided in this BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders to aid in the establishment of consistent data collection processes and procedures. In addition, this BMP can be used by GSAs to adopt a set of sampling and measuring procedures that will yield similar data regardless of the monitoring personnel. Finally, this BMP identifies available resources to support the development of monitoring protocols.

This BMP includes the following sections:

1. Objective. A brief description of how and where monitoring protocols are required under SGMA and the overall objective of this BMP.
2. Use and Limitations. A brief description of the use and limitations of this BMP.
3. Monitoring Protocol Fundamentals. A description of the general approach and background of groundwater monitoring protocols.
4. Relationship of Monitoring Protocols to other BMPs. A description of how this BMP is connected with other BMPS.
5. Technical Assistance. Technical content providing guidance for regulatory sections.
6. Key Definitions. Descriptions of definitions identified in the GSP Regulations or SGMA.
7. Related Materials. References and other materials that provide supporting information related to the development of Groundwater Monitoring Protocols.

2. USE AND LIMITATIONS

BMPs developed by the Department provide technical guidance to GSAs and other stakeholders. Practices described in these BMPs do not replace the GSP Regulations, nor do they create new requirements or obligations for GSAs or other stakeholders. In addition, using this BMP to develop a GSP does not equate to an approval determination by the Department. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. MONITORING PROTOCOL FUNDAMENTALS

Establishing data collection protocols that are based on best available scientific methods is essential. Protocols that can be applied consistently across all basins will likely yield comparable data. Consistency of data collection methods reduces uncertainty in the comparison of data and facilitates more accurate communication within basins as well as between basins.

Basic minimum technical standards of accuracy lead to quality data that will better support implementation of GSPs.

4. RELATIONSHIP OF MONITORING PROTOCOL TO OTHER BMPS

Groundwater monitoring is a fundamental component of SGMA, as each GSP must include a sufficient network of data that demonstrates measured progress toward the achievement of the sustainability goal for each basin. For this reason, a standard set of protocols need to be developed and utilized.

It is important that data is developed in a manner consistent with the basin setting, planning, and projects/management actions steps identified on **Figure 1** and the GSP Regulations. The inclusion of monitoring protocols in the GSP Regulations also emphasizes the importance of quality empirical data to support GSPs and provide comparable information from basin to basin.

Figure 1 provides a logical progression for the development of a GSP and illustrates how monitoring protocols are linked to other related BMPs. This figure also shows the context of the BMPs as they relate to various steps to sustainability as outlined in the GSP Regulations. The monitoring protocol BMP is part of the Monitoring step identified in **Figure 1**.

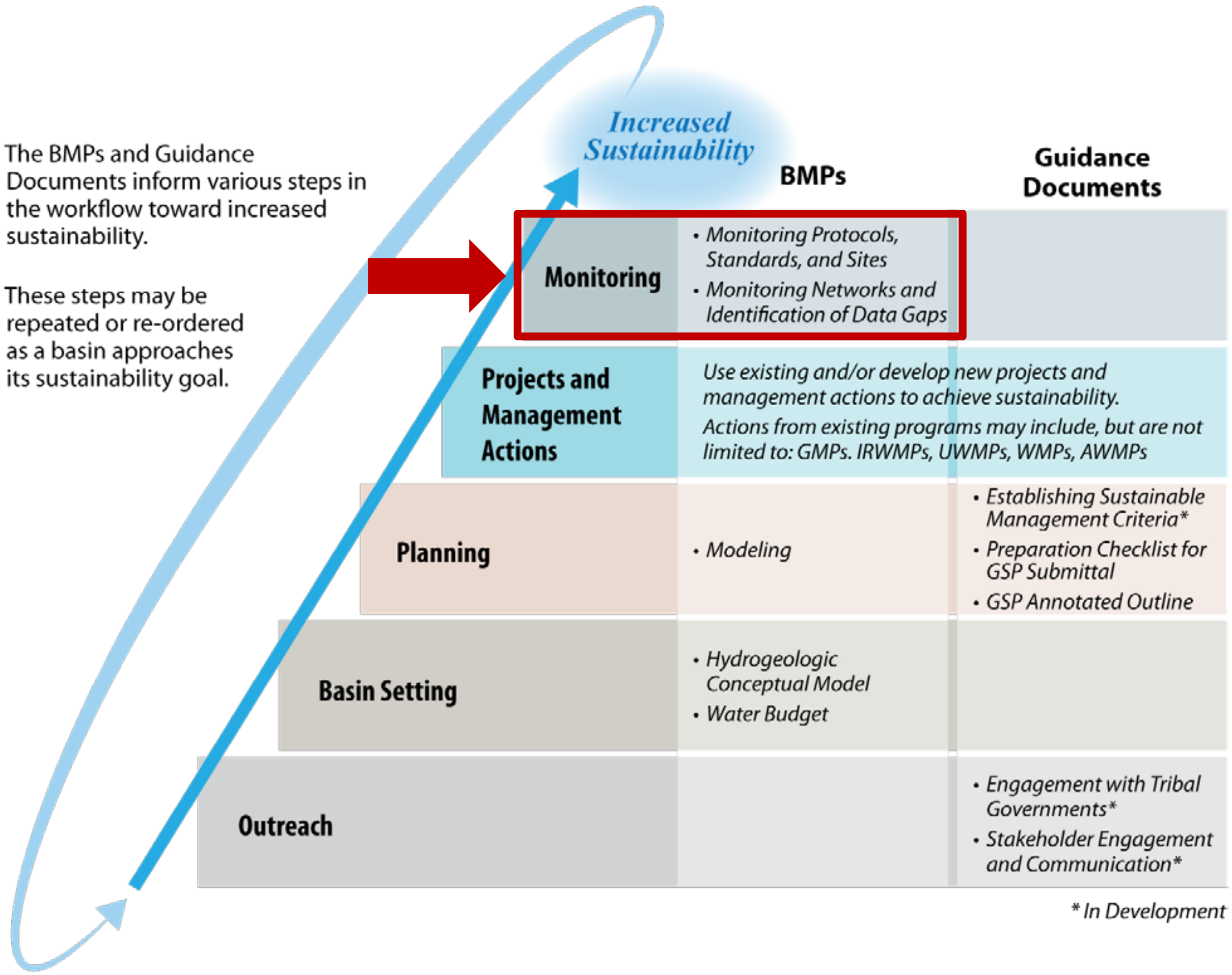


Figure 1 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

23 CCR §352.2. Monitoring Protocols. Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:
(a) Monitoring protocols shall be developed according to best management practices.
(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department, or may adopt similar monitoring protocols that will yield comparable data.
(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan, and modified as necessary.

The GSP Regulations specifically call out the need to utilize protocols identified in this BMP, or develop similar protocols. The following technical protocols provide guidance based upon existing professional standards and are commonly adopted in various groundwater-related programs. They provide clear techniques that yield quality data for use in the various components of the GSP. They can be further elaborated on by individual GSAs in the form of standard operating procedures which reflect specific local requirements and conditions. While many methodologies are suggested in this BMP, it should be understood that qualified professional judgment should be used to meet the specific monitoring needs.

The following BMPs may be incorporated into a GSP's monitoring protocols section for collecting groundwater elevation data. A GSP that adopts protocols that deviate from these BMPs must demonstrate that they will yield comparable data.

PROTOCOLS FOR ESTABLISHING A MONITORING PROGRAM

The protocol for establishment of a monitoring program should be evaluated in conjunction with the *Monitoring Network and Identification of Data Gaps* BMP and other BMPs. Monitoring protocols must take into consideration the *Hydrogeologic Conceptual Model, Water Budget, and Modeling* BMPs when considering the data needs to meet GSP objectives and the sustainability goal.

It is suggested that each GSP incorporate the Data Quality Objective (DQO) process following the U.S. EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). Although strict adherence to this method is not required, it does provide a robust approach to consider and assures that data is collected with a specific purpose in mind, and efforts for monitoring are as efficient as possible to achieve the objectives of the GSP and compliance with the GSP Regulations.

The DQO process presents a method that can be applied directly to the sustainability criteria quantitative requirements through the following steps.

1. State the problem – Define sustainability indicators and planning considerations of the GSP and sustainability goal.
2. Identify the goal – Describe the quantitative measurable objectives and minimum thresholds for each of the sustainability indicators.
3. Identify the inputs – Describe the data necessary to evaluate the sustainability indicators and other GSP requirements (i.e. water budget).
4. Define the boundaries of the study – This is commonly the extent of the Bulletin 118 groundwater basin or subbasin, unless multiple GSPs are prepared for a given basin. In that case, evaluation of the coordination plan and specifically how the monitoring will be comparable and meet the sustainability goals for the entire basin.
5. Develop an analytical approach – Determine how the quantitative sustainability indicators will be evaluated (i.e. are special analytical methods required that have specific data needs).
6. Specify performance or acceptance criteria – Determine what quality the data must have to achieve the objective and provide some assurance that the analysis is accurate and reliable.
7. Develop a plan for obtaining data – Once the objectives are known determine how these data should be collected. Existing data sources should be used to the greatest extent possible.

These steps of the DQO process should be used to guide GSAs to develop the most efficient monitoring process to meet the measurable objectives of the GSP and the sustainability goal. The DQO process is an iterative process and should be evaluated regularly to improve monitoring efficiencies and meet changing planning and project needs. Following the DQO process, GSAs should also include a data quality control and quality assurance plan to guide the collection of data.

Many monitoring programs already exist as part of ongoing groundwater management or other programs. To the extent possible, the use of existing monitoring data and programs should be utilized to meet the needs for characterization, historical record documentation, and continued monitoring for the SGMA program. However, an evaluation of the existing monitoring data should be performed to assure the data being collected meets the DQOs, regulatory requirements, and data collection protocol described in this BMP. While this BMP provides guidance for collection of various regulatory based requirements, there is flexibility among the various methodologies available to meet the DQOs based upon professional judgment (local conditions or project needs).

At a minimum, for each monitoring site, the following information or procedure should be collected and documented:

- Long-term access agreements. Access agreements should include year-round site access to allow for increased monitoring frequency.
- A unique identifier that includes a general written description of the site location, date established, access instructions and point of contact (if necessary), type of information to be collected, latitude, longitude, and elevation. Each monitoring location should also track all modifications to the site in a modification log.

PROTOCOLS FOR MEASURING GROUNDWATER LEVELS

This section presents considerations for the methodology of collection of groundwater level data such that it meets the requirements of the GSP Regulations and the DQOs of the specific GSP. Groundwater levels are a fundamental measure of the status of groundwater conditions within a basin. In many cases, relationships of the sustainability indicators may be able to be correlated with groundwater levels. The quality of this data must consider the specific aquifer being monitored and the methodology for collecting these levels.

The following considerations for groundwater level measuring protocols should ensure the following:

- Groundwater level data are taken from the correct location, well ID, and screen interval depth
- Groundwater level data are accurate and reproducible
- Groundwater level data represent conditions that inform appropriate basin management DQOs
- All salient information is recorded to correct, if necessary, and compare data
- Data are handled in a way that ensures data integrity

General Well Monitoring Information

The following presents considerations for collection of water level data that include regulatory required components as well as those which are recommended.

- Groundwater elevation data will form the basis of basin-wide water-table and piezometric maps, and should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1 to 2 week period.
- Depth to groundwater must be measured relative to an established Reference Point (RP) on the well casing. The RP is usually 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 reference point 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 elevation of the RP of each well must be surveyed to the North American Vertical Datum of 1988 (NAVD88), or a local datum that can be converted to NAVD88. The elevation of the RP must be accurate to within 0.5 foot. It is preferable for the RP elevation to be accurate to 0.1 foot or less. Survey grade global navigation satellite system (GNSS) global positioning system (GPS) equipment can achieve similar vertical accuracy when corrected. Guidance for use of GPS can be found at USGS http://water.usgs.gov/osw/gps/. Hand-held GPS units likely will not produce reliable vertical elevation measurement accurate enough for the casing elevation consistent with the DQOs and regulatory requirements.
- The sampler should remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.
- Depth to groundwater must be measured to an accuracy of 0.1 foot below the RP. It is preferable to measure depth to groundwater to an accuracy of 0.01 foot. Air lines and acoustic sounders may not provide the required accuracy of 0.1 foot.
- The water level meter should be decontaminated after measuring each well.

Where existing wells do not meet the base standard as described in the GSP Regulations or the considerations provided above, new monitoring wells may need to be constructed to meet the DQOs of the GSP. The design, installation, and documentation of new monitoring wells must consider the following:

- Construction consistent with California Well Standards as described in Bulletins 74-81 and 74-90, and local permitting agency standards of practice.
- Logging of borehole cuttings under the supervision of a California Professional Geologist and described consistent with the Unified Soil Classification System methods according to ASTM standard D2487-11.
- Written criteria for logging of borehole cuttings for comparison to known geologic formations, principal aquifers and aquitards/aquicludes, or specific marker beds to aid in consistent stratigraphic correlation within and across basins.
- Geophysical surveys of boreholes to aid in consistency of logging practices. Methodologies should include resistivity, spontaneous potential, spectral gamma, or other methods as appropriate for the conditions. Selection of geophysical methods should be based upon the opinion of a professional geologist or professional engineer, and address the DQOs for the specific borehole and characterization needs.
- Prepare and submit State well completion reports according to the requirements of §13752. Well completion report documentation should include geophysical logs, detailed geologic log, and formation identification as attachments. An example well completion as-built log is illustrated in **Figure 2.** DWR well completion reports can be filed directly at the Online System for Well Completion Reports (OSWCR) http://water.ca.gov/oswcr/index.cfm.

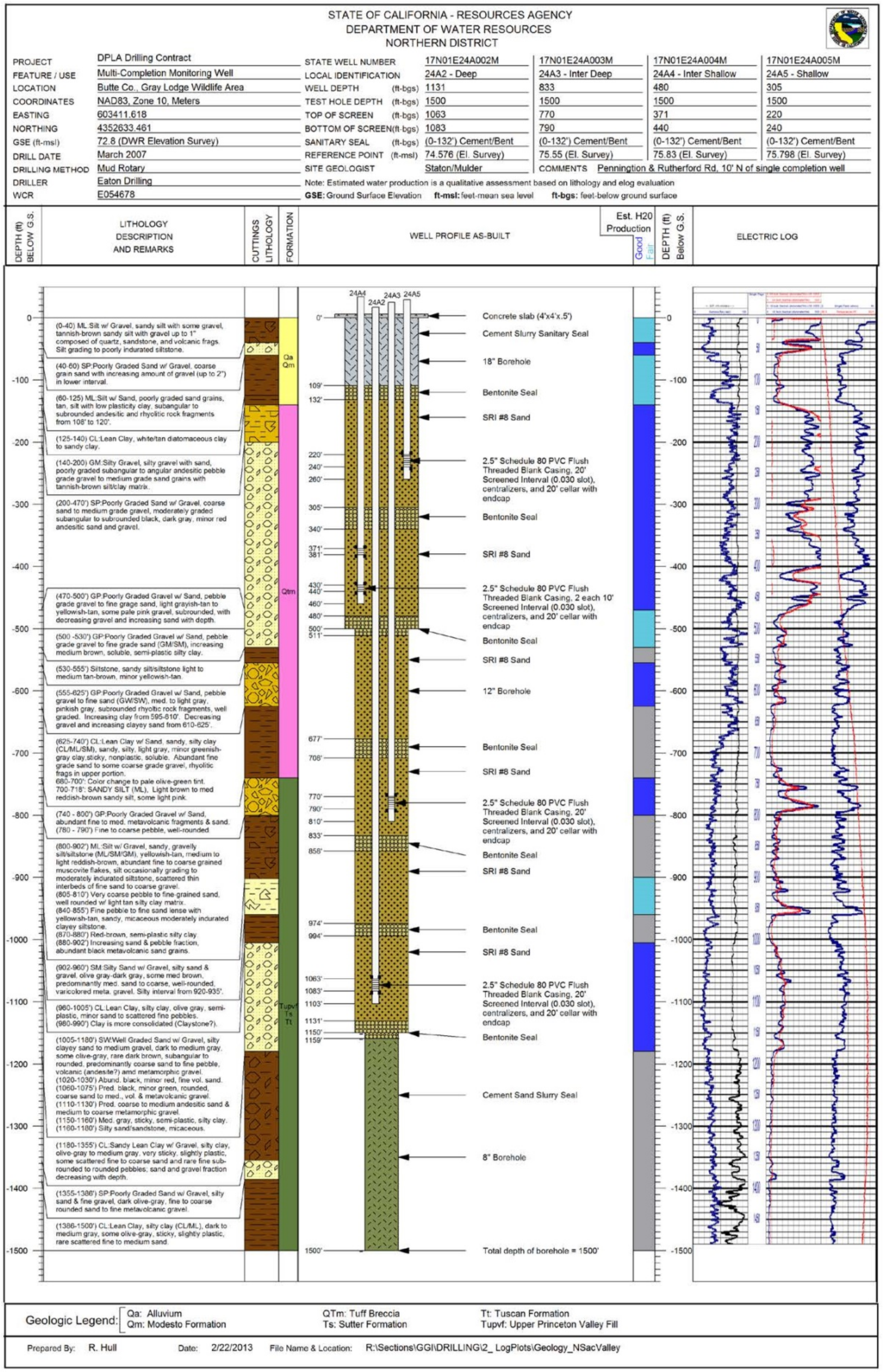


Figure 2 – Example As-Built Multi-Completion Monitoring Well Log

Measuring Groundwater Levels

Well construction, anticipated groundwater level, groundwater level measuring equipment, field conditions, and well operations should be considered prior collection of the groundwater level measurement. The USGS *Groundwater Technical Procedures* (Cunningham and Schalk, 2011) provide a thorough set of procedures which can be used to establish specific Standard Operating Procedures (SOPs) for a local agency. **Figure 3** illustrates a typical groundwater level measuring event and simultaneous pressure transducer download.

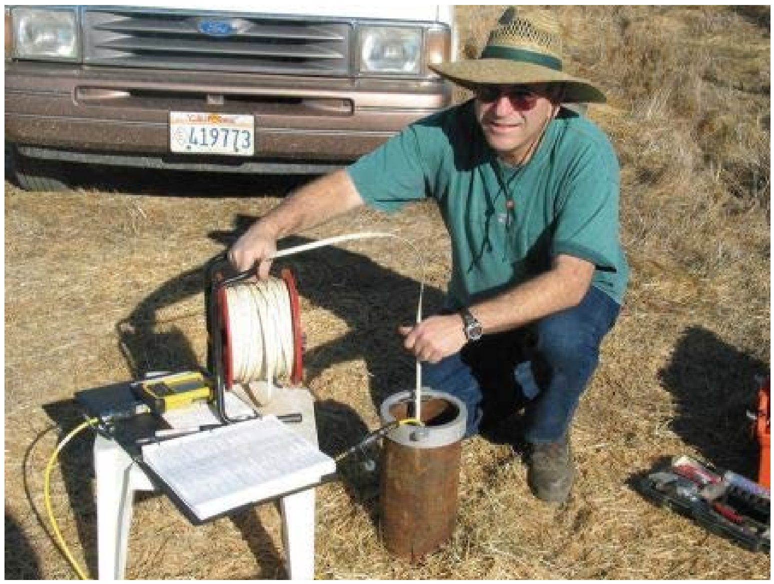


Figure 3 – Collection of Water Level Measurement and Pressure Transducer Download

The following points provide a general approach for collecting groundwater level measurements:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.01 foot relative to the RP.
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a

questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.

- The sampler should calculate the groundwater elevation as:

$$GWE = RPE - DTW$$

Where:

GWE = Groundwater Elevation

RPE = Reference Point Elevation

DTW = Depth to Water

The sampler must ensure that all measurements are in consistent units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.

Recording Groundwater Levels

- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. An example of a field sheet with the required information is shown in **Figure 4**. It includes questionable measurement and no measurement codes that should be noted. This field sheet is provided as an example. Standardized field forms should be used for all data collection. The aforementioned USGS *Groundwater Technical Procedures* offers a number of example forms.
- The sampler should replace any well caps or plugs, and lock any well buildings or covers.
- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person for compliance with the DQOs.

STATE OF CALIFORNA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WELL DATA

STATE WELL NUMBER	COUNTY	REFERENCE POINT ELEV.	MEASURING AGENCY
			DWR

NO MEASUREMENT	QUESTIONABLE MEASUREMENT
0. Measurement discontinued	0. Caved or deepened
1. Pumping	1. Pumping
2. Pump house locked	2. Nearby pump operating
3. Tape hung up	3. Casing leaky or wet
4. Can't get tape in casing	4. Pumped recently
5. Unable to locate well	5. Air or pressure gauge measurement
6. Well has been destroyed	6. Other
7. Special	7. Recharge operation at or nearby well
8. Casing leaky or wet	8. Oil in casing
9. Temporarily inaccessible	

DATE	N M	Q M	TAPE AT RP	TAPE AT WS	RP to WS	OBSR VR	COMMENTS

DWR 1213

Figure 4 – Example of Water Level Well Data Field Collection Form

Pressure Transducers

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitoring wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements.

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

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment should be exercised to ensure that the data being collected is meeting the DQO and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.
- Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.
- The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually or as necessary to maintain data integrity.

- The data should be downloaded as necessary to ensure no data is lost and entered into the basin's DMS following the QA/QC program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

PROTOCOLS FOR SAMPLING GROUNDWATER QUALITY

The following protocols can be incorporated into a GSP's monitoring protocols for collecting groundwater quality data. More detailed sampling procedures and protocols are included in the standards and guidance documents listed at the end of this BMP. A GSP that adopts protocols that deviate from these BMPs must demonstrate that the adopted protocols will yield comparable data.

In general, the use of existing water quality data within the basin should be done to the greatest extent possible if it achieves the DQOs for the GSP. In some cases it may be necessary to collect additional water quality data to support monitoring programs or evaluate specific projects. The USGS *National Field Manual for the Collection of Water Quality Data* (Wilde, 2005) should be used to guide the collection of reliable data. **Figure 5** illustrates a typical groundwater quality sampling setup.

Figure 5 – Typical Groundwater Quality Sampling Event

All analyses should be performed by a laboratory certified under the State Environmental Laboratory Accreditation Program. The specific analytical methods are beyond the scope of this BMP, but should be commiserate with other programs evaluating water quality within the basin for comparative purposes.

Groundwater quality sampling protocols should ensure that:

- Groundwater quality data are taken from the correct location
- Groundwater quality data are accurate and reproducible
- Groundwater quality data represent conditions that inform appropriate basin management and are consistent with the DQOs
- All salient information is recorded to normalize, if necessary, and compare data
- Data are handled in a way that ensures data integrity

The following points are general guidance in addition to the techniques presented in the previously mentioned USGS *National Field Manual for the Collection of Water Quality Data.*

Standardized protocols include the following:

- Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well used for groundwater quality monitoring must have a unique identifier. This identifier must appear on the well housing or the well casing to avoid confusion.
- In the case of wells with dedicated pumps, samples should be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.
- The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants. The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples.
- The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.
- For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally

considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling. Professional judgment should be exercised as to whether the sample will meet the DQOs and adjusted as necessary.

- Field parameters of pH, electrical conductivity, and temperature should be collected for each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to sampling. Measurements of pH should only be measured in the field, lab pH analysis are typically unachievable due to short hold times. Other parameters, such as oxidation-reduction potential (ORP), dissolved oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for meeting DQOs of GSP and assessing purge conditions. All field instruments should be calibrated daily and evaluated for drift throughout the day.
- Sample containers should be labeled prior to sample collection. The sample label must include: sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used, and analytes and analytical method.
- Samples should be collected under laminar flow conditions. This may require reducing pumping rates prior to sample collection.
- Samples should be collected according to appropriate standards such as those listed in the *Standard Methods for the Examination of Water and Wastewater*, USGS *National Field Manual for the Collection of Water Quality Data,* or other appropriate guidance. The specific sample collection procedure should reflect the type of analysis to be performed and DQOs.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative leading to inconsistent results of dissolve analytes. Specifically, samples to be analyzed for metals should be field-filtered prior to preservation; do not collect an unfiltered sample in a preserved container.
- Samples should be chilled and maintained at 4 °C to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.

- Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.
- Instruct the laboratory to use reporting limits that are equal to or less than the applicable DQOs or regional water quality objectives/screening levels.

Special protocols for low-flow sampling equipment

In addition to the protocols listed above, sampling using low-flow sample equipment should adopt the following protocols derived from EPA's *Low-flow (minimal drawdown) ground-water sampling procedures* (Puls and Barcelona, 1996). These protocols apply to low-flow sampling equipment that generally pumps between 0.1 and 0.5 liters per minute. These protocols are not intended for bailers.

Special protocols for passive sampling equipment

In addition to the protocols listed above, passive diffusion samplers should follow protocols set forth in USGS Fact Sheet 088-00.

PROTOCOLS FOR MONITORING SEAWATER INTRUSION

Monitoring seawater intrusion requires analysis of the chloride concentrations within groundwater of each principal aquifer subject to seawater intrusion. While no significant standardized approach exists, the methodologies described above for degraded water quality can be applied for the collection of groundwater samples. In addition to the protocol described above, the following protocols should be followed:

- Water quality samples should be collected and analyzed at least semi-annually. Samples will be analyzed for dissolved chloride at a minimum. It may be beneficial to include analyses of iodide and bromide to aid in determination of salinity source. More frequent sampling may be necessary to meet DQOs of GSP. The development of surrogate measures of chloride concentration may facilitate cost-effective means to monitor more frequently to observe the range of conditions and variability of the flow dynamics controlling seawater intrusion.
- Groundwater levels will be collected at a frequency adequate to characterize changes in head in the vicinity of the leading edge of degraded water quality in each principal aquifer. Frequency may need to be increased in areas of known preferential pathways, groundwater pumping, or efficacy evaluation of mitigation projects.
- The use of geophysical surveys, electrical resistivity, or other methods may provide for identification of preferential pathways and optimize monitoring well placement and evaluation of the seawater intrusion front. Professional judgment

should be exercised to determine the appropriate methodology and whether the DQOs for the GSP would be met.

PROTOCOLS FOR MEASURING STREAMFLOW

Monitoring of streamflow is necessary for incorporation into water budget analysis and for use in evaluation of stream depletions associated with groundwater extractions. The use of existing monitoring locations should be incorporated to the greatest extent possible. Many of these streamflow monitoring locations currently follow the protocol described below.

Establishment of new streamflow discharge sites should consider the existing network and the objectives of the new location. Professional judgment should be used to determine the appropriate permitting that may be necessary for the installation of any monitoring locations along surface water bodies. Regular frequent access will be necessary to these sites for the development of ratings curves and maintenance of equipment.

To establish a new streamflow monitoring station special consideration must be made in the field to select an appropriate location for measuring discharge. Once a site is selected, development of a relationship of stream stage to discharge will be necessary to provide continuous estimates of streamflow. Several measurements of discharge at a variety of stream stages will be necessary to develop the ratings curve correlating stage to discharge. The use of Acoustic Doppler Current Profilers (ADCPs) can provide accurate estimates of discharge in the correct settings. Professional judgment must be exercised to determine the appropriate methodology. Following development of the ratings curve a simple stilling well and pressure transducer with data logger can be used to evaluate stage on a frequent basis. A simple stilling well and staff gage is illustrated in **Figure 6**.

Streamflow measurements should be collected, analyzed, and reported in accordance with the procedures outlined in USGS Water Supply Paper 2175, *Volume 1. – Measurement of Stage Discharge* and *Volume 2. – Computation of Discharge.* This methodology is currently being used by both the USGS and DWR for existing streamflow monitoring throughout the State.

Figure 6 – Simple Stilling Well and Staff Gage Setup

PROTOCOLS FOR MEASURING SUBSIDENCE

Evaluating and monitoring inelastic land subsidence can utilize multiple data sources to evaluate the specific conditions and associated causes. To the extent possible, the use of existing data should be utilized. Subsidence can be estimated from numerous techniques, they include: level surveying tied to known stable benchmarks or benchmarks located outside the area being studied for possible subsidence; installing and tracking changes in borehole extensometers; obtaining data from continuous GPS (CGPS) locations, static GPS surveys or Real-Time-Kinematic (RTK) surveys; or analyzing Interferometric Synthetic Aperture Radar (InSAR) data. No standard procedures exist for collecting data from the potential subsidence monitoring approaches. However, an approach may include:

- Identification of land subsidence conditions.
    - Evaluate existing regional long-term leveling surveys of regional infrastructure, i.e. roadways, railroads, canals, and levees.
    - Inspect existing county and State well records where collapse has been noted for well repairs or replacement.
    - Determine if significant fine-grained layers are present such that the potential for collapse of the units could occur should there be significant depressurization of the aquifer system.

- Inspect geologic logs and the hydrogeologic conceptual model to aid in identification of specific units of concern.
- Collect regional remote-sensing information such as InSAR, commonly provided by USGS and NASA. Data availability is currently limited, but future resources are being developed.

- Monitor regions of suspected subsidence where potential exists.
  - Establish CGPS network to evaluate changes in land surface elevation.
  - Establish leveling surveys transects to observe changes in land surface elevation.
  - Establish extensometer network to observe land subsidence. An example of a typical extensometer design is illustrated in **Figure 7**. There are a variety of extensometer designs and they should be selected based on the specific DQOs.

Various standards and guidance documents for collecting data include:

- Leveling surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual.
- GPS surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual.
- USGS has been performing subsidence surveys within several areas of California. These studies are sound examples for appropriate methods and should be utilized to the extent possible and where available:
  - http://ca.water.usgs.gov/land_subsidence/california-subsidence-measuring.html
- Instruments installed in borehole extensometers must follow the manufacturer's instructions for installation, care, and calibration.
- Availability of InSAR data is improving and will increase as programs are developed. This method requires expertise in analysis of the raw data and will likely be made available as an interpretative report for specific regions.

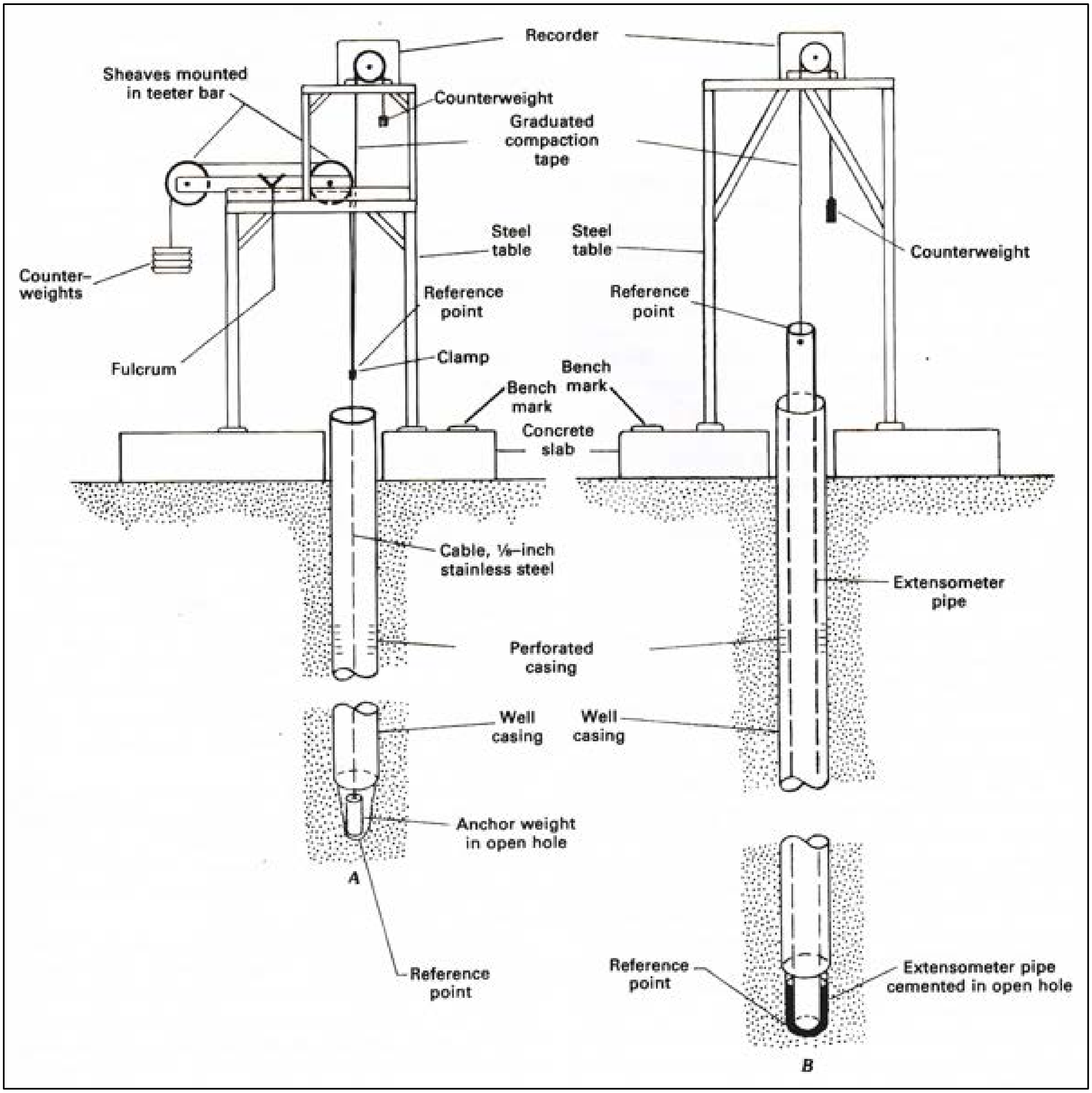


Figure 7 – Simplified Extensometer Diagram

6. KEY DEFINITIONS

The key definitions and sections related to Groundwater Monitoring Protocols, Standards, and Sites outlined in applicable SGMA code and regulations are provided below for reference.

Groundwater Sustainability Plan Regulations (California Code of Regulations §351)

- §351(h) "Best available science" refers to 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.
- §351(i) "Best management practice" refers to 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.

Monitoring Protocols Reference

§352.2. Monitoring Protocols

Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:

(a) Monitoring protocols shall be developed according to best management practices.

(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department, or may adopt similar monitoring protocols that will yield comparable data.

(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan, and modified as necessary.

SGMA Reference

§10727.2. Required Plan Elements

(f) Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin. The monitoring protocols shall be designed to generate information that promotes efficient and effective groundwater management.

7. Related Materials

CASE STUDIES

Luhdorff & Scalmanini Consulting Engineers, J.W. Borchers, M. Carpenter. 2014. *Land Subsidence from Groundwater Use in California*. Full Report of Findings prepared for California Water Foundation. April 2014. 151 p. http://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.html

Faunt, C.C., M. Sneed, J. Traum, and J.T. Brandt, 2015. *Water availability and land subsidence in the Central Valley, California, USA*. Hydrogeol J (2016) 24: 675. doi:10.1007/s10040-015-1339-x.
https://pubs.er.usgs.gov/publication/701605

Poland, J.F., B.E. Lofgren, R.L. Ireland, and R.G. Pugh, 1975. *Land subsidence in the San Joaquin Valley, California, as of 1972*; US Geological Survey Professional Paper 437-H; prepared in cooperation with the California Department of Water Resources, 87 p.
http://pubs.usgs.gov/pp/0437h/report.pdf

Sneed, M., J.T. Brandt, and M. Solt, 2013. *Land subsidence along the Delta-Mendota Canal in the northern part of the San Joaquin Valley, California, 2003-10*; USGS Scientific Investigations Report 2013-5142, prepared in cooperation with U.S. Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority.
https://pubs.er.usgs.gov/publication/sir20135142

Sneed, M., J.T. Brandt, and M. Solt, 2014. *Land subsidence, groundwater levels, and geology in the Coachella Valley, California, 1993–2010*: U.S. Geological Survey, Scientific Investigations Report 2014–5075, 62 p.
http://dx.doi.org/10.3133/sir20145075.

STANDARDS

California Department of Transportation, various dates. *Caltrans Surveys Manual*. http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/Manual_TOC.html

U.S. Environmental Protection Agency, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4 https://www.epa.gov/sites/production/files/documents/guidance_systematic_planning_dqo_process.pdf

Rice, E.W., R.B. Baire, A.D. Eaton, and L.S. Clesceri ed. 2012. *Standard methods for the examination of water and wastewater*. Washington, DC: American Public Health Association, American Water Works Association, and Water Environment Federation.

GUIDANCE

Barcelona, M.J., J.P. Gibb, J.A. Helfrich, and E.E.Graske. 1985. *Practical Guide for Ground-Water Sampling*. Illinois State Water Survey, Champaign, Illinois, 103 pages. www.orau.org/ptp/PTP%20Library/library/epa/samplings/pracgw.pdf

Buchanan, T.J., and W.P. Somers, 1969. *Discharge measurements at gaging stations; techniques of water-resources investigations of the United States Geologic Survey chapter A8*, Washington D.C. http://pubs.usgs.gov/twri/twri3a8/html/pdf.html

Cunningham, W.L., and Schalk, C.W., comps., 2011, *Groundwater technical procedures of the U.S. Geological Survey*: U.S. Geological Survey Techniques and Methods 1–A1. https://pubs.usgs.gov/tm/1a1/pdf/tm1-a1.pdf

California Department of Water Resources, 2010. *Groundwater elevation monitoring guidelines*. http://www.water.ca.gov/groundwater/casgem/pdfs/CASGEM%20DWR%20GW%20Guidelines%20Final%20121510.pdf

Holmes, R.R. Jr., P.J. Terrio, M.A. Harris, and P.C. Mills, 2001. *Introduction to field methods for hydrologic and environmental studies*, open-file report 01-50, USGS, Urbana, Illinois, 241 p. https://pubs.er.usgs.gov/publication/ofr0150

Puls, R.W., and Barcelona, M.J., 1996, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*; US EPA, Ground Water Issue EPA/540/S-95/504. https://www.epa.gov/sites/production/files/2015-06/documents/lwflw2a.pdf

Rantz, S.E., and others, 1982. *Measurement and computation of streamflow*; U.S. Geological Survey, Water Supply Paper 2175. http://pubs.usgs.gov/wsp/wsp2175/#table

Subcommittee on Ground Water of the Advisory Committee on Water Information, 2013. *A national framework for ground-water monitoring in the United States*. http://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf

Vail, J., D. France, and B. Lewis. 2013. *Operating Procedure: Groundwater Sampling SESDPROC-301-R3*.

https://www.epa.gov/sites/production/files/2015-06/documents/Groundwater-Sampling.pdf

Wilde, F.D., January 2005. *Preparations for water sampling (ver. 2.0)*: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A1, http://water.usgs.gov/owq/FieldManual/compiled/NFM_complete.pdf

ONLINE RESOURCES

Online System for Well Completion Reports (OSWCR). California Department of Water Resources. http://water.ca.gov/oswcr/index.cfm

Measuring Land Subsidence web page. U.S. Geological Survey. http://ca.water.usgs.gov/land_subsidence/california-subsidence-measuring.html

USGS Global Positioning Application and Practice web page. U.S. Geological Survey. http://water.usgs.gov/osw/gps/

Appendix C - Public Meeting Tracker

New Stone Water District GSA - Madera Subbasin Outreach Check List
Localized/GSA Engagement
Informing the Public about GSP Development Progress

Meeting/Event	Meeting/Event date	Topics presented	Audience (estimated # participants; interests represented)	E-blast to Interested Parties list? Which list and when?	Email to Others? Which list and when?	Flyer created?	Flyer distributed at other meetings/events? Where and when?
SGMA GSP-Specific Events: GSA meetings, capacity-building events, educational tours, e-blasts							
NS GSA Meeting	December 20, 2017	GSP funding & timeline, question & answer	8				
Madera Subbasin Workshop	May 24, 2018	Management areas, base period, GSA water budgets, & management actions	90	Yes		Yes	Yes
NS GSA Meeting	July 17, 2017	Discuss Basin Setting, Sustainability goals, Public comment	9				
Madera Tech Workshop	October 18, 2018	Future of groundwater, projects, & management actions	90	Yes		Yes	Yes
SGMA technical workshop	February 7 2019		90	Yes		Yes	Yes
SGMA technical workshop	February 25, 2019		10				
SGMA technical workshop	March 6, 2019		11				
SGMA technical workshop	March 8, 2019		10				
SGMA technical workshop	April 18, 2019		10				
Madera Coordination Committee	March 21, 2019	Groundwater modeling, importnace of coordination	110	Yes		Yes	Yes
Technical Experts Review	May 6, 2019		10				
Madera Public Technical Workshop	May 29, 2019		110				
Madera County Advisory Committee	June 20 2019		100				
Farm Bureue Water Forum	July 9, 2019		120				
NS GSA Meeting	July 24, 2019		8				
NS GSA Meeting	August 7, 2019		7				
Delta-Mendota Madera Subbasins Coordinationn	September 10, 2019		15				
NS GSA Meeting	September 11, 2019		8				
NS GSA Meeting Public Hearing	December 23, 2019		8				

Appendix D - Comment Log

Comment Response Summary

GSA **New Stone Water District GSA**

Date: December 23, 2019 **Job No.:**

No.	Section	By	Review Comments	Date Received	Response
1.	General	North Kings GSA	NKGSA feels that the NSWD GSA's GSP contains deficient arising to a definition of sustainability, improperly relying on boundary flows.	12/23/19	Thank you for your comments. All comments are given due consideration.
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					

Appendix E - Newspaper Notice

December 18, 2019

Contact Person: Roger Skinner
New Stone Water District

Phone: (559) 834-6677

FOR IMMEDIATE RELEASE

The New Stone Water District is holding a board meeting on Monday December 23, 2019 at 2:00 p.m. at 9500 S. DeWolf Avenue, Selma, CA 93662. Public Hearing for Review and Adoption of New Stone Groundwater Sustainability Plan by the New Stone Groundwater Sustainability Agency.

Anyone desiring further information regarding filing for this board meeting should contact Mr. Roger Skinner at (559) 834-6677.

END OF RELEASE

No. 2915 - December 21, 2019

Appendix F - County & City Notice

NEW STONE WATER DISTRICT

September 18, 2019

Supervisor Brett Frazier, Chairman
Madera County Board of Supervisors
200 W. 4th Street
Madera, CA 93637

David Merchen
Dir. of Community Development
City of Madera
205 W 4th Street
Madera, CA 93637

Subject: Notice of Intent to Adopt the New Stone Water District Groundwater Sustainability Plan

The New Stone Water District Groundwater Sustainability Agency ("NSWD GSA") hereby provides notice to the County of Madera and City of Madera of NSWD GSA's intent to adopt the New Stone Water District Groundwater Sustainability Plan ("GSP") no earlier than 90-days following your receipt of this notice. NSWD is scheduled to consider adopting this GSP during a public hearing of the NSWD GSA on December 23, 2019. Once adopted, the NSWD GSA's GSP will govern sustainable groundwater management actions within the NSWD GSA's jurisdictional boundaries located in the Madera Subbasin (Groundwater Basin No. 5-22.07). California Water Code (CWC) Section 10728.4, pursuant to passage of the Sustainable Groundwater Management Act of 2014, obligates distribution of this notice to any city or county whose jurisdictional area is within the area of the proposed GSP.

Cities and counties to which this notice is directed may request to consult on the NSWD GSA's GSP. These requests must be received within 30 calendar days after receipt of this notice. Written requests to consult with the NSWD GSA intending to adopt the NSWD GSA's GSP shall be delivered to:

Roger Skinner
P.O. Box 1350
Selma, CA 93662
rskinner@lionraisins.com

To review information about the public hearing or to download a copy of the Public Draft GSP, and to receive other information, visit https://ppeng.sharefile.com/d-s26016fda6e2407c9

Sincerely,

Roger Skinner
New Stone Water District Board

cc: Stephanie Anagnoson, Director, Madera County Dept. of Water and Natural Resources
Rhonda Cargill, Clerk of the Madera County Board of Supervisors

Appendix G - Adoption Resolution

NEW STONE WATER DISTRICT
GROUNDWATER SUSTAINABILITY AGENCY

RESOLUTION

WHEREAS, the Sustainable Groundwater Management Act (California Water Code, Section 10720, *et seq.*) requires Groundwater Sustainability Agencies to adopt a Groundwater Sustainability Plan (GSP), either individually or in conjunction with other agencies; and

WHEREAS, New Stone Water District Groundwater Management Agency (the "Agency") has prepared, published, and received public comments on a GSP specifying the Agency's groundwater sustainability goals, contemplated projects and management actions to achieve them, undesirable results, and minimum thresholds; and

WHEREAS, the Agency has made certain revisions to the published GSP after receiving the public comments; and

WHEREAS, the Agency desires to adopt the revised GSP;

NOW, THEREFORE, BE IT RESOLVED, that the revised GSP is hereby adopted for the Agency;

RESOLVED FURTHER, that the Agency's president, officers, staff, and counsel are authorized and directed to enter into a Coordination Agreement, on behalf of the Agency and on such terms as they may deem appropriate, with the other GSAs in the Madera Groundwater Subbasin; and

RESOLVED FURTHER, that the Agency's president, officers, staff, and counsel are authorized and directed to submit the revised GSP to the California Department of Water Resources, as required by California Water Code, Section 10733.4.

AYES:	3
NOES:	0
ABSENT:	2
ABSTAIN:	0

Jeff Lion, President

ATTEST:

Gabriella Lion, Secretary

CERTIFICATE OF SECRETARY

The undersigned, Secretary of the New Stone Water District, hereby certifies that the foregoing Resolution was adopted by the Board of Directors of said District at a public meeting thereof, duly noticed and regularly held, on December 23, 2019 at which meeting a quorum of the Board of Directors was at all times present and acting.

IN WITNESS WHEREOF, I have set my hand this 27 day of December, 2019.

Gabriella Lion, Secretary

NEW STONE WATER DISTRICT
GROUNDWATER SUSTAINABILITY AGENCY

RESOLUTION

WHEREAS, California has enacted the California Sustainable Groundwater Management Act, Cal. Water Code, § 10720, et seq. ("SGMA") in an effort to reduce, and eventually eliminate, the overdrafting of groundwater within the State; and

WHEREAS, SGMA requires each groundwater basin or subbasin to adopt and implement of one or more Groundwater Sustainability Plans (each a "GSP") to sustainably manage groundwater resources; and

WHEREAS, the New Stone Water District (the "District") is situated within the Madera Subbasin (the "Subbasin") and has formed the New Stone Water District Groundwater Sustainability Agency (the "Agency") to prepare and implement a GSP for the land within the District; and

WHEREAS, In January 2020, the Agency submitted a GSP to the California Department of Water Resources ("DWR"), along with GSPs submitted by the other Groundwater Sustainability Agencies ("GSAs") within the Subbasin; and

WHEREAS, on September 22, 2022, the DWR notified the GSAs within the Subbasin that the DWR deemed all of the GSPs submitted for the Subbasin in January 2020 to be "Inadequate;" and

WHEREAS, the Agency, in consultation with the engineering firm of Provost and Prichard, has prepared a Revised Groundwater Sustainability Plan (the "Plan") to address the deficiencies in the Agency's GSP identified by the DWR; and

WHEREAS, in conjunction with the preparation of their respective GSPs, the GSAs within the Subbasin have entered into a Coordination Agreement; and

WHEREAS, the GSAs within the Subbasin now desire to amend the Coordination Agreement;

NOW THEREFORE, BE IT RESOLVED by the undersigned members of the Agency that the Plan and the First Amendment to the Coordination Agreement (the "Amendment") are hereby approved.

RESOLVED FURTHER, that the Agency's officers, staff, and counsel are authorized and directed to enter into the Amendment and to cause the Plan to be submitted to the DWR.

AYES: 4

NOES: 0

ABSENT: 1

ABSTAIN: 0

CERTIFICATE OF SECRETARY

The undersigned, Secretary of the New Stone Water District, hereby certifies that the foregoing Resolution was adopted by the Board of Directors of said District at a public meeting thereof, duly noticed and regularly held, on March 16, 2023 at which meeting a quorum of the Board of Directors was at all times present and acting.

IN WITNESS WHEREOF, I have set my hand this 20th day of March, 2023.

Gabriella Lion, Secretary