Aliso Water District
Groundwater Sustainability Agency

Groundwater Sustainability Plan

Final

January 2020

Amended July 2022

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 7/7/2022

This Plan is a work product of the Aliso Water District Groundwater Sustainability Agency (AWD 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 AWD 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 AWD 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 .... Acre-feet

af/y .... acre-feet per year

Authority .... San Joaquin Valley Water Infrastructure Authority

AWD .... Aliso Water District; Aliso Water District GSA

BGS .... Below Ground Surface

BMP .... Best Management Practice

Cal-SIMETAW .... California Simulation of Evapotranspiration of Applied Water

CASGEM .... California Statewide Groundwater Elevation Monitoring

CBP, Bypass .... Chowchilla Bypass

CCC .... Columbia Canal Company

CDEC .... California Data Exchange Center

CDFW .... California Department of Fish and Wildlife
CERCLA...... Comprehensive Environmental Response, Compensation, and Liability Act
cfs.. Cubic feet per second
CGPS .... Continuous Global Positioning System
CIMIS ....California Irrigation Management Information System
Coordination Agreement .... Delta-Mendota Coordination Agreement
Corps...United States Army Corps of Engineers
CVRWQCB .... Central Valley Regional Water Quality Control Board
DAC...Disadvantaged Communities
DHS, CDPH ....Department of Health Services, California Department of Public Health
District .... Aliso Water District; Aliso Water District GSA
DMGB .... Delta-Mendota Groundwater Subbasin
dS/m...DeciSiemens per meter
DTSC ....Department of Toxic Substances Control
DWR...Department of Water Resources
DWSAP ....Drinking Water Source Assessment and Protection
EPA .... United States Environmental Protection Agency
ESJWQC...East San Joaquin Water Quality Coalition
FAO ....Food and Agriculture Organization
FIFRA...Federal Insecticide, Fungicide, and Rodenticide Act
GAMA... Groundwater Ambient Monitoring and Assessment
GDE ....Groundwater Dependent Ecosystem
GMP ....Groundwater Management Plan
GPS...Global Positioning System
GRF.. Gravelly Ford Gauging Station
GSA...Groundwater Sustainability Agency
GSP.. Groundwater Sustainability Plan
HCM ....Hydrogeologic Conceptual Model
InSAR... Interferometric Synthetic Aperture Radar
ILRP .... Irrigated Lands Regulatory Program
IRWMP..Integrated Regional Water Management Plan

ITRC .... Irrigation Training & Research Program
KDSA .... Kenneth D. Schmidt and Associates
MAGSA .... McMullin Area Groundwater Sustainability Agency
meq/L .... milliequivalent per liter
mg/L .... milligrams per liter
MPG .... Mendota Pool Pumpers Group
MT .... Minimum Thresholds
NASA .... National Aeronautics and Space Administration
NAVSTAR .... Navigation Satellite Timing and Ranging
NC Dataset Viewer .... Natural Communities Dataset Viewer
NGS .... National Geodetic Survey
NRDC .... Natural Resources Defense Council
RCRA .... Resource Conservation and Recovery Act
RWQCB .... Central Valley Regional Water Quality Control Board
SDWA .... Safe Drinking Water Act
Settlement .... San Joaquin River Settlement
SJB .... San Joaquin River Below Bifurcation
SJR .... San Joaquin River
SJR FNF .... San Joaquin River Full Natural Flow
SJRECGSA .... San Joaquin River Exchange Contractors GSA
SJRRP, Restoration Program .... San Joaquin River Restoration Program
SMC .... Sustainable Management Criteria
SWRCB .... State of California Water Resources Control Board
TFR .... Temperance Flat Reservoir
TNC .... The Nature Conservancy
TSCA .... Toxic Substances Control Act
UAVSAR .... Uninhabited Aerial Vehicle Synthetic Aperture Radar
UNAVCO .... University NAVSTAR Consortium
URF .... Unreleased Restoration Flows
USACE .... United States Army Corps of Engineers
USBR, Bureau .... United States Bureau of Reclamation

USDA .... United States Department of Agriculture
USFWS .... United States Fish and Wildlife Service
USGS .... United States Geological Survey
USJRBSI .... Upper San Joaquin River Basin Storage Investigation
WDR .... Waste Discharge Requirements
WHPA .... Wellhead Protection Area
WHPP .... Wellhead Protection Program

Executive Summary

The Aliso Water District (AWD, District) Groundwater Sustainability Agency (GSA) has prepared a Groundwater Sustainability Plan (GSP) to comply with the Sustainable Groundwater Management Act (SGMA). The AWD GSA is located within the Delta-Mendota Groundwater Subbasin (DMGB, Subbasin), which consists of six GSP Groups (**Figure ES- 2**) that encompass 23 GSAs. The following is a summary of the content and layout of the document.

The January 2020 AWD GSA GSP, along with the other GSPs of the Delta-Mendota Subbasin, was deemed incomplete by DWR January 21, 2022 (**Appendix H**). The incomplete determination provided 180 days to respond to the deficiencies identified by DWR. Subsequently, multiple consultations with DWR and meetings of the Delta-Mendota GSP groups were held to develop a coordinated response. This GSP, including the Common Chapter (**Appendix B**), addresses the concerns of DWR's January 2022 Determination Letter.

Chapter 1 - Introduction

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act of 2014 (SGMA), which is codified in Section 10720 et seq. of the California Water Code. This legislation created a statutory framework for groundwater management in California that must be achieved during the planning and implementation horizon from 2020 to 2040 and sustained into the future without causing undesirable results. SGMA requires that the following six sustainability indicators must be considered:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply
- Significant and unreasonable reduction of groundwater storage
- Significant and unreasonable seawater intrusion
- Significant and unreasonable degraded water quality
- Significant and unreasonable land subsidence
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

Figure ES- 1 Undesirable Results Definition

The AWD GSA consists solely of the Aliso Water District and is governed by a common board of directors comprised of five members. In addition to AWD, the DMGB consists of a governing body that ensures coordination using the same data and methodology, develops sustainable management criteria (SMC) that is approved by all members of the Subbasin, and a comprehensive monitoring network for each of the sustainability indicators above. Compliant with SGMA and the Coordination Agreement (**Appendix B**), the AWD agrees to submit the GSP to the Department of Water Resources (DWR) through the Coordination Committee and Plan Manager. The AWD GSP is considered complete with the submittal of the Common Chapter and appended Technical Memoranda (**Appendix B**).

The sustainability goal will be met by balancing water demand with available water supply and reducing dependence on groundwater from the lower aquifer zone in order to avoid subsidence that could in turn impact beneficial users of surface water and cause a loss of conveyance capacity. Full implementation of GSPs in the Subbasin should result in stabilization of groundwater levels and reductions in the rate of subsidence without significantly or unreasonably impacting groundwater storage, water quality, or interconnected surface water.

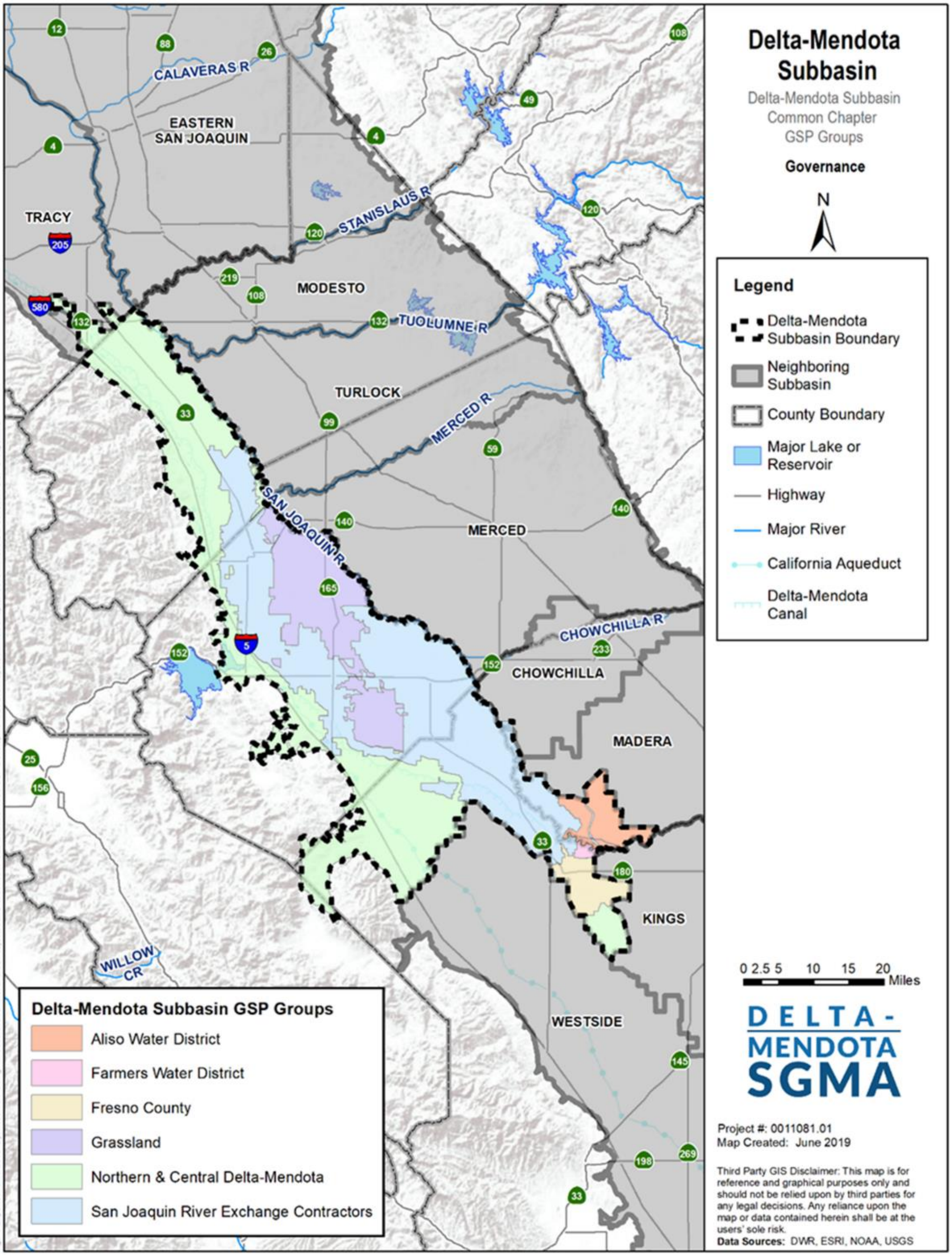

Figure ES- 2. Map of the Six GSP Groups of the Delta-Mendota Subbasin

Chapter 2 - Plan Area

The AWD GSA boundary is the same area as the Aliso Water District; therefore, this GSP will refer to the AWD GSA as AWD or District. AWD is located in western Madera County. AWD encompasses roughly 26,000 acres. The land is predominantly agricultural. The majority of the crops in AWD are permanent crops, the bulk being nuts and vines with some annual row crops. The District is completely developed, although developed land uses may change over time. In addition to agricultural lands, there are a nut processing plant and an underground natural gas storage facility. There are less than 20 permanent residents in the District and no cities or towns. There are no adjudicated areas or state or federal lands within the GSA except the Chowchilla Bypass, which is owned by the State of California and maintained by the Lower San Joaquin Levee District.

AWD is bordered by non-districted lands (white areas), managed by the Madera County GSA, that lie within the Madera Subbasin to the north and east; Columbia Canal Company (CCC) to the west, which is in the San Joaquin River Exchange Contractors GSA (SJRECGSA); and the McMullin Area GSA (MAGSA) in the Kings Subbasin to the south. The eastern boundary is bordered by the Madera County GSA, Madera Irrigation District GSA, and Gravelly Ford Water District GSA, all of which are in the Madera Subbasin. **Figure ES-3** shows nearby GSAs.

AWD is agricultural land with very minimal industrial and residential land use. There are no federal or tribal lands within AWD. AWD is adjacent to the San Joaquin River which is influenced by the San Joaquin River Restoration Program (SJRRP, Restoration Program). The District is made up of several individual landowners. There are no other water districts within the GSA; however, the Lower San Joaquin Levee District overlies portions of the GSA. AWD’s main water supply is groundwater since the District does not currently have surface water supplies. However, there are individual landowners within the District that do have access to surface water from the San Joaquin River and the Chowchilla Bypass.

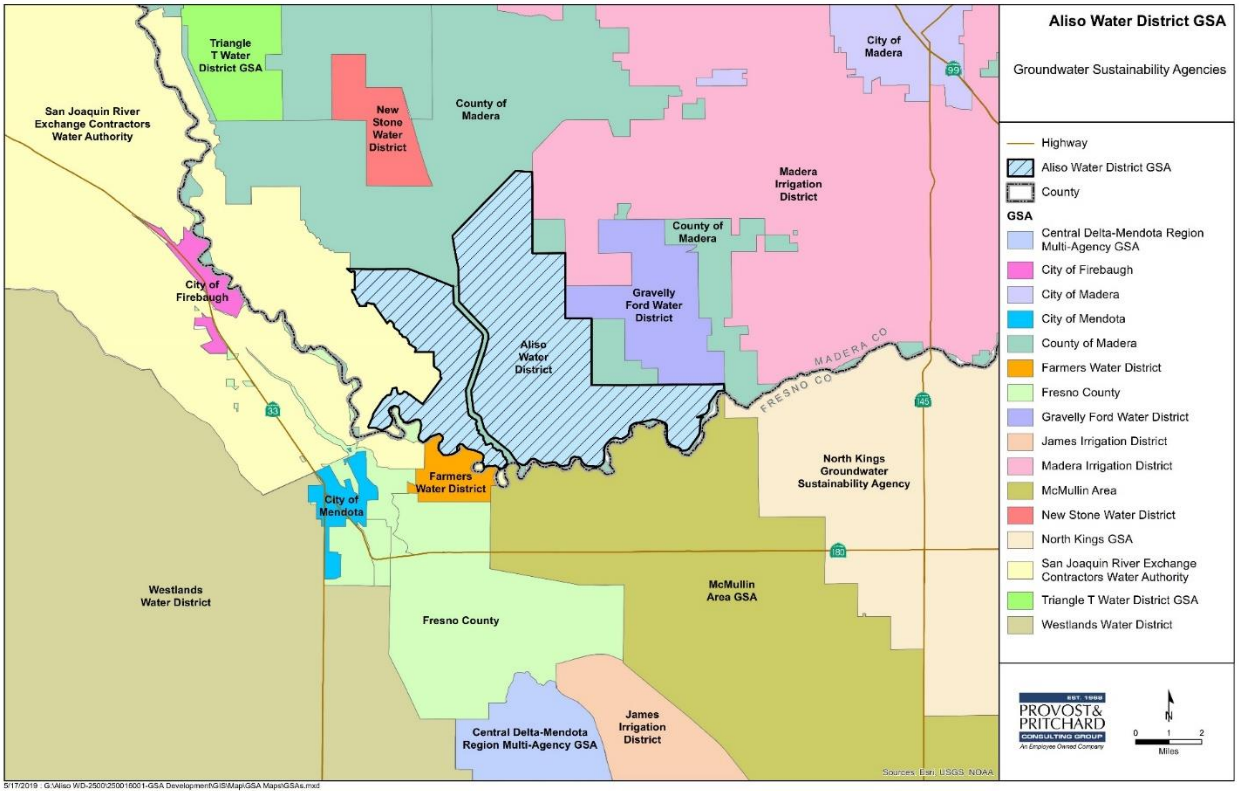

Figure ES-3 Neighboring GSAs

Chapter 3 - Basin Setting

Hydrogeologic Conceptual Model/Groundwater Conditions

The Hydrogeologic Conceptual Model (HCM) provides a description of the general physical characteristics of the regional hydrology, geology, geologic structure, water quality, principal aquifers, and principal aquitards in the basin setting. The Groundwater Conditions (GC) provide a historic, average, and current description of subsurface hydrology, water quality, and subsidence. The HCM/GC lays the foundation for development of water budgets, monitoring networks, and identification of data gaps. The narrative HCM/GC was developed by Kenneth D. Schmidt & Associates (KDSA) and has been attached as **Appendix A**. Basin-wide hydrologic conditions are discussed in the Common Chapter (**Appendix B**).

Water Budgets

A water budget is an account of all the water that flows into and out of a specified area and describes the various components of the hydrologic cycle (**Figure ES-4**). A water budget includes all the water supplies, demands, modes of groundwater recharge, and non-recoverable losses, making it possible to identify how much water is stored in a system and changes in groundwater storage during a given period.

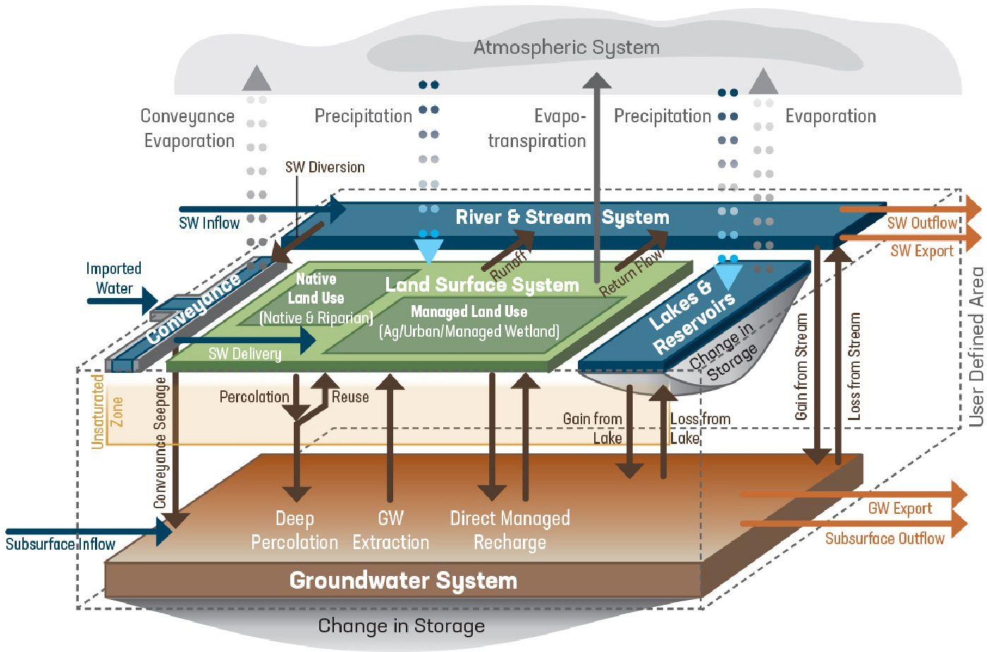

Figure ES-4 DWR Water Budget Graphic

Water budgets were prepared for a historical period (2003-2012), current period (2013), and future periods (2020-2070). The historical water budget covers a hydrologically average period based on San Joaquin River (SJR) full natural flow (FNF) to assist in calibration of the water budget. The future water budgets are based on numerous assumptions related to climate change, population growth, water use, and future project implementation. The estimated annual decline in groundwater storage for the aquifer underlying the AWD GSA during the historic period was approximately 2,200 acre-feet.

The Subbasin GSAs convened to develop consistent, basin-wide water budget schematic components. A detailed explanation of these coordinated components, their respective data, and the methodologies used is discussed in the Common Chapter (**Appendix B**). A crosswalk is provided in **Figure 3-6** and **Figure 3-7** to correlate the AWD GSA water budget to the Subbasin Coordinated water budget in the Common Chapter.

Chapter 4 - Sustainable Management Criteria

SGMA defines sustainable groundwater management as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results. The avoidance of undesirable results is essential to the success of each GSP in the Subbasin. Several requirements from GSP regulations have been grouped together under the heading of Sustainable Management Criteria, including a Sustainability Goal, Significant and Unreasonable Effects, Undesirable Results, Minimum Thresholds, and Measurable Objectives for the various indicators of groundwater conditions shown above. Development of these Sustainable Management Criteria is dependent on the best available basin information developed and presented in the HCM/GC prepared by KDSA (**Appendix A**) and the water budget.

The six GSP groups within the Subbasin have been coordinating for several years on how to reach and maintain sustainability. Geographically, the Subbasin is positioned to benefit from the natural recharge of the SJR. Additionally, many of the GSAs within the Subbasin have significant surface water contracts that reduce the reliance on groundwater from the lower aquifer zone that leads to subsidence. Coordination efforts between the GSAs have resulted in the development of Minimum Thresholds and Measurable Objectives for each monitoring site included in the representative monitoring network in order to achieve sustainability. These SMCs will continue to be monitored and the data evaluated as additional information is gathered.

Sustainability Goal

The sustainability goal for the DMGB was established to succinctly state the objectives and desired conditions of the Subbasin that culminate in the absence of undesirable results by 2040. The sustainability goal of the Subbasin recognized by the AWD GSA is as follows:

The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.

Undesirable Results

Undesirable Results were broadly defined by SGMA as outlined in **Figure ES- 1**. It is the intent of SGMA to allow subbasins and GSAs to define the conditions at which the sustainability indicators become significant and unreasonable, causing an Undesirable Result. Because of the dynamics of the Delta-Mendota Subbasin, a broad definition of Undesirable Results was originally developed to expand on DWRs definition above, while still allowing flexibility for GSAs and GSP Groups to define them on a local level. However, in response to DWR 'incomplete' determination, and in the spirit of cooperation within the Subbasin, the DMGB has commonly defined Undesirable Results as (See Common Chapter – **Appendix B)**:

Groundwater Levels

> *Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.*

Groundwater Storage Volume

> *A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.*

Seawater Intrusion

> *Not defined – Inapplicable.*

Water Quality

> *Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.*

Subsidence

> *Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.*

Interconnected Surface Water

Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users.

Significant and Unreasonable Effects

Significant and unreasonable effects were considered for each of the undesirable results defined above. Several public meetings of the Delta-Mendota Coordination Committee and its Technical Working Group were held to develop consistent definitions of SMCs and significant and unreasonable effects specifically. Collaboration provided neighboring GSP Groups the opportunity to discuss significant and unreasonable effects being experienced by others as well A description of these coordinated definitions is included in the Common Chapter (**Appendix B**).

The Aliso GSA maintains that significant and unreasonable effects will occur if mitigation actions for any of the sustainability indicators became financially or logistically unfeasible.

Minimum Thresholds & Measurable Objectives

Minimum Thresholds were developed collectively by the Coordination Committee using common data and coordinated assumptions to define a minimum value for each sustainability indicator at which undesirable results might be experienced. The table below provides a synopsis for each SMC which is more fully defined in the Common Chapter (section 5.4 of **Appendix B**).

Sustainability Indicator	Minimum Threshold Description
Water Levels	The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low prior to the end of Water Year 2016 at more than 50% of the RMSs. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements.
Groundwater Storage	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.
Subsidence	The minimum threshold is set to not exceed 2 ft of additional inelastic land subsidence attributable to groundwater extraction.
Water Quality	The minimum threshold for salinity is set to not exceed 1,000 mg/L (TDS) at more than 50% of RMSs.
Interconnected Surface Water	Identified data gap in the DMGB. The Chronic Lowering of Groundwater Levels Minimum Threshold is used as an interim minimum threshold.
Seawater Intrusion	Not Defined – Not Applicable

Measurable objectives were developed as practical goals that could be achieved over the implementation horizon, as well as to provide operation flexibility above the minimum threshold. It is possible that sustainability could be achieved with values other than those set as measurable objectives, but due to the lack of significant and unreasonable effects thus far these values are unknown. For some sustainability indicators, such as subsidence, development of the measurable objectives considered the critical water conveyance infrastructure within the Subbasin and were set to minimize inelastic land subsidence attributable to groundwater extraction, with no additional subsidence after 2040. Historical high groundwater elevations (Water Year 2015 if available) were used to quantify the measurable objectives at each representative groundwater level monitoring site, compared to a four-year rolling average to account for water level variability. Where Water Year 2016 data wasn’t available, most monitoring sites established measurable objectives using a historical high during the drought years in 2014 and 2016. Groundwater quality used TDS levels that are acceptable for drinking water standards for development of interim milestones and measurable objectives.
Specific details on measurable objectives can be seen in **Table ES-1**, **Table ES-2** and **Table ES-3**, and are elaborated in **Chapter 4.** Measurable objectives for each sustainability indicator are further outlined in the Common Chapter (**Appendix B**).

Table ES-1 Water Level SMCs

Depth to Water (ft bgs)							
AWD Monitoring Zone	Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	12S15E32B002M	09-001	≥43.0	≥43.0	≥43.0	≥43.0	116.8
3	13S15E14M001M	09-003	≥113.5	≥113.5	≥113.5	≥113.5	129.0
2	13S16E30A001M	09-004	≥125.5	≥125.5	≥125.5	≥125.5	139.7
1	12S16E31G001M [1]	09-002	≥162.8	≥162.8	≥162.8	≥162.8	183.9
Water Surface Elevation (ft above msl)							
AWD Monitoring Zone	State Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	12S15E32B002M	09-001	≥114.3	≥114.3	≥114.4	≥114.3	40.5
3	13S15E14M001M	09-003	≥52.9	≥52.9	≥52.9	≥52.9	37.4
2	13S16E30A001M	09-004	≥51.9	≥51.9	≥51.9	≥51.9	37.7
1	12S16E31G001M [1]	09-002	≥17.1	≥17.1	≥17.1	≥17.1	-4.0

1. *Composite Well to be evaluated for replacement at Year-5 Interim Milestone.*

Table ES-2 Subsidence SMCs

Elevation Monitoring (ft above msl)							
Subsidence Benchmark	DMS ID	Dec. 2020 Level	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
ALISO WD 1 RESET	09-006	158.52	≥157.52	≥157.02	≥156.77	≥156.52	156.52
DWR at Gravelly Ford Canal	09-007	202.39	≥201.39	≥200.89	≥200.64	≥200.39	200.39
LIFESON	09-008	179.33	≥178.33	≥177.83	≥177.59	≥177.33	177.33

Table ES-3 Water Quality SMCs

TDS (mg/L)							
AWD Monitoring Zone	Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	AWD-1	09-005	<1,000	<1,000	<1,000	<1,000	1,000
3	13S15E14M 001M	09-003	<1,000	<1,000	<1,000	<1,000	1,000
2	13S16E19J0 01M	09-196	<1,000	<1,000	<1,000	<1,000	1,000
1	12S16E31G 001M[1]	09-002	<1,000	<1,000	<1,000	<1,000	1,000
1. Composite Well to be evaluated for replacement at Year-5 Interim Milestone.							

Chapter 5 - Monitoring Network

This chapter describes current monitoring programs and the monitoring network being developed by the AWD that will collect sufficient data to determine short-term, seasonal, and long-term trends in groundwater and related surface conditions, ultimately providing information necessary to support the implementation of this Plan, evaluate the effectiveness of this Plan, and aid in decision-making by the AWD management.

The GSAs within the Delta-Mendota Subbasin have established monitoring networks within each GSA. The objectives of the various monitoring programs include:

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

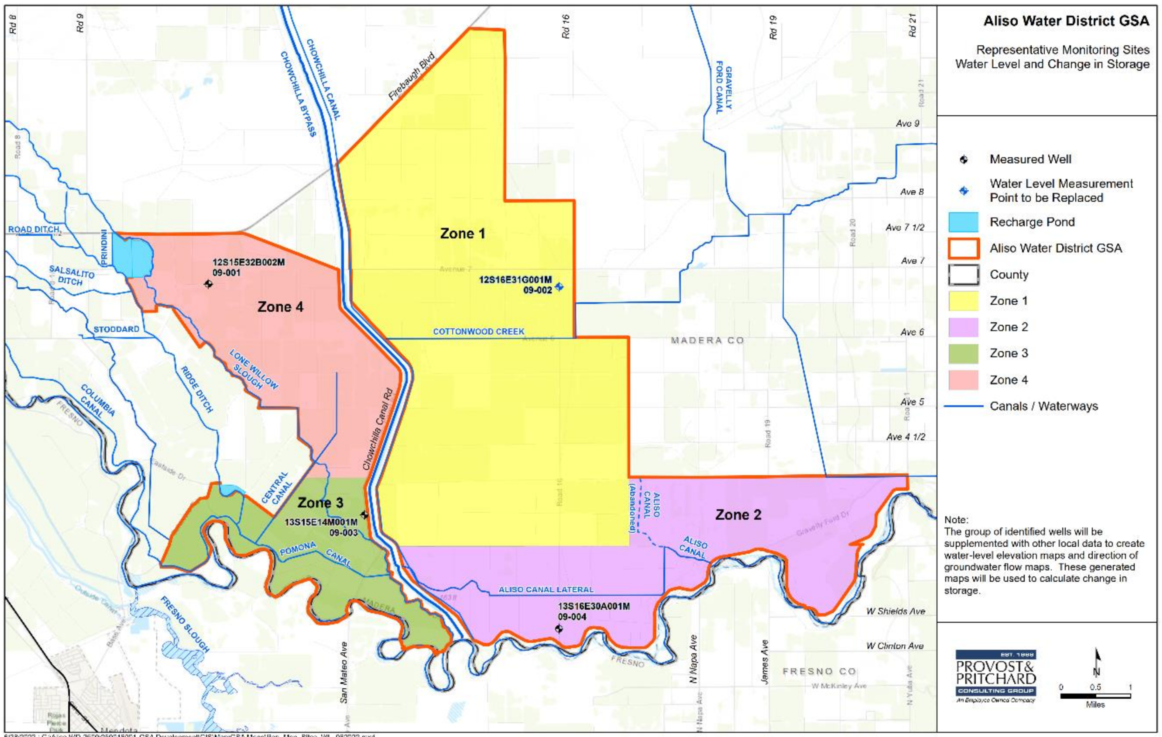

Figure ES-5 Representative Monitoring Site Water Level and Change in Storage

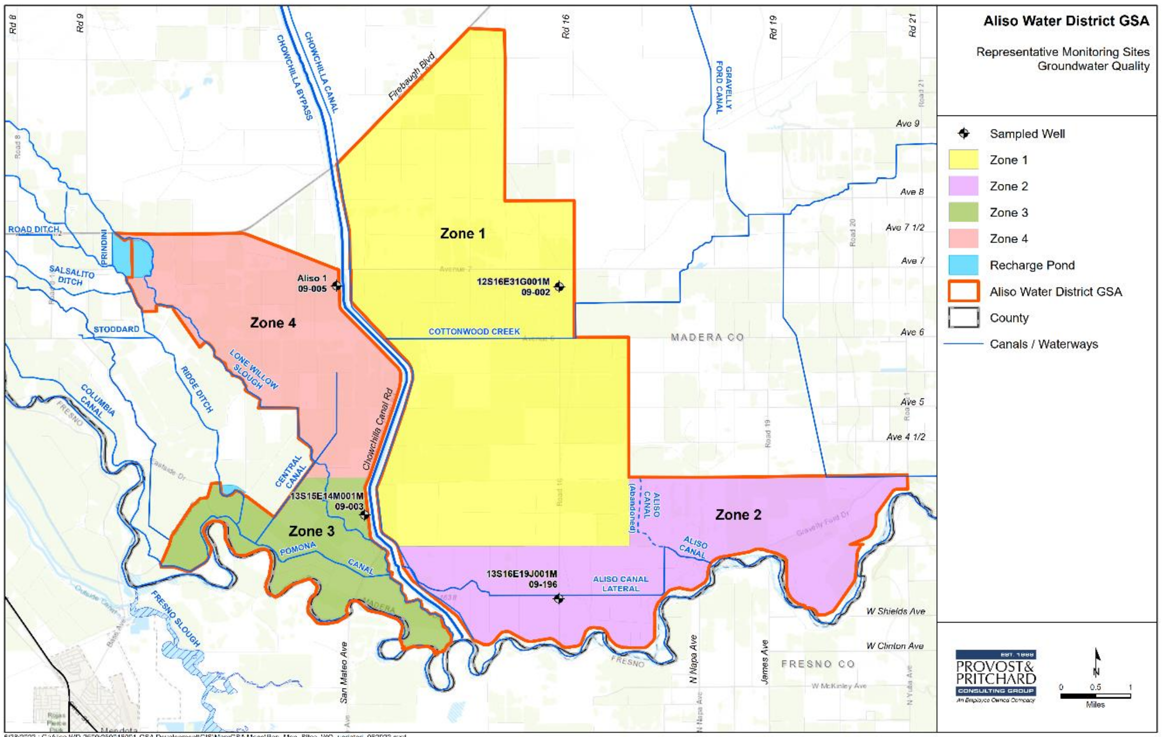

Figure ES-6 Representative Monitoring Sites - Groundwater Quality

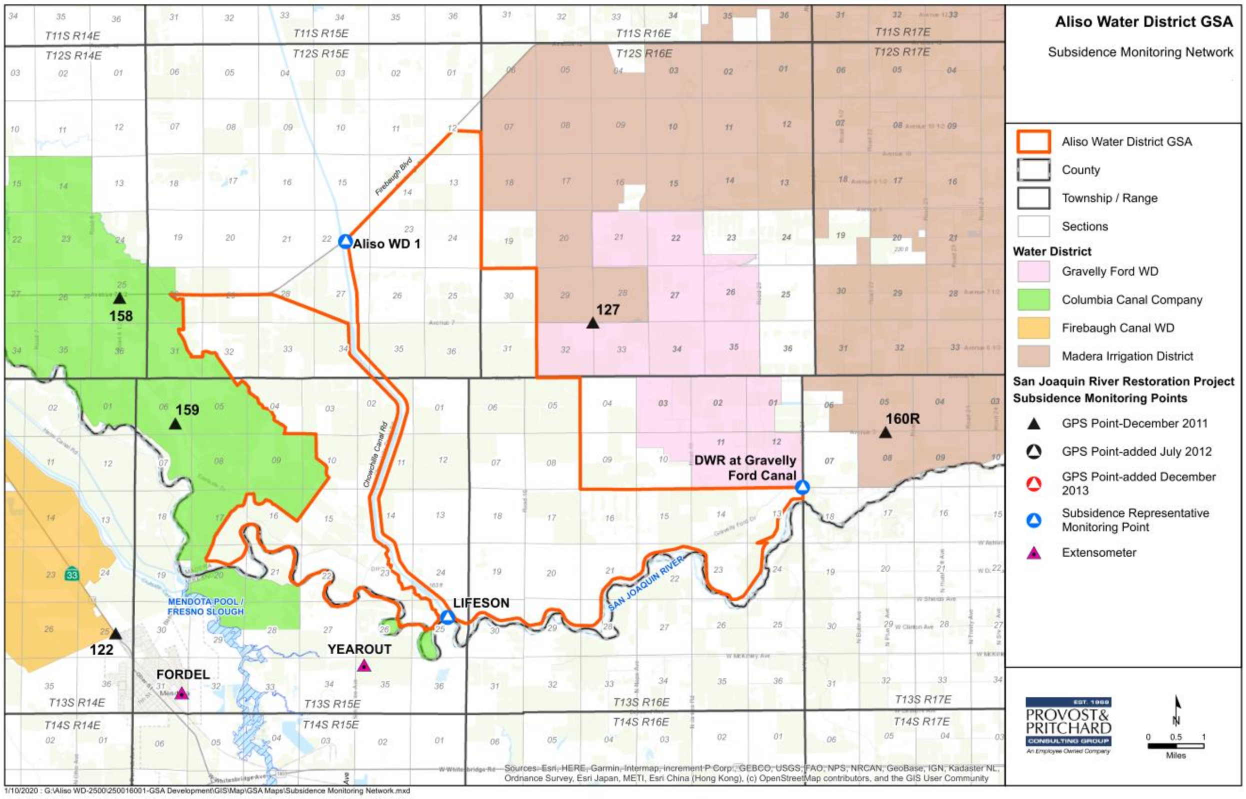

Figure ES-7 Subsidence Monitoring Network

Chapter 6 - Projects and Management Actions

Projects and management actions will be implemented locally to avoid undesirable results and achieve groundwater sustainability goals by 2040. Several workshops were held with the AWD GSA Ad Hoc Committee in 2018 and 2019 to finalize project descriptions, develop District priorities, and score projects based on criteria developed. The District analyzed several project types and management programs during the Ad Hoc Committee planning process, which are summarized into the following categories.

- *Surface Water Acquisition Projects*
- *Groundwater Use & Recharge Projects*
- *Efficiency/Conservation Projects & Management Programs*

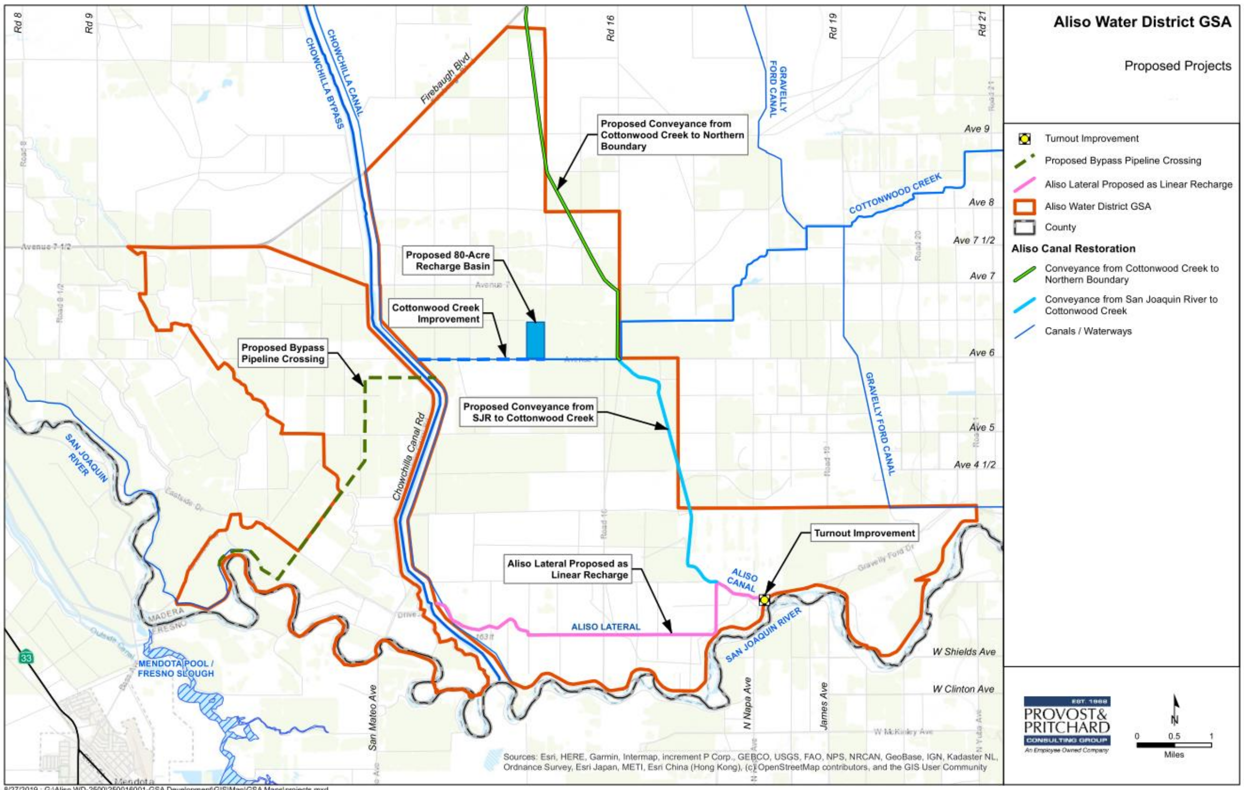

Figure ES- 8 Potential Projects Considered

After consideration and ranking of all conceptualized projects the District settled on the following four actions to focus on:

1. *Water Rights on the Chowchilla Bypass*
2. *Chowchilla Bypass Recharge Project*
3. *Well Permitting Review*
4. *Land Fallowing (low priority, but included to establish baseline)*

Water Rights on the Chowchilla Bypass

During extreme wet years, non-contracted water sourced from high flow events is released into the SJR. When the lower reaches of the SJR are at capacity, water is diverted from those lower reaches into the Bypass. The Bypass diverts flood waters from the lower reaches of the SJR in order 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.

Access to surface water is a critical first step to any subsequent project. Acquiring temporary water rights to capture surface water during high flow events from the Bypass would allow AWD to implement groundwater recharge, in-lieu recharge, and flood relief projects. This project proposes to acquire rights to divert unappropriated high-flow waters from the Bypass via existing flap gates, non-permanent pump stations, and future turnouts into the District. Water could be delivered from the Bypass to ponds and on-farm recharge areas within the District. Water would be applied directly to crops until land for a recharge basin can be acquired and developed. Temporary water rights would be applied for on an annual basis until permanent water rights can be acquired by the GSA.

Chowchilla Bypass Recharge Facility

Once a water right is established to the Chowchilla Bypass, then this proposed project becomes feasible, although the availability of floodwater would determine its operation. The proposed projects would construct a turnout from the Bypass near the termination of Cottonwood Creek, construct improvements to Cottonwood Creek itself, and develop an approximately 80-acre recharge basin (collectively known as the Chowchilla Bypass Recharge Facility or Facility). This facility would allow AWD to implement groundwater recharge, in-lieu recharge, and flood relief projects. This project's primary purpose is to divert and recharge unappropriated high-flow waters from the Bypass via a new turnout owned and operated by AWD. Water will be delivered from the Bypass to the proposed Facility and on-farm recharge areas within AWD. The turnouts will be similar to others on the Bypass in the surrounding area and will divert water using a slide gate-controlled gravity pipeline turnout that will penetrate through the levee and end at a sump pump on the field side of the Bypass levee. Fish screens will be required at the inlet. A flashboard check structure at the downstream (western) end of Cottonwood Creek would be required to prevent diverted water from backflowing into an existing drainage ditch that parallels the Bypass. Water conveyance from the Bypass turnout to the Facility ponds could be achieved by raising the embankments of Cottonwood Creek. Due to existing topographic conditions, water for recharge would require pumping to reach the Chowchilla Bypass Recharge Facility ponds.

Well Permitting Review

This project involves an agreement between AWD and Madera County to allow AWD to review any new well drilling permits submitted both within the GSA and outside of the District but within the County, white areas included. This will increase the ability of AWD to manage the aquifer and increase sustainability. AWD will be able to provide oversight on new well depths, perforated intervals, and extractions from the upper and lower aquifer zones, as well as ensure that future wells are equipped with appropriate appurtenances such as flow meters. Having the authority to review the locations and depths of new wells within and adjacent to the GSA is a crucial step to obtaining the information necessary to maintain basin sustainability, alleviate current overdraft conditions, and prevent continued over-extraction of the aquifer. While Madera County will ultimately be responsible for approving well permits, AWD's review of the permits will help ensure that new wells are compliant with current and future sustainable practices.

Land Fallowing

Land fallowing is the practice of removing crops from production and allowing the field to remain unirrigated. As a last resort, if additional surface water cannot be secured for recharge to stabilize groundwater levels, then land fallowing would be implemented. Although one of the most effective ways to remedy over-extraction is through the fallowing of land, it would also have a correspondingly detrimental impact to the culture and economy of this agricultural community. Because the GSA is highly dependent on groundwater pumping, fallowing land would help balance groundwater levels and increase DMGB stability by reducing the demands on the aquifer. If the fallowed land had been irrigated with composite or deep-water wells, fallowing would support land subsidence goals as well. Fallowing could be performed on either a permanent or annual basis, and fallowed land could be used for groundwater recharge if surface supplies become available. Implementation could be achieved either through voluntary fallowing with incentives or through mandatory fallowing.

Chapter 7 - Plan Implementation

The adoption of the GSP will be the official start of the Plan Implementation. The GSA will continue its efforts to engage the public and 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, the GSA will coordinate with various stakeholders and beneficial users to improve the monitoring networks and begin the implementation of projects and management actions.

AWD's overlying overdraft was estimated to be approximately 2,200 AFY prior to the development of the GSP. It is planned that by 2025, the pre-existing overdraft value will have decreased by approximately 10%. In the years 2030, 2035, and 2040 it is expected that overdraft will have decreased incrementally by 30% for each 5-year period. The cumulative progress toward eliminating overdraft will continue throughout the GSP's implementation until sustainability is met by 2040. AWD is hopeful that their project to recharge water from the CBP, will offset existing overdraft during an average hydrological period. However, should the project not perform as anticipated, AWD will seek additional methods to meet the goals outlined in the projections by implementing other projects and management actions described in Chapter 6.

Costs to implement solutions, monitor, and update the GSP were estimated conservatively at approximately $750,000 annually starting in 2020. Funding for projects and management actions will be secured through assessments and grant funds when available. The majority of the projects are conceptual. As projects are developed during the implementation period, costs will be refined. The schedules and estimates presented in the GSP are initial estimates and will likely change as the Plan is implemented and periodically evaluated.

Successful implementation of this GSP over the planning and implementation horizon (2020-2040) will require ongoing efforts to engage stakeholders and the general public in the sustainability process, communicate the statutory requirements and GSP objectives, and progress toward each identified Measurable Objective. The AWD will report the result of the SMC monitoring including annual groundwater levels, extraction volume, surface water use, total water use, groundwater storage change, and progress of GSP implementation to the public and DWR on an annual basis, in cooperation with the other GSAs in the Subbasin. The Delta-Mendota Subbasin has developed a Data Management System to help store and evaluate groundwater related data. In addition, the GSA will provide updated information and amend the GSP at least every five years. The update will include the results of the Subbasin operations and progress in achieving sustainability including current groundwater conditions, status of projects or management actions, evaluation of undesirable results relating to Measurable Objectives and Minimum Thresholds, changes in monitoring networks, summary of enforcement or legal actions, and agency coordination efforts to the public and DWR.

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

(1) Chronic lowering of groundwater levels indicating a significant and unreasonable lowering of groundwater levels
(2) Significant and unreasonable reduction of groundwater storage
(3) Significant and unreasonable seawater intrusion
(4) Significant and unreasonable degraded water quality
(5) Significant and unreasonable land subsidence
(6) Depletions of interconnected surface water that have significant and unreasonable impacts on beneficial uses of surface water

Under SGMA, the high and medium priority basins should reach sustainability within 20 years of implementing their sustainability plans and avoid causing significant and unreasonable effects leading to undesirable results as related to the six sustainability indicators. For critically over-drafted high priority basins, including the Delta-Mendota Groundwater Subbasin (Delta-Mendota Subbasin, DMGB, or Subbasin) that the Aliso Water District (AWD or District) Groundwater Sustainability Agency (GSA) 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.” The Groundwater Sustainability Agencies (GSAs) within the Delta-Mendota Subbasin are working cooperatively to achieve basin-wide sustainability. With local funding and ongoing financial and technical assistance from the Department of Water Resources (DWR), the AWD participants are collaborating with neighboring agencies to achieve groundwater sustainability for the DMGB at the local level.

1.2 Sustainability Goal

The sustainability goal for the DMGB was established to succinctly state the objectives and desired conditions of the Subbasin that culminate in the absence of undesirable results by 2040. The sustainability goal of the Subbasin recognized by the AWD GSA is as follows:

The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and *milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.*

The following definitions of "undesirable results" were agreed upon and are common between all six of the Delta-Mendota Subbasin Groundwater Sustainability Plan (GSP) Groups (defined in **Appendix B**) for the following applicable sustainability indicators:

- ***Chronic lowering of groundwater levels*** *- Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.*
- ***Reduction in groundwater storage*** *- A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.*
- ***Degraded water quality*** *- Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.*
- ***Land subsidence*** *- Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.*
- ***Depletions of interconnected surface water*** *- Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources of downstream beneficial uses and users.*
- ***Seawater Intrusion*** *- The Delta-Mendota Subbasin has acknowledged seawater intrusion as not being applicable. As it applies to AWD, the Pacific Ocean is located approximately 100 miles west and is separated from the Subbasin by the Coastal Range. Given the distance separating the District from the Pacific Ocean, saltwater intrusion from the ocean into the freshwater aquifer is not a concern for the area and not applicable for analysis in the GSP.*

A full description of undesirable results as defined by the Coordination Committee of the DMGB is available in **Chapter 4** – Sustainable Management Criteria. This definition has been expanded to include spatial and temporal limitations that could lead to undesirable results and definitions of "significant and unreasonable effects" which assist in defining groundwater conditions that could lead to undesirable results as well as causes of those groundwater conditions.

The sustainability goal will be met by balancing water demand with available water supply and reducing dependence on groundwater from the lower aquifer, which may cause subsidence and result in impacts to beneficial users of surface water and loss of conveyance capacity. Full implementation of the GSP in the Subbasin should result in stabilization of groundwater levels and reductions in the rate of subsidence without significantly or unreasonably impacting groundwater storage, water quality, or interconnected surface water.

The Delta-Mendota Subbasin, identified by the DWR as groundwater Subbasin Number 5-022.07, is located within the San Joaquin River Hydrologic Region and the Tulare Lake Hydrologic Region, San Joaquin Valley Groundwater Basin. Prior to the adoption of SGMA, the Delta-Mendota Subbasin was recognized as being in a state of groundwater overdraft. The State recently identified the Delta-Mendota Subbasin as a “high priority, critically overdrafted” subbasin. The sustainability indicator of greatest concern in the Delta-Mendota Subbasin is subsidence which shows strong correlation to groundwater overdraft in the lower aquifer; however, AWD has not historically experienced the rates and impacts of significant subsidence that other Delta-Mendota Subbasin GSP participants have experienced (**Chapter 3**). Additionally, the AWD has not experienced any significant and unreasonable effects induced by groundwater use that would lead to undesirable results. **Chapter 3** of this GSP discusses the technical quantification of overdraft within AWD. The Delta-Mendota Subbasin Common Chapter (Common Chapter) in **Appendix B** further explores the variability in historic overdraft across the Delta-Mendota Subbasin.

To that end, this GSP recognizes various measures to improve trends toward sustainability while working and coordinating with neighboring GSP groups and subbasins to meet SGMA requirements and their respective goals.

As part of accomplishing this overarching sustainability goal, the DMGB defines undesirable results as outcomes that could be realized should the strategies in each of the six Subbasin GSPs not be effective or not be effectively implemented. Undesirable results are marked by minimum thresholds, which aid in quantifying the point at which an undesirable result may occur. The AWD has not historically experienced undesirable results. However, to prevent undesirable results defined in this GSP from occurring in the future may require implementation of projects and management actions as identified in **Chapter 6**. The measurable objectives quantitatively reflect the desired achievements of the sustainability goal at 2040 and the associated 5-year interim milestones (interim goals) have been defined to gauge progress during the intervening years. The interim milestones help assure that the District and its neighboring DMGB GSP groups are not only moving toward its sustainability goals, but that the rate of progress is as planned and sufficient to meet the overall implementation schedule.

Significant and unreasonable effects, undesirable results, minimum thresholds, and measurable objectives to meet the sustainability goal of the Subbasin are all defined and discussed in detail in **Chapter 4**.

1.3 Coordination Agreements

Regulation Requirements:

§ 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.

This section includes a description of intra-basin coordination agreements, which are required where there is more than one GSP to be implemented in a groundwater basin, pursuant to Article 8. Interagency Agreements, § 357.4.

The Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), effective as of December 12, 2018, has been signed by all participating agencies in the Delta-Mendota Subbasin. The Coordination Agreement can be found attached to the Common Chapter in **Appendix B**. This Coordination Agreement defines how the coordination efforts will be achieved and documented and outlines the process for identifying the Plan Manager.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. *Purpose of the Agreement, including:*
    a. *Compliance with SGMA*
    b. *Description of Criteria and Function*
2. *General Guidelines, including:*

   a. *Responsibilities of the Parties*
   b. *Adjudicated or Alternative Plans in the Subbasin*
3. *Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:*
   a. *Agreement to Serve*
   b. *Reimbursement of SLDMWA*
   c. *Termination of SLDMWA's Services*
4. *Responsibilities for Key Functions, including:*
   a. *Coordination Committee*
   b. *Coordination Committee Officers*
   c. *Coordination Committee Authorized Action and Limitations*
   d. *Subcommittees and Workgroups*
   e. *Coordination Committee Meetings*
   f. *Voting by Coordination Committee*
5. *Approval by Individual Parties*
6. *Exchange of Data and Information, including:*
   a. *Exchange of Information*
   b. *Procedure for Exchange of Information*
7. *Methodologies and Assumptions, including:*
   a. *SGMA Coordination Agreements*
   b. *Pre-GSP Coordination*
   c. *Technical Memoranda Required*
8. *Monitoring Network*
9. *Coordinated Water Budget*
10. *Coordinated Data Management System*
11. *Adoption and Use of the Coordination Agreement, including:*
    a. *Coordination of GSPs*
    b. *GSP and Coordination Agreement Submission*
12. *Modification and Termination of the Coordination Agreement, including:*
    a. *Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages)*
    b. *Modification or Amendment of Coordination Agreement*
    c. *Amendment for Compliance with Law*
13. *Withdrawal, Term, and Termination*
14. *Procedures for Resolving Conflicts*
15. *General Provisions, including:*
    a. *Authority of Signers*
    b. *Governing Law*
    c. *Severability*
    d. *Counterparts*
    e. *Good Faith*
16. *Signatories of all Parties*

Department of Water Resources Point of Contact

The point of contact with DWR for the Delta-Mendota Subbasin is:
Christopher Olvera
Department of Water Resources
Christopher.Olvera@water.ca.gov
(559) 230-3373

Agency Responsibility

All Delta-Mendota Subbasin GSAs, including AWD, have agreed to work collaboratively to meet the objectives of SGMA and the terms of the Coordination Agreement as an individual party. More information regarding agency responsibility can be found in the **Common Chapter**.

Coordinated Data and Methodology

To ensure the Coordination Agreement requirements for coordinated data and methodology were achieved, the Delta-Mendota Subbasin participants formed a technical subcommittee of technical staff representing each of the GSP groups. GSP items that were both required or beneficial to all parties regarding coordinated efforts were discussed, resulting in coordinated data and methodologies for the entire Subbasin. More information regarding common data and methodologies can be found in the **Common Chapter** and the accompanying **Technical Memoranda** that specifically outline common data sources and methodology decisions.

Dispute Resolution

The Coordination Agreement outlines a path to dispute resolution, should it arise. The **Common Chapter** summarizes the method for resolution as follows:

The disputing Party or Parties are to provide written notice of the basis of the dispute to the other Parties within thirty (30) calendar days of the discovery of the events giving rise to the dispute. Within thirty (30) days after such written notice, all interested Parties are to meet and confer in good faith to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. In such an event, within ten (10) days following the failed informal proceedings, each interested Party is to nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties are to rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, and one point to the third choice and zero points to all others. Each interested Party will then forward its tally to the Secretary, who tabulates the points and notifies the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties for selection of an arbitrator in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration is be administered in accordance with the procedures set forth in the California Code of Civil Procedure, Section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring legal action relating to the controversy.

Plan Implementation and Submittal

Compliant with the SGMA and the Coordination Agreement, the AWD agrees to submit the GSP to DWR through the Coordination Committee and Plan Manager. The Aliso Water District GSP is considered complete with the submittal of the **Common Chapter** and appended **Technical Memoranda**. The GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin.

The Coordination Agreement does not otherwise affect each Plan Area's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, the Coordination Agreement is the mechanism through which the participating GSAs will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA. Each GSP group and respective GSA(s) is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline.

The Coordination Committee is responsible for assuring the timely submittal of annual reports and providing five-year assessments recommending any needed revisions to the Coordination Agreement. More Information on GSP implementation and submittal is found in the **Common Chapter** and Coordination Agreement.

Adjudicated Areas and Alternative Plans
There are no adjudicated areas within the Delta-Mendota Subbasin, and no Alternative Plans have been submitted by the local agencies within the Subbasin.

1.4 Interbasin Agreements

Regulation Requirements:

§ 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.

This section includes a description of inter-basin coordination agreements, which are optional agreements between neighboring groundwater subbasins pursuant to Article 8. § 357.2 Interbasin Agreements.

The sole interbasin agreement in the Delta-Mendota Subbasin is limited to a data-sharing agreement between SLDMWA and Westlands Water District.

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, executed an interbasin data sharing agreement with Westlands Water District in April 2018. The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between Westland Water District's service area and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA.

The District has had, and will continue, conversations with neighboring subbasins, but the District has not entered into any interbasin agreements at this time. However, as the District and its neighbors implement their respective sustainability plans, such agreements may be explored to better coordinate among neighboring areas.

1.5 Agency Information

Regulation Requirements:

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

This Groundwater Sustainability Plan covers the same jurisdictional boundary as the AWD GSA and associated Aliso Water District. The mailing address for the AWD GSA is as follows:

Aliso Water District
Groundwater Sustainability Agency
13991 Avenue 7
Madera, CA 93637

1.5.1 Organization and Management Structure of the GSA

Regulation Requirements:

§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.

In accordance with the Coordination Agreement discussed in **Section 1.3**, The Delta-Mendota Subbasin Plan Manager is recognized as:

John Brodie
Water Resources Program Manager

San Luis & Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
John.brodie@sldmwa.org (209) 826-1872

The AWD GSA is composed of Aliso Water District. The participants of the AWD GSA recognize the GSP Manager as Roy Catania, Board President of AWD and the AWD GSA.

Roy Catania, Board President
Aliso Water District
13991 Avenue 7
Madera, CA 93637
(559) 431-5489
roy@oneillag.com

1.5.2 Legal Authority of the GSA

Regulation Requirements:

§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. **§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.

The Agency was created by Special Act legislation via Senate Bill 564, passed by the Legislature and signed by Governor Brown on September 16, 2016.

The SGMA legislation requires a GSA to develop and implement a Groundwater Sustainability Plan to achieve groundwater sustainability management within the territory of the Agency, in compliance with the mandates and timelines in SGMA. In the case of AWD, the plan participants coordinated to develop and implement a single GSP to abide under.

The Agency's enabling act provides in Water Code Appendix Section 143-801 that, pursuant to Chapter 8 of Part 2.74 of Division 6 of the Water Code, AWD may impose a variety of fees as it may determine to be necessary, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activities in order to fund the costs of a groundwater sustainability program, which include, but are not limited to, preparation, adoption, and amendment of a GSP, and investigations, inspections, compliance assistance, enforcement, and program administration during implementation of the GSP, including a prudent reserve. An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs are discussed in **Chapter 7**.

1.6 GSP Organization and Preparation Checklist

The AWD GSP is organized in accordance with the Emergency Regulations in a format similar to the outline provide by DWR. The Elements of the Plan (i.e. where in this GSP each regulation is addressed) is provided in **Appendix G**.

- ***Executive Summary*** *provides a summary of what will be included in the GSP.*
- ***Chapter 1*** *describes the Introduction, including purpose of the GSP, sustainability goals, agency information, and GSP organization.*
- ***Chapter 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 GSA boundary, and additional GSP components.*
- ***Chapter 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 the special management areas created within the overall boundary.*
- ***Chapter 4*** *sets forth the GSA's adopted sustainability goals, addresses the mandated Undesirable Results, defines Minimum Thresholds for each Undesirable Result, and sets Measurable Objectives for both intermediate plan years (Interim Milestones) and for the Plan's complete implementation.*
- ***Chapter 5*** *describes the network of monitoring wells and other facilities adopted by the GSA 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.

- ***Chapter 6*** *lists and describes each project and management action that will be evaluated and may be adopted by the GSA in pursuit of sustainability. The section includes such project details as measurable objectives, required permits, anticipated benefits, project capital and operations/maintenance costs, project schedules, and required ongoing management operations, along with management actions that may be implemented.*
- ***Chapter 7*** *describes the Plan implementation process, including estimated costs, sources of funding, an overall preliminary schedule through full implementation, description of the required data management system, methodology for annual reporting, and how progress evaluations will be made over time.*
- ***Chapter 8*** *summarizes the references and sources used to prepare and document this Plan.*

2 Plan Area

Regulation Requirements:

§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.

2.1 Plan Area Description

This Groundwater Sustainability Plan (GSP) applies to the Aliso Water District (AWD) Groundwater Sustainability Agency (GSA), which is located within the Delta-Mendota Groundwater Subbasin (DMGB). There are 23 GSAs in the DMGB, drafting six individual GSPs. This GSP will also cover the DMGB coordinated efforts. This GSP's methodologies and data are coordinated and approved through the DMGB Coordination Committee.

2.1.1 Groundwater Basin Boundary

The DMGB is part of the San Joaquin Valley Groundwater Basin. The DMGB is bordered to the south by the Westside Subbasin and the Kings Subbasin; by the Madera, Chowchilla, Merced, and Turlock Subbasins along the eastern border; and by the Coastal Range to the west. See **Figure 2-1** for the Groundwater Subbasin Map. The San Joaquin River lies within and borders the Subbasin. The groundwater basin boundary is defined in the Department of Water Resources (DWR) Bulletin 118 as DWR Basin No. 5-22.07. The groundwater basin includes 1,170 square miles (747,000 acres). DWR estimated in 1995 that the groundwater storage for the entire DMGB is about 26.6 million acre-feet (AF) to a depth of 300 feet (DWR, 2003).

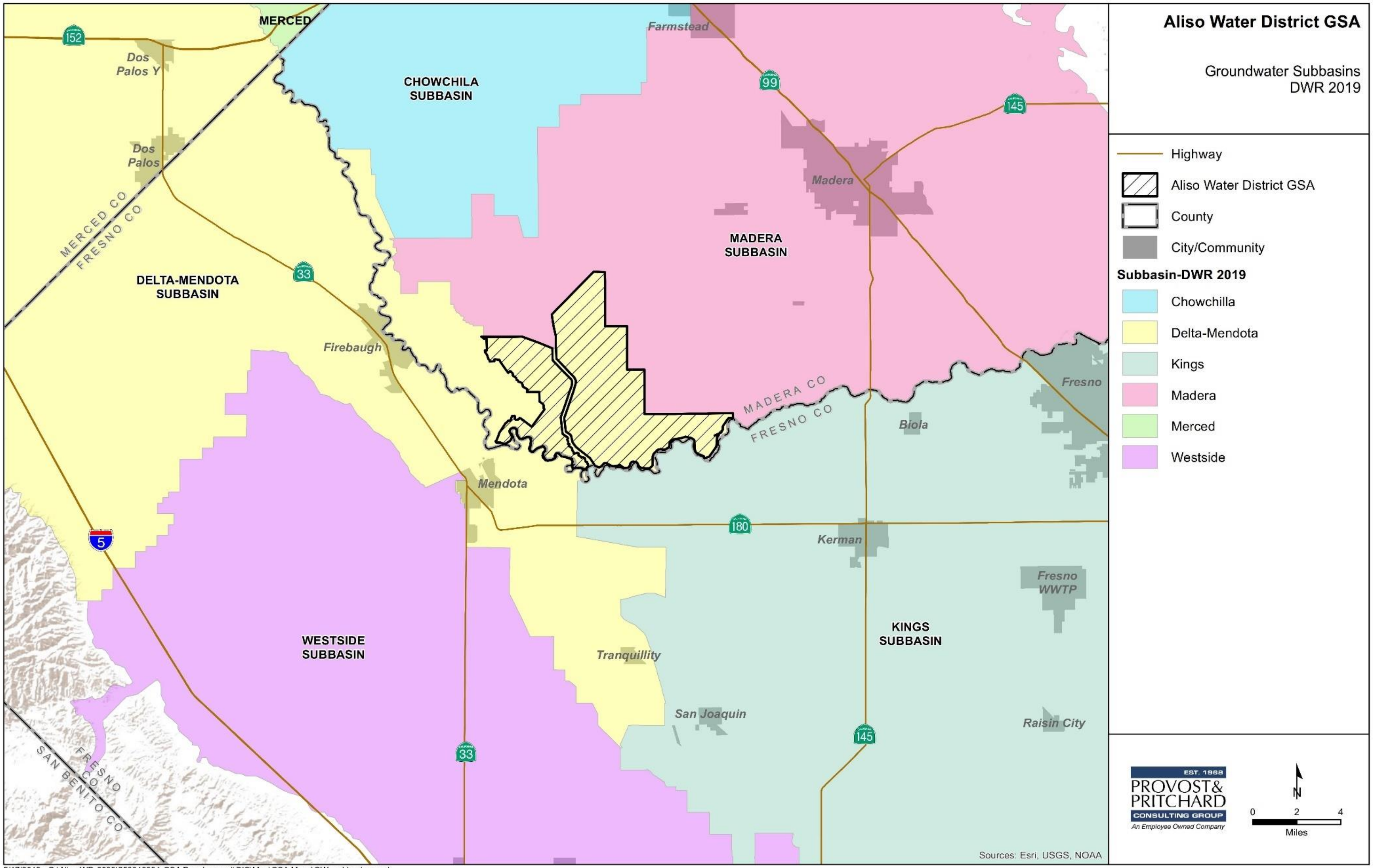

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Figure 2-1: Groundwater Subbasin Map

2.1.2 Groundwater Sustainability Plan Area

The AWD GSA boundary is the same area as the Aliso Water District; therefore, this GSP will refer to the AWD GSA as AWD or District. AWD is located in western Madera County. AWD encompasses roughly than 26,000 acres. The land is predominantly agricultural. The majority of the crops in AWD are permanent crops, the bulk being nuts and vines with some annual row crops. The District is completely developed, and while there is no additional land to develop, land uses may change over time. In addition to agricultural lands, there are a nut processing plant and an underground natural gas storage facility. There are less than 20 permanent residents in the District and no cities or towns. There are no adjudicated areas or state or federal lands within the GSA except the Chowchilla Bypass, which is owned by the State of California and maintained by the Lower San Joaquin Levee District.

AWD is bordered by non-districted lands (white areas), managed by the Madera County GSA, that lie within the Madera Subbasin to the north and east; Columbia Canal Company (CCC) to the west, which is in the San Joaquin River Exchange Contractors GSA (SJRECGSA); and the McMullin Area GSA (MAGSA) in the Kings Subbasin to the south. The eastern boundary is bordered by the Madera County GSA, Madera Irrigation District GSA, and Gravelly Ford Water District GSA, all of which are in the Madera Subbasin. **Figure 2-2:** shows nearby GSAs.

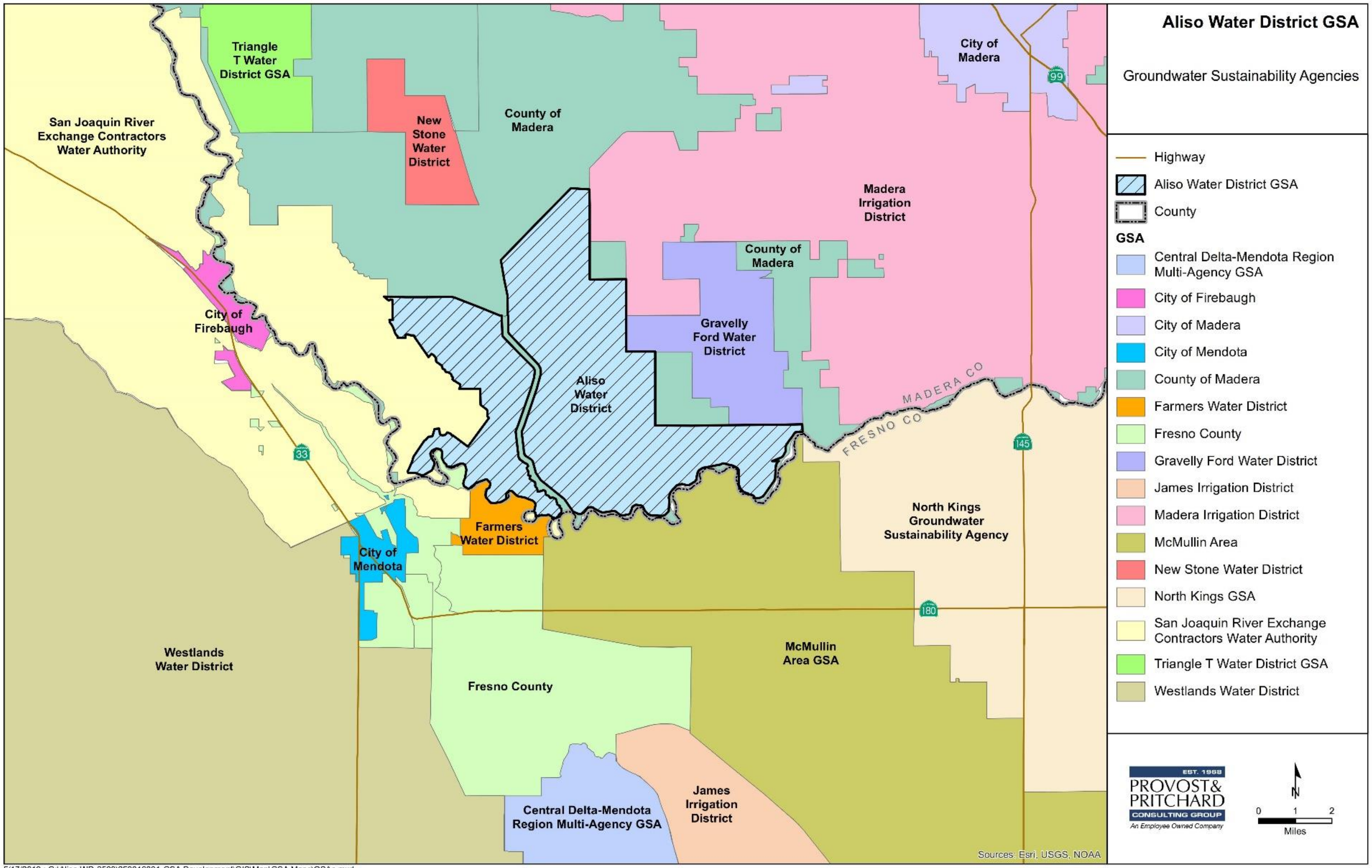

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Figure 2-2: Neighboring GSAs

2.1.3 Land Use

AWD is comprised of agricultural lands with very minimal industrial and residential land use. There are no federal or tribal lands within AWD. AWD is adjacent to the San Joaquin River which is influenced by the San Joaquin River Restoration Program (SJRRP, Restoration Program). The District is made up of several individual landowners. There are no other water districts within the GSA; however, the Lower San Joaquin Levee District overlies portions of the GSA. See **Table 2-1** and **Figure 2-3:** for land use in AWD.

Table 2-1: Average Historic Land Use (2003 to 2012)

Land Use	Average Historic Acreage (Rounded)
Alfalfa	979
Idle/Open Space	977
Fruit & Nut Trees	16,110
Row Crops	701
Urban/Developed	307
Vines	7,541
Open Water	21
Total Acreage	26,636

Historic land use data were obtained using spatial imagery and ground truthing methods/survey. Current land use (as of 2017) is more refined and tracked by the District. **Table 2-1** shows average historic land use compiled from DWR land use surveys and the US Department of Agriculture's (USDA) CropScape land use tool from 2003-2012. Agriculture is the primary beneficial user of water in the District. AWD currently only tracks cropping information, not other land use types.

2.1.4 Water Sources and Use

The District's main water supply is from pumping groundwater since the District currently has no surface water supplies of its own. However, there are individual landowners within the District that do have access to surface water from the San Joaquin River and the Chowchilla Bypass. The well density map (**Figure 2-4:**) shows all the wells that had Well Completion Reports submitted to DWR by section. The data provided does not specify whether the reported wells are currently active.

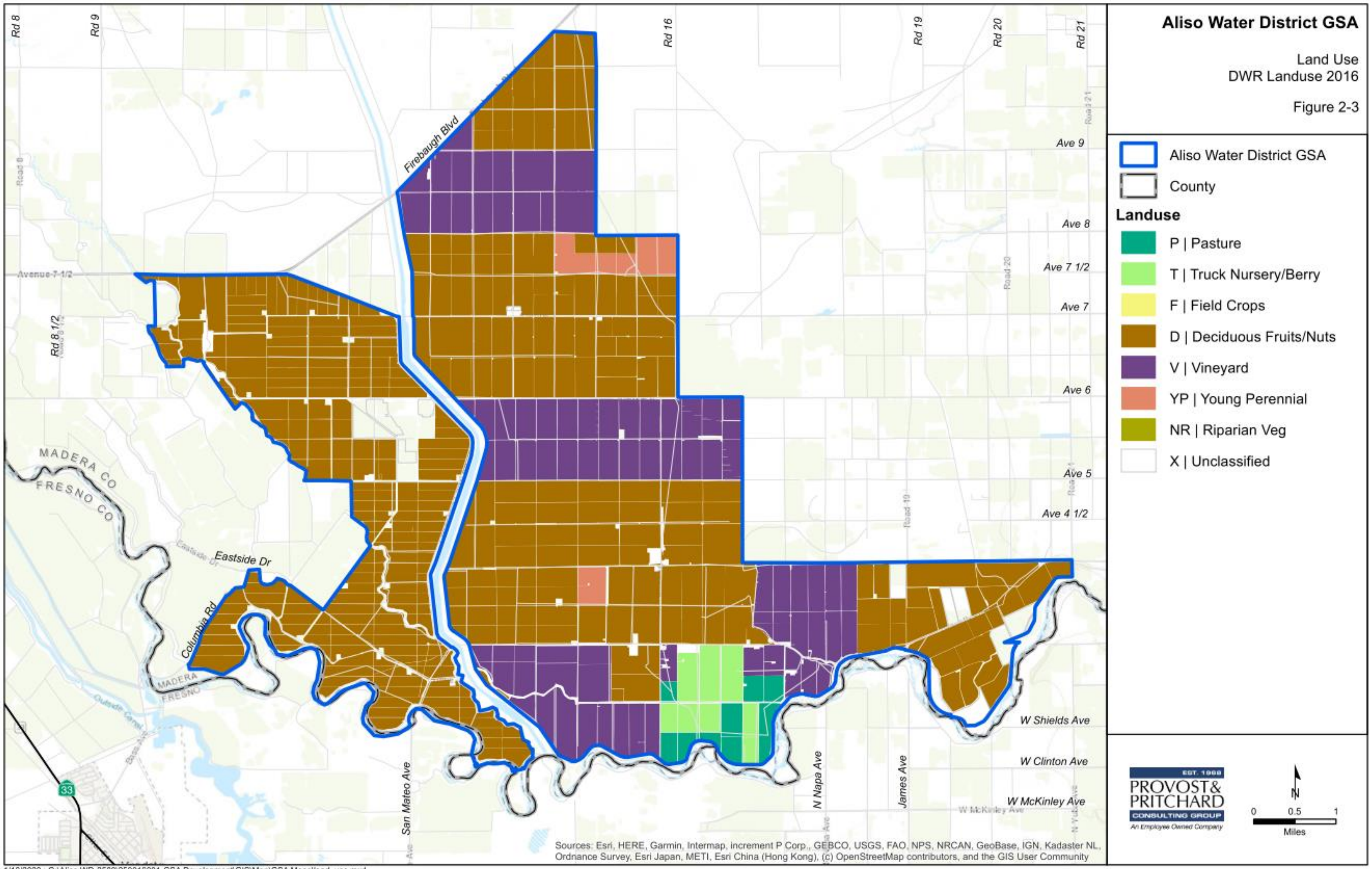

Figure 2-3: Land Use

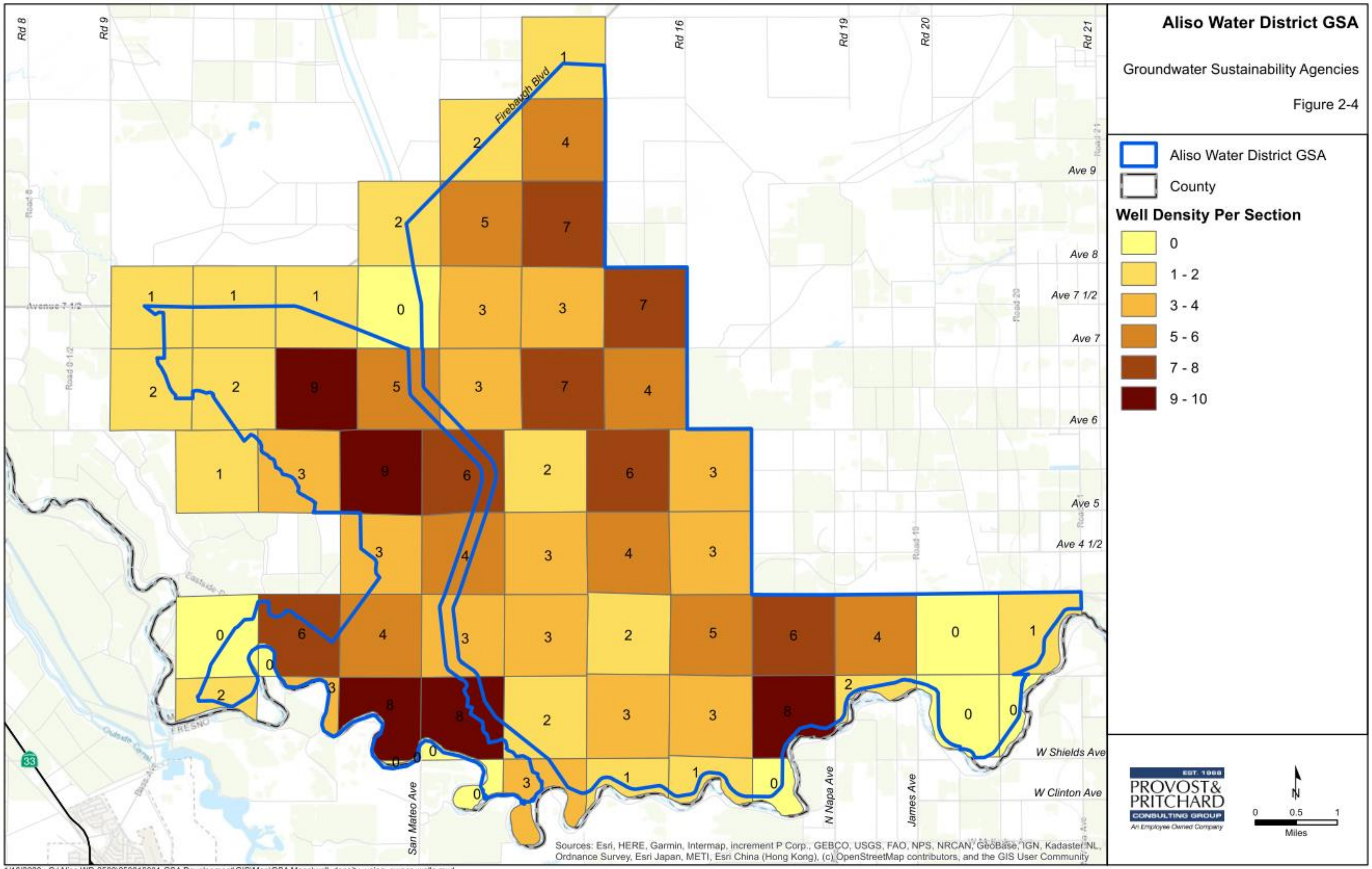

Figure 2-4: Well Density

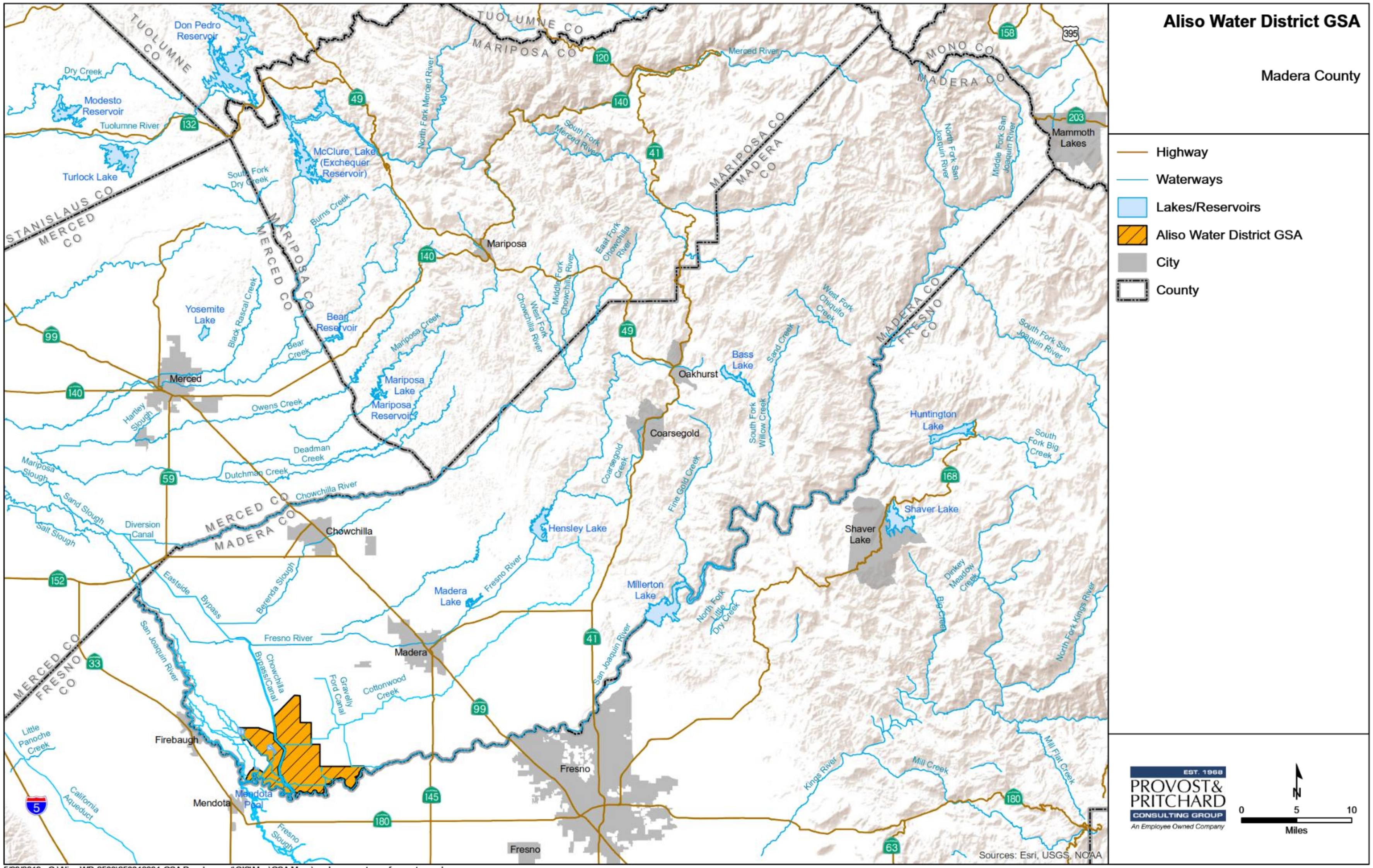

Figure 2-5: Madera County

2.1.5 Madera County

Madera County was first formed in 1893. The County currently has a total area of 2,147 square miles. Fresno County borders on the south, Mariposa and Merced counties on the north, and Mono County to the east (see **Figure 2-5:**). Major watercourses are the San Joaquin River, Chowchilla/Eastside Bypass, Fresno River, Ash Slough, Berenda Slough, Chowchilla River, and Madera Canal. The 2010 United States Census reported that Madera County had a population of 150,865. Madera County is home to two incorporated communities, Chowchilla and Madera, and 11 unincorporated communities. AWD lies within the southwestern tip of Madera County. AWD and a portion of the SJRECGSA covering CCC are the only GSAs in Madera County to lie within the Delta-Mendota Subbasin. The remaining GSAs in Madera County lie within the Madera and Chowchilla Subbasins.

2.2 Water Resources Monitoring and Management Programs

Regulation Requirements:

§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.

§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.

2.2.1 Monitoring and Management Programs

Groundwater Level Monitoring

Currently within the AWD, private landowners monitor groundwater levels in their own wells. Monitoring and reporting within the Aliso Water District was minimal until 2015. The existing Aliso Groundwater Management Plan only requires District members to monitor and report groundwater levels to the District every three years for the preparation of groundwater contour maps. The Madera County California Statewide Groundwater Elevation Monitoring (CASGEM) program administered by Madera Irrigation District only monitors a select few of the wells within AWD. Currently all reporting is voluntary. Groundwater level monitoring is typically done for management purposes during pump tests or groundwater quality sampling and during the spring and fall. An updated groundwater monitoring program consistent with the requirements of SGMA is described in **Chapter 5.** On the basin-wide scale, the GSAs in the DMGB will coordinate a groundwater monitoring program to track groundwater sustainability indicators. Both the regional and basin-wide monitoring efforts will take the place of any groundwater monitoring that has historically occurred within the GSA.

Groundwater Extraction Monitoring

Most wells within AWD are unmetered, and volumes pumped are not precisely known. Volume of groundwater pumped is currently estimated based on unit water demand associated with a land use type. Unit water demand or annual water duty is defined as the amount of water used per acre per year. This results in groundwater extraction estimates with varying levels of accuracy. Potential future groundwater extraction estimations and metering policies are discussed in **Chapters 5 and 6.**

Groundwater Quality Monitoring

Most of the wells in AWD are used for agricultural purposes. Wells are typically monitored for water quality by landowners and ranch managers to ensure proper function and crop productivity and to fulfill other state program requirements. Except for the Mendota Pool Group pumping program monitoring network which overlaps a portion of the District, monitoring records are typically private and are not available to the public. Historically, due to the privacy and personal property rights of landowners in AWD, obtaining localized water quality results is challenging and limited to publicly available data. However, with the implementation of this plan, water quality data will be more regularly collected by the District. Possible approaches to obtaining a better understanding of localized groundwater quality and influences of regional groundwater quality will be investigated. Monitoring will include coordinating with neighboring GSAs and implementing data management programs that protect private property rights. More details are provided in **Chapter 5**.

Irrigated Lands Regulatory Program

The Irrigated Lands Regulatory Program (ILRP) addresses discharge of wastes (e.g., sediments, pesticides, nitrates) from commercial irrigated lands. These wastes can harm aquatic life or make water unusable for drinking or agricultural uses. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver for agricultural waste discharges. The Bill required the Water Boards to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Regional Water Quality Control Board (CVRWQCB) adopted a conditional Waiver of Waste Discharge Requirements (WDRs) to regulate agricultural discharges to surface waters. In December 2012, the CVRWQCB started adopting WDRs that address discharges to both surface water and groundwater, thus requiring ILRP enrollment for all commercially irrigated agricultural operations. Surface water quality has been monitored for several years, and in the future groundwater quality will be monitored.

Under the ILRP rules, growers may form “third party” coalitions to assist with required monitoring, reporting, and education requirements for irrigated agriculture. The East San Joaquin Water Quality Coalition (ESJWQC) was established in 2003 to pool resources and combine regional efforts to comply with the regulatory requirements of the ILRP. The entire AWD area falls within the boundary served by ESJWQC. Growers also have the option to complete regulatory requirements independently, but this is not typically done due to the high cost and complexity of performing required studies. Therefore, most growers have opted to join a third party. Additional information on the ESJWQC is located on their website at http://www.esjcoalition.org/. Regional information on surface and groundwater quality is available from the Coalition.

Land Subsidence Monitoring

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 (gas fields do exist within the GSA). The main forms of subsidence in the AWD area are deep subsidence and shallow subsidence.

Two types of subsidence can occur as a result of groundwater pumping: elastic and inelastic. Elastic subsidence can be reversed as the water table recovers, while inelastic subsidence is permanent. Elastic subsidence generally occurs in the unconfined (shallow) 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. Most of the 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.

Land subsidence is well documented in much of the Central Valley. The District has elected to install benchmarks to monitor localized subsidence and are measured to coincide with collection efforts by the US Bureau of Reclamation (Bureau or USBR) (See **Figure 5-5**).The Bureau documents subsidence benchmarks along the San Joaquin River (SJR) and Eastside Bypass as part of the SJRRP and measures them semiannually. Reports of the results from this monitoring are presented to the AWD GSA Board at their regular meetings. In addition, subsidence is monitored throughout the San Joaquin Valley with measurements performed and tracked by regional water agencies or State and Federal government entities. A Global Positioning System (GPS) control network has been established throughout the subbasin area. This control network can be utilized to survey existing benchmarks to monitor subsidence. Recent concerns over drought conditions and groundwater pumping caused California's DWR to have National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory analyze data and provide an update on land subsidence using Satellite Interferometric Synthetic Aperture Radar (InSAR) and Airborne Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) methods. DWR, US Geological Survey (USGS) and NASA have maps on their websites that show the subsidence for a defined period.

Surface Water Monitoring

Surface water bodies within AWD include Cottonwood Creek, Chowchilla Canal, Buttonwillow and Lone Willow Sloughs, San Joaquin River, and the Chowchilla Bypass (see **Figure 2-6:**). Surface water flows are monitored by others in major waterways. Information is publicly available for the SJR and the Chowchilla Bypass (CBP, Bypass) through the California Data Exchange Center (CDEC). Lesser creeks and canals are typically monitored outside of the District boundary, when monitored, requiring the District to estimate losses. Some landowners in the District have water rights to high-flow water or riparian water along the Chowchilla Canal and SJR. Surface water that can be diverted during wet years is typically metered at the point of diversion and blended with groundwater prior to irrigation. Surface water is also diverted to recharge basins or spread on farmland for in-lieu recharge when possible. It will become important for AWD to monitor waterways not regularly monitored and reported by others, especially for smaller creeks and streams.

Monitoring and Management Plans

The District has in place the *Aliso Water District Groundwater Management Plan* (KDSA, 2013, updated 2014). The Aliso GMP requires coordination with other districts and the existing Madera Integrated Regional Water Management Plan (IRWMP). AWD opted out of participating in the 2014 Madera County Groundwater Management Plan. It is the intention of AWD to coordinate as much as possible with existing monitoring programs to prevent unnecessary duplication of efforts and to prevent adding additional burden to landowners. As needed, landowners will report the water quality and water supply data to AWD. The District will then report the results of representative sites to the DMGB and the Madera IRWMP group. The monitoring program is described later in this GSP (**Chapter 5**).

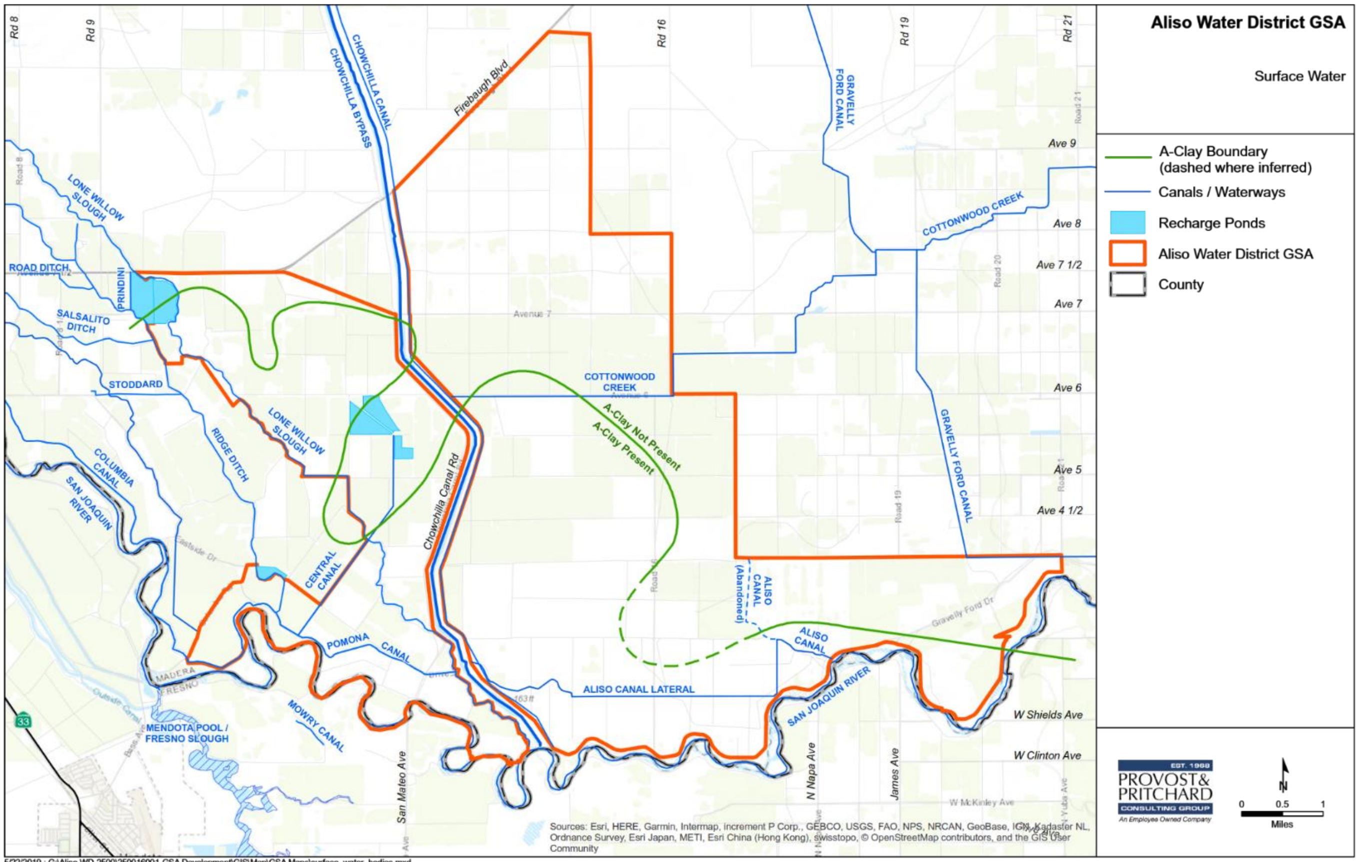

Figure 2-6: Surface Water

2.2.2 Impacts to Operational Flexibility

The presence of different existing or planned water management programs constitutes constraints that will impact operational flexibility and water operations for the AWD. These programs are illustrated in **Figure 2-7**, followed by a description of each program and possible measures for adaptive management as well as potential benefits.

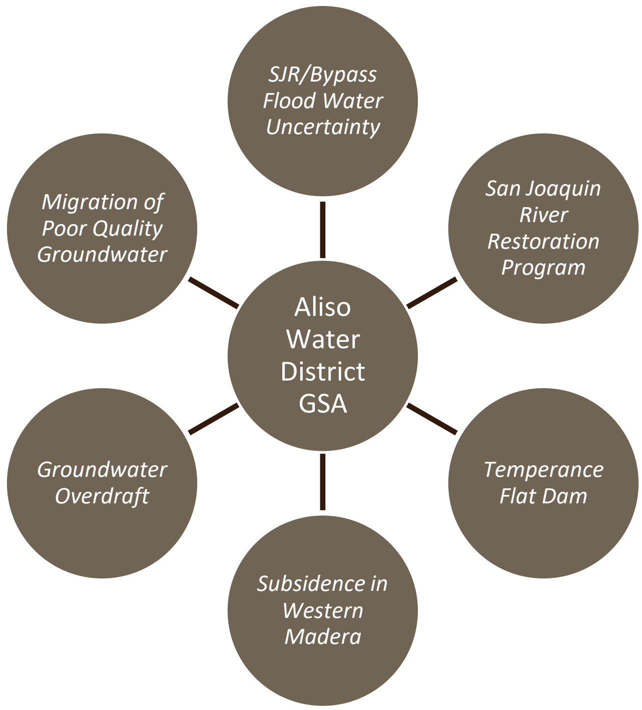

Figure 2-7: Potential Factors Impacting Operational Flexibility

2.2.2.1 San Joaquin River Flood Water and Chowchilla Bypass Operation Uncertainty

San Joaquin flows are regulated by Friant Dam, completed in 1954 for flood control, recreation, irrigation, and hydroelectric purposes. Millerton Lake has a storage capacity of approximately 520,000 acre-feet. The flood control functions of the facility are managed by the US Army Corps of Engineers (Corps), while the releases for irrigation diversion and water rights are managed by the USBR.

Because of the severe threat of flooding along the lower reaches of the San Joaquin River, the State constructed the CBP/Eastside Bypass, which diverts water at the bifurcation structure, located at the divergence of the San Joaquin River and the Bypass. Waters diverted down the Bypass have historically been considered abandoned. However, recent attempts to construct points of diversion to access this high-flow water were met with a requirement to obtain a license to appropriate said water. The Aliso Water District has submitted a temporary application to divert high-flow water from the Bypass and this is in the review process.

Flood water availability between 1997-2017 in the SJR and CBP are as follows:

- *Seven major flood events occurred in which average annual flow rate in the Bypass exceeded 500 cfs during the period of study.*

- *The typical flood event ranged from 137-192 days.*
- *The flood period typically lasted from mid-January to mid-July.*

High-flow surface water will be used to offset groundwater overdraft, estimated as 2,200 acre-feet (AF) per year (AF/y) (KDSA, 2013). Considering the Bypass typically flows once every four years, the District has requested 10,000 acre-feet of water to be put into underground storage or used for in-lieu recharge to combat four years of overdraft between high-flow events. The application must be resubmitted annually until a permanent appropriative water right is obtained.

2.2.2.2 Temperance Flat Dam

The USBR has been conducting a study, the Upper San Joaquin River Basin Storage Investigation (USJRBSI), for new surface water storage. This study resulted in what is commonly called Temperance Flat Reservoir (TFR) and includes constructing a dam in the upstream portion of Millerton Lake at river mile 274. The purpose of the investigation is to determine the type and extent of federal, state, and regional interests in a potential dam project in the upper San Joaquin River watershed to expand water storage capacity; improve water supply reliability and flexibility for agricultural, urban, and environmental uses; and enhance San Joaquin River water temperature and flow conditions to support anadromous fish restoration efforts (USBR, 2017). Evaluations conducted through the USJRBSI led to selection of the Temperance Flat RM 274 Reservoir as the preferred surface water storage measure for further development.

Temperance Flat RM 274 Reservoir would include construction of a dam in the upstream portion of Millerton Lake at RM 274. The proposed dam site is located approximately 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake. Temperance Flat is estimated to provide an additional 1.26 million AF of water storage capacity on the San Joaquin River that would manage water supplies stored from inflow that exceeds the operational capabilities of Millerton Lake and exchanged water supplies developed through coordinated operations with statewide water systems.

With an additional 1.26 million AF of water storage above Millerton Lake, the frequency and magnitude of flood releases to the San Joaquin River would likely decrease. This may reduce the availability of seepage from the San Joaquin River to the local groundwater basin. The ability for entities to capture future flood flows for beneficial uses may also be reduced. Although water in Temperance Flat may reduce seepage along the SJR and Bypass, it may provide a more reliable source of water that could increase operational flexibility and reduce impacts of drought for neighbors and adjoining basins.

2.2.2.3 San Joaquin River Restoration Program

The San Joaquin River Restoration Act, included in Public Law 111-11 and signed into law on March 30, 2009, authorizes and directs the Secretary of the Interior to implement the Settlement between Natural Resources Defense Council (NRDC), Friant Water Authority, and the U.S. Departments of the Interior and Commerce.

The Settlement establishes two primary goals:

- *Restoration Goal – To restore and maintain fish populations in "good condition" in the main stem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.*

- *Water Management Goal – To reduce or avoid adverse water supply impacts on all the Friant Division long-term contractors that may result from the Interim and Restoration flows provided for in the Settlement.*

To achieve the Restoration Goal, the Settlement requires releases of water from Friant Dam to the confluence of the Merced River (referred to as Restoration Flows). Restoration Flows vary by hydrologic year type and through the year in support of fish life-stage requirements.

Estimated water supply reductions to all Friant Division contractors resulting from the Restoration Flows under the San Joaquin River Restoration Program are about 200,000 AF/y (Provost & Pritchard, 2017). The stipulated Restoration Flows for each year type represents the total release from Friant Dam required to satisfy SJRRP Restoration Flows (riparian diversions between Friant Dam and Gravelly Ford) and to maintain a minimum 5 cubic feet per second (cfs) of flow at the Gravelly Ford gage station during critical years. The Settlement also stipulates that an additional buffer flow of up to 10 percent of the Restoration Flows could be made for releases to the river to address unexpected seepage losses, as flushing flows to enhance gravel conditions for spawning during wet and normal-wet years, and for riparian recruitment flows.

The SJRRP is currently behind schedule. Due to this uncertainty, the added seepage associated with implementation of the SJRRP is not taken into consideration in the water balance projections.

2.2.2.4 Subsidence in Western Madera

Subsidence is currently a driving factor for SGMA in the DMGB. Although subsidence in AWD is minimal, it still remains an issue for other GSAs along the Chowchilla Bypass and the SJR. AWD will work with other agencies and water districts to reduce the dependence on subsidence inducing groundwater pumping of the lower aquifer in western Madera County and the DMGB.

Land subsidence has been occurring at unsustainable rates in the western Madera County. Historically, this subsidence was east of the Eastside Bypass and north of Firebaugh Boulevard. However, in the past ten years, land subsidence has become more pronounced, and the subsidence has extended west of the Eastside/Chowchilla Bypass to at least the San Joaquin River. This has been associated with the development of new wells in the area tapping the lower aquifer (below the Corcoran Clay). Increased pumping from the lower aquifer is believed to cause increased rates of subsidence, which has affected the elevations of the river channel, the San Luis Canal Company's Sack Dam diversion structure, the Eastside/Chowchilla Bypass, and other local canals and diversion structures. Addressing this subsidence primarily entails actions to decrease lower aquifer pumping, such as switching groundwater reliance to the upper aquifer in conjunction with increased intentional recharge and in-lieu recharge efforts.

Because most of the wells in the area near the Mendota Pool and north of the SJR (west of the Chowchilla Bypass) pump primarily from the upper aquifer, AWD has a relatively small amount of subsidence along the Chowchilla Bypass compared to downstream lands to the north, (SJRRP 2018).

2.2.2.5 Groundwater Overdraft

The Madera County IRWMP of April 2008 indicated an average annual overdraft in the valley floor part of the County of about 100,000 AF/y. Because of the development of new lands for irrigation and other factors, the present overdraft is probably greater. This overdraft is not sustainable over the long term. Average water-level declines have been less than one foot per year near the San Joaquin River, compared to more than four feet per year beneath a large part of the Chowchilla Water District and lands to the east and in the Madera Ranchos vicinity. The IRWMP discusses a number of alternatives for decreasing the groundwater overdraft.

2.2.2.6 Migration of Poor-Quality Groundwater

There are no known sites of concern in Aliso Water District regrading water quality. The closest known area of concern is the Spreckels Sugar Company site, which is located south of Aliso Water District and the San Joaquin River in Fresno County and Farmers GSA. It is approximately 5 miles from AWD.

2.2.3 Conjunctive Use Programs

Regulation Requirements:

§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 their efficient use. Conjunctive water use programs utilize a combination of surface water and groundwater to satisfy demands. Conjunctive use systems increase water reliability and act to buffer the effects of drought. Conjunctive use allows for augmentation of groundwater sources by using surface water in lieu of groundwater and banking (recharge) excess water. Banking water during wet years allows for storage in the underground aquifer mitigating impacts of groundwater overdraft. The landowners within the District use groundwater to satisfy most demands. AWD does not divert surface water from the San Joaquin River or Chowchilla Bypass. However, individual landowners located adjacent to the SJR and the Chowchilla Bypass have water rights to high-flow water, and some operate recharge basins. Other owners claim riparian rights.

During high-flow events when the Chowchilla Canal Bypass and Cottonwood Creek are flowing, and the SJR flows are high enough to allow water into the Aliso Canal Turnout (a private facility) from the SJR, growers in Aliso have historically used the water for irrigation and recharge, thereby reducing groundwater pumping and allowing the groundwater levels to rise. These types of practices will continue and be expanded as identified in the GSP **Chapter 6**.

2.3 Relation to General Plans

2.3.1 Summary of General Plans/Other Land Use Plans

Regulation Requirements:

§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.

California Government Code (§65350-65362) requires that each county and city in the state develop and adopt a general plan. The General Plan is a comprehensive, long-term framework for the protection of the agricultural, natural, and cultural resources and for development in the county or city. Designed to meet state general plan requirements, it outlines policies, standards, and programs and sets out plan proposals to guide day-to-day decisions concerning a county's or city's future. Each general plan must include the vision, goals, and objectives of the city or county in terms of planning and development within eight different "elements" defined by the state as: land use, housing, circulation, conservation, noise, safety, open space, and environmental justice. 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. Madera County is the only agency within the Plan area that has a general plan: Madera County - 1995 General Plan. Other elements and updates or amendments have been added since then.

2.3.2 Impact of Land Use Planning on Water Demands

Regulation Requirements:

§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.

As the Madera County General Plan was adopted prior to the development of the GSA and this GSP, the General Plan did not consider the impacts of SGMA or this GSP's implementation. This GSP uses the same land use change assumptions identified in the General Plan for forecasting the anticipated water budget and land use changes, described later in this GSP.

Land use within the Aliso Water District is not likely to change; however, agricultural practices and/or commodity demands may change, resulting in changes in cropping and therefore water demand. No changes in zoning or land use designations are shown for the AWD GSA area in the current Madera County General Plan. Therefore, this GSP will assume no change in land use over the planning horizon. Cropping patterns are likely to persist to 2040, when sustainability is to be achieved. The entire District, with few exceptions, is agricultural land consisting mostly of permanent crops.

2.3.3 Impact of GSP on Land Use Plan Assumptions

Regulation Requirements:

§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.

As mentioned above, there is only one General Plan within the Plan area, the Madera County General Plan. As noted, the plan was developed prior to the development of the GSP. Future updates to the Madera County General Plan will include specific goals and policies related directly to SGMA and the GSAs within Madera County.

Section 3.C, the Public Facilities and Services section of the Madera County General Plan, discusses various topics including water supply and delivery. 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 GSP 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 Requirements:

§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.

In California, regulatory authority over well construction, alteration, and destruction activities is with local jurisdictions who have the authority to adopt a local well ordinance that meets or exceeds DWR Well Standards. The well permitting process is under review as Madera County reviews Senate Bill (SB) 252 – Water Well Program, passed October 2017, which will go into effect January 2020. This policy will require all new water well permit applications to be submitted for public review for critically overdrafted basins. Madera County Environmental Health Division plans to comply with these new requirements by 2020. Currently permit applications can be obtained directly from the Madera County Environmental Health Division. More information regarding permitting of wells in Madera County can be found in Title 13 (Water and Sewers) of the Madera County municipal code in Chapter 13.09 (Authorization—Fees) and Chapter 13.52 (Well Standards).

2.3.5 Land Use Plans Outside the Basin

Regulation Requirements:

§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 DMGB lies within several counties and encompasses several communities; all of which may have general plans or other planning documents that may affect sustainability in neighboring GSAs. Land use and more importantly water use in these neighboring areas will impact sustainability efforts of the Aliso Water District.

2.4 Additional GSP Components

Regulation Requirements:

§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

Saltwater intrusion is a major concern commonly found in coastal aquifers. Saltwater intrusion is the induced flow of seawater into freshwater aquifers primarily caused by groundwater development near the coast. Where groundwater is being pumped from aquifers that are in hydraulic connection with the sea, induced gradients may cause the migration of saltwater from the sea toward a well, making the freshwater well unusable. Given the distance separating the District from the Pacific Ocean, saltwater intrusion from the ocean into the freshwater aquifer is not a concern for the area.

However, groundwater with naturally occurring elevated concentrations of salts exist below the local aquifers. The interface between the freshwater zone and the brackish water zone represents a flow divide. Below this depth, because of the relatively great depth of the brackish groundwater, the presence of numerous clay layers at depth, and the higher density of the brackish water, there is little mixing of modern groundwater recharge with formation waters. By determining the depth of this mixing zone throughout the study area, a physically based bottom boundary can be represented (base of freshwater system). 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 is discussed in detail in the Hydrogeological Conceptual Model prepared by Kenneth D. Schmidt and Associates - **Appendix A.**

There are actions that can degrade water quality. First, as wells are drilled deeper, pumping in some areas can cause upconing (i.e., upward vertical migration) of saline water thus increasing salinity in the freshwater aquifer. Second, poor quality surface waters could also be imported into the District, which ultimately degrade the groundwater. AWD will monitor water quality in a manner that provides management information about salinity in the area.

2.4.2 Wellhead Protection

Wellhead protection requirements are regulated by federal, state, and local agencies to protect groundwater supplies and public water systems. The Aliso Water District does not own or operate wells or public water systems. All wells within the District are privately owned and operated. Most wells are operated for irrigation purposes; only a few wells in the area are used for domestic purposes.

A wellhead protection area (WHPA) is a surface and subsurface land area regulated to prevent contamination of a well or well-field supplying a public water system. This program, established under the Safe Drinking Water Act (SDWA) (42 U.S.C. 330f-300j), is implemented through state governments. The WHPA may also be the recharge area that provides the water to a well or wellfield. WHPAs can vary in size and shape depending on subsurface geologic conditions, the direction of groundwater flow, pumping rates, and aquifer characteristics.

The Wellhead Protection Program (WHPP) was established following the 1986 amendments to the federal SDWA. The program was designed to protect groundwaters that supply drinking water to wells at public water systems across the nation. The 1996 federal Safe Drinking Water Act amendments require each state to develop and implement a Source Water Assessment Program. Section 11672.60 of the California Health and Safety Code requires the Department of Health Services (DHS, the precursor to CDPH) to develop and implement a program to protect sources of drinking water, specifying that the program must include both a source water assessment program and a wellhead protection program. In response to both legal mandates, DHS developed the Drinking Water Source Assessment and Protection (DWSAP) Program.

California's DWSAP Program addresses both groundwater and surface water sources. The groundwater portion of the DWSAP Program serves as the state's wellhead protection program. In developing the surface water components of the DWSAP Program, DHS integrated the existing requirements for watershed sanitary surveys. DHS submitted the DWSAP Program http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Documents/DWSAPGuidance/DWSAP_document.pdfin January 1999. The US Environmental Protection Agency (EPA) approved the DWSAP as California's wellhead protection program in January 1999. In November 1999, EPA gave final approval of the DWSAP Program as California's sources water assessment and protection program. DHS was responsible for the completion of all assessments by May 2003.

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 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.

Agricultural wells constructed in the GSA are supposed to be constructed in accordance with Madera County code requirements. Landowners must acquire a permit from the County to construct new wells (see **Section 2.3.4**). Madera County Municipal Code Title 13, Chapter 13.52.050 provides specifications pertaining to well construction which consider wellhead protection, including:

- *Location of wells*
- *Casings, casing materials, and casing thickness*
- *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*

2.4.3 Migration of Contaminated Groundwater

The following is a general description of migration of contaminated groundwater. There are no known sites of groundwater contamination in AWD. Specific information on groundwater quality is located in **Appendix A - Groundwater Conditions** prepared by KDSA. Groundwater within AWD is generally of suitable quality for agricultural use.

Groundwater can become contaminated from natural sources or human activities. Residential, municipal, commercial, industrial, and agricultural activities can all affect groundwater quality. Contaminants may reach groundwater from activities on the land surface, such as releases or spills from stored industrial wastes; from sources below the land surface but above the water table, such as septic systems or leaking underground petroleum storage systems; from structures beneath the water table, such as wells; or from contaminated recharge water. Depending on its physical, chemical, and biological properties, a contaminant that has been released into the environment may move within an aquifer in the same manner that groundwater moves. It is possible to predict, to some degree, the transport within an aquifer of those substances that move along with groundwater flow.

The size and speed of movement of contaminant plumes depends on the concentration and type of contaminant, its solubility, and the velocity of the groundwater. Contaminants can also move into the groundwater system through macro-pores—root systems, animal burrows, abandoned wells, and other systems of holes and cracks. In areas surrounding pumping wells, the potential for contamination increases due to an induced gradient toward the well during pumping. Under certain conditions, pumping can also cause the groundwater (and associated contaminants) from another aquifer to enter the one being pumped. This phenomenon is called inter-aquifer leakage. Thus, properly identifying and protecting the areas affected by well pumping is important to maintain groundwater quality.

Several programs and acts provide regulations to help with water quality:

- *The SDWA established three drinking water source protection programs. The Wellhead Protection Program, Sole Source Aquifer Program, and the Source Water Assessment Program call for regulation of the use of underground injection wells for waste disposal and provide the EPA and the states with the authority to ensure that drinking water supplied by public water systems meets minimum health standards.*
- *The Clean Water Act regulates groundwater that is shown to have a connection with surface water. It sets standards for allowable pollutant discharges to surface water.*
- *The Resource Conservation and Recovery Act (RCRA) regulates treatment, storage, and disposal of hazardous and nonhazardous wastes.*
- *The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) authorizes the government to clean up contamination or sources of potential contamination from hazardous waste sites or chemical spills, including those that threaten drinking water supplies. CERCLA includes a "community right-to know" provision.*
- *The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates pesticide use.*
- *The Toxic Substances Control Act (TSCA) regulates manufactured chemicals.*

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:

<u>California State Water Resources Control Board:</u> The State of California Water Resources Control Board (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.

<u>The Department of Toxic Substances Control:</u> The State of California Department of Toxic Substances Control (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 State Water Resources Control Board Groundwater Ambient Monitoring and Assessment (GAMA) program collects data by testing untreated raw water for naturally occurring and man-made chemicals and compiles all the data into a publicly accessible online database. The online database can be accessed at http://geotracker.waterboards.ca.gov/gama/.

2.4.4 Well Abandonment/Well Destruction Program

Well abandonment generally includes properly capping and locking a well that is no longer used. Well destruction generally includes filling an abandoned well and removal of its ground surface interface. Madera County code stipulates that any abandoned well shall be considered the property owner's responsibility and shall be destroyed in accordance with the methods prescribed in the standards according to Department of Water Resources Bulletin 74-81 and 74-90 and applicable revisions and addendums. An important issue is unused wells that have not been properly destroyed and may function as conduits for downward flow of poor-quality groundwater to the lower aquifer. Abandoned wells must be destroyed to promote and protect the public welfare by preventing pollution of the groundwater and physical injury to persons or damage to property. An abandoned well shall not be used for the disposal of any liquid or solid waste. Well destruction includes completely filling in a well in accordance with standard procedures. Proper well abandonment and then destruction accomplishes the following: 1) eliminates the physical hazard of the well, and 2) eliminates a pathway for migration of poor-quality groundwater. They are necessary to protect groundwater resources and public safety.

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 Madera Title 13, Chapter 13.52 – Well Standards.

The AWD will encourage well owners to properly destroy their wells that are no longer used in accordance with the County. In addition, AWD will encourage landowners and developers to convert unusable wells with suitable conditions to monitor wells, rather than destroy them, so that they can become a part of the GSA's groundwater monitoring program.

2.4.5 Replenishment of Groundwater Extractions

Groundwater replenishment happens through direct recharge and in-lieu recharge. Water used for recharge most often comes from flood flows and water transfers. Replenishment occurs naturally when rain, stormwater, and the flow from rivers, streams, and creeks seep into an aquifer. Water also infiltrates to groundwater as farmers irrigate fields and orchards. Replenishment within the context of groundwater management is accomplished through recharge; maintaining or improving groundwater elevation levels. Two recharge methods are used: direct spreading and aquifer injection. There is also in-lieu recharge in which an alternative source is provided to users who would normally use groundwater, thereby leaving groundwater in place for later use and increasing the potential to improve groundwater levels.

In the Aliso Water District, the primary local water sources for groundwater replenishment include seepage from the San Joaquin River and other water ways, precipitation, and in-lieu recharge from the Cottonwood Creek, San Joaquin River, and Chowchilla Bypass flood flows. Opportunities to recharge groundwater exist within the District. These recharge ponds are privately owned and operated. The District is considering additional recharge opportunities as well as expanding the current recharge programs already in operation by pursuing additional water supplies and infrastructure to divert and store surface water underground.

2.4.6 Conjunctive Use

See **Section 2.2.3.**

2.4.7 Well Construction Policies

Proper well construction is important to ensure reliability, longevity, and protection of groundwater resources from contamination. The well permitting process is under review as Madera County reviews Senate Bill (SB) 252 – Water Well Program, passed October 2017, which will go into effect January 2020. This policy will require all new water well permit applications to be submitted for public review for critically overdrafted basins. Madera County Environmental Health Division plans to comply with these new requirements by 2020. Currently, permit applications can be obtained directly from the Madera County Environmental Health Division. State well standards address annular seals, surface features, well development, water quality testing, and various other topics. Refer to DWR Bulletins 74-81 and 74-90 for more details. Well construction policies intended to ensure proper wellhead protection are discussed in Wellhead Protection Section above.

2.4.8 Groundwater Replacement Projects

Historically, the District has had little input on land development or agricultural practices in the area. AWD landowners operate independent irrigation and domestic well systems. Landowners also develop and fund their own projects to meet water demands on their lands when surface water is available. The District is considering the implications of SGMA and is taking an active role in developing projects and management actions to address groundwater issues and to expand what the landowners are currently accomplishing. Management actions to be considered include direct groundwater recharge, dormant crop flooding, in-lieu surface water deliveries, and groundwater banking. **Chapter 6** provides descriptions, estimated costs, and estimated yield for numerous proposed projects.

Most of these projects propose to utilize high-flow events along the Chowchilla Bypass flood control structure, Cottonwood Creek, and the Aliso Canal diversion off the SJR for areas that are groundwater dependent. Aliso Water District is currently in the process of obtaining water rights to high-flow water for recharge when it occurs in the Bypass. Other landowners in the District are also taking advantage of AWD's proximity to the Bypass and obtaining their own appropriative and riparian water rights.

The role of the Groundwater Sustainability Agency in AWD is to promote cooperation and sharing of information and ideas within the Aliso Water District and the greater Delta-Mendota Groundwater Subbasin. AWD will also support measures to assist in identifying funding and implementing projects that help achieve groundwater sustainability not only on a local, but on a regional basis when possible. This can include projects that take advantage of areas conducive to recharge and areas where recharge provides the most benefits. AWD has provided input and is a local jurisdiction to the Central California Irrigation District's Multi-Jurisdictional Hazard Mitigation Plan, where many of the GSP projects are identified.

2.4.9 Efficient Water Management Practices

Water management is an important element of irrigated crop production. Efficient irrigation systems and water management practices can help maintain farm profitability in an era of limited, higher-cost water supplies. As is often the case, technology is not the whole solution anywhere but part of the solution almost everywhere. Water conservation has been and will continue to be an important tool in local water management, as well as a key strategy in achieving sustainable groundwater management.

Since groundwater is currently the main source of water for the farmers and the few domestic users within AWD, it is important to focus on water conservation and continue to develop opportunities to utilize surface water, expand recharge projects, and encourage use of efficient irrigation tools and practices. Diverting high-flow water from the Cottonwood Creek, San Joaquin River, and Chowchilla Bypass during wet years to adjacent farms and existing and proposed recharge/groundwater storage basins will help move AWD towards sustainability. Recycled water use is considered an important beneficial use of water but is unavailable in this area. Future efforts will include an increased focus on elevating awareness on groundwater overdraft, potential implementation of well metering and reporting, expansion of groundwater monitoring, and continued monitoring of land subsidence as well as general awareness of sustainable groundwater management.

2.4.10 Relationships with State and Federal Agencies

AWD has numerous relationships with state and federal agencies related to water supply, water quality, and water management. Those relationships that are common to all water agencies, such as regulation of municipal water by the California Division of Drinking Water, are not discussed here. AWD maintains relationships with USBR, the Central Valley Flood Protection Board, the DWR, and the SWRCB regarding the San Joaquin River Restoration Project, San Joaquin River flows, and the Chowchilla Bypass flood control structure. The District anticipates a growing relationship with these agencies as they continue to manage groundwater.

2.4.11 Land Use Planning

The AWD is located within the County of Madera which has direct land-use planning authority. AWD is completely developed with agricultural land and is not anticipated to change.

2.4.12 Impacts on Groundwater Dependent Ecosystems

The Nature Conservancy (TNC) worked with DWR to identify groundwater dependent ecosystems (GDE) throughout the state. Their determinations are depicted on the interactive mapping tool, Natural Communities Dataset Viewer (NC Dataset Viewer). TNC primarily used vegetative indices applied to historical aerial imagery cross referenced with CASGEM well levels to identify possible GDEs. The data used in GDE identification pre-dates the baseline year of 2015, with a mode aerial imagery date of 1987. Land use and hydrogeological changes have occurred since that period, and AWD GSA's analysis of possible GDEs considered recent water levels and land use maps to verify the determinations identified in the NC Dataset Viewer. Using the Current Water Budget period of the 2013 Water Year, Spring 2013 contours were used to assess groundwater levels within the GSA. The depth to groundwater throughout the GSA exceeds the 30-ft rooting-depth threshold for vegetative GDEs, significantly deeper than the wetland GDE threshold of approximately 2-ft. An improved data inventory of the San

Joaquin River hydrogeology is needed to verify possible riparian GDEs. Consideration of SJRRP reports and data on interactions of the San Joaquin River and underlying groundwater will be considered in future updates of the GSP.

Due to the foresight of the USBR in developing the CVP, lands along the San Joaquin River within the AWD are subject to pumping restrictions above the A-Clay (e.g. Contract Number 14-06-200-4339A – Contract Between the United States of America and the Newhall Land and Farming Company). The intention of the USBR was to prevent inducing seepage from the SJR. Therefore, AWD's groundwater pumping activities are not anticipated to significantly impact possible riparian GDEs within or adjacent to their jurisdiction. The GDE determinations are depicted in **Figure 2-8.**

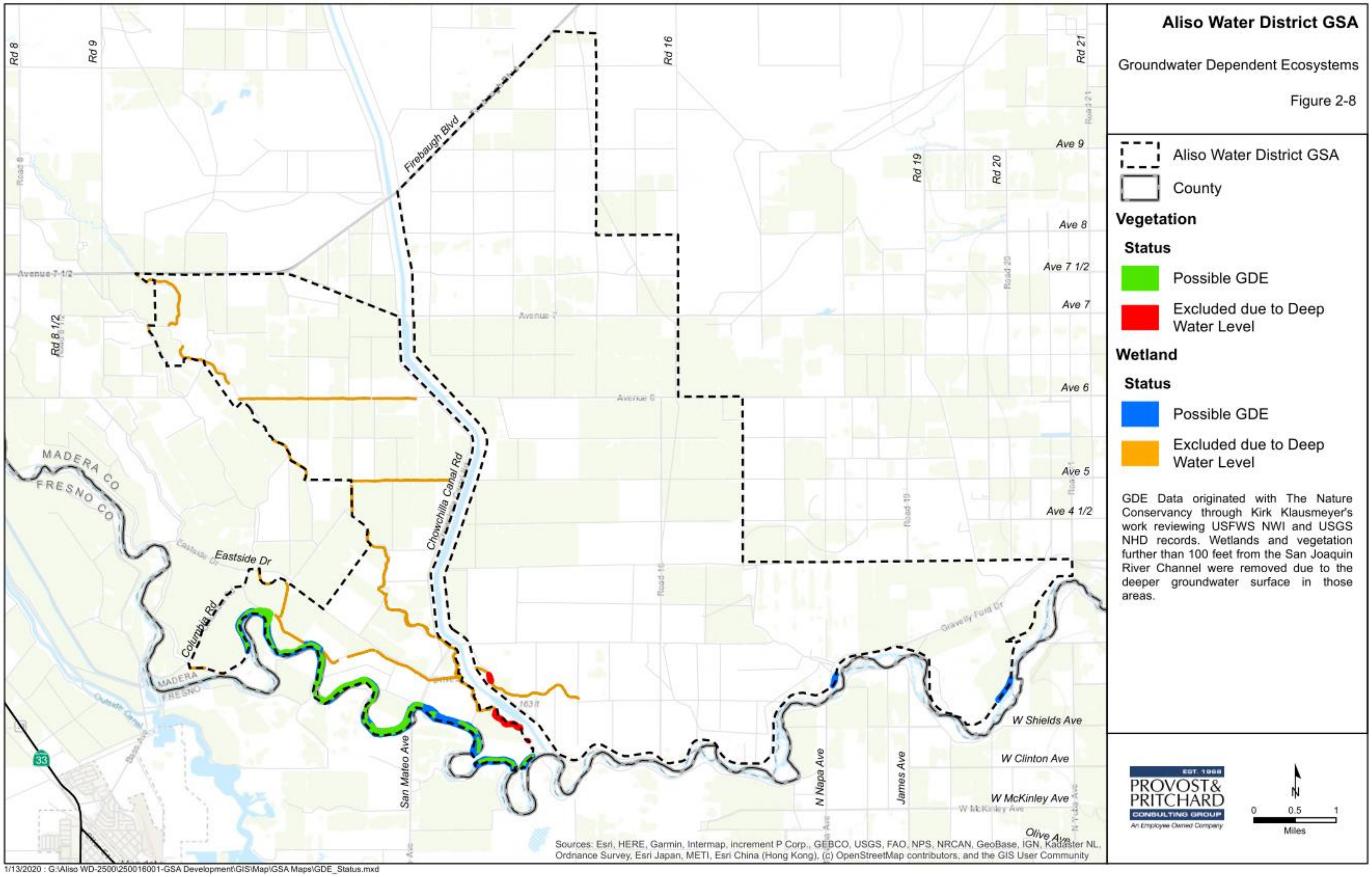

Figure 2-8: Groundwater Dependent Ecosystems

2.5 Notice and Communication

2.5.1 Description of Beneficial Users

§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.

Agricultural Users – AWD is an agricultural water district. There are limited residential and commercial activities in the District. As such, the District and overlying GSA interested parties are made up mainly of landowners and farm managers.

Domestic Well Users – There are very few domestic wells within the AWD GSA. It is anticipated that domestic wells will quantify as "de minimis extractors" under SGMA and will be excluded from certain regulatory requirements of the GSP.

Municipal Well Operators – There are no municipal wells within the AWD GSA.

Public Water Systems – There are no public water systems within the AWD GSA.

Local Land-Use Planning Agencies – The AWD GSA lies entirely within Madera County. The District consulted with Madera County when forming the GSA and developing the Plan. Other counties within the subbasin include the counties of San Joaquin, Stanislaus, Madera, and Fresno.

Environmental Users of Groundwater –The Subbasin consulted with California Department of Fish and Wildlife (CDFW), US Fish and Wildlife Service (USFWS), TNC and USBR when forming the GSA and preparing the GSP.

Surface Water Users– There are some privately held surface water rights that are used within the AWD GSA.

Lower San Joaquin Levee District – AWD consulted regularly with the Levee District regarding SGMA and the potential access to flood waters.

California Native American Tribes – There are no Native American Tribes within or adjacent to the AWD GSA.

Disadvantaged Communities (DAC) – There are no disadvantaged communities within the AWD GSA. Nearby disadvantaged communities include Firebaugh and Mendota.

2.5.2 Public Meetings and Plan Comments

Regulation Requirements:

§354.10 (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.

The District maintains an interested parties list that is updated periodically. They host board meetings and GSA workshops that are open to the public. Information on past or future meetings is available on the AWD GSA website (http://alisowdgsa.org). Emails are sent out from AWD GSA to inform interested parties of SGMA actions, and meeting notices are posted at several locations throughout the District. **Table 2-2** summarizes notable public outreach and engagement milestones. The GSA convenes quarterly to update the public on SGMA developments and GSP progress. AWD is also active at public outreach events performed at the Basin level. **Table 2-3** summarizes basin-wide public meetings and workshops. Additional information and public outreach opportunities for the DMGB can be found at the Delta-Mendota website (http://deltamendota.org).

Table 2-2 Aliso Water District SGMA Public Outreach and Engagement

Aliso Water District GSP Public/Stakeholder Outreach
January 26, 2016 – Basin Boundary Modification Public Meeting
April 26, 2016 – GSA Formation Public Meeting
April 23, 2018 – Water Budget Workshop
August 2, 2018 – Projects & Management Actions Ad-Hoc Committee Meeting #1
November 20, 2018 – Sustainable Management Criteria Workshop #1
April 29, 2019 – Outreach Meeting with TNC on GDE Mapping
May 17, 2019 – Projects & Management Actions Ad-Hoc Committee Meeting #2
May 18, 2019 – Sustainable Management Criteria Workshop #2

Table 2-3 Delta-Mendota Subbasin GSP Public Workshops

Delta-Mendota Subbasin GSP Public Workshops		
Spring 2018 – Workshop #1		
Los Banos Monday, May 14, 4:00 – 6:00 PM SLDMWA Los Banos Administrative Office 842 6th Street, Los Banos 93635	Patterson Wednesday, May 16, 4:00 – 6:00 PM Hammon Senior Center 1033 W Las Palmas Ave, Patterson 95363	Mendota Thursday, May 17, 4:00 – 6:00 PM Mendota Public Library 1246 Belmont Ave, Mendota 93640
Fall 2018 – Workshop #2		
Firebaugh Monday, October 22, 5:00 - 7:00 PM Firebaugh Middle School MPR 1600 16th St, Firebaugh 93622	Los Banos Wednesday, October 24, 4:00 - 6:00 PM College Greens Building 1815 Scripps Drive, Los Banos 93635	Patterson Thursday, October 25, 4:00 - 6:00 PM Hammon Senior Center 1033 W Las Palmas Ave, Patterson 95363
Winter 2019 – Workshop #3		
Los Banos Tuesday, February 19, 4:00 - 6:00 PM	Patterson	Santa Nella Monday, March 4, 6:00 - 8:00 PM

<table>
<tr><th colspan="12">Delta-Mendota Subbasin
GSP Public Workshops</th></tr>
<tr><td colspan="4">College Greens Building
1815 Scripps Drive, Los Banos, 93635</td><td colspan="4">Wednesday, February 20, 4:00 - 6:00 PM
Patterson City Hall
1 Plaza Circle, Patterson, CA 95363</td><td colspan="4">Romero Elementary School MPR
13500 Luis Ave, Gustine, CA 95322</td></tr>
<tr><td colspan="12">Spring 2019 – Workshop #4</td></tr>
<tr><td colspan="3">Patterson
Monday, May 20, 4:00 - 6:00 PM
Patterson City Hall
1 Plaza Circle, Patterson, CA 95363</td><td colspan="3">Los Banos
Tues, May 21, 4:00 - 6:00 PM
College Greens Building
1815 Scripps Drive, Los Banos, 93635</td><td colspan="3">Santa Nella
Weds, May 22, 6:00 - 8:00 PM
Romero Elementary School MPR
13500 Luis Ave, Gustine, CA 95322</td><td colspan="3">Mendota
Thurs, May 23, 6:00 – 8:00 PM
Mendota Public Library
1246 Belmont Ave, Mendota 93640</td></tr>
</table>

2.5.3 Decision-Making Process

Regulation Requirements:

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

The AWD submitted a letter (dated April 26, 2016) to DWR notifying them that they had elected to become a GSA for the area of the Delta-Mendota Subbasin encompassed by the District. No other entity has elected to form a GSA for this specific area. While developing their own plan, the AWD is also currently coordinating with other GSAs in the Delta-Mendota Subbasin to develop and implement a coordinated GSP in order to comply with SGMA requirements.

When the AWD Directors are deciding on matters related to implementing SGMA, they review reports provided by either staff and/or ad hoc committees. The reports can provide recommendations or different options on how the Board can proceed. In addition to reports from staff and ad hoc committees, the Board considers the input of stakeholders. All Board meetings are open to the public, except in special cases when confidential information, as permitted by law, requires a closed session.

The AWD decision-making process is a bottom-up process in which stakeholders take part in the planning, implementation, monitoring, and evaluation of projects and programs. Stakeholder involvement is encouraged and sought not only through workshops and direct communications but also through the structure of the two-stage decision-making procedure.

2.5.4 Public Engagement and Outreach

Regulation Requirements:

§354.10 (d)(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of 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

The AWD continues to work in concert with the other six GSP groups in the basin on developing a coordinated GSP while still allowing for the development of its own GSP and entering into a coordination agreement with the other GSAs in the basin. AWD has formed a technical advisory ad hoc committee to develop and implement the GSP. The committee reports any activity to the Board of Directors at the quarterly meetings when public comments can be made. Board meetings are held quarterly on the 3rd Tuesday of the Month. SGMA specific public workshops are conducted to obtain input to finalize the GSP.

Since AWD is the sole GSA for this area, they did not create new bylaws for governance. The AWD bylaws (adopted by the District's Board of Directors January 31, 1995) provide the following decision-making organization (with current position holders):

- Board President – Roy Catania
- Treasurer – Michael Logoluso
- Secretary – Ross Franson
- Board Members – Bernard Puget and Jeremy Seibert

Engagement with groundwater users occurs in the following phases of the development and implementation of the GSP:

1. *Modification of the Basin Boundary*
2. *Formation of the GSA*
3. *Development of the Draft GSP*
4. *Finalization of the GSP*
5. *Implementation of the GSP*

The plan's overarching goal is to inform, engage, and build stakeholder support for AWD's GSP metrics and thresholds and ultimately for those of the Delta-Mendota Subbasin service area. A diverse, active, engaged public will help better identify issues, form solutions, and create a partnership between the AWD Board and stakeholders.

Multiple stakeholders have a personal or professional stake in the AWD Board decisions and associated GSP implementation. AWD will implement the Plan in a coordinated effort that engages these multiple audiences throughout various outreach and involvement activities. Public outreach meeting and workshops have been held to address specific points of concern regarding the GSP development. The District conducted public outreach meetings and workshops to gather input on water budget parameters, sustainable management criteria, monitoring networks, and project priorities. Stakeholders engaged in both program-level and project-specific activities. Stakeholders are asked to contribute their knowledge and voice their opinions at key decision points.

3 Basin Setting

3.1 Hydrogeologic Conceptual Model

See **Appendix A – Hydrogeologic Conceptual Model and Groundwater Conditions for the Aliso Water District GSP prepared by Kenneth D. Schmidt & Associates.**

3.2 Current and Historical Groundwater Conditions

See **Appendix A – Hydrogeologic Conceptual Model and Groundwater Conditions for the Aliso Water District GSP prepared by Kenneth D. Schmidt & Associates.**

3.3 Water Budget Information

Regulation Requirements:

§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 crucial to sustainable groundwater management. Quantifying the historic, current, and projected overdraft provides a deeper understanding of water use in a GSA and allows districts to set supply augmentation and demand mitigation objectives. The water budget for AWD was developed using information gathered from various sources, including the hydrogeologic conceptual model and groundwater conditions report, precipitation and evapotranspiration databases, measurements of inflows and outflows, landowners and managers, and other relevant data sources described in greater detail below. Individual historical, current, and projected water budgets were developed for each GSP group for their respective Plan Area at a granular level to capture the unique characteristics of each GSP group. To make the GSP group water budgets comparable, the Coordination Committee developed common and consistent water budget schematic components that were agreed upon by the GSP groups of the Subbasin. To correlate the AWD GSA GSP to the basinwide water budget of the common chapter, a 'crosswalk' was developed to capture this recategorization (**Figure 3-6** and **Figure 3-7).** A detailed explanation of the coordinated water budget components, along with a discussion of the data and methodologies used, is also included in the Common Chapter – **Appendix B**.GSP regulations stipulate the use of 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 and consistent with scientific and engineering professional standards of practice. The best available information at the time the GSP is developed may be limited spatially and temporally. It is the intention of AWD and the Subbasin to continue to compile data, seek additional data sources, and improve means and methods of analyzing data moving forward in order to provide a clear and accurate description of the annual Groundwater Conditions and development of future annual Water Budgets.

3.3.1 Description of Groundwater Model

Regulation Requirements:

§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 sophisticated numerical computer model to quantify and evaluate water budget conditions and the potential impacts to beneficial uses and groundwater users. 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.

Due to the homogeneous nature of the District area regarding water use, cropping patterns, and climate, AWD has decided to use an analytical accounting tool to quantify the historic water budget conditions and project historic trends into the future while incorporating factors such as climate change and land use that may alter these trends going forward. The analytical accounting tool was also chosen to alleviate costs, to provide clarity in assumptions and data that were used, and to prevent the need to use unrealistic assumptions in order to calibrate a model. when limited data is available for analysis, models can be very complicated and produce results well out of the expected range of error. This is especially true when dealing with systems like groundwater and subsidence. To properly calibrate these complex groundwater models requires long term and extensive local data, contour maps, trusted external data sets and equations, and physical observation and surveys. AWD will consider using a groundwater model once datasets are fully developed and would be likely to produce reasonable results without making unrealistic assumptions. It should be noted that existing models were referenced during the development of this water budget.

The complete historic, current, and projected water budget for AWD was developed using information from the hydrogeological conceptual model, the groundwater conditions section developed by Kenneth D. Schmidt & Associates discussed earlier in this chapter, and data from sources such as the California Irrigation Management Information System (CIMIS), DWR, Irrigation Training & Research Center (ITRC), and CDEC, among others. Data from these existing programs as well as internal monitoring data and other publicly available information were used to develop the AWD water budget. It should be noted that there are limitations to the existing analyses performed by others, such as the spatial extent of analysis in the District or limited long-term data.

The Delta-Mendota Subbasin’s Coordination Committee approved the coordinated historic period of 2003 to 2012 WY and a current year of 2013 for the Subbasin. The Projected Water Budget was analyzed from 2014 – 2070. The hydrologically average period was developed using San Joaquin River – Full Natural Flow (SJR FNF) data, the DWR water year index, and precipitation data from nearby gauging stations. A 50-year average of approximately 1.83 million AF of SJR FNF runoff was calculated from 1966 to 2015. A series of analyses were done for periods ranging from 1990-2015, but it was decided that the period chosen should avoid the most recent drought. The period from 2003-2012 was chosen because:

- *The average represented nearly 100% of the 50-year average for hydrological conditions (**Table 3-6**).*
- *The period was recent and reflects recent conditions.*
- *It met the minimum 10-year requirement.*
- *It had a balanced number of water year types.*
- *The data for the period would be more readily available given that it is relatively recent.*

Additional details on the development of the historic water budget and hydrological average period can be found in **Section 3.3.4**.

AWD has two principal aquifers (described in detail in **Appendix A – HCM**): the upper unconfined aquifer and the lower confined aquifer, with the Corcoran Clay layer separating the two. Most wells in AWD west of the Chowchilla Bypass are shallow (upper aquifer only). East of the Chowchilla Bypass, many of the wells are composite wells that perforate both the upper and lower aquifer causing the system to behave as single aquifer. Therefore, only total pumping has been calculated and water budgets do not differentiate between upper and lower aquifer contributions. Further investigations will be needed to distinguish separate amounts for upper and lower aquifer pumping. Site-specific evaluations of the interactions between the two primary aquifers may consist of geophysical log reviews, leaky aquifer tests, and spinner tests.

3.3.2 Method for Quantification of Inflows and Outflows

Regulation Requirements:

§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.

Quantification of inflows and outflows to the GSA is necessary for developing the historic, current, and projected water budgets. Some variables were estimated using the best available science and methods due to an absence of either temporal or spatial data. Inflows and outflows were broken down by water source and use. Each of the parameters described below has been incorporated into the Water Budget spreadsheet tool. **Figure 3-1** shows the DWR diagram of typical inflows and outflows for the atmospheric, land surface, and groundwater systems. The AWD water budget analysis only looks at the land surface and the groundwater systems; any losses to or gains from the atmospheric system are included as evaporation or precipitation in the land surface system. Results of the historic, current, and projected water budget are provided in subsequent sections of this chapter.

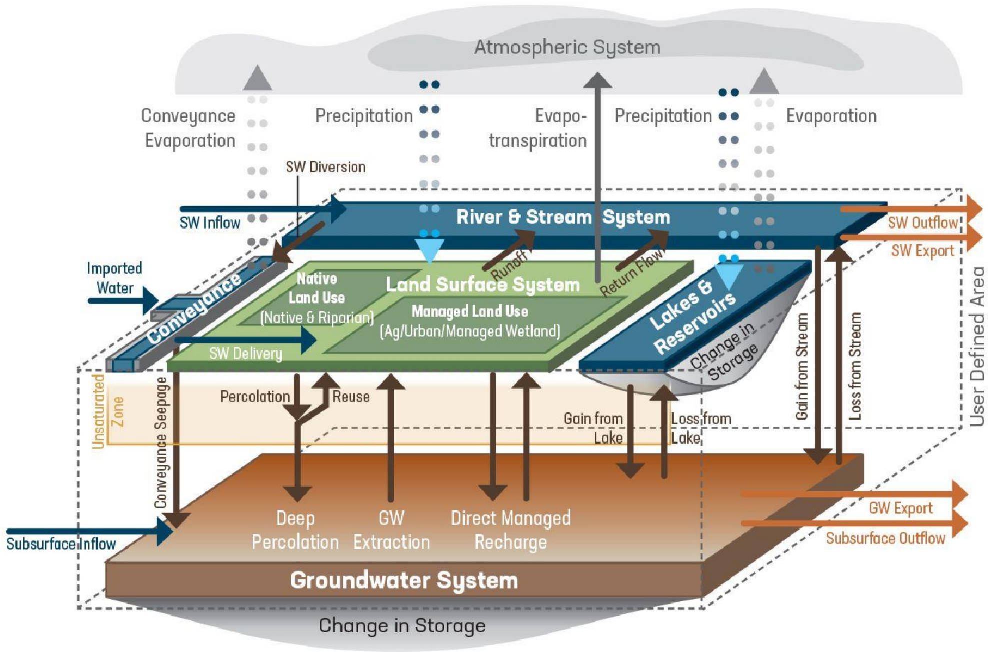

Figure 3-1: DWR Water Budget Graphic

3.3.2.1 Land Surface System Inflows

3.3.2.1.1 Surface Water for Irrigation

AWD has limited access to surface water. There are private landowners that have rights to surface water, mainly during high-flow years, and have mechanisms in place to receive transfer water when available. When water is available for diversion under the private lawful rights, it is diverted directly from the SJR to the Lone Willow Slough and from the SJR to the Chowchilla Bypass flood control facility through the bifurcation structure. Historically, growers along the Bypass diverted high-flow water through coordination with the Lower San Joaquin River Levee District. However, since the implementation of SGMA, the SWRCB has been working to establish a process to obtain rights to this water. The District was originally developed anticipating construction of the never-built USBR Mid-Valley Canal, and as a result AWD has had limited involvement in individual grower operations in the past, although this is expected to change due to the enactment of SGMA. This makes gathering historic data complex. Few growers keep detailed records of flows taken off the Bypass or SJR system during flood events. According to the SJRRP modeling and existing records, AWD landowners have diverted an average of approximately 8,400 AF a year of surface water for irrigation and direct recharge during the 10-year average hydrologic period as shown in **Table 3-7**. Acquisition of additional surface water for irrigation is listed in the projected water budget as a future project. It is anticipated that the District will get a minimum of 10,000 AF/Y during high-flow water years in addition to acquisition of water for the system by private entities.

3.3.2.1.2 Surface Water for M&I

Surface water is not used to meet the limited commercial and industrial demand in the area.

3.3.2.1.3 Spill Inflows

There are no surface water inflows into AWD as a result of spill from an adjacent entity.

3.3.2.1.4 Precipitation

Monthly precipitation data was collected from the Firebaugh CIMIS station for the 2003-2012 period for the historic water budget and the 2013 current water budget. The same station was used for analysis of data for the projected water budgets; however, data interpolated from the PRISM model was used in representative years prior to the installation of the Firebaugh CIMIS station (see **Section 3.3.4.3).** This model calculates precipitation and evapotranspiration values in locations where monitoring stations do not exist and during years prior to establishment of data collection. Using this method, it was calculated that AWD has an average annual precipitation of 7.1 inches over the hydrologic base period of 2003-2012.

Precipitation either is utilized by the crops as Effective Precipitation and evapo-transpired as an output from the surface water system, leaves the surface water system as Runoff of Precipitation, or enters the groundwater system and becomes Deep Percolation of Precipitation and is input to the groundwater system and output from the surface water system. These will be detailed further in their respective sections.

Effective Precipitation

Effective precipitation is the amount of rainfall that is beneficially used by the crops. In this analysis it is calculated as 50% of total annual precipitation for the October-September water year. The 50% effective precipitation assumption is a commonly used assumption based on the typical results achieved from the more rigorous calculation method developed by DWR which requires monthly time steps for precipitation data. This DWR method is based on the set of three equations seen below as **Equation 3-1**(1989 Macgillivray report for DWR).

Equation 3-1 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, inches

After consideration of the complexities of the projected water budget and the limitations in the abilities to assess monthly data sets for all parameters, the 50% of total precipitation method for determining effective precipitation was used instead of the series of equations developed by DWR. Essentially, it was not practical to do a high-level analysis on effective precipitation when the margin of error of so many other Water Budget components have larger effects. The Macgillivray method for calculating effective precipitation in annual water budgets may be used in the future as data collection and monitoring efforts improve and accurate and detailed data yields quantifiable results.

It is important to note that the effective precipitation and any applied surface water use are considered as part of the consumptive use of crops and deducted from groundwater pumping.

3.3.2.1.5 Groundwater for Irrigation

Groundwater is the primary source of water in AWD. The District pumps an average of 85,600 AF of groundwater annually for irrigation, including a 70% efficiency factor for irrigation. Measured groundwater pumping for irrigation of crops is currently only available for portions of AWD. However, non-metered groundwater pumping can be estimated with land use cropping data, ET data, an understanding of irrigation methods and associated efficiencies, effective precipitation amounts, and known surface water used for irrigation. Groundwater pumping was estimated using a consumptive use method (**Equation 3-2**). After all inputs were considered, the remainder of consumptive use was assumed to be met with groundwater. This method does not account for pumping and exports; however, there is no indication that exports occur. Pumping was calculated as crop demand minus effective precipitation and applied surface water. An irrigation efficiency factor of 70% (based on survey results from the AWD growers) was applied to the crop demand remainder not met by effective precipitation in order to account for losses in the irrigation system, primarily deep percolation into the aquifer. Groundwater pumping is an outflow of the groundwater system and an inflow to the land surface system.

Equation 3-2 Groundwater Pumping

$$GW = \left[\frac{(CD - EP)}{IE}\right] - SW$$

Where:
GW = Groundwater Pumped for Irrigation
CD = Crop Demand
EP = Effective Precipitation
IE = Irrigation Efficiency
SW = Surface Water for Irrigation

3.3.2.1.6 Groundwater for M&I

All domestic wells within the District are privately owned and operated. There is a minimal amount of industry and a few permanent residents that use groundwater as their primary water source. An additional 200 AFY was assumed to cover any incidental groundwater use not previously accounted for.

3.3.2.2 Surface System Outflows

3.3.2.2.1 Runoff of Precipitation

Runoff of precipitation is calculated as the volume of precipitation that has not been attributed to deep percolation or effective precipitation. See **Equation 3-4** for calculating effective precipitation. It has a negligible effect on groundwater storage changes.

3.3.2.2.2 Consumptive Use

AWD is unique in that nearly all their groundwater use is for agriculture. Therefore, 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 to calculate crop water demand or consumptive use for the historic and current water budget. Crop consumptive use is the amount of water that is consumptively used by the crop, typically given in acre-feet per acre (AF/ac) or acre-inches per acre. **Table 3-1** shows ET rates developed by ITRC of specific crop types that have been farmed in AWD. Crop consumptive use was calculated annually for the District from 2003-2012. **Figure 3-2** shows cropping during the average historic period.

Historic cropping patterns were requested from District members, but the data was incomplete for the historic period. Therefore, it was decided to use the publicly available CropScape and DWR data. It is also notable that cropping from 2003-2006 is held static. This is because CropScape data was not available before 2007 and the DWR land use survey was done in 2001. This data was used for the unknown period from 2003-2007 and kept constant. In the future, cropping data will be requested annually from the landowner by the AWD GSA to obtain higher quality data.

Table 3-1: ITRC Crop Evapotranspiration Rates by Irrigation Method and Water Year Type (ac-in/ac)

Crop	ETc - Drip			ETc - Sprinkler			ETc - Flood		
	Dry	Normal	Wet	Dry	Normal	Wet	Dry	Normal	Wet
Alfalfa	0.0	0.0	0.0	47.5	49.2	45.8	47.5	49.2	45.8
Berries and other Nursery	26.4	27.0	29.3	26.2	26.7	29.5	26.3	26.8	29.6
Corn	0.0	0.0	0.0	29.4	29.8	33.0	29.4	30.5	33.1
Cotton	33.7	33.8	37.3	34.2	34.4	37.0	33.5	33.9	37.0
Double Crops	0.0	0.0	0.0	45.6	50.2	50.0	45.7	50.9	50.0
Fruit trees	38.8	39.6	39.5	41.3	42.2	41.3	40.6	41.4	40.8
Grapes	28.3	29.0	31.2	28.9	29.4	31.5	28.9	29.3	31.5
Grasses/Pasture	0.0	0.0	0.0	48.1	49.7	46.2	48.1	49.7	46.2
Melons	16.4	16.8	21.3	19.7	20.0	23.3	18.6	19.0	23.0
Misc. Field Crops	26.4	27.0	29.3	26.2	26.7	29.5	26.3	26.8	29.6
Misc. Vegetables	22.8	23.7	24.1	22.4	26.5	23.2	27.0	29.3	13.3
Nut trees	39.9	41.6	41.3	41.0	41.6	42.1	40.9	41.5	42.0
Onions	16.5	20.7	17.6	17.0	20.5	17.3	17.0	20.5	17.3
Potatoes	36.3	37.9	36.0	34.5	37.3	32.9	34.5	37.3	32.9
Rice	0.0	0.0	0.0	0.0	0.0	0.0	41.7	42.3	42.4
Safflower	0.0	0.0	0.0	29.1	29.1	25.3	26.2	29.1	25.3
Wheat	0.0	0.0	0.0	16.3	20.4	16.9	16.3	20.4	16.9

3.3.2.2.3 Irrigation Efficiency

Irrigation efficiencies are the combination of actual irrigation practices and distribution system design. Irrigation methods were assigned to specific crop types based on known irrigation trends and interviews with growers. Typical efficiencies of each irrigation method were used to estimate irrigation efficiency as it relates to irrigation practices, which was closer to 85-90%. However, losses from the distribution system, which consist of losses due to unlined canals or channels and other leaks and seeps, make up a considerable portion of the irrigation efficiency with losses due to seepage ranging from 0.4-0.8 feet per day. These two factors were combined to develop the 70% irrigation efficiency estimate. Irrigation efficiency was applied to crop water demands (**Table 3-1**) not met by effective precipitation.

Irrigation efficiencies are not a direct loss to the surface water system. The volume of water applied that exceeds crop water demand as a result of irrigation inefficiency is assumed to percolate back into the groundwater system. Excess water that is pumped to meet losses due to irrigation efficiency is returned to the groundwater system as recharge. Because recharge due to irrigation efficiency is considered as excess water pumped and returned to the groundwater system, it is not considered in the calculations that estimate recharge from irrigation canals or channels. Recharge from irrigation canals or channels is only considered when surface water is being used (see **Table 3-2 & Table 3-3**). This is discussed again in the Groundwater System Inflow section as Deep Percolation of Irrigation Water.

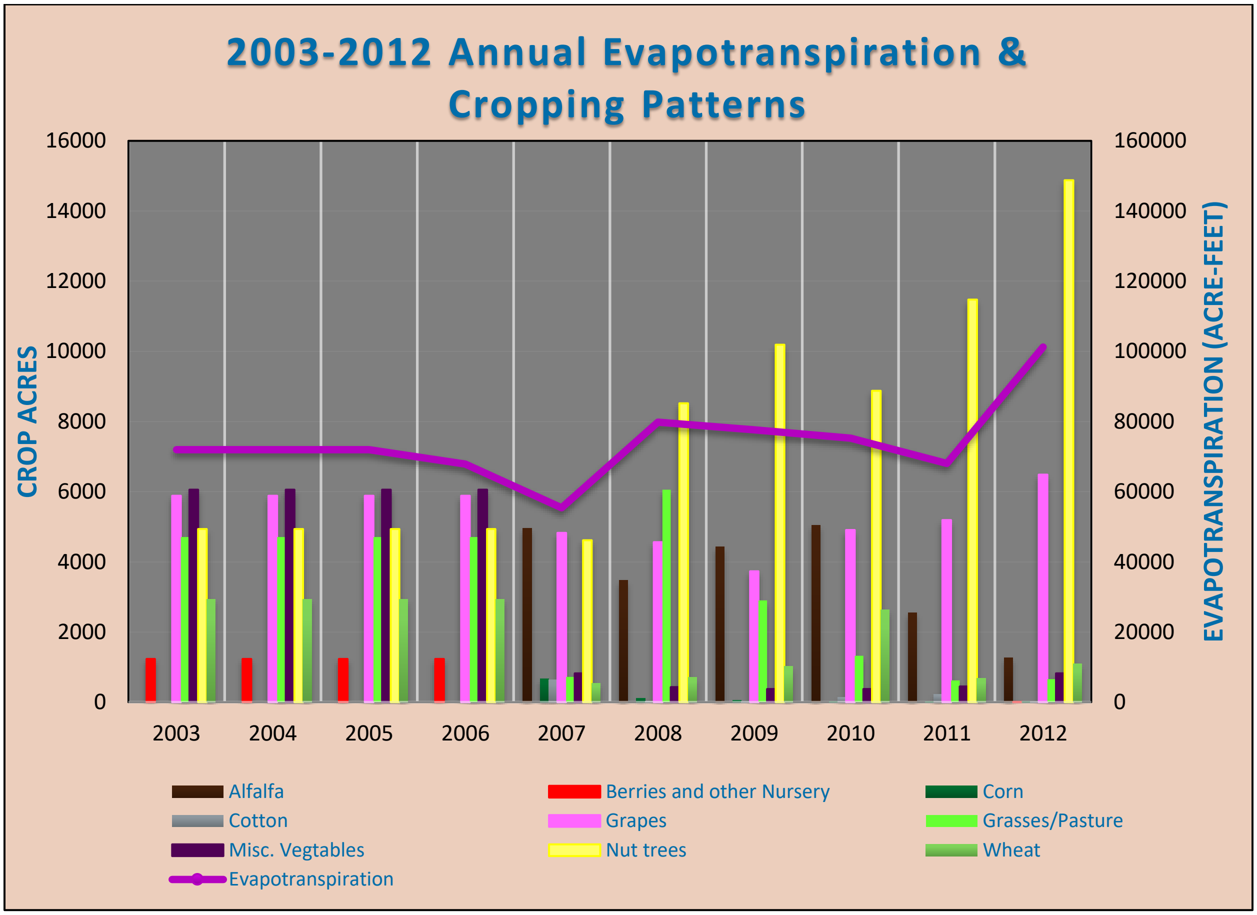

Figure 3-2: Cropping and Consumptive Use 2003-2012

3.3.2.2.4 Evaporation of Channels and Recharge Basins

Evaporation of water from Channels and Recharge Basins is calculated for the surface of waterbodies in the District that convey irrigation water. The surface area of each water body is determined using surveyed areas and aerial images. An open water evapotranspiration factor of 80% of the reference evapotranspiration is applied for each day the channel or basin is filled with surface water on average during the irrigation season. Only surface water is considered because groundwater losses due to evaporation are accounted for in irrigation efficiency calculation. Approximately 700 AFY of water evaporates from ponds and conveyance systems.

3.3.2.2.5 Groundwater for M&I

Users of groundwater for domestic, commercial, and industrial uses are de minimus. 200 AFY of groundwater is assumed to account for any unknown use. Losses due to inefficiencies in the production or distribution system are not considered.

3.3.2.3 Groundwater System Inflows

Inflows to the groundwater system are any sources of water that contribute to the groundwater system as a result of natural or managed inflow. Inflows may come from the surface water system or groundwater system. Inflows from the surface water system include recharge from natural bodies of water, losses from irrigation and conveyance systems, and managed or intentional recharge. Inflows from the groundwater system include groundwater boundary flows from the western boundary of AWD and from the southern boundary along the SJR.

3.3.2.3.1 Deep Percolation of Irrigation Water

Deep percolation of irrigation water is an inflow from the land surface system to the groundwater system. Deep percolation of irrigation water is calculated using the assumption that all applied water in excess of the consumptive use (due to irrigation inefficiencies) infiltrates past the root zone and makes it back into the groundwater system. With annual average consumptive use of 70,500 AFY and effective precipitation of 7,000 AFY, the remaining crop needs are calculated using the irrigation efficiency of 70%. This gives a quantity for average water needs for irrigation of 90,700 during the historic period. Approximately 27,000 AF of irrigation water is unused by crops and recharged through deep percolation.

Equation 3-3 Total Irrigation needs

$$Deep\ Percolation\ of\ Irrigation = \left[\frac{(CD - EP)}{IE}\right] - (CD - EP)$$

Where:
CD = Crop Demand
EP = Effective Precipitation
IE = Irrigation Efficiency
ET = Crop Evapotranspiration

3.3.2.3.2 Deep Percolation of Precipitation

Deep percolation of precipitation is an inflow from the land surface system to the groundwater system. Deep percolation of precipitation is estimated to be 10% of total annual precipitation based on previously made assumptions and the known characteristics of the hydrogeological area. Moving forward, quantification of this process may be refined to estimate the likely deep percolation of precipitation by year type.

3.3.2.3.3 Deep Percolation of Rivers, Streams, and Channels

Deep percolation of water from surface water bodies, natural or managed, is often called seepage or infiltration. Seepage of water in surface water bodies is typically affected by soil permeability and channel width (as a function of water depth). Other factors that can affect seepage include sedimentation of silts in channels, decaying vegetative matter, groundwater levels, and hydraulic gradient. Several sources and existing studies were examined to develop seepage estimates. The seepage analysis evaluated the following sources of data:

- *Studies on behalf of the San Joaquin River Restoration Program (SJRRP)*
- *The Friant Water Users Settlement*
- *Saturated hydraulic conductivity maps developed using NRCS mapping layers*
- *Soil texture and hydrologic grouping maps*
- *Pond drop tests*
- *Other existing plans and studies*

- *Professional knowledge of observed seepage rates in channels and ponds with similar soils, widths/areas, and depths*

Surface water from flood flows in the CBP are available approximately 38 days on average over the historic period, whereas surface water from the SJR may be available for longer durations of time. The following parameters utilized the seepage analysis to determine infiltration rates. There are dedicated ponds into which surface water is sent for recharge when there is flood water available in the CBP and along the SJR; however, this too is taken into account as a separate parameter – Intentional Recharge. A detailed summary of the development of seepage rates, recharge, and flood hydrology for the water budget is available in the Seepage Technical Memo included as **Appendix C**. It should be noted that seepage water from rivers, streams, and channels is not directly available for capture using existing wells in AWD.

3.3.2.3.4 Deep Percolation of Channels and Storage/Regulating Reservoirs

Water from irrigation delivery systems incidentally infiltrates through the soil in unlined canals and storage and regulating reservoirs. However, a large portion of the irrigation losses are accounted for in the irrigation efficiency calculation. Deep percolation of channels and reservoirs for the purposes of the AWD water budget is reserved for surface water losses only. Losses of groundwater due to infiltration are accounted for in the Deep Percolation of Irrigation Water parameter. Seepage of storage and regulating reservoirs in AWD is considered negligible. While regulating reservoirs do exist that receive surface water, they are too small to have a significant impact on the water budget.

Soils profiles, previous soil infiltration studies, and ponding tests were analyzed along with professional knowledge in the area to develop infiltration rates where geometry of canals and average days with surface water flow, as determined by flood water hydrology records, were considered. **Table 3-2** shows channel infiltration rates and total channel seepage in AWD.

Table 3-2: Irrigation Channel Seepage

Location	Area of Channels (acres)	Infiltration Rate (feet/day)	Average Number of Days with Surface Water	Total Seepage (AF)
Chowchilla Canal N	9	0.80	38	290
Chowchilla Canal S	15	0.40	38	230
Aliso Canal 1	8	0.40	38	130
Aliso Canal 2	9	0.40	38	140
Aliso Lateral	8	0.50	38	150
Lone Willow Slough	73	0.60	38	1,660
			Total Seepage	2,600

3.3.2.3.5 Local River and Stream Seepage

The San Joaquin River that runs along the edge of AWD is the main source of surface water providing seepage to the upper aquifer. The Chowchilla Bypass and the Mendota Pool also contribute seepage to the District. A detailed description of the seepage analysis follows for each source of seepage. Additional details on the seepage analysis are available in the Seepage Technical Memo, which describes the hydrology of the SJR and CBP, the process for determining seepage rates, and other assumptions made during the analysis process.

<u>Chowchilla Bypass and Cottonwood Creek Seepage</u>

Infiltration losses for natural waterways in AWD such as the Chowchilla Bypass and Cottonwood Creek were estimated using the same method described for channel seepage above. For the purposes of this analysis, natural waterways are defined as waterways unmanaged by the District or District members that flow into or through the District. The Chowchilla Bypass and Cottonwood Creek only run during wet years, which occur about every four years. The Bypass and Cottonwood Creek contribute approximately 5,400 AFY of recharge to the District over the historically average hydrologic period (**Table 3-3**).

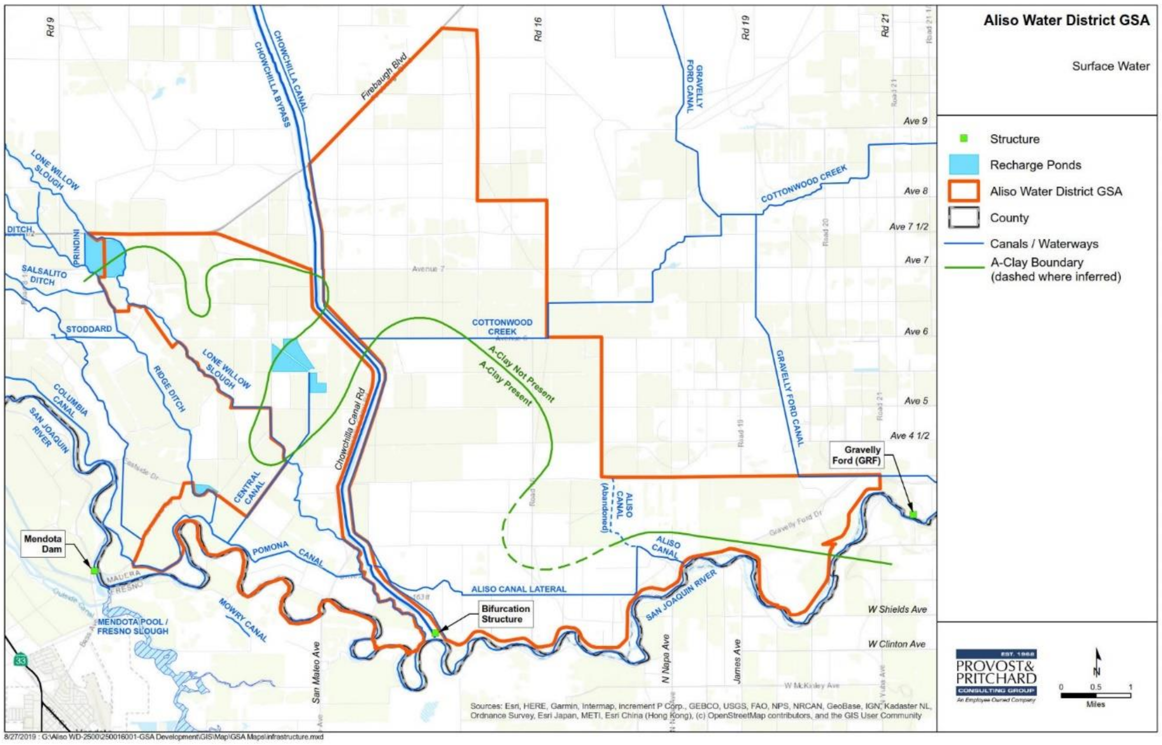

Figure 3-3: Aliso Water District Infrastructure Map

Table 3-3: Chowchilla Bypass and Cottonwood Creek Seepage

Local Waterway	Area of Channels (acres)	Infiltration Rate (feet/day)	Average Number of Days with Surface Water	Total Seepage (AF)
Cottonwood Creek	**13**	**0.30**	**38**	**150**
Cottonwood Creek Lateral	**1**	**0.30**	**38**	**12**
Chowchilla Bypass N	**29**	**0.80**	**38**	**880**
Chowchilla Bypass S	**287**	**0.40**	**38**	**4,360**
			Total Seepage	5,400

San Joaquin River Seepage

The analysis of the SJR considered previously established seepage losses defined by the Background Study for San Joaquin River Settlement (Settlement), the Tetra Tech SJR Loss Study, and the SJRRP Groundwater Water Model. Natural and Unavoidable loss rates for Reach 2 of the SJR (the reach that is adjacent to AWD) were developed in each study, typically by tracking flow at the Gravelly Ford (GRF) flow gauging station and the Bifurcation flow gauging station, both available on DWR's CDEC site. These losses between the two gauging stations were graphed and tabulated in the Settlement and Tetra Tech Studies. Losses as a function of flow at Gravelly Ford were graphed and an equation was developed to calculate loss rates from flow at various flow rates, as shown on **Figure 3-4**. Actual average daily flow rates in cfs at the GRF station were calculated from hourly data available from CDEC for the historic water budget. The equation was used to calculate daily average losses which were then converted to acre-feet. As expected, losses (seepage) increase with flow rate due to the changing width of the SJR channel with flow depth. The higher the flow, the wider the channel which allows for greater soil contact resulting in increased seepage rates until the full width of the channel is reached at the higher flows.

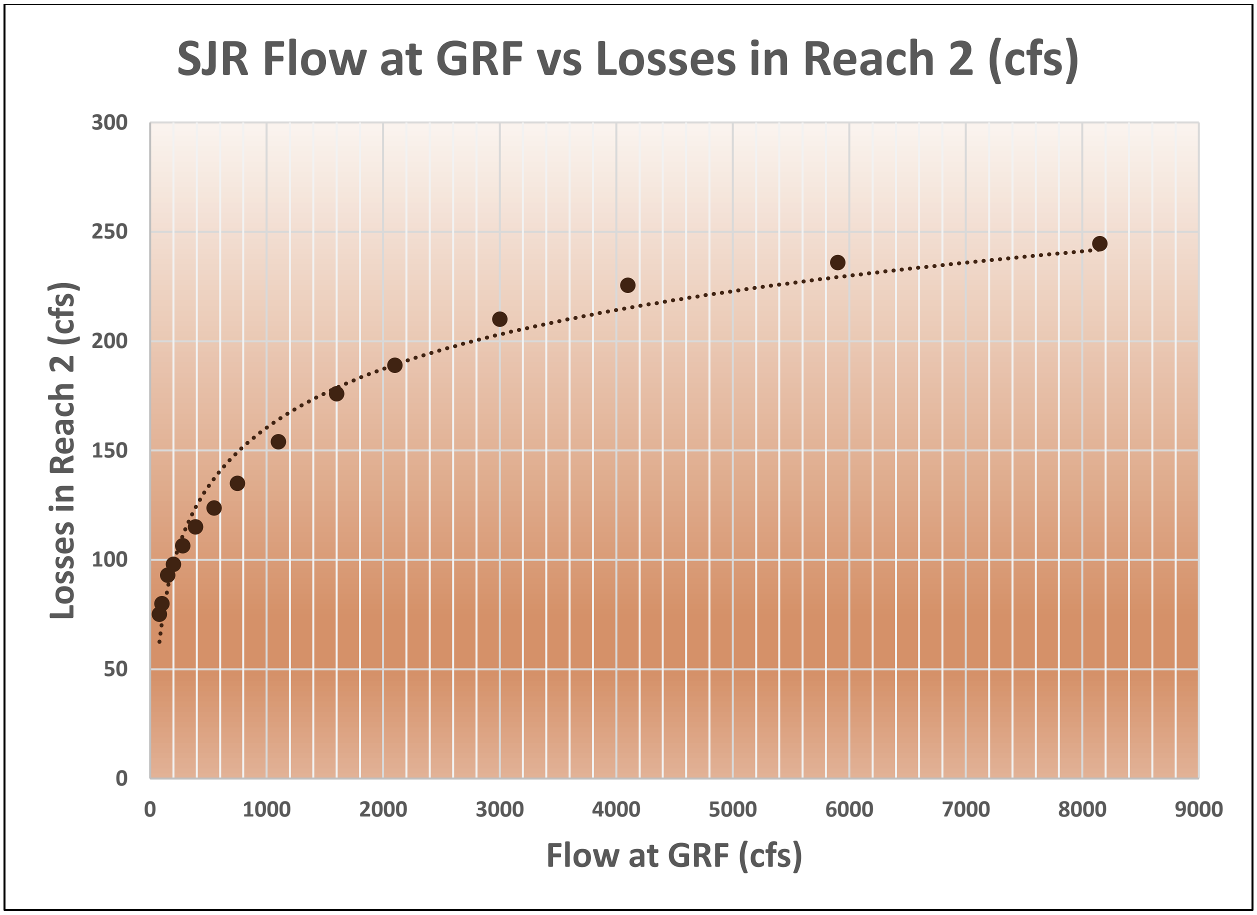

Figure 3-4: Reach 2 Loss Graph

Seepage from the SJR enters the groundwater system and flows into the Delta-Mendota Basin, Madera Basin, and the Kings Basin. **Figure 3-5** illustrates how this seepage water is allocated along the SJR for the GRF gaging station to the Mendota Pool. For the purposes of this water budget, 50% of the losses have been allocated to the northern bank along Reach 2 of the SJR from the easternmost boundary (near GRF) of the District to the Bifurcation of the Chowchilla Bypass and the SJR. The remaining 50% has been allocated to the south side of the river into the Kings Subbasin. Methodologies for calculating and allocating seepage water have been coordinated between the Kings and Delta-Mendota Subbasins.

Based on groundwater levels historically showing a gradient toward AWD from the Bifurcation to the Mendota Pool, 100% of the seepage losses flow to AWD along this stretch of Reach 2. Using the loss equation, 31,800 AF per year of seepage from the SJR enters the groundwater system and becomes groundwater inflow into AWD over the 10-year average hydrologic period. Note that the SJR Restoration Program was evolving during the 10-year hydrologic period and has not yet reached its planned flow rates (Settlement Hydrograph). The flows that occurred during the average and current years are expected to increase upon full development of the program and implementation of the Settlement Hydrograph. To that extent the natural and unavoidable losses in Reach 2 of the SJR are expected to increase in the future; however, those increased flows are not included in the forecasts for the projected water budget. Those adjustments can be made in future updates to the GSP as the Restoration Program progresses.

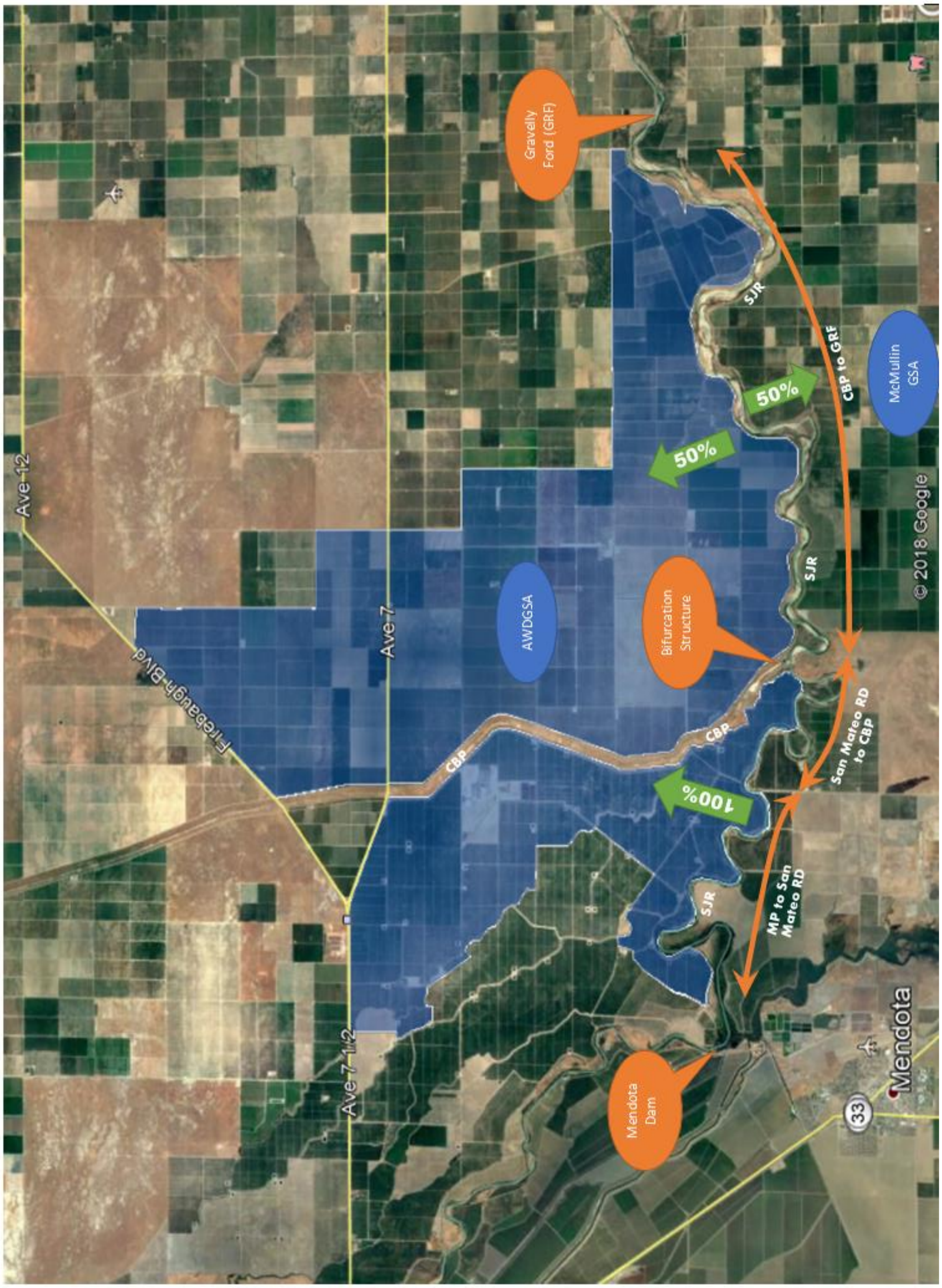

Figure 3-5. Diagram of Seepage Distribution

Mendota Pool Seepage

The Mendota Pool also contributes to groundwater inflow into AWD. The Mendota Pool Group calculates losses from the pool annually in the Mendota Pool Annual Report, so data was available for the entire period of study. The Mendota Pool is 1,087 acres with a length of approximately 17 miles. The established loss/seepage rate is 80 acre-feet per day for a loss rate of .075 ft/day. The area of the pool adjacent to Aliso is about 129 acres, so the losses would be about 9.5 AF/day. Over the approximately 335 operational days of the year, the Mendota Pool contributes an average of 3,200 AFY. For the 129 acres of the Mendota Pool which borders AWD, 100% of the calculated seepage contributes to the AWD water budget based on groundwater levels historically showing a gradient toward AWD in the area between the Bifurcation to the Mendota Pool (**Figure 3-5**).

It should be noted however, that the Mendota Pool Annual Report value is based on a pond drop test for entire pool (including the Fresno Slough Reach as well as the SJR) and should be refined in the future with new data and studies.

3.3.2.3.6 Urban Stormwater Recharge

There is no urban stormwater recharge.

3.3.2.3.7 Intentional Groundwater Recharge

Groundwater is recharged in private recharge basins. There are approximately 230 acres of private recharge ponds in the District. Water for recharge is mainly available during high-flow years when the Bypass is running or from neighboring agencies as part of an exchange. Water diverted into the recharge basins is metered and recorded monthly. AWD does not manage or monitor these recharge basins. However, all water diverted into the basin is assumed to recharge excepting losses to evaporation. Evaporation is analyzed separately as a loss to the surface water budget above. When averaged over the 10-year period, recharge equals 1,600 AF per year.

3.3.2.3.8 Groundwater Inflow

Water movement in surface water and groundwater occurs due to hydraulic pressure gradients. Calculation of groundwater movement is done using transmissivity values based on aquifer tests, groundwater elevation level contours, and cross boundary flow directions. Transmissivity changes with depth due to variations in aquifer material; however, an average transmissivity value was used for each boundary line for the depth of the aquifer based on data available to the hydrogeologist. Because groundwater contours were unavailable or inconsistent in areas adjacent to and within AWD for most years within the historically average period using publicly available data, AWD worked with neighboring districts that had sufficient internal data to develop groundwater flow contours. Both the SJRECGSA and Farmers GSA calculated average outflows from their respective boundaries and worked in collaboration with Kenneth D. Schmidt and Associates (KDSA) to develop subsurface groundwater flow estimates into AWD (see **Appendix A)**. A per mile inflow along the shared boundary was calculated using the outflow provided and used to estimate inflow for the southern portion of the District. It should be noted that seepage from the SJR becomes groundwater inflow as described above. However, seepage from the SJR and groundwater inflow are essentially the same source of water in the southern part of the District. There may be some contributions from imported water by agencies to the west which influence groundwater inflow along that boundary. Groundwater inflow excluding seepage from the river is approximately 21,300 AFY along the southern and western boundaries of the district.

3.3.2.3.9 Other Recharge

There are no other known recharge components.

3.3.2.4 Groundwater System Outflows

3.3.2.4.1 Groundwater Pumping

Groundwater is pumped from both the upper and lower aquifers in AWD. It is not yet known how much is pumped from each aquifer; total pumping can however be estimated using cropping data, population, and known industrial and commercial activities. Groundwater pumping is a surface water system input, which requires an understanding of the surface water system for proper analysis and calculation. Groundwater pumping is essentially the closure term for the surface water system and has therefore been explained in more detail in the surface water input section. Many factors contribute to accurate calculations of groundwater pumping including effective precipitation, crop evapotranspiration, and available surface water. See **Equation 3-2** in the Surface Water Inflow section for the full groundwater pumping calculation.

3.3.2.4.2 Groundwater Outflow

Groundwater outflow was calculated the same way as inflow. Similarly, there is limited data both temporally and spatially. All groundwater outflow from Aliso leaves the Delta-Mendota Basin boundary and enters the Madera Subbasin. Per analysis by KDSA, which looked at average water year hydrographs and contour maps **(Appendix A)**, an average value for groundwater outflow was developed. Due to limited years of sufficient data, 2010 and 2016 were chosen as representative normal years and were used to calculate outflow. Approximately 11,100 AF/year of groundwater flows out of the AWD (and thus the subbasin) during normal water years. It should be noted that during different year types outflow may change significantly due to changes in groundwater gradient and irrigation practices when surface water becomes more or less available to areas surrounding Aliso Water District. AWD will continue to perform internal monitoring of water levels to supplement publicly available data and allow for quantification of groundwater outflows in future water budget updates.

3.3.3 Quantification of Overdraft and Sustainable Yield

Regulation Requirements:

§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.

3.3.3.1 Overdraft/Change in Groundwater Storage

Overdraft happens when more water is flowing out of the aquifer system than is being replenished. Overdraft is often synonymous with a negative change in groundwater storage. This is also the change in available water within an aquifer, or the change in available storage space in an aquifer.

There are two primary aquifers in AWD: the upper unconfined aquifer and the lower confined aquifer. The upper aquifer overdraft (change in storage) is calculated using changes in the amount of water available for use from year to year and can be calculated in two different ways: Inflow/Outflow Method and Specific Yield Method. The change in lower aquifer storage is the loss of the system's ability to store water due to soil compaction from land subsidence and is calculated as the Subsidence Mapping Method of the deep aquifer.

3.3.3.1.1 Upper Aquifer Overdraft/Change in Storage

Change in storage is typically based on annual seasonal high groundwater level measurements (Specific Yield Method), or a comparison of groundwater inflows and outflows (Inflow/Outflow Method). In the Specific Yield Method. seasonal high groundwater level measurements trends are plotted as hydrographs to track long term changes in water level for a single well. The measurements are also used to create contour maps which observe water levels over a large area at a single moment in time. Hydrographs and contour maps are compared by location and from year to year respectively to determine change in groundwater storage. In the Inflow/Outflow Method the change in storage is quantified by summing the groundwater inflows and outflows components of the water budget; however, subsurface groundwater flows are still dependent on seasonal high contour maps to determine subsurface inflow and outflow gradients.

Inflow/Outflow Method

The Inflow/Outflow Method is based on the water budget difference between inflow to the area (supply sources) and outflow from the area (uses). **Equation 3-4** shows the method.

Equation 3-4 Groundwater Storage Change (Inflow Outflow Method)

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

Where:
Inflows = Groundwater system inflows
Outflows = Groundwater system outflows

Specific Yield Method

Equation 3-4 was compared to the calculated annual change in groundwater storage based on average annual water level decline, developed using hydrographs, contour maps, and specific yield. See **Table 3-4** for a comparison of change in storage calculations. As defined in the HCM, the specific yield for AWD is 0.12 and average annual water level decline across the district is approximately 0.7 feet per year during the 10-year average hydrologic period. This Specific Yield Method for calculating annual change in groundwater uses **Equation 3-5**:

Equation 3-5 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)

Both methods for determining upper aquifer overdraft and change in groundwater storage were utilized. The Specific Yield Method was used to inform and calibrate the inflows and outflow components (i.e. the Specific Yield method was used as check against the Inflow/Outflow method.) This allowed for known physical conditions, such as groundwater elevation and specific yield, to be used for calculating the change in groundwater storage over the historic period (**Table 3-4– Method 2**). An average change in groundwater elevation was used due to a lack of sufficient data by year.

The average change in storage calculated using the specific yield method was then used to help quantify unknown water budget parameters, such as groundwater inflow by setting the inflow/outflow change in groundwater storage equal to the specific yield change in storage.

Once values were developed for all water budget parameters in the inflow/outflow method, AWD was able to analyze individual water years during the hydrological average period as required for the Coordinated Delta-Mendota Water Budget. Since some of the values for the inflow/outflow method were calculated using the average period, values were unavailable for various year types. This created additional error in the water budget when inflows and outflows were assessed for individual years. **Table 3-4** compares the two methods with the inflow/outflow method calculated annually for the historic period.

Subsidence Mapping Method

Change in storage in the lower aquifer can be directly correlated to subsidence. Because of this subsidence mapping, as described in the Monitoring Network chapter, was used to calculate a change in lower aquifer storage using the following formula shown in **Equation 3-6 Groundwater Storage Change (Subsidence Mapping)**.

Equation 3-6 Groundwater Storage Change (Subsidence Mapping)

$$\Delta\ Storage = Average\ \Delta GS * A$$

Where:
Average ΔGS = Average Change in Ground Surface Elevation (feet)
A = Area of GSA (acres)

The average change in ground surface elevation was calculated over the available period of record from Local Surveys and USBR and SJRRP monitoring data from 2011-2017. This period likely results in higher than average subsidence, however, it is the best available data and is considered conservative for this estimate. The average annual rate of subsidence from that period amounted to a 0.17-ft/yr loss of elevation. Because compaction of fine-grained strata, including the Corcoran Clay and deeper clays, is responsible for the storage change in the lower aquifer, the subsidence mapping method is the preferred method for determining average change in storage in the lower aquifer.

Table 3-4: Average Annual Change in Storage

Method	Upper	Lower
Specific Yield (AF/y)	- 2,200	NA
Inflow/Outflow (AF/y)	- 2,200	NA
Subsidence Mapping (AF/y)	NA	- 4,400

3.3.3.2 Sustainable Yield

The Delta-Mendota Coordination Committee developed basin-wide sustainable yield numbers for both the upper and lower aquifer in a coordinated fashion as required by SGMA; however, estimates were developed using limited data. Improved sustainable yield estimates should be prepared as additional data are collected over the first five years. The basin-wide analysis resulted in an Upper Aquifer Sustainable Yield estimate of 403,000 AF.

The basin-wide estimates for the Lower Aquifer sustainable yield are approximately 101,000 acre-feet per year over the approximately 750,000-acre Subbasin. Sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of AWD to monitor groundwater conditions that may result from lower aquifer pumping. Additional information on the sustainable yield development for the upper and lower aquifer is available in **Appendix B – Common Chapter**.

3.3.4 Current, Historical, and Projected Water Budget

Regulation Requirements:

§354.18
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

3.3.4.1 Current Water Budget

Regulation Requirements:

§354.18
(c) (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.
(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:
(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.

The Current Water Budget is just a snapshot, while the Historic Water Budget more accurately portrays the cause and effect of parameters in the District. The Delta-Mendota Subbasin chose 2013 as the current year. Since there was no requirement in 2013 to monitor to the level required for a districtwide water budget, the data is limited to what is publicly available. Because data was not available for each parameter, averages from the historic water budget were used to supplement data gaps. Data gaps include annual values for surface water infiltration from irrigation canals and channels, annual groundwater inflow and outflows, and flow to the lower aquifer from the upper aquifer. The 2003-2012 historic average value from **Table 3-7** was used for the purposes of the current water budget in **Table 3-5**. **Figure 3-6** provides a cross-walk between the AWD current water budget categories and the coordinated, basin-wide water budget categories.

Table 3-5: 2013 - Current Water Budget

Aliso Water District 2013 – Current Water Budget			
Surface Water System			
Inflows	Precipitation		10,600
	Surface Water Inflows		-
	Applied Water - Groundwater		103,471
	Applied Water - Imported Surface Water		-
	Other Direct Recharge		-
	Total Inflows		**114,071**
Outflows	Runoff		4,200
	Evapotranspiration		76,000
	Surface Water Outflows		700
	Deep Percolation		36,300
	Total Outflows		**117,200**
Groundwater System			
Inflows	Deep Percolation	*Precipitation Infiltration*	1,100
		Surface Water Infiltration	2,600
		Applied Water Infiltration	32,600
	Subsurface Groundwater Inflows	*Upper Aquifer*	21,300
		Lower Aquifer	-
	Other Recharge/Seepage (CBP, SJR, MP)		44,500
	Total Inflows		**102,100**
Outflows	Groundwater Extraction from Upper Aquifer		103,271
	Groundwater Extraction from Lower Aquifer		-
	Subsurface Groundwater Outflows[1]	*Upper Aquifer*	11,100
		Lower Aquifer	-
	Total Outflows		**114,371**
Change in Storage	Estimated Annual Change in Groundwater Storage	Inflows	102,100
		Outflows	114,371
		Change in Storage - Upper Aquifer	(12,271)
		Change in Storage - Lower Aquifer	-
		Change in Storage - Total	(12,271)

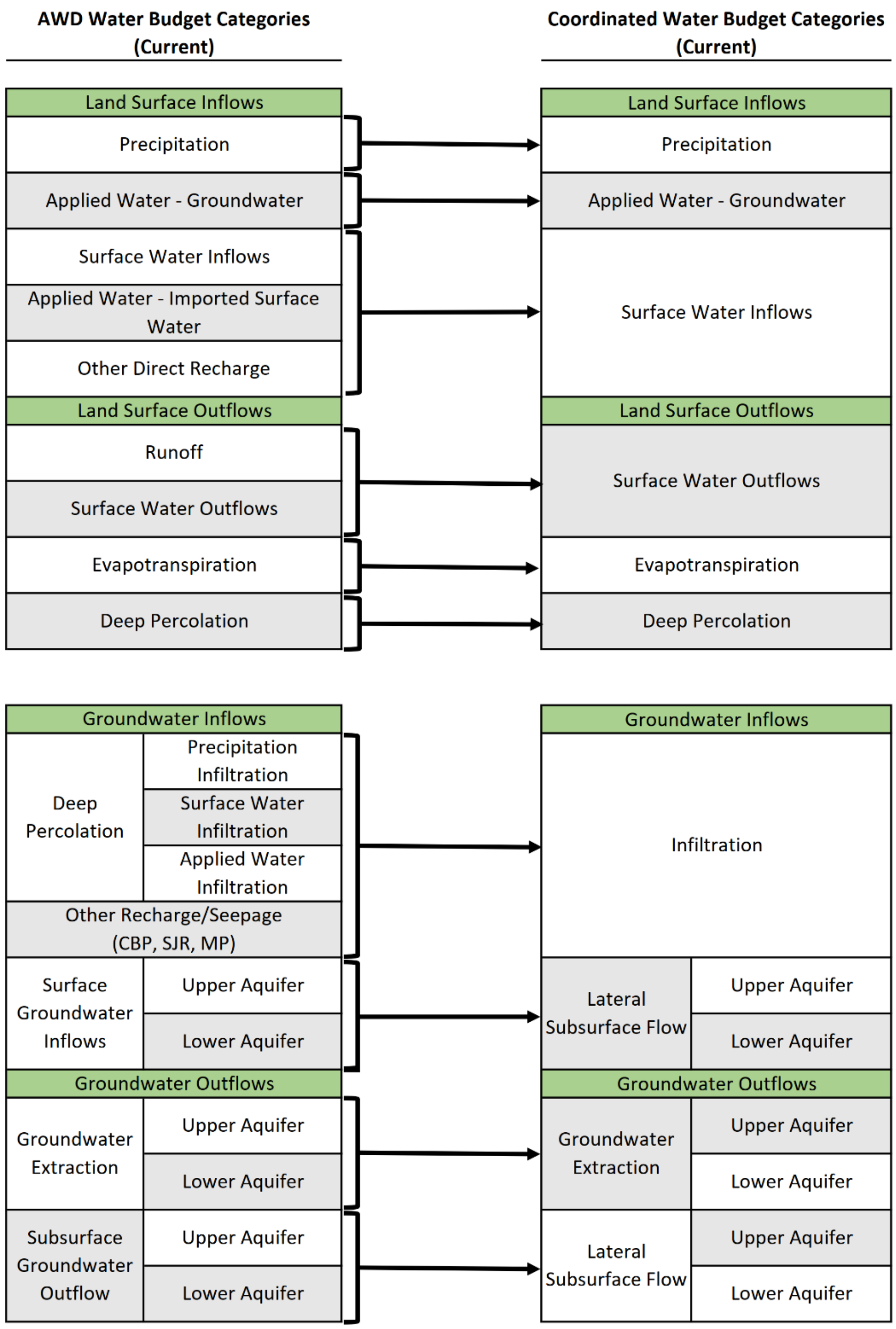

Figure 3-6: Water Budget Cross-Walk (Current)

3.3.4.2 Historic Budget

Regulation Requirements:

§354.18
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(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.
(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.

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 soil conditions, adequate data availability; and inclusion of current hydrologic, cultural, and water management conditions in the basin.

As previously mentioned, the historic water budget was prepared using data from the water years 2003-2012, which represents a typical hydrologic period for the Subbasin based on flow in the SJR. In building the water budget, full natural flow of the SJR was evaluated for the duration of historic record, going back to 1901, to get a long-term average flow rate. Historical averages were calculated from 1990 to 2015 using different time periods. The period of WY 2003-2012 was chosen because it represents a recent average period that lies outside the most recent drought. The full natural flow was also compared to precipitation records in the area and the SJR water year index. The percent water year is based on DWR's water year index for the SJR. It should be noted that for simplification purposes above normal and below normal years were grouped into "normal years" and dry and critically dry years were grouped into "dry years." **Table 3-6** shows the full natural flow and percent water year of the SJR for average historic period chosen.

Table 3-6: Average Historic Period – SJR Full Natural Flows

Water Year	Water Year Type	Runoff (AF)	Percent Water Year
2003	Normal	1,450,000	81%
2004	Dry	1,131,000	63%
2005	Wet	2,830,000	158%
2006	Wet	3,181,000	177%
2007	Dry	684,000	38%
2008	Dry	1,117,000	62%
2009	Dry	1,455,000	81%
2010	Normal	2,029,000	113%
2011	Wet	3,305,000	184%
2012	Dry	832,000	46%
	Average Percent Water Year		100.3%

All other parameters for factoring inflow and outflow have been described in the previous section and are summarized in the Historic Water Budget Summary (**Table 3-7**). In compliance with the Coordination Agreement, water budget schematic components were revised to establish consistent methodology throughout the entire Subbasin; a water budget crosswalk was developed to outline this effort (**Table 3-8**; **Figure 3-6** and **Figure 3-7).**

The historic water budget was prepared for an average 10-year period, and each parameter was analyzed independently and averaged over a 10-year period and on a year-by-year basis as required by DWR. On an average annual basis, the water budget for AWD shows an average change in storage of approximately 2,200 AF/Y. As discussed earlier in chapter two, the District is primarily made up of farmland, which means high water demand for irrigation. Total water demand has increased over the period as permanent crops have replaced row crops, while surface supplies vary. Historically, water year type has a limited effect on groundwater overdraft on a year to year basis, except during wet years when the aquifer responds with significant increases in groundwater storage. During normal and dry years change in storage is relatively constant, with water levels dropping at a similar rate. The District is mainly groundwater dependent; however, seepage from the SJR and Chowchilla Bypass and other surface water sources allow significant groundwater inflow to replenish water levels. This has kept the overall long-term decline in groundwater levels at a rate of less than one foot per year over a hydrologically average period.

Table 3-7: Historic Water Budget Summary

Aliso Water District
Aliso GSA Water Budget (2003-2012)
Water Balance - Average Annual Values
Period of Record: 2003-2012

(all units in acre-feet)

Description	Irrigation Eff. Symbol	70% Volume (AF)	Source
Supply			
1) Surface Water - Irrigation	Qirr	8,400	Measured
2) Surface Water - Recharge	Qmi	1,600	Measured
3) **Groundwater Pumping - Irrigation (Private Wells, calculated/estimated)**	Gwirra	0	Measured
4) **Groundwater Pumping - Irrigation (Private Wells, unknown)**	Gwirrp	85,600	Residual
5) **Groundwater Pumping - M&I (Agency Wells)**	Gwmia	0	Measured
6) **Groundwater Pumping - M&I (Private Wells)**	Gwmip	200	Calculated
7) Precipitation	P	15,500	Measured
8) Spill Inflows	Si	0	Calculated
9) Other Supply:	Os	0	
Total Supply		**111,300**	
Demand			
Consumptive Use			
10) Evapotranspiration met by Applied Water	ETc	63,500	Calculated
11) Evapotranspiration met by Effective Precipitation	ETp	7,000	Calculated
12) Evapotranspiration - M&I	ETmi	0	Calculated
13) Other Consumptive Use:	Od	200	Calculated
Consumptive Subtotal		**70,700**	
Groundwater Recharge			
14a) **Groundwater - Inflow**	GWi	8,900	Residual
14b) **Groundwater - Inflow**	GWi	12,400	Calculated
15) **Deep Percolation - Irrigation**	PRCirr	27,200	Calculated
16) **Deep Percolation - Precipitation**	PRCp	1,600	Calculated
17) **Deep Percolation - M&I**	PRCmi	0	Calculated
18) **Seepage - Channels (& Pipeline Leakage)**	Sch	2,600	Calculated
19) **Seepage - Reservoirs**	Sr	0	Calculated
20) **Urban Stormwater - Recharge**	Rus	0	Calculated
21) **Local Streams/Rivers - Recharge**	Rst	40,400	Calculated
22) **Groundwater - Intentional Recharge**	Rint	1,600	Measured
23) **Other Recharge:**	Or	0	
GW Recharge Subtotal		**94,700**	
Losses			
24) **Groundwater - Outflow**	GWo	11,100	Calculated
25) Evaporation - Channels	Ech	400	Calculated
26) Evaporation - Reservoirs & Recharge Basins	Er	300	Calculated
27) Precipitation - Evaporation and Runoff	Ep	6,900	Residual
28) Operational Spills	S	0	Measured
29) **Groundwater - Export**	GE	0	Measured
30) Other Losses:	Ol	0	
Loss Subtotal		**18,700**	
Method 1			
Estimated Annual Change in Groundwater Storage		**(2,200)**	Calculated
Groundwater Inflow GW Recharge - #15 thru #23	73,400		
Inflow - #14a and #14b	21,300		
Groundwater Outflow GW Pumping - #3 thru #6	(85,800)		
Outflow - #24 and #29	(11,100)		
Method 2			
Calculated Annual Change in Groundwater Storage		**(2,200)**	Measured
Average water level change during period	(0.70)	feet/year	
District size	26,600	acres	
Assumed specific yield	0.12		

Table 3-8: Historic Water Budget Summary with Reference to Coordinated Water Budget Categories

Water Budget Overview

Aliso Water District
Aliso GSA Water Budget (2003-2012)
Water Balance - Average Annual Values
Period of Record: 2003-2012

(all units in acre-feet)

Coordinated Water Budget Categories (See Common Chapter - Appendix B, Section 4.3)	Description	Symbol	Volume (AF)	Source
		Irrigation Eff.	70%	
	Supply			
Surface Water Inflows	1) Surface Water - Irrigation	Qirr	8,400	Measured
Surface Water Inflows	2) Surface Water - Recharge	Qmi	1,600	Measured
Groundwater Extraction - Upper Aquifer / Applied Water - Groundwater	3) **Groundwater Pumping - Irrigation (Private Wells, calculated/estimated)**	Gwirra	0	Measured
Groundwater Extraction - Upper Aquifer / Applied Water - Groundwater	4) **Groundwater Pumping - Irrigation (Private Wells, unknown)**	Gwirrp	85,600	Residual
Groundwater Extraction - Upper Aquifer / Applied Water - Groundwater	5) **Groundwater Pumping - M&I (Agency Wells)**	Gwmia	0	Measured
Groundwater Extraction - Upper Aquifer / Applied Water - Groundwater	6) **Groundwater Pumping - M&I (Private Wells)**	Gwmip	200	Calculated
Precipitation	7) Precipitation	P	15,500	Measured
	8) Spill Inflows	Si	0	Calculated
	9) Other Supply:	Os	0	
	Total Supply		**111,300**	
	Demand			
	Consumptive Use			
Evapotranspiration	10) Evapotranspiration met by Applied Water	ETc	63,500	Calculated
Evapotranspiration	11) Evapotranspiration met by Effective Precipitation	ETp	7,000	Calculated
Evapotranspiration	12) Evapotranspiration - M&I	ETmi	0	Calculated
Evapotranspiration	13) Other Consumptive Use:	Od	200	Calculated
	Consumptive Subtotal		**70,700**	
	Groundwater Recharge			
Lateral Subsurface Flow - Upper Aquifer	14a) **Groundwater - Inflow/Out Basin**	GWi	8,900	Residual
Lateral Subsurface Flow - Upper Aquifer	14b) **Groundwater - Inflow/In Basin**	GWi	12,400	Calculated
Infiltration	15) **Deep Percolation - Irrigation**	PRCirr	27,200	Calculated
Infiltration	16) **Deep Percolation - Precipitation**	PRCp	1,600	Calculated
Infiltration	17) **Deep Percolation - M&I**	PRCmi	0	Calculated
Infiltration	18) **Seepage - Channels (& Pipeline Leakage)**	Sch	2,600	Calculated
Infiltration	19) **Seepage - Reservoirs**	Sr	0	Calculated
Infiltration	20) **Urban Stormwater - Recharge**	Rus	0	Calculated
Infiltration	21) **Local Streams/Rivers - Recharge**	Rst	40,400	Calculated
Infiltration	22) **Groundwater - Intentional Recharge**	Rint	1,600	Measured
Infiltration	23) **Other Recharge:**	Or	0	
	GW Recharge Subtotal		**94,700**	
	Losses			
Lateral Subsurface Flow - Upper Aquifer	24) **Groundwater - Outflow/In Basin**	GWo	11,100	Calculated
Surface Water Outflows	25) Evaporation - Channels	Ech	400	Calculated
Surface Water Outflows	26) Evaporation - Reservoirs & Recharge Basins	Er	300	Calculated
	27) Precipitation - Evaporation and Runoff	Ep	6,900	Residual
	28) Operational Spills	S	0	Measured
	29) **Groundwater - Export**	GE	0	Measured
	30) Other Losses:	Ol	0	
	Loss Subtotal		**18,700**	
	Method 1			
	Estimated Annual Change in Groundwater Storage		**(2,200)**	Calculated
	Groundwater Inflow — GW Recharge - #15 thru #23	73,400		
	Inflow - #14a and #14b	21,300		
	Groundwater Outflow — GW Pumping - #3 thru #6	(85,800)		
	Outflow - #24 and #29	(11,100)		
	Method 2			
	Calculated Annual Change in Groundwater Storage		**(2,200)**	Measured
	Average water level change during period	(0.70) feet/year		
	District size	26,600 acres		
	Assumed specific yield	0.12		
		Water balance closes within acceptable limit		

3.3.4.3 Projected Water Budget

Regulation Requirements:

§354.18
(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:
(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:
(3) Projected water budget information for population, population growth, climate change, and sea level rise.

The goal of a projected water budget is to estimate future baseline conditions in response to GSP implementation. The projected water budget must use 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.

A yearly sequence was chosen to line up historical data to projected years from 2018 to 2070. A similar historic period to the recent drought was identified from 1975-1977. The following year 1978 was used to be the first projected year and corresponded to 2017. The historical sequence of years from 1978 through 2017 were used in the projected water budget to represent future water years 2017 until 2056. For the years 2012-2017, which would correspond to projected years 2052-2056, climate change factors were not available, so surrogate years were chosen based upon similar water years. **Table 3-9** shows the matching surrogate years for this period. For the years 2057-2070 the historical water years of 1965-1978 were used in sequence.

Table 3-9: Surrogate Projected Years (2052-2056)

Surrogate Years for 2012-2017	
Historical Year	**Surrogate Year**
2012	2001
2013	1992
2014	1976
2015	1977
2016	2002
2017	2011

A simplified model was used to calculate the projected water budget for 2020-2070. Precipitation and ET components were calculated based upon historical measurements. For projected land use, cropping was maintained at 2017 acreages for all future years. No communities are within the GSA, so population growth was not considered. Cross-boundary groundwater flows had the greatest uncertainty and were set during the calibration of the model. Other components were formulated by selecting and applying conditions based on four different water year types. Three types were identified based upon historical indices of the San Joaquin River: Dry, Normal, Wet. The fourth water year type, Wet-Flood, was identified as a Wet San Joaquin River year in which the Chowchilla Bypass was utilized. Water year types were kept the same for projected years and not recalculated based upon climate change. For each year type, water budget components had specified volumes, which were applied to the projected year from which climate was derived. Wet and Wet-Flood years were represented with values from 2006, dry years from 2012, and normal years from 2010. **Table 3-10** shows the values used for each representative year component and **Figure 3-7** illustrates the relationship between the AWD projected water budget categories to the coordinated projected water budget categories.

Table 3-10: Projected Water Budget Representative Year Type Component Values in AF/year

Representative Water Year Type	Wet-Flood	Wet	Normal	Dry
Representative Year	**2006**	**2006**	**2010**	**2012**
Surface Water Inflow				
Surface Water Inflows	0	0	0	0
Applied Water - Imported Surface Water	16,700	16,700	3,300	500
Surface Water for Recharge	0	0	200	1,500
Other Pumping (M&I)	200	200	200	200
Surface Water Outflow				
Canal/Reservoir Evaporation	700	700	700	700
Groundwater Inflow				
Surface Water Infiltration	2,600	2,600	2,800	4,100
Subsurface Groundwater Inflow	10,000	10,000	15,000	20,000
Other Direct Recharge	75,000	54,300	44,400	42,000
Projects	10,000*	0	0	0
Groundwater Outflow				
Subsurface Groundwater Outflow	6,000	10,000	30,000	40,000
***For 2046-2070 21,500 AF/year was used for projects during Wet-Flood years**				

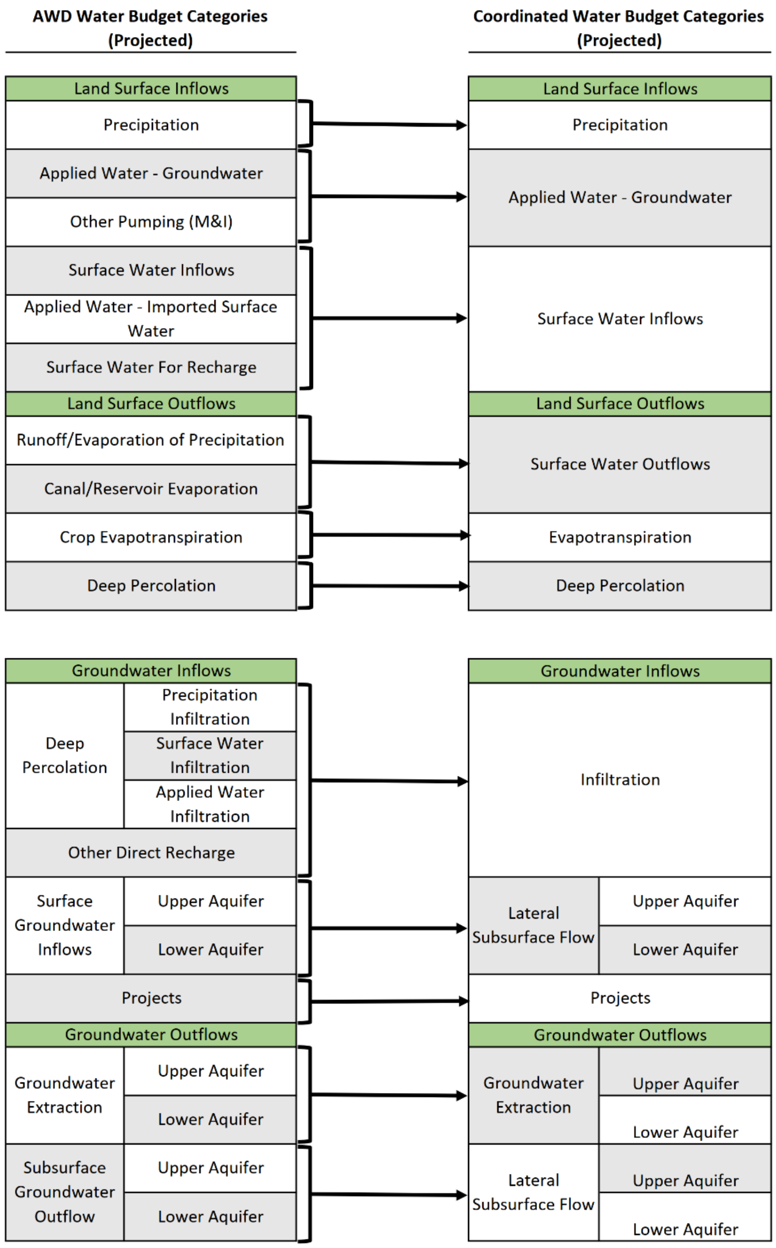

Figure 3-7: Water Budget Cross-Walk (Projected)

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. Precipitation and minimum and maximum temperature measurements were obtained from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) historical datasets located at http://www.prism.oregonstate.edu (Daly et al.,1994). 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 considered 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. Monthly evapotranspiration was instead calculated with PRISM temperature data using the Hargreaves-Samani equation (Hargreaves and Samani, 1982), shown in **Equation 3-7**, from the DWR California Simulation of Evapotranspiration of Applied Water (Cal-SIMETAW) model (Orang et al., 2013). 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 3-7 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

Precipitation and derivation of ET from PRISM were used in the baseline calculations for the model. To consider the effects of climate change, DWR provided a dataset containing factors to apply to historical data. 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 period 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 period change factors were used.

The baseline calculations were used to calibrate the model based upon known historical change in storage. The tabulation for cross-boundary groundwater flows in and out of the District are the most uncertain of the considered components. There will be added uncertainty in the future as the conditions of neighboring basins change in the process of becoming sustainable. In consideration of these factors, subsurface groundwater flow components were adjusted to calibrate yearly overdraft estimation from the 50-year base climate period without climate change factors applied. The baseline calibrated change in storage is shown in **Figure 3-8**.

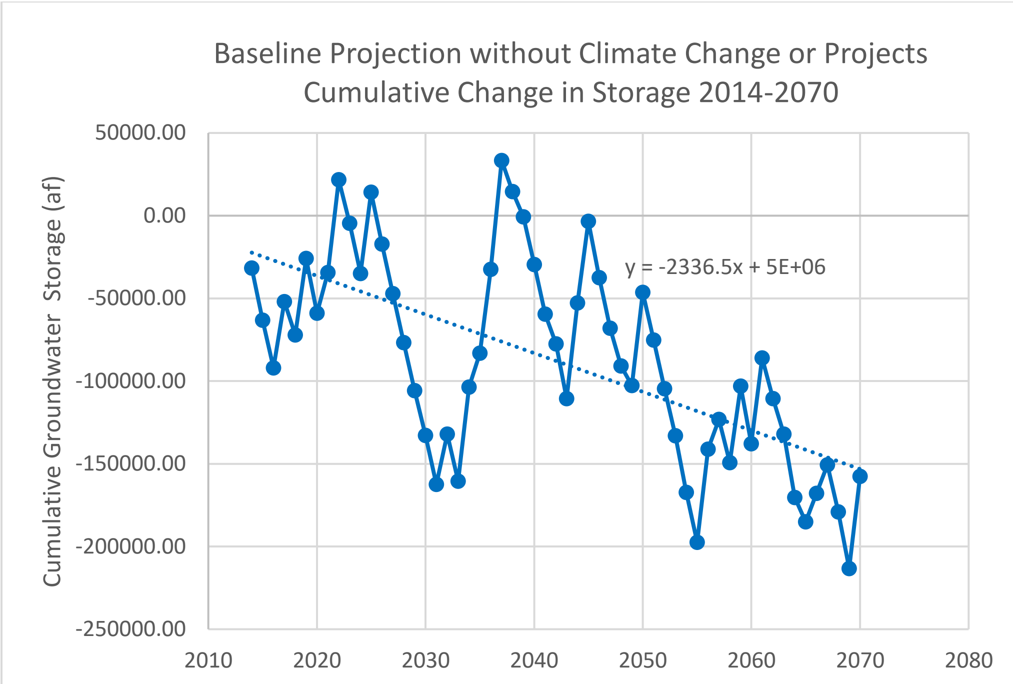

Figure 3-8: Water Budget Projection Baseline

The climate change factors were then applied to the calibrated baseline. The modeled change in storage with climate change is shown in **Figure 3-9**. Using 2030 climate change factors through 2045 (diversions off the Chowchilla Bypass were considered a source of surface water that would be diverted for recharge, estimated to be available for utilization on an average of every four years). A pending water rights application for diversions up to 10,000 AF were used to make up for change in storage. Beginning in 2045, climate change factors from the 2070 period were applied resulting in a projection of increased ET. To make up for the corresponding change in storage, an additional recharge volume of 21,500 AF from projects during Wet-Flood years was used to balance the budget. The modeled change in storage considering climate change and the corresponding recharge from projects is shown in **Figure 3-10**. For more information on projects see **Chapter 6**.

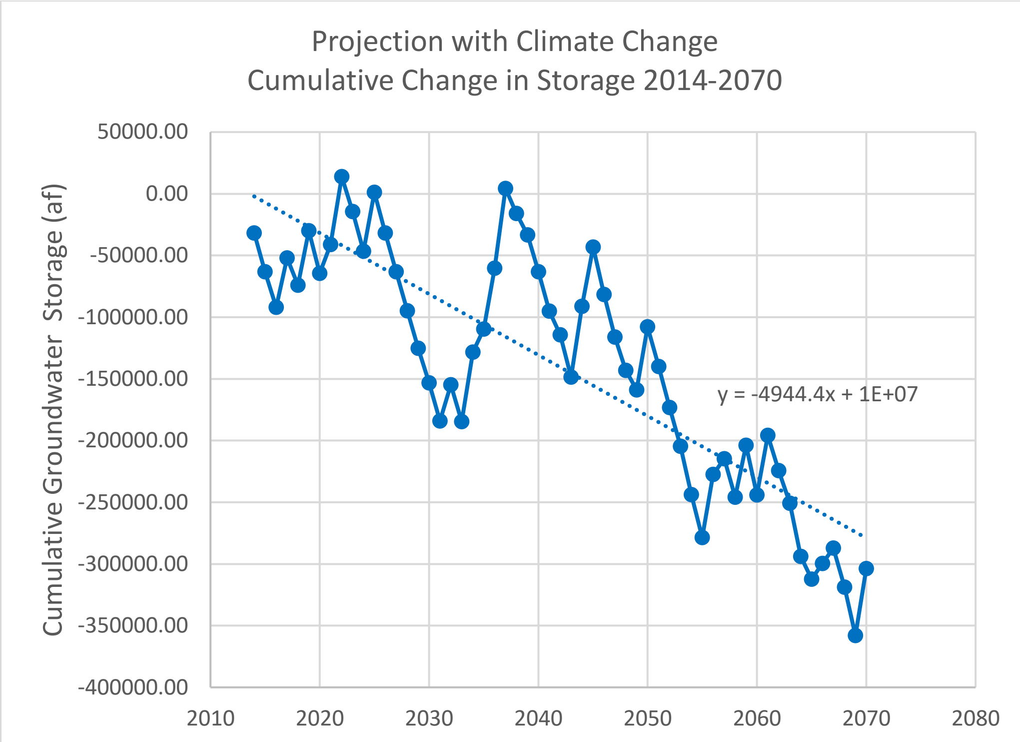

Figure 3-9: Water Budget Projection with Climate Change and Management Actions

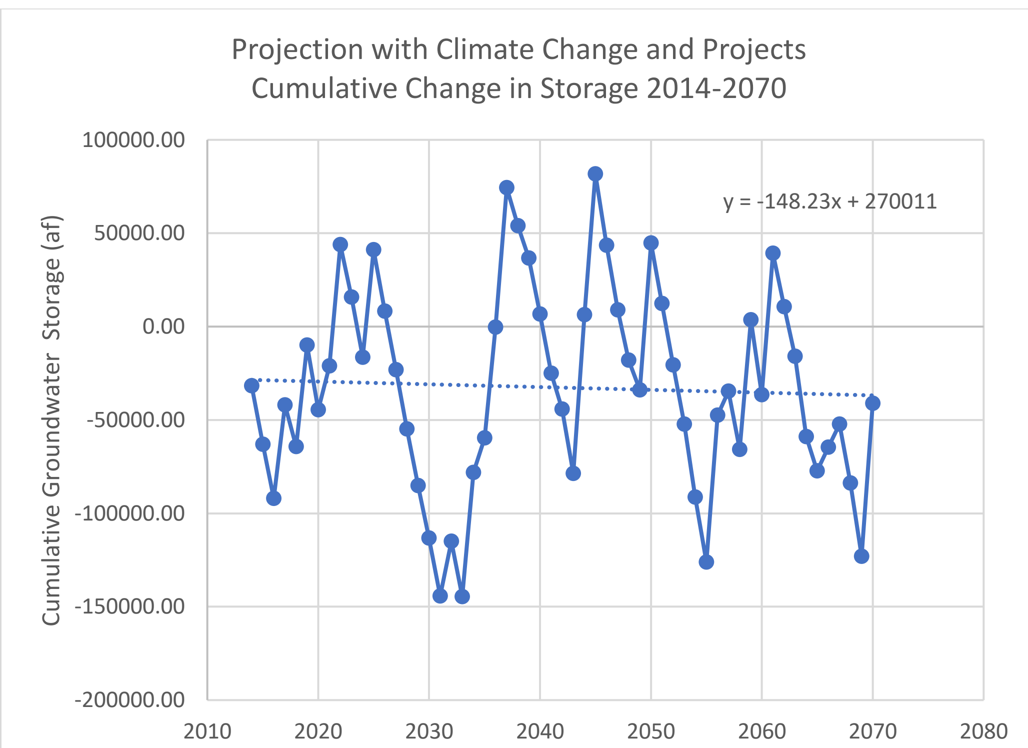

Figure 3-10: Calibrated Water Budget Projection with Climate Change and Management Actions

In addition to the uncertainties of changes in climate, groundwater outflow, and land use, there were other factors that affected the projected change in storage calculations. The water budget was computed for each projected year individually, so inter-year trends and variability did not affect water budget components. The lack of inter-year variability led to compounding effects of wet or dry years. Because every dry year was represented by 2012 conditions, a four-year drought would result in four consecutive years of 2012 conditions. If this sequence of years were to occur, the years would be either slightly wetter or drier, resulting in different availabilities of water and changes in management that would consume a different volume of water.

Projected changes in population were not made because there are no nearby communities. As a result, effects of drought and water shortage beyond the conditions of the historical data were not considered. The most recently calculated crop coefficients were used to determine the consumptive use of crops, but it is unknown how the coefficients will change under future management and climate change. There are also limitations in future conditions for flows in the SJR. The SJRRP projects have increased flows from those that occurred during the 10-year average hydrologic period. These are not accounted for in the specific year types used to project current conditions due to uncertainty of implementation. In addition, the climate change factors for SJR flows have not been included, but based on studies by others for Temperance Flat, it is expected that flood releases from Millerton may occur earlier in the year and at higher rates than those occurring historically. This would result in more high-flow periods which would increase the seepage, associated groundwater flows, and availability of water in the Chowchilla Bypass for diversion to recharge.

3.4 Management Areas

Regulation Requirements:

§354.20 (a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.

(b) A basin that includes one or more management areas shall describe the following in the Plan:

(1) The reason for the creation of each management area.

(2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.

(3) The level of monitoring and analysis appropriate for each management area.

(4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.

(c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.

The Aliso Water District GSA will be managing the basin as one unit.

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4 Sustainable Management Criteria

Regulation Requirements:

> **§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 each GSP in the Subbasin. 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. The development of these Sustainable Management Criteria was coordinated at the Subbasin level through the DMGB Technical Working Group and Coordination Committee.

Indicators for the sustainable management of groundwater were determined by SGMA based on criteria 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, discuss why they are significant, and will define the management thresholds for maintaining sustainability.

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 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 sustainability goal is a general description of the objectives of the GSP for the Subbasin. It is important to note that the identified successful result of each GSP in the Subbasin is the avoidance of undesirable results defined in **Section 4.3**.

The sustainability goal for the Delta-Mendota Subbasin was established to succinctly state the objectives and desired conditions of the Subbasin that will culminate in the absence of undesirable results by 2040. The sustainability goal for the Delta-Mendota Subbasin is as follows and was approved by the Delta-Mendota Subbasin Coordination Committee during the June 10, 2019 meeting (See **Common Chapter – Appendix B**):

> *The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.*

It is the intent of AWD to work collaboratively with the Subbasin to continue to better understand the basin characteristics by establishing a coordinated network of monitoring points and reporting requirements. This will help to recognize existing hydrogeological patterns to better refine Sustainable Management Criteria (SMC) in future Plan updates. It is also the intent of AWD GSA and other Basin members to establish criteria and implement programs and projects to monitor and manage groundwater levels and storage, protect water quality, and reduce the effects of subsidence in a manner that is open to the public and stakeholders and considers the needs of all beneficial users. **Table 4-1** shows all SMCs developed for each sustainability indicator by location.

The intent for each GSP in the Subbasin is to provide a tool for managing groundwater that will assist in maintaining basin-wide sustainability for the long-term. Sustainability will be determined by the Subbasin's ability to avoid undesirable results by establishing a common definition of minimum thresholds and measurable objective of each sustainability indicator defined in **Section 4.2**. The participants in the Delta-Mendota Subbasin will work collectively to manage groundwater resources in the basin. **Chapter 3** provides insight to current and historical groundwater conditions demonstrating the natural variability of the region and a water budget which quantifies factors contributing to inflows and outflows.

In order to achieve the goals outlined in the Common Chapter, continued management practices, monitoring, and projects to secure alternative sources of water will be implemented over the course of the next 20 years. When surveyed, landowners within AWD GSA noted that they have not experienced significant and unreasonable groundwater conditions that would lead to undesirable results. However, plans to increase monitoring of the sustainability indicators will improve analysis of groundwater conditions in the future. Existing and planned projects and management actions to aid in Plan implementation are identified in further detail in **Chapter 6**.

To assess the path to sustainability, the sustainable management criteria will be evaluated in conjunction with the data obtained via monitoring efforts identified in **Chapter 5**. Every five years, AWD and the other five Subbasin GSP groups can revise their Plans with the intention of refining the course to basin-wide sustainability, based on information learned via monitoring, outreach, and improved data quality and quantity (i.e., adaptive management).

The measurable objective quantitatively reflects the sustainability goal at 2040 and the interim goals quantitatively represent the sustainability goal at five-year increments, corresponding with Plan update periods. Monitoring results will be compared to the interim goals, measurable objective, and minimum threshold during Annual Report and GSP update development. The analysis will assess the District's ability, and the Subbasin as a whole, to prevent undesirable results as they relate to the other SMCs.

Table 4-1: Sustainable Management Criteria Summary

Sustainability Indicator	Threshold Description	Monitoring Site ID	DMS ID	Threshold Units	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
Water Levels	Historical seasonal low prior to the end of Water Year 2016	12S15E32B002M	09-001	Feet above msl	≥114.3	≥114.3	≥114.3	≥114.3	40.5
		13S15E14M001M	09-003	Feet above msl	≥52.9	≥52.9	≥52.9	≥52.9	37.4
		13S16E30A001M	09-004	Feet above msl	≥51.9	≥51.9	≥51.9	≥51.9	37.7
		12S16E31G001M[1]	09-002	Feet above msl	≥17.1	≥17.1	≥17.1	≥17.1	-4.0
Groundwater Storage	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.								
Subsidence	The minimum threshold is set to not exceed 2 ft of additional inelastic land subsidence attributable to groundwater extraction.	Lifeson	09-008	Feet above msl	≥178.33	≥177.83	≥177.59	≥177.33	177.33
		Aliso WD 1 Reset	09-006	Feet above msl	≥157.52	≥157.02	≥156.77	≥156.52	156.52
		DWR at Gravelly Ford Canal	09-007	feet above msl	≥201.39	≥200.89	≥200.64	≥200.39	200.39
Water Quality	TDS – 1,000 mg/L based on drinking water standards	AWD-1	09-005	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		13S15E14M001M	09-003	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		13S16E19J001M	09-196	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		12S16E31G001M[1]	09-002	TDS (mg/L))	<1,000	<1,000	<1,000	<1,000	1,000
Interconnected Surface Water	Identified data gap in the DMGB. The Chronic Lowering of Groundwater Levels Minimum Threshold is used as an interim minimum threshold.								
Seawater Intrusion	Not Applicable	N/A		N/A	N/A	N/A	N/A	N/A	N/A

1. ***Composite Well to be evaluated for replacement at Year-5 Interim Milestone.***

4.2 Sustainability Indicators

AWD and the DMBG will monitor groundwater conditions that correspond with sustainability indicators established by DWR (**Figure 4-1**) when feasible and applicable to the Subbasin. SMCs were developed during numerous meetings with the Coordination Committee for each indicator, setting consistent definitions and methodologies for establishing values at which undesirable results would be avoided. These values are intended to define the range in which groundwater is in a sustainable condition. Exceedances of these SMCs do not signify unsustainable conditions in themselves. However, they may initiate additional investigations or monitoring to determine if significant and unreasonable effects are being experienced as a result of exceeding set SMCs. With the limited data available to set SMCs, it is possible that the thresholds used to define significant and unreasonable conditions resulting in an undesirable result will require reevaluation and revision. Therefore, AWD will be a proponent of using adaptive management to adjust criteria while avoiding threshold exceedances which may result in undesirable results. For example, if a threshold set for a specific sustainability indicator exceeds the minimum value for any length of time without triggering significant and unreasonable effects, SMCs may be reconsidered. Conversely, should significant and unreasonable effects be experienced prior to threshold exceedance, SMC values may also be reconsidered.

Figure 4-1: Sustainability Indicators

4.3 Undesirable Results

Undesirable results are broadly defined by SGMA. This allows for local control at the subbasin level to define what would significantly and unreasonably impact beneficial users of groundwater within their boundaries. Due to the broad definition of undesirable results and the need to identify localized significant and unreasonable impacts for each Plan Area, undesirable results were refined at the subbasin level by the Delta-Mendota Subbasin Coordination Committee that met and agreed to a singular coordinated definition of undesirable results to be used by the six Delta-Mendota GSP groups.

Definitions for specific sustainability indicators are provided in Section 10721 of the SGMA regulations.

Groundwater Levels

> Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

Groundwater Storage Volume

Significant and unreasonable reduction of groundwater storage.

Seawater Intrusion

Significant and unreasonable seawater intrusion.

Water Quality

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

Subsidence

Significant and unreasonable land subsidence that substantially interferes with surface land uses.

Interconnected Surface Water

Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

It is incumbent of agencies to define potential significant and unreasonable effects within each basin or plan area. This is the basis for establishing the SMC and allows flexibility for Plan implementation. Undesirable Results will be discussed in greater detail for each sustainability indicator in the following sections.

4.3.1 Undesirable Result Development

Regulation Requirements:

§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.

4.3.1.1 Delta-Mendota Subbasin

Undesirable Results were broadly defined by SGMA as outlined above. It is the intent of SGMA to allow basins and GSAs to define the specific conditions at which sustainability indicators become significant and unreasonable and cause an undesirable result. Because of the dynamic nature of the Delta-Mendota Subbasin, the DMGB Technical Working Group and Coordination Committee held numerous meetings to develop common definitions of Undesirable Results, Significant and Unreasonable results, and common methodologies for establishing numeric Minimum Thresholds, Measurable Objectives, and 5-year Interim Goals for each sustainability indicator. The DMGB has defined Undesirable Results as (See Common Chapter – **Appendix B**):

Groundwater Levels

Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.

Groundwater Storage Volume

A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.

Seawater Intrusion

Not defined – Inapplicable.

Water Quality
Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.
Subsidence
Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.
Interconnected Surface Water
Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources of downstream beneficial uses and users.

4.3.1.2 Aliso Water District

During the development of the AWD GSA January 2020 GSP, the District introduced stakeholders to Sustainable Management Criteria at a regularly scheduled meeting of the AWD GSA. SMCs were defined and discussed at length. The Board requested input on defining significant and unreasonable undesirable results and determining how minimum threshold exceedances translate into undesirable results, while considering historic groundwater conditions, aquifer characteristics, well construction, existing infrastructure, production costs, improvement costs, adjacent agencies and basins, and previously experienced issues.

The District then conducted two workshops to address Sustainable Management Criteria. The first requested input from all interested parties on identifying significant and unreasonable impacts to beneficial users. The District developed and sent out an Undesirable Result Questionnaire to stakeholders to determine:

- *Potential impacts in Aliso due to changing groundwater conditions*
- *Impacts that had been experienced previously*
- *Resiliency of aquifer to changes in groundwater conditions*
- *Tolerance of beneficial users to impacts*
- *Financial and environmental tolerance to impacts*

The purpose of the workshop was to rank potential impacts and determine at which point potential impacts would become significant and unreasonable.

The second workshop requested input from stakeholders on the development of methods for setting SMC values. Both workshops were open to the public. AWD discussed undesirable results and other SMC development concerns at their publicly noticed quarterly board meetings to keep interested parties, stakeholders, and board members up to date and involved. Generally, the following conclusions were made by stakeholders to guide the development of undesirable results and other SMC requirements:

- *It is unlikely that significant changes in groundwater conditions will occur as a result of AWD's existing agricultural practices.*
- *Impacts to beneficial users were minimal during the most recent drought and easily mitigated (e.g. lower pump bowl setting).*
- *AWD shows significant resiliency in the upper aquifer to the effects of District operations and hydrological cycles.*
- *Tolerances for reductions in water levels are high due to the resiliency of the upper aquifer and feasible and affordable implementation of possible mitigation efforts.*

- *Tolerances for increased subsidence is moderate. The landowners can tolerate modest costs to mitigate subsidence effects to their facilities (e.g. new wells or land grading). However, the GSA does not want to affect neighboring agencies, or bear the financial burden of mitigating impacts to subsidence to public infrastructure (e.g. flood levees or the Mendota Dam).*
- *Tolerances for groundwater quality are high due to the existing good water quality and the feasible and affordable implementation of possible mitigation efforts.*
- *Financial impacts are only likely to become significant and unreasonable if significant upgrades to infrastructure are required. Although subsidence only minimally affects the District, the effects of subsidence may prove costly if unmitigated due to impacts to others in the Subbasin.*
- *Environmental tolerances have been considered in depth by the SJRRP. The development of the Settlement Hydrographs and subsidence monitoring network take into consideration the environmental tolerances of flows in the SJR, losses along the SJR/AWD boundary, and impacts due to subsidence.*

These conclusions laid the foundation for the development of the significant and unreasonable impacts leading to undesirable results within the boundary of AWD, when developing the January 2020 GSP. Subsequently, following DWR's 'incomplete' determination in January 2022, these conclusions became guiding principles of the AWD GSA in their deliberations with the Delta-Mendota Coordination Committee and Technical Working Group to develop common SMCs. **Section 4.3.3** provides a full description of how SMCs will be evaluated to determine the presence of undesirable results.

4.3.2 Causes of Groundwater Conditions Leading 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.

As a result of stakeholder outreach, it was determined that there are currently no conditions causing significant and unreasonable undesirable results in the GSA. However, the following unforeseen and unpredictable changes in policy, land management, and the environment may impact groundwater conditions and lead to undesirable results in the Subbasin:

1. ***Climate Change***
    a. *Some information developed by the DWR suggests that warmer conditions could lead to more rain and less snowpack. This would lead to more runoff earlier on and less reliability of surface water sources during the irrigation season.*
    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**. Almonds, pistachios, grapes, and alfalfa are the predominant crops within AWD with almonds making up a majority of the land use. A change in cropping to include more water-intensive and permanent crops would increase crop demand.*

3. ***Lack of Access to Surface Supply***. *AWD currently relies almost completely on groundwater, surface water will likely be needed to supplement groundwater extractions in order to meet the sustainability goals set forth in the GSP.*
4. ***Excess Nutrient Application***. *The accumulated effects of nutrient application and other farming practices could lead to higher concentrations of contaminants of concern.*

4.3.3 Significant and Unreasonable Impacts & Threshold Exceedances Defining Undesirable Results

Regulation Requirements:

§354.26 (b) The description of undesirable results shall include the following:
(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.

Groundwater Levels/Groundwater Storage Volume

Groundwater levels directly influence the reduction of groundwater storage and interconnected surface water; therefore, groundwater levels will be used as a proxy for upper aquifer groundwater storage and interconnected surface water. Reviewing groundwater level changes over the 10-year hydrologically average period has shown that groundwater levels in AWD were dropping at a rate of less than 1 foot per year. Projections of continued decline at those rates indicate that no significant and unreasonable effects are likely to occur under a repeat of hydrologically average conditions through 2040. The most likely significant and unreasonable impact to the Subbasin would be the depletion of upper aquifer groundwater supplies creating increased dependence on the lower aquifer which over a series of years would cause accelerated rates of subsidence. Therefore, the sustainable management criteria for groundwater levels reflect thresholds to prevent the depletion of the productive layers of the upper aquifer that would cause increased reliance on the lower aquifer and thus potentially accelerate subsidence.

Groundwater Levels

The definition of significant and unreasonable for groundwater levels as described in Table CC-16 of the Common Chapter – **Appendix B**. is defined as follows:

> *Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increased costs associated with higher total pumping lift, lowering pumps, drilling deeper wells, or otherwise modifying wells to access groundwater, securing alternative water sources, or required mitigation of groundwater dependent ecosystems. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area.*

Groundwater Storage

The definition of significant and unreasonable for groundwater storage as described in Table CC-18 of the Common Chapter – **Appendix B**. is defined as follows:

> *A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial uses and natural resource areas in the Subbasin, including the conjunctive use of groundwater.*

AWD and other GSP groups in the Subbasin recognize that the undesirable result must be pervasive and chronic. Therefore, it was decided that if more than 50% of the RMS wells exceed minimum threshold values on a four-year rolling average, then significant and unreasonable effects could occur. The consideration of a four-year rolling average allows for natural hydrological fluctuations.

<u>Seawater Intrusion</u>

Not defined – Inapplicable. See **Section 4.3.6** – Sustainability indicators not used.

<u>Groundwater Quality</u>

Review of groundwater quality data in AWD determined water is of suitable quality for irrigation. Projections of groundwater quality indicate little change in groundwater quality under a repeat of hydrologically average conditions and land use through 2040, signifying that no significant and unreasonable effects are likely to occur. A proposed Mendota Pool Group pumping program has the potential to intercept good quality water that would normally flow to AWD GSA, but this program was not developed enough to need to consider its potential effects at this time. The most likely significant and unreasonable impact to the GSA would be severe economic hardship due to either a loss of crop production as a result of groundwater quality degradation or the costs associated with modifying existing wells, drilling new wells, or blending/treatment of groundwater. Future consideration may be given to drip irrigation. This is a widely used irrigation method throughout the District, and has its own concerns with groundwater quality, especially in regard to plugging.

The definition of significant and unreasonable for water quality as described in Table CC-19 of the Common Chapter – **Appendix B**. is defined as follows:

Significant and unreasonable impacts to beneficial uses and users of groundwater as a result of groundwater management activities are the migration of contaminant plumes or elevated concentrations of constituents of concern that reduce groundwater availability, and the degradation of surface water quality as a result of groundwater migration that substantially impair an existing beneficial use. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area where current groundwater quality (as established in the Subbasins GSPs) does not exceed 1,000 mg/L TDS.

<u>Subsidence</u>

Changes in ground surface elevation in and near AWD were only analyzed between 2012-2018 due to limited previous subsidence monitoring. AWD is subsiding at an average rate of less than 0.2 ft per year. Subsidence has been greatest along the northern edge of the AWD GSA, furthest Plan area from the SJR. Projections of continued declines at those rates indicate that no significant and unreasonable effects are likely to occur under a repeat of hydrologically average conditions through 2040. The most likely significant and unreasonable impact in the Subbasin would be an accelerated rate of subsidence causing damage to critical infrastructure, which may occur if reliance on the lower aquifer increased or either the upper or lower aquifer was not replenished sufficiently.

Significant and unreasonable damage to critical infrastructure may occur if the levees within the District have subsided to an elevation that diminishes the water-carrying capacity of the SJR and CBP beyond their design flow rates, as this could cause significant and unreasonable flooding or damage to personal property. Also accelerated subsidence could significantly and unreasonably damage older wells. Significant and unreasonable damage to infrastructure is likely to occur if average rates of subsidence accelerate.

The definition of significant and unreasonable for subsidence as described in Table CC-21 of the Common Chapter – **Appendix B**. is defined as follows:

Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard.

Significant and unreasonable impacts to natural resource areas from in elastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity

Significant and unreasonable threats to public health and safety from inelastic land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.

Interconnected Surface Water

Undesirable Results have been defined for interconnected surface waters even though it is identified as a data gap within the Subbasin. Until the GSAs are able to collect the additional data necessary to define this sustainability indicator, groundwater levels in the upper aquifer will serve as a proxy. In AWDGSA, due to the foresight of the USBR in developing the CVP, lands along the San Joaquin River within the AWD are subject to pumping restrictions above the A-Clay (e.g. Contract Number 14-06-200-4339A – Contract Between the United States of America and the Newhall Land and Farming Company). For example, wells in the area must be sealed to below a significant clay strata and be no shallower than a minimum depth of 75-feet. The intention of the USBR was to prevent inducing seepage from the SJR. AWD GSA will participate in Inter- and intra-basin coordinated effort to develop a comprehensive understanding of the characteristics and effects of interconnected surface water and methods for quantification of surface water depletions, which may result in defined undesirable results in the future.

The definition of significant and unreasonable for interconnected surface waters as described in Table CC-23 of the Common Chapter – **Appendix B**. is defined as follows:

Significant and unreasonable impacts on natural resources or downstream beneficial uses and users of groundwater are a reduction in available surface water supplies for natural resource areas, and reductions in downstream water availability as a result of increased streamflow depletions along the San Joaquin River when compared to similar historic water year types.

4.3.4 Threshold Exceedance Response

Additional monitoring will be triggered should any threshold exceedance be identified in a representative well that is used to indicate water quality or water levels. Additional wells within the monitoring zone (See **Figure 4-3)** will be analyzed to determine the extent of the exceedance, validity of the measurement, and the potential for Undesirable Results to occur. Likewise, future monitoring in representative wells that experienced a threshold exceedance in previous years will be accompanied by an analysis of randomly selected wells to verify measurements and ensure that Sustainability Indicators are within operational ranges.

Additional analysis will be done to assess subsidence rates in the District once an exceedance is determined for water levels. **Figure 4-2** shows the flow chart utilized to determine whether threshold exceedances are likely to result in undesirable results.

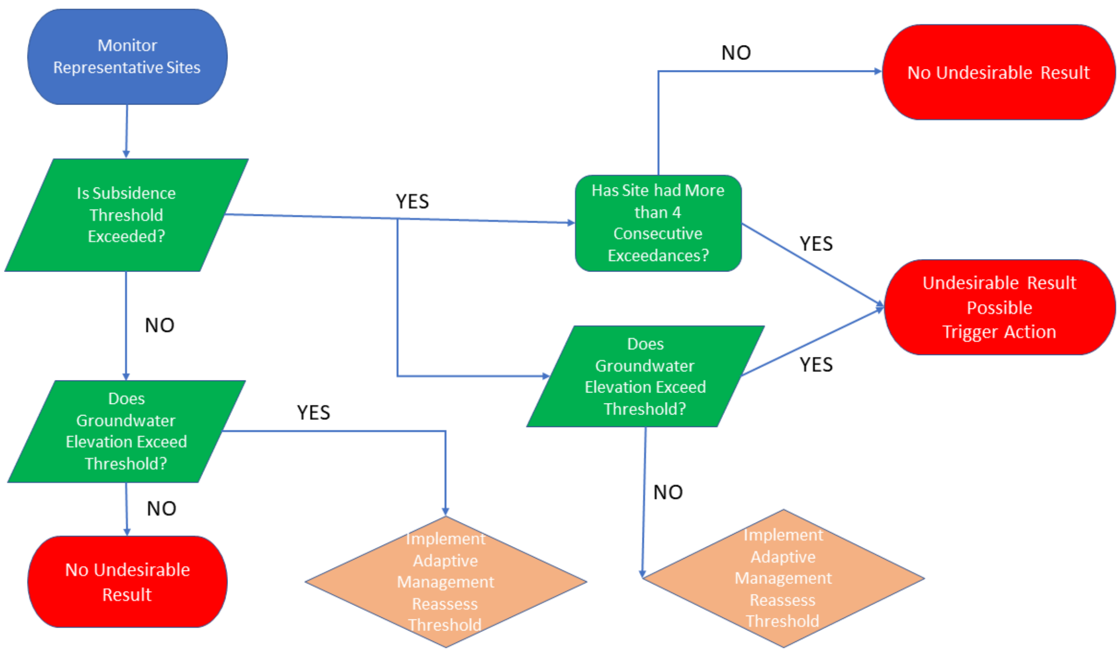

Figure 4-2: Water Level/Subsidence Undesirable Result Flow Chart

4.3.5 Effects on Beneficial Users

Regulation Requirements:

§354.26 (b) The description of undesirable results shall include the following: (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.

During the outreach process there were several commonly identified impacts that could become significant and unreasonable if mitigation were to become unfeasible or cost prohibitive. These included:

(1) Wells becoming unproductive necessitating the construction of new or deeper wells
(2) Impacted water quality in irrigation wells causing loss of crops or productivity
(3) Excessive flooding and seepage causing damage to public and personal property

However, at the stakeholder workshop, attendees stated that none of the potential impacts identified above were occurring, nor have they experienced significant or unreasonable impacts in the past that were beyond reasonable mitigation measures. The only exception was flooding and damage to property and infrastructure that occurred in 1997 and 1998 when the levees in AWD washed out and flooded large areas along the east side of the CBP.

Effects to the SJRRP, domestic users, and adjacent agencies were also considered during the development of the significant and unreasonable effects that could lead to undesirable results and minimum thresholds. The SJRRP monitors conditions along the SJR to ensure the protection of environmental beneficial uses of both surface and groundwater. The SJRRP is discussed in greater detail in **Chapter 2-1**. The SJRRP is unlikely to be negatively affected by the current management practices in AWD. Domestic users of groundwater are minimal in AWD. Significant and unreasonable impacts to drinking water are unlikely to occur as landowners are prepared to mitigate impacts and provide reliable sources of drinking water to employees and residents. Domestic wells are privately owned and will be managed by landowners as necessary.

Adjacent agencies within the DMGB have been consulted, and it was discussed that groundwater conditions and practices in AWD are unlikely to cause significant and unreasonable impacts. However, some neighboring agencies are experiencing undesirable results in their GSAs, the most significant being subsidence. Several agencies are experiencing damage to infrastructure and loss of operational capability as a result of subsidence. Therefore, significant and unreasonable effects were developed to consider subsidence as a limiting factor when possible. AWD will continue to work with neighboring agencies to monitor groundwater conditions and prevent undesirable results.

4.3.6 Evaluation of Multiple Minimum Thresholds

Regulation Requirements:

> **§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.

Subsidence has been defined as the limiting factor for undesirable results in the Plan Area with regard to water levels, change in storage, and subsidence thresholds. It should be understood that changes in water levels, and by proxy changes in groundwater storage, are only used as indicators of potential increases in the rate of subsidence, which is much more likely to have significant and unreasonable impacts to infrastructure that are both physically and financially unfeasible to mitigate. Therefore, threshold exceedances for subsidence will determine whether or not an actual undesirable result is occurring. See **Figure 4-2** which shows how undesirable results will be determined based on threshold exceedances of water level and subsidence sustainability indicators. Determination of undesirable results for water quality will be independent of groundwater levels and subsidence rates; it is, however, important to note that groundwater quality may be affected by groundwater levels. There is currently no existing correlation between the two, but AWD will analyze trends between sustainability indicators to develop an understanding of the effects of groundwater levels on groundwater quality.

4.3.7 Sustainability Indicators Not Considered

Regulation Requirements:

> **§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.

Interconnected Surface Water

Presently, the depletion of interconnected surface water is identified as a data gap within the Subbasin, and the GSAs plan to collect additional data necessary to set quantitative SMCs for this Sustainability Indicator. However, it is important to note, landowners within AWD cannot deplete interconnected surface waters due to legal decisions and agreements such as Contract Number 14-06-200-4339A – Contract Between the United States of America and the Newhall Land and Farming Company for Groundwater Pumping that restrict well design and construction to limit the strata in which production of groundwater occurs. Groundwater extraction in wells near the SJR must occur below the semi-confining clay layer commonly referred to as the A-Clay in order to prevent unintended pumping of hydrologically connected surface water. **Chapter 2** contains more detail on policies and restrictions governing pumping of interconnected surface water within the District.

Seawater Intrusion
AWD is located roughly 100 miles from the Pacific Ocean. Seawater intrusion is not applicable to the area.

More detail on decisions for omitting the development of this sustainability indicator can be found in **Chapter 2** and **Chapter 3**.

4.4 Minimum Thresholds

Regulation Requirements:

> **§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.

Minimum thresholds (MT) were developed for all sustainability indicators with the exception of seawater intrusion . MTs were established to address changes in groundwater conditions with the potential to cause significant and unreasonable effects that could lead to an undesirable result. Undesirable results were defined in **Section 4.3** for all sustainability indicators as they relate directly to beneficial users of groundwater in the Subbasin. Minimum thresholds were developed using known basin/plan area characteristics and available data to quantify rates, elevations, and concentrations at which a significant and unreasonable impact and an eventual undesirable result may occur.

4.4.1 Description of Minimum Thresholds

Regulation Requirements:

> **§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.

Table 4-1 shows the minimum threshold for each sustainability indicator for selected representative monitoring sites. Information to develop these MTs is discussed in Chapter 3 and refined in this Chapter 4.

Table 4-2: Minimum Thresholds

Sustainability Indicator	Threshold Description	Monitoring Site ID	DMS ID	Minimum Threshold	Threshold Units
Water Levels/ Groundwater Storage/Interconnected Surface Water	Historical seasonal low prior to the end of Water Year 2016	12S15E32B002M	09-001	40.5	Feet above msl
		13S15E14M001M	09-003	37.4	Feet above msl
		13S16E30A001M	09-004	37.7	Feet above msl
		12S16E31G001M[1]	09-002	-4.0	Feet above msl
Subsidence	The minimum threshold is set to not exceed 2 ft of additional inelastic land subsidence attributable to groundwater extraction.	Lifeson	09-008	177.33	Feet above msl
		Aliso WD 1 Reset	09-006	156.52	Feet above msl
		DWR at Gravelly Ford Canal	09-007	200.39	Feet above msl
Water Quality	TDS – 1,000 mg/L based on drinking water standards	AWD-1	09-005	1,000	TDS (mg/L)
		13S15E14M001M	09-003	1,000	TDS (mg/L)
		13S16E19J001M	09-196	1,000	TDS (mg/L)
		12S16E31G001M[1]	09-002	1,000	TDS (mg/L))
Seawater Intrusion		Not Applicable			

1. ***Composite Well to be evaluated for replacement at Year-5 Interim Milestone.***

4.4.1.1 Upper Aquifer Groundwater Levels, Groundwater Storage, and Interconnected Surface Water Threshold Development

Regulation Requirements:

§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.
(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.

SMCs for groundwater levels and groundwater storage (using groundwater levels as a proxy) were only developed considering the upper aquifer wells (and composite wells on the eastside of the District) due to a considerable lack of deep wells in the District. The SMCs for lower aquifer storage are based on inelastic land subsidence, and is further explained in Section 5.4.2 of the Common Chapter – **Appendix B**. Well completion reports available from DWR show only one deep well identified in the District that exclusively penetrates the lower aquifer. The majority of wells in the District are upper aquifer wells that pump below the semi-confining A-Clay layer (when it is present) and above the confining Corcoran Clay layer. These wells are typically located on the west side of the Bypass and to the south within a few miles of the SJR. Most of the remaining wells are composite, with perforations extracting water from both above and below the Corcoran Clay. These are typically located in the northeastern part of AWD to the east of the Bypass. Because well construction and proximity to the river varies across AWD, the District has been separated into zones (**Figure 4-3**) and **Table 4-3**. These are not to be confused with management areas. All zones used the same methods and criteria to develop SMCs for water level thresholds and will be managed and monitored consistently. The zones were selected to provide sufficient spatial coverage with the specific conditions of each zone in mind (see **Chapter 5**).

Table 4-3. Description on Monitoring Zones

Zone	Description
1	East of the CBP. No significant source of surface water. Most wells are composite.
2	East of the CBP, along the SJR. Minor surface water. Wells are mostly above the Corcoran Clay in the Upper Aquifer.
3	West of the CBP, along the SJR. Greater surface water accessibility. Wells are mostly above the Corcoran Clay in the Upper Aquifer.
4	West of the CBP. Greater surface water accessibility. Blend of upper aquifer and composite wells.

Groundwater Levels
The minimum threshold for groundwater levels as described in Table CC-16 of the Common Chapter – **Appendix B**. is defined as follows:

> *The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low. The historic seasonal low is a fixed elevation at each site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements.*
>
> *Shorter-term ("acute") groundwater elevation thresholds will also be established at each representative monitoring site by 2025 using a coordinated methodology. Acute thresholds will be established at levels that are intended to avoid short-term undesirable results, particularly for domestic water wells, groundwater dependent ecosystems, and interconnected surface waters where present in the Upper Aquifer, and for subsidence in the Lower Aquifer. Each year, both the historic seasonal low and the acute groundwater elevation thresholds will apply, whichever is more protective. Groundwater levels are measured as watersurface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. SeeTable CC-17 for numeric MTs.*
>
> *For any RMS without data prior to Water Year 2016, MTs and acute thresholds will be established using the aforementioned methodologies and the data resulting from the first five years of monitoring following Water Year 2016 or following construction of the well*.

Figure 4-5 shows the hydrographs for each representative groundwater level monitoring site reflecting this basin-wide approach, and their respective position in the District. Individual hydrographs can be seen in **Section 4.5.1, Figure 4-8- Figure 4-11.** Hydrographs show that aquifers recover significantly after drought periods during wet years and in some hydrographs have shown that aquifers can make a full recovery.

Groundwater Storage
The minimum threshold for groundwater storage as described in Table CC-18 of the Common Chapter – **Appendix B**. is defined as follows:

For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels.

For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.

Considering reductions in groundwater storage, it should be noted that the limited average change in groundwater elevation over the Plan Area provides justification that the hydrogeological conditions and the agricultural practices in AWD are sustainable in nature. If the historic reduction in groundwater storage were to continue, there would be little effects to beneficial users of groundwater. Projected water use will change very little over the 20-year implementation period, as the District is fully built out and there are no plans to change land use in the area.

Interconnected Surface Water
The minimum threshold for interconnected surface water as described in Table CC-23 of the Common Chapter – **Appendix B**. is defined as follows:

Interconnected Surface Water is an identified data gap in the Delta-Mendota Subbasin. As an interim minimum threshold, use the Chronic Lowering of Groundwater Level Minimum Threshold as a proxy for impacts to interconnected surface waters.

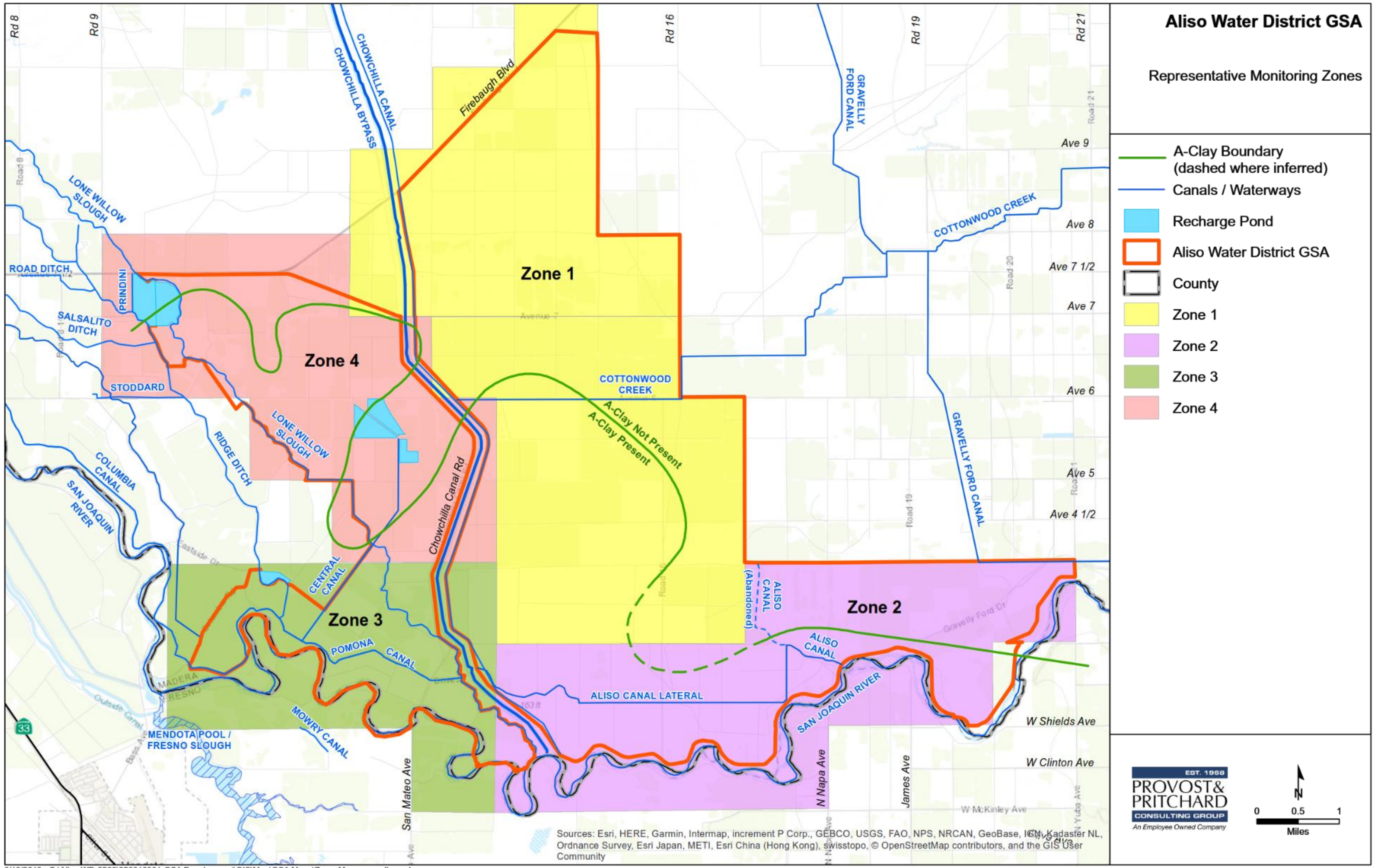

Figure 4-3: Monitoring Zone Map

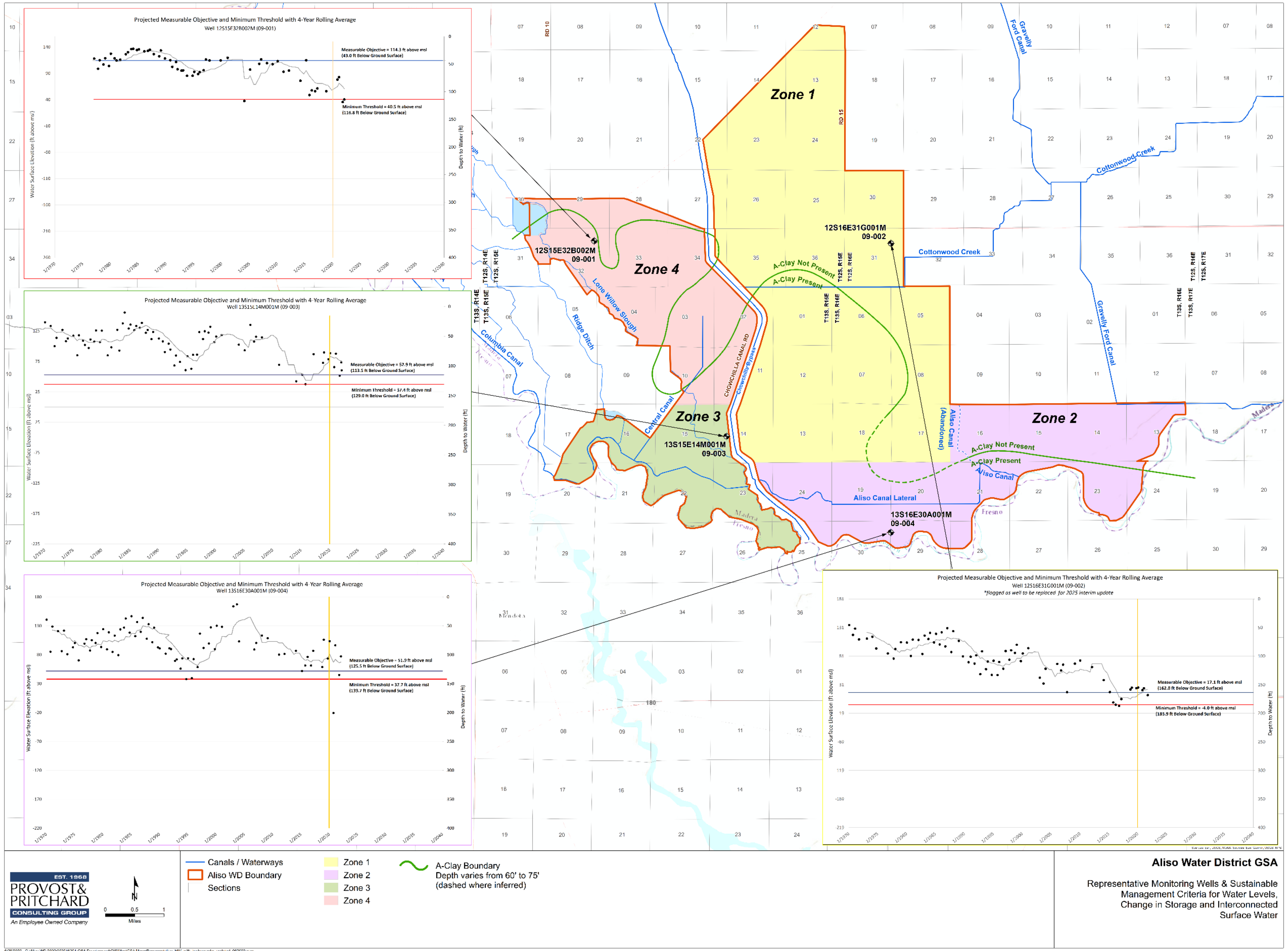

Figure 4-4: Groundwater Level/Storage SMC Development Map

4.4.1.2 Subsidence/ Threshold Development

Regulation Requirements:

§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.

The minimum threshold for subsidence as described in Table CC-21 of the Common Chapter – **Appendix B**. is defined as follows:

> *At representative monitoring sites, the change in ground surface elevation that would cause undesirable results is up to 2 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin. Prevent subsidence caused by groundwater extractions in the Delta-Mendota Subbasin that exceeds corrective design standards or established triggers for critical infrastructure including the Delta-Mendota Canal, California Aqueduct, and roads and bridges.*

Subsidence was determined to be the most limiting sustainability indicator for the determination of undesirable results. As such, groundwater levels and groundwater storage thresholds were set to account for effects of groundwater extraction and to prevent acceleration of subsidence as discussed previously. Subsidence was chosen as the limiting factor for sustainability in order to account for undesirable results occurring adjacent to the Subbasin. Significant damage to critical infrastructure such as the DMC or the Mendota Dam as well as other conveyance structures was identified as a significant and unreasonable effect of subsidence by the Subbasin.

It should be noted has localized effects as well as regional, and that it is possible that significant and unreasonable effects will occur in neighboring agencies prior to AWD reaching their minimum threshold.

Subsidence in AWD has been minimal when compared to neighboring areas. To the north of AWD subsidence is occurring at a much greater rate, and pumpage from the lower aquifer in the area north of the AWD can contribute to subsidence in the northern part of the AWD. This is illustrated by the average subsidence rates for the District using data from the Bureau for Reclamation's subsidence monitoring performed from 2011-2018 (**Figure 4-5**) and the SJRRP Evaluation of the Effect of Subsidence that analyzed subsidence rates along each levee of the CBP from 2008-2016 (**Figure 4-6**)

During Plan development, effects of subsidence were considered as it affects shallow groundwater levels during flood releases, which has the potential to cause damage to crop roots and overtopping of the levees and could damage other personal property such as operational systems for irrigation, crops, levees, and buildings depending on the magnitude of the flood releases. Critical infrastructure in or directly adjacent to the District are the SJR and CBP levee system. It is likely that subsidence along the levees in excess of the minimum carrying capacity could cause significant and unreasonable flooding that may threaten health and safety and might cause loss of personal property such as crops. **Figure 4-7** shows monitoring locations in and near AWD, and elevations for minimum thresholds were set for the representative monitoring sites and are displayed in **Table 4-2** at the beginning of the section.

The effects of subsidence on groundwater wells were also considered. There is insufficient data at this point to develop a definitive threshold for damage to wells. It has been reported that wells extending through the Corcoran Clay begin experiencing irreversible damage once land has subsided 6-feet. It has recently become practice in areas of subsidence to install compression joints in new wells to mitigate the effects, which can considerably increase well tolerance to subsidence.

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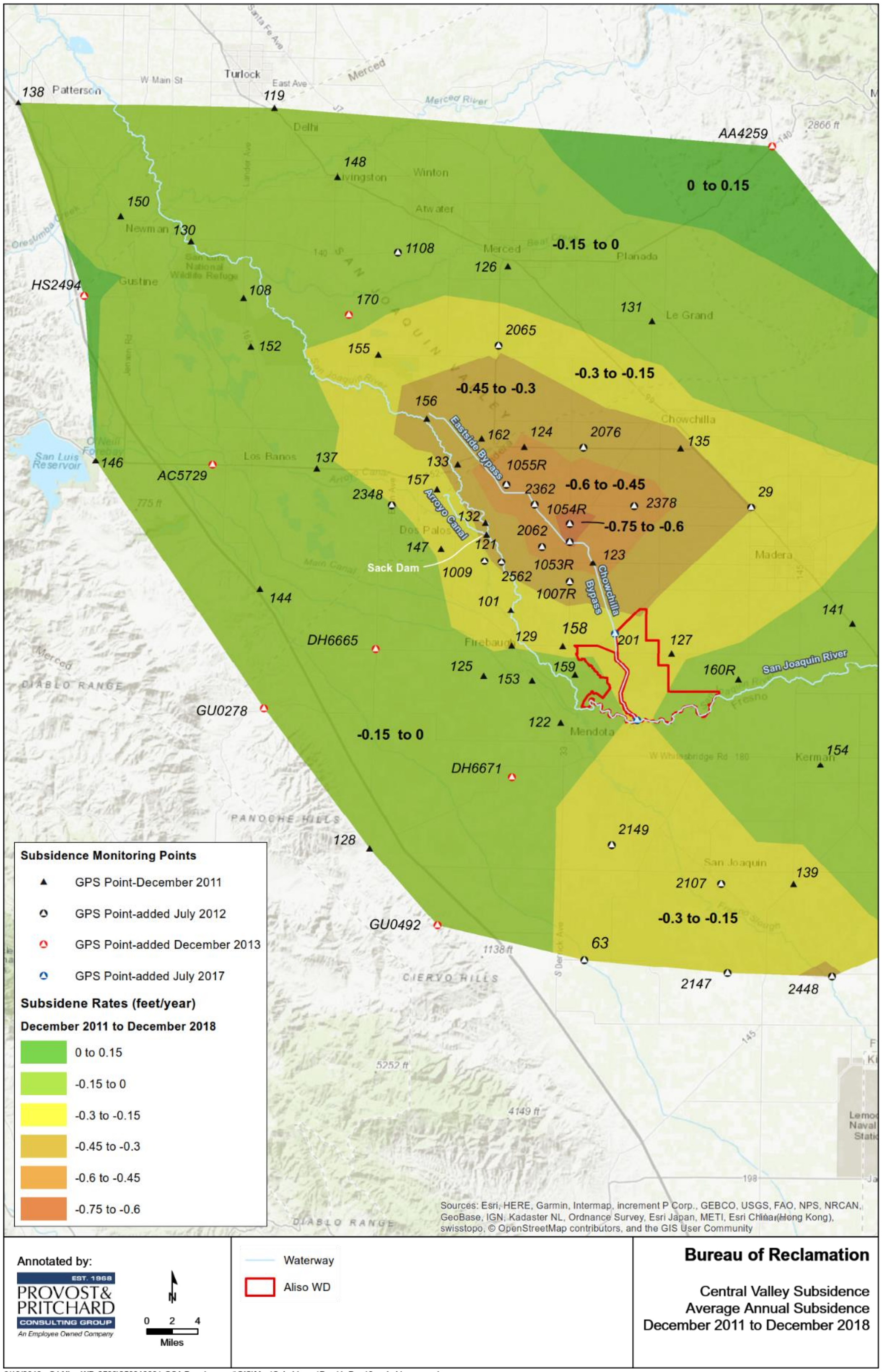


Figure 4-5: USBR Subsidence Map 2011-2018

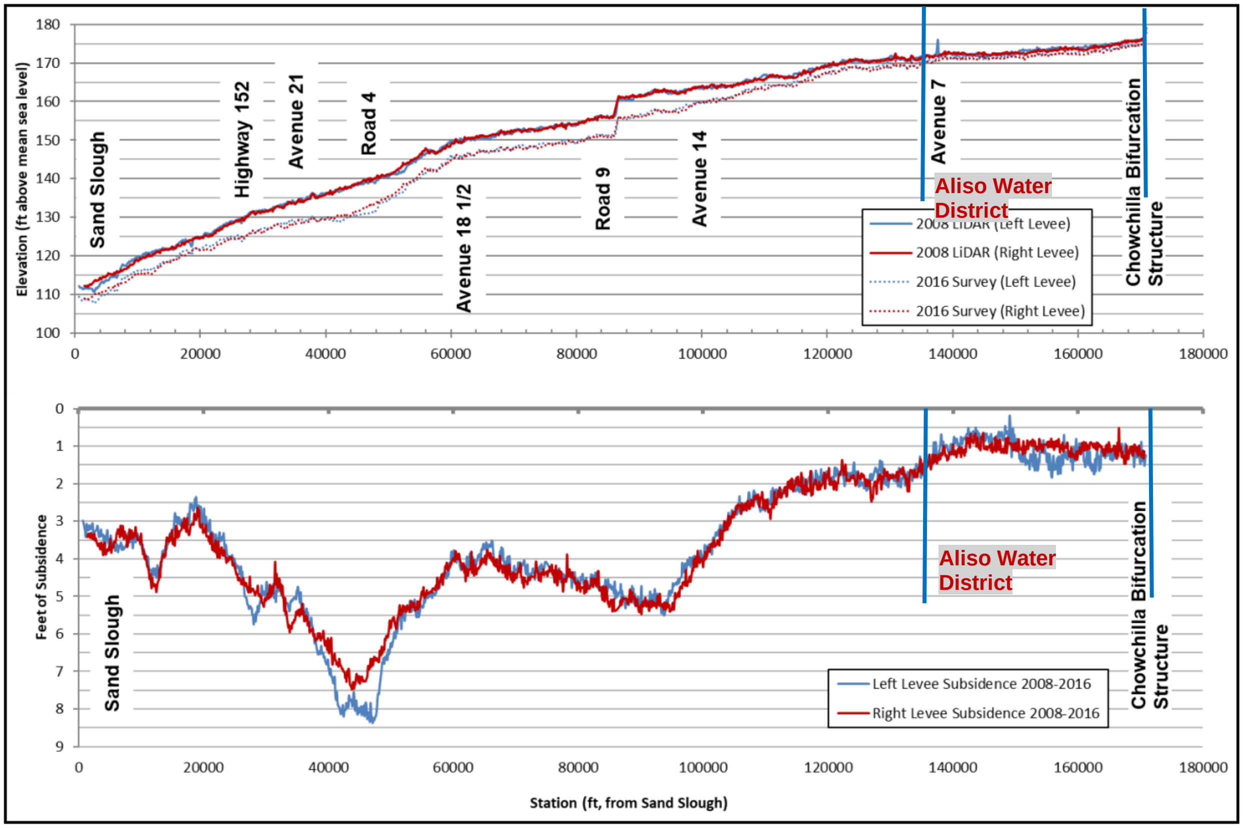


Figure 4-6: SJRRP Bypass Profile (SJRRP, 2018)

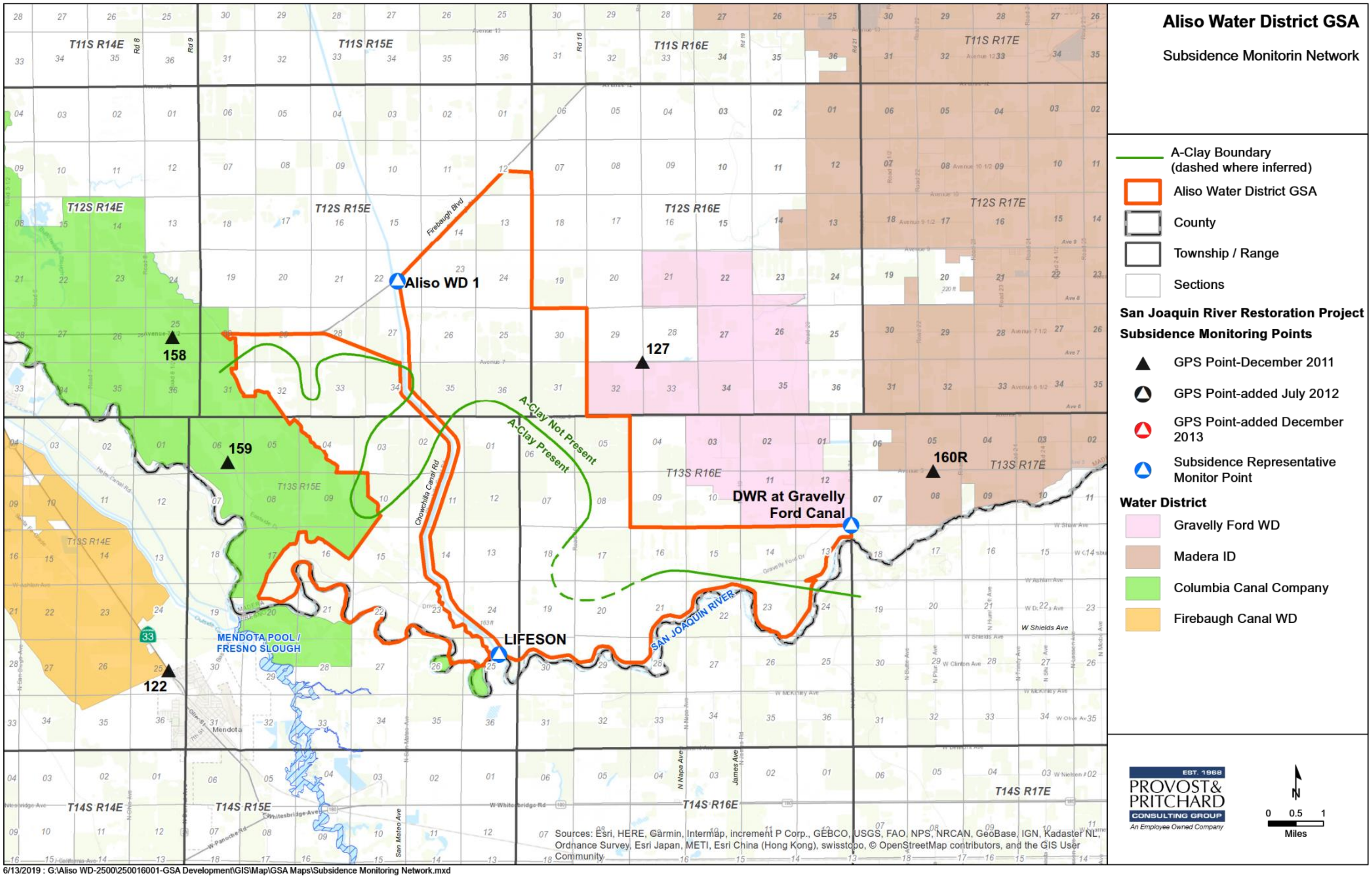


Figure 4-7: Subsidence Monitoring Network

4.4.1.3 Water Quality Threshold Development

Regulation Requirements:

§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 minimum threshold for water quality as described in Table CC-19 of the Common Chapter – **Appendix B**. is defined as follows:

> *The minimum threshold for salinity is1,000 mg/L TDS. For representative monitoring sites that currently exceed the minimum threshold, existing regulatory water quality compliance and remediation programs will apply, including but not limited to, the CV-SALTS Salt Control Program, the Irrigated Lands Regulatory Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), and the Safe and Affordable Funding for Equity and Resilience (SAFER) program. For any RMS without data prior to the end of Water Year 2016, current (ambient) groundwater quality will be established using data collected during the first five years of monitoring following Water Year 2016 or following construction of the well.*
>
> *For representative monitoring sites that do not currently exceed the minimum threshold, but are found to exceed minimum thresholds in the future, the applicable GSP group will conduct and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently, if needed, to avoid exacerbating the exceedance. The applicable GSP group will also coordinate with the appropriate regulatory program to address the impact.*

The groundwater is generally of good quality for irrigation use and there are limited types of beneficial use. There are few permanent residents and domestic wells in AWD and those that are there are associated with the farms. If water quality issues should arise relating to domestic wells, landowners will be individually responsible for compliance. Landowners have indicated that if any issues should arise with regard to domestic wells they would be mitigated as needed. Growers within AWD will typically be concerned with crop tolerances for stone fruit, nuts, and grapes.

It is assumed that if water quality were to be significantly degraded, landowners would begin implementing mitigation measures prior to reaching thresholds if applicable. Standards for drinking water was used as the primary reference for developing thresholds for water quality across the Subbasin. Threshold values are presented in **Table 4-2**. Water quality will be monitored using the same zones as groundwater levels and storage. Each zone shown in **Figure 4-3** will be monitored for the groundwater quality.

4.4.1.4 Relationship Between Thresholds

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:
(2) The relationship between the minimum thresholds for each sustainability indictor, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

When developing thresholds in coordination with the Subbasin, from AWD's perspective, thresholds were evaluated considering the following questions:

1. *Who are the beneficial users of groundwater?*
2. *How are/could they be impacted?*
3. *At what level does the impact become significant and unreasonable?*

These questions were developed independently of groundwater conditions and historic trends in order to determine what problems existed or were likely to develop, and at which point mitigation would become too expensive or logistically unfeasible. Considering AWD has no documented instances of significant and unreasonable effects, discussions were held with the DMCC to see what impacts others were experiencing. As explained previously, damage to infrastructure and the inability to operate systems at full capacity due to subsidence was the overwhelming response within the DMGB.

AWDGSA considers subsidence the limiting factor for groundwater conditions, due to the potential effects to multiple parties. Exceeding thresholds set for groundwater levels and change in storage will have little effect on agricultural operations, infrastructure, or other potential land uses in the District. There is a potential need for growers to modify their systems to access water if levels approach the threshold by lowering pumps or deepening wells. Several economically feasible mitigation options exist should issues arise with infrastructure or the ability to access water.

The existing basin conditions have been compared to the proposed conditions for each minimum threshold. Subsidence is unlikely to affect either water quality or water levels and change in groundwater storage in the upper aquifer. As a result of the lack of long-term subsidence data and the possibility of subsidence being caused by outside influences, water levels will be related to subsidence to determine any correlation. If the water level threshold is reached without significant increases in average subsidence rates, the relationship will be reevaluated, and a new proxy water level may be established as it relates to subsidence.

It is unknown whether exceedances of other sustainability indicators could affect exceedances in water quality thresholds. Conversely the same is true, but it is unlikely that water quality threshold exceedances will influence water levels, whereas lowering of groundwater levels could have adverse impacts on water quality.

Water quality was considered independently from the regional subsidence issue. To comply with the requirements of SGMA, groundwater quality SMCs were set to address the state drinking water standards across the DMGB. Should water quality become an issue, the need to extract water from one location within the District for use in another or the need to import additional surface water for blending purposes may become necessary. The District does not anticipate water quality impacting AWD to the extent that it becomes necessary to deepen wells or require the use of the lower aquifer due to water quality issues in the upper aquifer. It is unlikely that undesirable results due to water quality will be experienced during the Plan implementation horizon.

4.4.1.5 Groundwater Level Proxy

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.

Upper Aquifer Groundwater Storage
Water level elevations in the upper aquifer will be used as a proxy for groundwater volume in storage in the upper aquifer. The volume of groundwater storage will be quantified on an annual basis using a larger network of hydrographs and contour maps as described in **Section 3.2** using changes in groundwater elevation, specific yield of the aquifer, and acreage of the District. Attempting to quantify the volume of groundwater storage at a single representative well using water level elevation should be avoided; however, it can be a good indicator of sustainability without having to quantify all use and extraction. A more robust data set using water level when available should be employed for quantifications of volume. This method of calculating change in groundwater storage is a widely used, acceptable substitution for determining changes in groundwater storage and considering all sources of groundwater.

Lower Aquifer Groundwater Storage
Ground surface elevations will be used as a proxy for storage volumes in the lower aquifer because subsidence is the controlling factor. As described in **Section 3.2**, changes in ground elevations can be directly related to loss of storage in the lower aquifer. It should be noted that subsidence monitoring points are not as prevalent as groundwater level monitoring points nor is the data collection period as long. This limits the accuracy of calculations developed using this data or analysis of trends.

Subsidence
Subsidence will be directly measured as changes in the ground surface elevation; however, water levels in the lower aquifer will be tracked and compared to subsidence rates to attempt to establish a more robust correlation between the two. Water level thresholds may be adjusted in the future if subsidence rates are not impacted by the current thresholds set or if subsidence rates increase prior to the water level threshold being reached.

Interconnected Surface Water
Due to interconnected surface water being presently identified as a data gap within the Subbasin, the AWD GSP and other GSP groups in the Subbasin have decided to use water elevation SMCs as a proxy for interconnected surface water on an interim basis until replacement thresholds, based on a rate or volume of interconnected surface water losses, can be established for the Subbasin. The GSAs anticipate completing an interconnected surface water monitoring network to gather data and further develop unique SMCs for interconnected surface water.

4.4.1.6 Effects on Adjacent Basins

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following: (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.

AWD has performed outreach internally with other members of the DMGB as well as neighboring Madera and Kings subbasins and agencies within these subbasins. As a result of coordination and collaboration with neighboring agencies, implementation of the Plan and minimum thresholds developed during the planning process are not anticipated to affect neighboring subbasins. Careful consideration was given to existing conditions outside the District.

Within the DMGB, AWD has coordinated directly with the SJRECGSA and Farmers Water District GSA. It was understood that priorities for these agencies were focused on the effects of subsidence on infrastructure such as the Mendota Dam and maintaining water supply in the Mendota Pool. AWD will work with other GSAs in the basin to mitigate undesirable results to these critical pieces of infrastructure.

AWD has been following developments of SGMA planning in the Madera Subbasin and agencies within the basin such as Gravelly Ford GSA and Madera County GSA, both of which border AWD. Initial proposals in the May 29, 2019, public meeting for minimum thresholds for water levels were set for approximately 120 feet below msl. Measurable objectives were proposed at approximately 10 feet above msl. AWD will continue to see effects of subsidence and groundwater decline until overdraft corrections are made in the area north of AWD (in the Madera Subbasin). Madera Subbasin is proposing to use water level thresholds as a proxy for subsidence and water quality.

AWD has also been in contact with the Kings Basin and agencies within the Kings Basin such as McMullin Area GSA (MAGSA). AWD and MAGSA share a boundary along the SJR and they compared and coordinated development of water budgets and basin settings to get a better understanding of conditions in both basins. Thresholds set are unlikely to affect the Kings Basin since the SJR acts as a physical boundary.

AWD has had some interaction with GSAs in the Chowchilla and Madera Subbasins regarding methods of bringing surface water into the area via the Chowchilla Bypass. There is a significant amount of subsidence in the Chowchilla Subbasin and in the Madera Subbasin, both of which are possibly experiencing undesirable results. Agencies in the DMGB who neighbor these subbasins are working to coordinate thresholds and potential projects to offset subsidence and prevent undesirable results in all three subbasins.

4.4.1.7 Affects to Beneficial Uses and Users

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

Groundwater Levels/Storage/Interconnected Surface Water
Implementation of thresholds and associated projects and management actions are not likely to affect any beneficial uses of groundwater. It is not the intention of the DMGB or AWD to restrict access to groundwater unless undesirable results occur. However, thresholds may establish conditions that would require mitigation for users to continue accessing groundwater. Most wells in the part of AWD west of the bypass are shallow, while most of the wells east of the bypass are composite. Lowering of pumps and deepening of wells may be necessary to continue to access groundwater in the upper aquifer. Groundwater quality issues may become more pronounced as a result of loss of groundwater storage in the upper aquifer and treatment or blending may be required.

Subsidence

Maintaining the rate of subsidence may affect levees along the bypass and other infrastructure in the District. It may become necessary to build up levees and reinforce new wells with compression joints to address and prevent damage to infrastructure. There is also the potential of uneven ground surface movement (differential settlement) to cause changes to the flow of gravity systems and damage to underground infrastructure, which could require changes and updates to irrigation systems or other types of mitigation.

Groundwater Quality

Changes in water quality may require that wells undergo treatment of groundwater prior to irrigation to prevent a reduction in crop production. It is also possible that additional sources of water would need to be brought into the District for blending, or that wells be relocated to areas with better water quality.

4.4.1.8 Relation to State or other Existing Standards

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:
(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.

There are no existing local, state, or federal standards governing groundwater levels or subsidence in the area. AWD will be setting thresholds and objectives for water quality in relation to drinking water standards in coordination with the subbasin. Regulations for water quality are typically tracked by existing agencies and programs that are responsible for groundwater quality remediation such as SWRCB and the ILRP program. In the future the landowners will have to comply with the upcoming CV-SALTS program to monitor and remediate salts and nitrogen impacts.

4.4.1.9 Threshold Measurement Methods

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater Levels/Groundwater Storage/Interconnected Surface Water

Groundwater levels, and groundwater storage and interconnected surface water thresholds by proxy, will be measured biannually to correlate with seasonal high and low groundwater levels and the monitoring schedule set forward by the DMGB Coordination Committee. Groundwater levels will be taken as depth to water measurements in feet and converted to elevations with reference to msl. Thresholds have been identified in both depth to water and water surface elevation for each site in **Table 4-4** to assist with comparison to the top of the Corcoran Clay, reported in depth, and groundwater surface contouring efforts. Additional monitoring requirements are outlined in **Appendix B** – Common Chapter and **Chapter 5**.

Subsidence

Subsidence will be surveyed at discrete reference points biannually in the summer and winter to correlate with monitoring efforts currently underway by USBR. Subsidence will be reported as a ground surface elevation relative to msl for both thresholds and contouring efforts. Thresholds have been identified at each discrete location and summarized in **Table 4-5**. Additional monitoring requirements are outlined in **Appendix B** – Common Chapter and **Chapter 5**.

Groundwater Quality
Groundwater quality will be measured in the summer. Thresholds have been identified for each constituent at each site in **Table 4-6** and results will be reported in the units provided. Water quality will be analyzed at a certified laboratory. Additional monitoring requirements are outlined in **Appendix B** – Common Chapter and **Chapter 5**.

4.5 Measurable Objectives

Regulation Requirements:

§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.

Measurable objectives were defined by the Subbasin for each Sustainability Indicator, it is possible that sustainability could be achieved with values other than those set as measurable objectives, but due to the lack of significant and unreasonable effects thus far these values are unknown. For some sustainability indicators, such as subsidence, development of the measurable objectives considered the critical water conveyance infrastructure within the Subbasin and were set to minimize inelastic land subsidence attributable to groundwater extraction, with no additional subsidence after 2040. Generally, historical high groundwater elevations (Water Year 2015 if available) were used to quantify the measurable objectives at each representative groundwater level monitoring site, compared to a four-year rolling average to account for water level variability. Groundwater quality used TDS levels that are acceptable for drinking water standards for development of interim milestones and measurable objectives. Specific details on measurable objectives can be seen in **Table 4-1**. Measurable objectives for each sustainability indicator are further outlined in the Common Chapter (**Appendix B**).

During the Plan implementation AWD will identify and take measures to obtain surface water to offset reductions in water levels as they correspond to declining groundwater storage. Additional information on possible projects and management actions that may be implemented are detailed in **Chapter 6**. Exceedance of measurable objectives does not imply a lack of sustainability. Measurable objectives and interim milestones should be considered the upper limit of acceptable values for sustainability indicators. Future measurement of sustainability indicators will be compared to measurable objectives and interim milestones. Annual effects to other indicators, operations, and groundwater conditions not actively monitored by SGMA will be documented as data is collected and trends are established. This will allow the Subbasin to refine measurable objectives to reflect observed seasonal and long-term conditions that have temporary or limited-to-no impacts on beneficial users.

4.5.1 Groundwater Levels, Storage, & Interconnected Surface Water

Groundwater Levels

The measurable objective for groundwater levels as described in Table CC-16 of the Common Chapter – **Appendix B**. is defined as follows:

> *Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at more than 50% of representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the measurable objective applies. See Table CC-17 for numeric MOs.*
>
> *For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and the data resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.*

Groundwater Storage

The measurable objective for groundwater storage as described in Table CC-16 of the Common Chapter – **Appendix B**. is defined as follows:

> *For the Upper Aquifer, maintain groundwater levels in accordance with the measurable for Chronic Lowering of Groundwater Levels.*
>
> *For the Lower Aquifer, minimize loss of groundwater storage caused by inelastic land subsidence*

Interconnected Surface Water

The measurable objective for groundwater storage as described in Table CC-13 of the Common Chapter – **Appendix B**. is defined as follows:

> *Interconnected Surface Water is an identified data gap in the Subbasin. As an interim measurable objective, use the Chronic Lowering of Groundwater Level Measurable Objective as a proxy for interconnected surface waters.*

Operational flexibility is the difference between the minimum threshold and the 2040 measurable objective **Figure 4-8** through **Figure 4-11** show the development of the interim milestones, measurable objectives, and operational flexibility relative to the minimum thresholds. **Table 4-4** summarizes all the SMCs for groundwater levels, storage (upper aquifer), and interconnected surface water (interim).

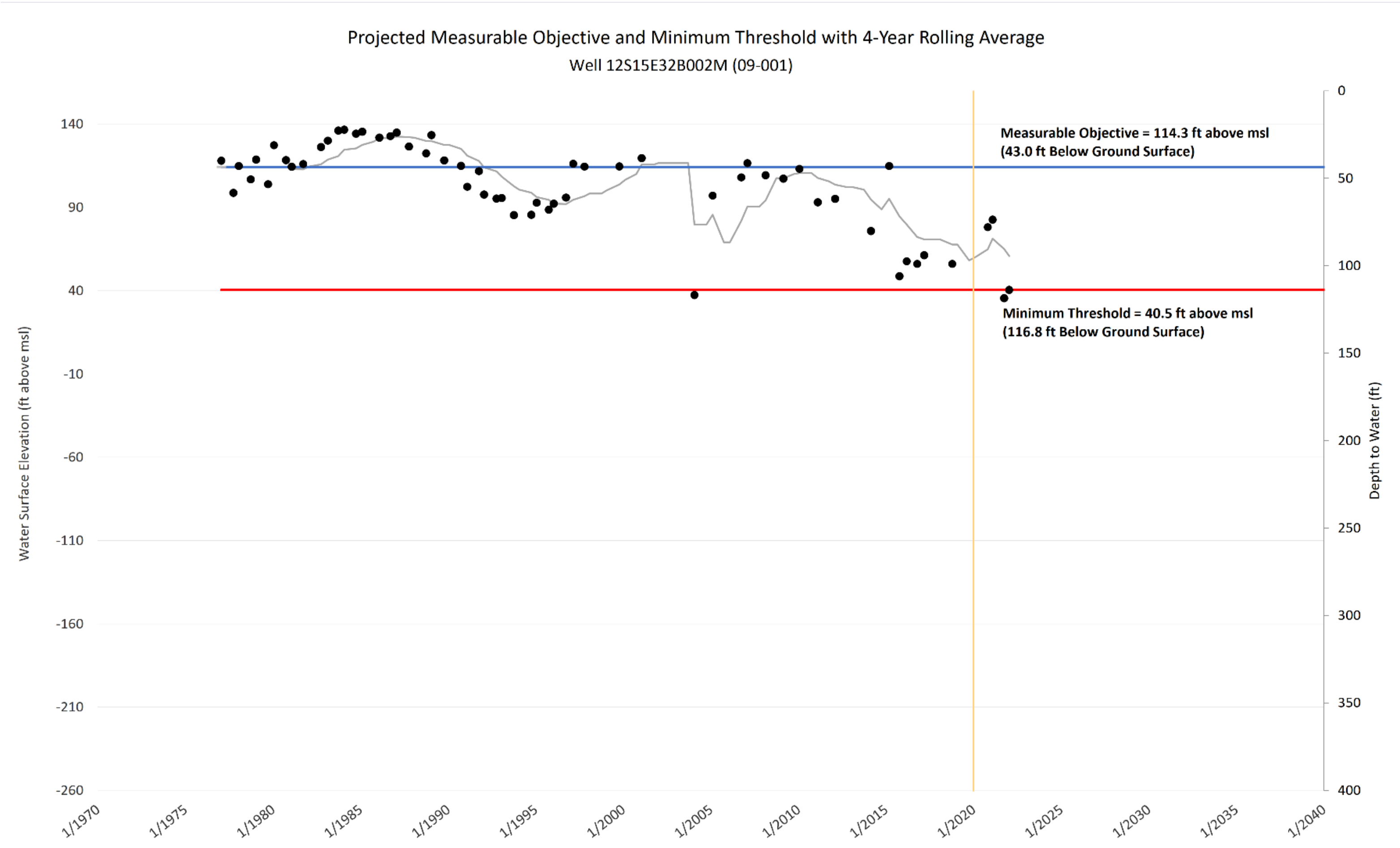


Figure 4-8: Well 12S15E32B002M (09-001)

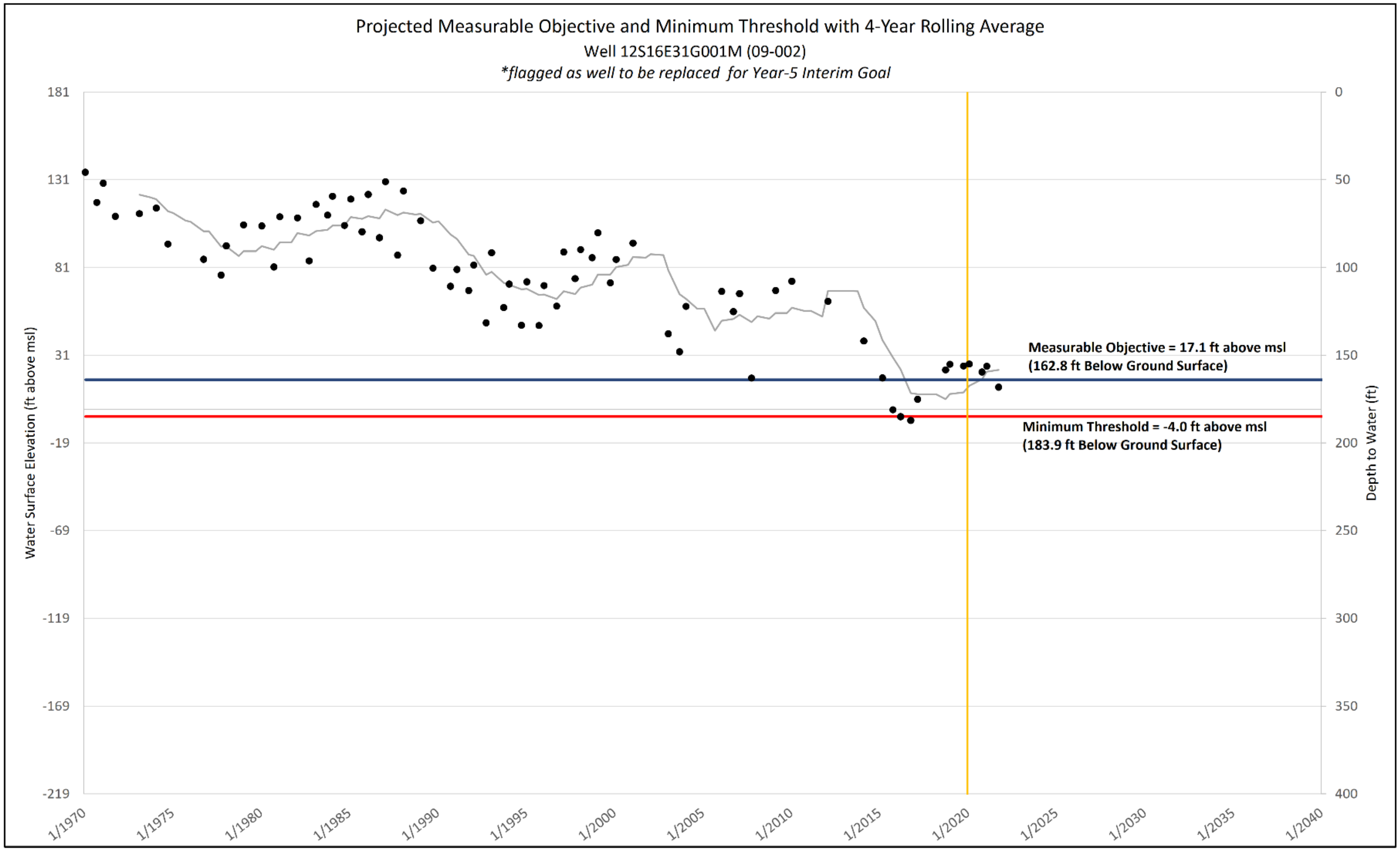


Figure 4-9: Well 13S15E14M001M (09-003)

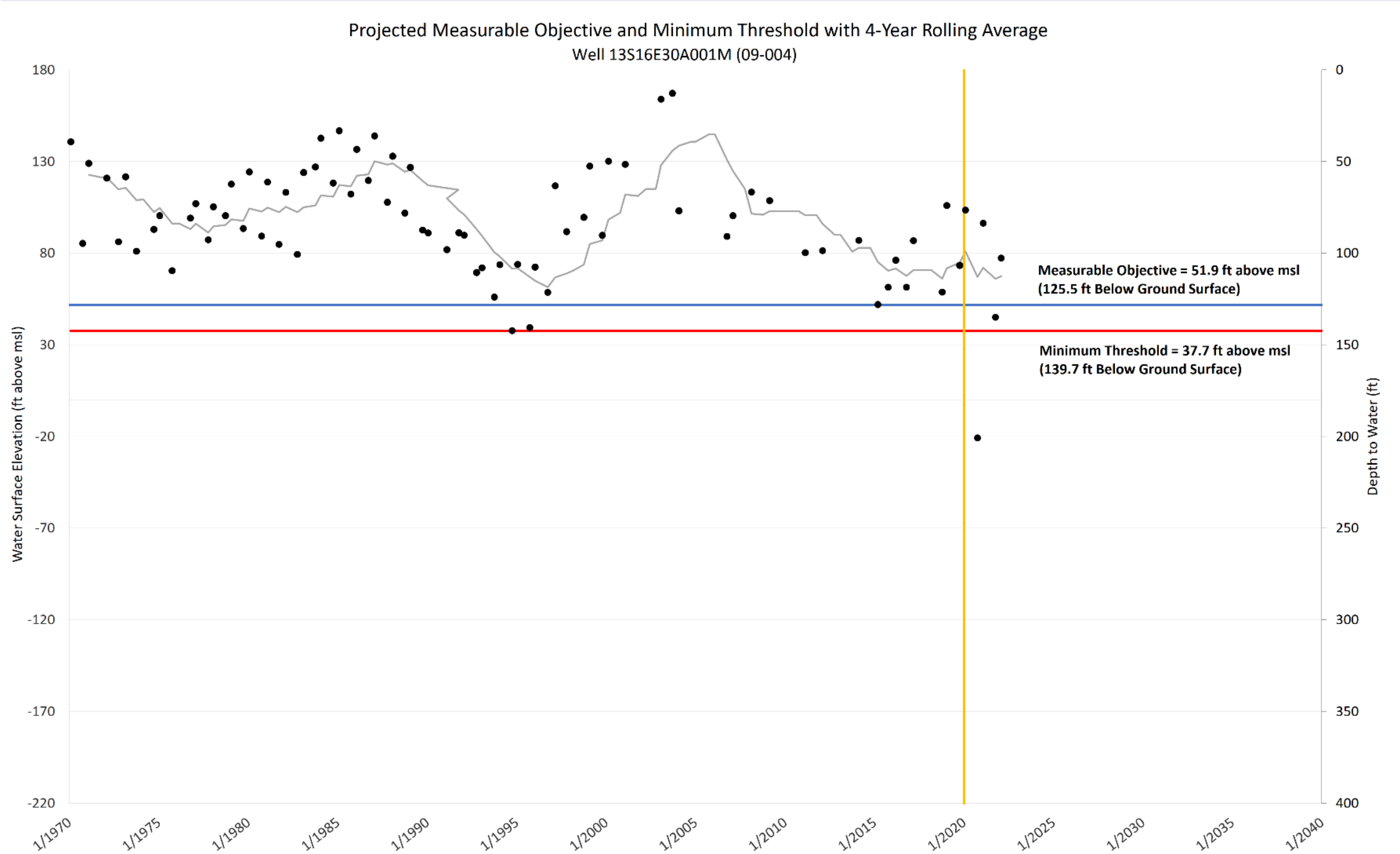


Figure 4-10: Well 13S16E30A001M (09-004)

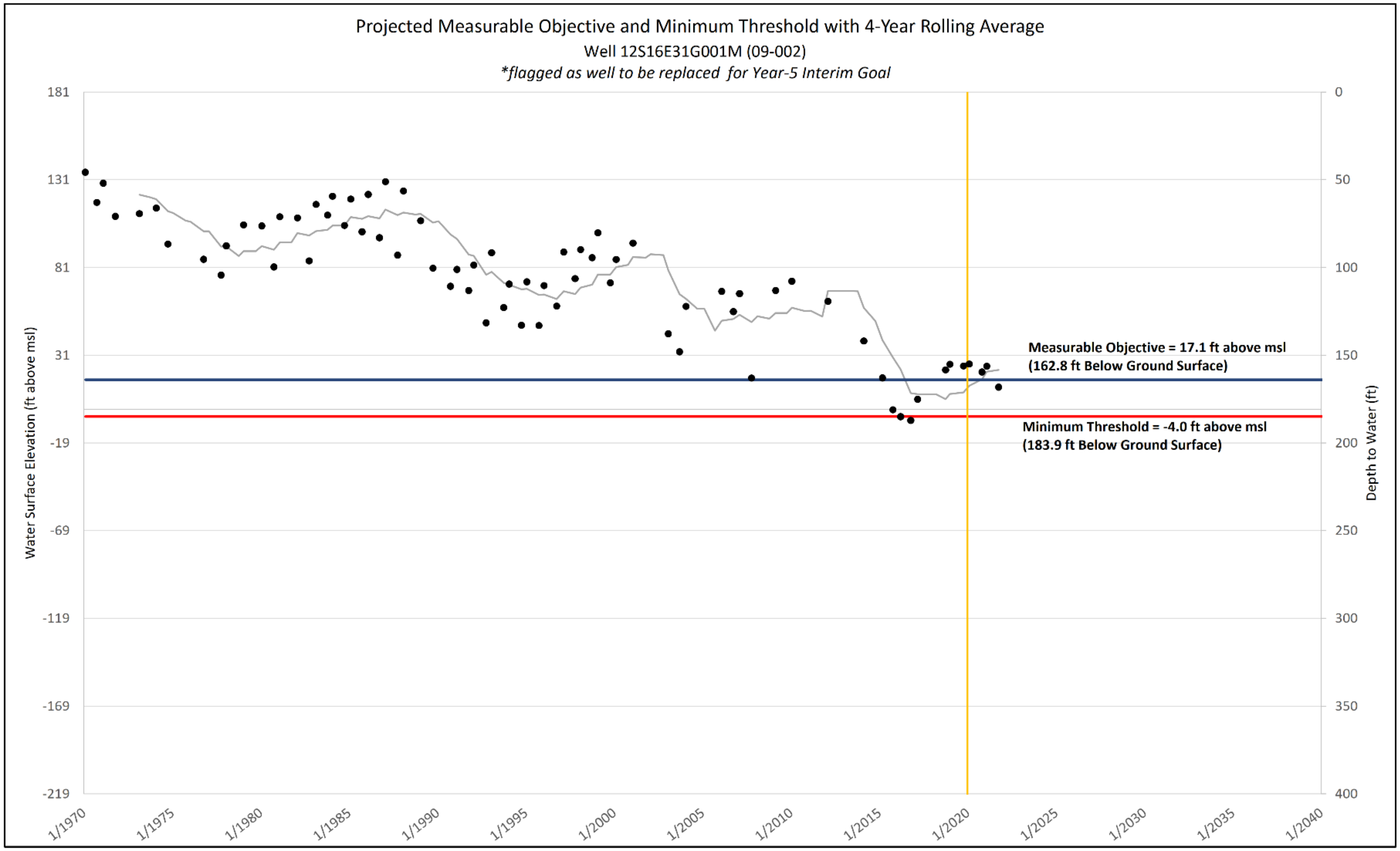


Figure 4-11: Well 12S16E31G001M (09-002)

Table 4-4: Water Level SMCs

			Depth to Water (ft below ground surface)				
AWD Monitoring Zone	Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	12S15E32B002M	09-001	≥43.0	≥43.0	≥43.0	≥43.0	≥116.8
3	13S15E14M001M	09-003	≥113.5	≥113.5	≥113.5	≥113.5	≥129.0
2	13S16E30A001M	09-004	≥125.5	≥125.5	≥125.5	≥125.5	≥139.7
1	12S16E31G001M [1]	09-002	≥162.8	≥162.8	≥162.8	≥162.8	≥183.9
			Water Surface Elevation (ft above msl)				
AWD Monitoring Zone	State Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	12S15E32B002M	09-001	≥114.3	≥114.3	≥114.4	≥114.3	≥40.5
3	13S15E14M001M	09-003	≥52.9	≥52.9	≥52.9	≥52.9	≥37.4
2	13S16E30A001M	09-004	≥51.9	≥51.9	≥51.9	≥51.9	≥37.7
1	12S16E31G001M [1]	09-002	≥17.1	≥17.1	≥17.1	≥17.1	≥-4.0

1. ***Composite Well to be evaluated for replacement at Year-5 Interim Milestone.***

4.5.2 Subsidence

The measurable objective for subsidence as described in Table CC-21 of the Common Chapter – **Appendix B**. is defined as follows:

> *Minimize inelastic land subsidence attributable to groundwater extraction within the Subbasin, with no additional subsidence after 2040*

Measurable objectives for subsidence were difficult to develop because of the lack of sufficient long-term historic data. However, the Subbasin desires to reduce subsidence caused by groundwater extraction. The GSAs further developed Interim Milestones to allow no more than 1.0 foot of additional subsidence by 2025, 0.5 feet of additional subsidence by 2030, 0.25 feet of additional subsidence by 2035, and 0.25 feet of additional subsidence by 2040.

Table 4-5 outlines subsidence SMCs, including measurable objectives and interim goals.

Table 4-5: Subsidence SMCs

Elevation Monitoring (ft above msl)							
Subsidence Benchmark	DMS ID	Dec. 2020 Level	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
ALISO WD 1 RESET	09-006	158.52	≥157.52	≥157.02	≥156.77	≥156.52	156.52
DWR at Gravelly Ford Canal	09-007	202.39	≥201.39	≥200.89	≥200.64	≥200.39	200.39
LIFESON	09-008	179.33	≥178.33	≥177.83	≥177.59	≥177.33	177.33

4.5.3 Groundwater Quality

The measurable objective for water quality as described in Table CC-19 of the Common Chapter – **Appendix B**. is defined as follows:

> *The measurable objective for salinity will be concentrations less than 1,000 mg/L TDS. Each GSP group will participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative.*

The groundwater quality monitoring program has not been in practice long enough to have a general understanding of groundwater quality trends, the effects of specific water year types, or other groundwater conditions on groundwater quality. As more information is obtained, interim goals may be refined to reflect actual groundwater quality conditions in the District over the long term. **Table 4-6** shows groundwater quality SMCs for TDS in the AWD including the measurable objectives and interim milestones.

Table 4-6: Groundwater Quality SMCs

TDS (mg/L)							
AWD Monitoring Zone	Well ID	DMS ID	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
4	AWD-1	09-005	<1,000	<1,000	<1,000	<1,000	1,000
3	13S15E14M001M	09-003	<1,000	<1,000	<1,000	<1,000	1,000
2	13S16E19J001M	09-196	<1,000	<1,000	<1,000	<1,000	1,000
1	12S16E31G001M[1]	09-002	<1,000	<1,000	<1,000	<1,000	1,000

1. ***Composite Well to be evaluated for replacement at Year-5 Interim Milestone.***

4.5.4 Additional Measurable Objective Elements

Regulation Requirements:

§354.30 (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.

No additional objective elements were set for this GSP.

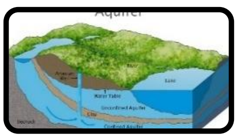
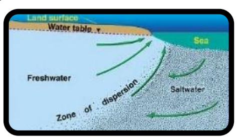
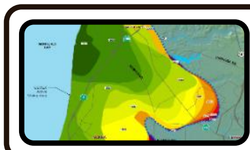
5 Monitoring Network

Regulation Requirements:

> **§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 towards groundwater sustainability. **Table 5-1** includes the monitoring programs 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 Aliso Water District GSA

Monitoring programs for these indicators are described below, including the history of existing monitoring programs, proposed SGMA compliance monitoring, and the adequacy and scientific rationale for each monitoring network.

5.1 Description of Monitoring Network

Regulation Requirements:

§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.

This chapter describes current monitoring programs and the monitoring network being developed by the AWD that will collect sufficient data to determine short-term, seasonal, and long-term trends in groundwater and related surface conditions, ultimately providing information necessary to support the implementation of this Plan, evaluate the effectiveness of this Plan, and aid in decision-making by the AWD management. The results of historical monitoring efforts can be found in **Appendix A -** Groundwater Conditions.

5.1.1 Monitoring Network Objectives

Regulation Requirements:

§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. Help to quantify annual changes in water budget components.
3. Develop meaningful long-term trends in groundwater characteristics.
4. Provide data compatible with the Delta-Mendota basin-wide coordinated effort.
5. Demonstrate progress toward achieving measurable objectives described in the Plan.
6. Monitor changes in groundwater conditions relative to Sustainable Management Criteria.
7. Monitor impacts to the beneficial uses or users of groundwater.
8. Use data to generate information for water resources evaluation.
9. Develop methods for identification of potential future problems.

5.1.2 Implementation of Monitoring Network

Groundwater monitoring has been predominantly performed in the AWD on an individual property owner basis. Landowners and managers comply with monitoring requirements as required by the ILRP and other state programs including the 2013 AB3030 Groundwater Management Plan. The District currently records groundwater levels, groundwater quality, and subsidence data as reported by various entities and landowners. These programs will continue and be expanded to comply with SGMA monitoring requirements. Partnerships will also be forged and maintained to provide and share useful agency and region-wide information that will assist all agencies in the Delta-Mendota Basin in monitoring the health of the aquifers.

New monitoring networks will be developed, and existing networks enhanced when necessary using the Data Quality Objective (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 (DWR, 2016a) and monitoring protocols (DWR, 2016b). 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.

The DQO process helps to ensure a robust approach and that data is collected with a specific goal in mind.

5.1.3 Sustainability Indicator Monitoring

Regulation Requirements:

§354.34(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

The following are descriptions of the existing and proposed monitoring programs for groundwater levels, groundwater storage, water quality, land subsidence, and depletion of interconnected surface water. Seawater Intrusion will not be monitored.

5.1.3.1 Groundwater Levels

Regulation Requirements:

§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.

Groundwater levels have been measured using select wells within the District since the 1950s. Groundwater levels at these sites are publicly available on the CASGEM and DWR Water Data Library websites. However, measurements in these wells have become sporadic over the last few decades and several of the measured wells are no longer measured. The Mendota Pool Pumpers Group (MPG) pumping program has provided additional monitoring and analysis, including annual reports that contain water-level maps for shallow aquifer wells for groundwater above and below the A-clay. In recent years, water-level measurements have become available for a series of shallow observation wells that were installed along the SJR as part of the SJRRP, which will be explained in greater detail in **Section 5.1.3.6**.

Private landowners have historically had groundwater levels measured as part of their best management practices for maintaining pump efficiency. However, this information has never been compiled into a single database. Land within the District is managed by landowners and farm managers. It is the intention of AWD to continue to coordinate the collection groundwater levels and quality at the individual farm level. Each owner/manager will continue to manage groundwater levels on their property and report back to the District, utilizing standard reporting forms. If agreed upon in the future, the District may assist with data collection and monitoring. Currently all reporting is voluntary (except for representative monitoring sites).

The District is currently looking into options for a data management system. It is the intent of the District to compile the data received from landowners into a single database that does the following: protects the privacy of landowners, assists with regional evaluations including groundwater contour maps, supports groundwater flow determination, and aides in annual report development. Representative monitoring sites have been selected as a subset of these wells. Evaluations at these sites will be shared with the DMGB group in order to prepare regional groundwater contour maps, annual reports, and verification of progress toward sustainability.

As stated previously, monitoring in the District has been performed independently by landowners and sporadically by agencies. The seasonal water-level highs and lows have not historically been consistently measured. However, it is the intent of the District to recommend that landowners and farm managers measure groundwater levels approximately every February and October in order to provide the seasonal high and low and consistency in the measurements taken at representative sites. Monitoring at representative sites will be coordinated with the DMGB to present a consistent snapshot in time.

Various types of wells typically available for groundwater level measurements are described below:

- **Domestic Wells**: There are few residences and thus few domestic wells. Water-level measurements may be available for some of these wells.
- **Dedicated Monitor Wells**: The District may elect to monitor existing abandoned wells, wells that are out of production, or wells that are part of the SJRRP monitoring network.
- **Private Irrigation Wells**: All wells within the District are privately owned and operated. Monitoring in accordance with ILRP and existing management practices is performed as necessary. The monitoring information is not publicly available, but the District and the Delta-Mendota Coordination Committee are working to make the information available while protecting the privacy of individual landowners. A representative selection of wells has been identified for water-level measurements and will be measured semi-annually.
- **Wells in Adjacent GSAs**: Groundwater level data from adjoining areas, including other agencies, will also be collected as available to help provide a better understanding of District boundary flow conditions.

5.1.3.2 Groundwater Storage

Regulation Requirements:

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

AWD has estimated long term groundwater storage change using publicly available data from select wells located throughout the District. The District has not historically mapped annual changes in groundwater storage. AWD will continue to gather spring and fall water-level measurements to calculate annual change in storage within the District boundaries.

Groundwater storage change in the upper aquifer will be estimated by multiplying local specific yield values by the change in water levels, as described in **Section 3.3.3**. Specific yield values identified in the AWD hydrogeologic conceptual model (**Appendix A**) were obtained from the USGS. This value took average specific yield values for designated areas, usually 36-square-mile townships, for depths of 10-50 feet, 50-100 feet, and 100-200 feet below the ground surface. In some areas, specific yield data is limited to one value from 10-300 feet. Approximately 60% of the lands in AWD are served by shallow wells, perforated in the upper aquifers about 100-200 feet below the ground surface. The remaining 40% are served by composite wells perforated above and below the Corcoran Clay.

It is the intention of AWD to identify lower aquifer wells in and around the District to better understand both changing water level and groundwater flow in the lower aquifer if possible. The change in storage of the lower aquifer has been estimated from subsidence.

5.1.3.3 Seawater Intrusion

Regulation Requirements:

§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.

Seawater intrusion is not feasible for this district, as AWD is approximately 100 miles from the ocean with mountain ranges between the coast and the district area. As a result, seawater intrusion is not discussed hereafter in this chapter. Saline water intrusion from up-coning of deep saline groundwater from below the base of freshwater is a potential problem and will be monitored as part of general water quality monitoring (see following **Section 5.1.3.4**).

5.1.3.4 Water Quality

Regulation Requirements:

§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.

Groundwater quality is generally suitable for agriculture, a detailed groundwater quality assessment for the AWD area is provided in **Appendix A – Groundwater Conditions**. Water quality monitoring is an important aspect of groundwater management in the area and serves the following purposes:

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

Water quality monitoring will be performed annually at representative wells. In addition to the SGMA water quality monitoring network, the following are descriptions of the various existing water quality monitoring programs in the AWD. There are no municipal water systems privately or publicly operated and domestic water use is via privately owned wells. No domestic water quality issues have been identified and there are no known contaminant plumes in the District.

Private Agricultural Water Quality Monitoring

Agricultural water supplies in the AWD are typically provided by groundwater with some surface water available during flood and high-flow years. Groundwater quality in the area is generally good for irrigation. When surface water is available from the SJR or CBP it is typically of high-quality due to the District's location in the upper reaches of the SJR. The District does not actively monitor surface water in the SJR or CBP, but water quality is monitored by the SJRRP for ecosystem health if concerns are raised about surface water quality. Surface water that recharges the groundwater via deep percolation of irrigation water helps to further improve groundwater quality. Many local growers have irrigation suitability analyses performed on water from their wells. Much of this data is available to the AWD for limited use and is being inventoried.

Irrigated Lands Regulatory Program

The ILRP was initiated in 2003 to address pollutant discharges to surface water and groundwater from commercially irrigated lands. The primary purpose of the ILRP is to address key pollutants of concern, including salinity, nitrates, and pesticides introduced through runoff or infiltration of irrigation water and stormwater. The program is administered by the Central Valley Regional Water Quality Control Board (RWQCB). The Eastern San Joaquin Water Quality Coalition (ESJWQC) was established in 2003 to combine regional efforts to comply with the regulatory requirements of the ILRP.

Other Agencies

Several other agencies play important roles in the monitoring of groundwater quality. These include the Regional Water Quality Control Board, US Environmental Protection Agency, Department of Toxic Substances Control, US Geological Survey, and State Water Resources Control Board. The District has collected and reviewed pertinent water quality data and included results in **Appendix A – Groundwater Conditions**.

San Joaquin River Restoration Program

The SJRRP monitors the San Joaquin River for temperature, salinity (EC), dissolved oxygen (DO), turbidity, pH, and chlorophyll at Gravelly Ford (GRF) and at the San Joaquin River Below Bifurcation (SJB). SJRRP also measures groundwater quality in monitoring wells along the river. Information on water quality along the SJR adjacent to AWD can be found on the SJRRP website. http://www.restoresjr.net/restoration-flows/water-quality/

5.1.3.5 Land Subsidence

Regulation Requirements:

§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.

While some local agencies in the San Joaquin Valley monitor for land subsidence, the majority rely on monitoring performed by regional water agencies or the State and Federal government. Measurement and monitoring for land subsidence are performed by a variety of agencies including USGS, DWR, USBR, USACE, University NAVSTAR (Navigation Satellite Timing and Ranging) Consortium (UNAVCO), and various private contractors. Interagency efforts between the USGS, USBR, the U.S. Coast and Geodetic Survey (now the National Geodetic Survey), and DWR resulted in a series of investigations that identified and characterized subsidence in the San Joaquin Valley. NASA also measures subsidence in the Central Valley and has maps that show the subsidence for a defined period.

The District typically uses USBR subsidence monitoring data as a part of the SJRRP to assess subsidence. The District will continue to work with USBR and other public and private agencies to monitor subsidence biannually. USBR monitors subsidence in conjunction with DWR, USGS, and USACE along the SJR and Bypass levees. This data is limited in scope as it only uses surveyed benchmarks that are surveyed biannually within the limits of the study area. Maps of the subsidence in the study area have been produced after every July and December survey since 2012. More information can be found on their website. http://www.restoresjr.net/monitoring-data/subsidence-monitoring/. Maps of the extent and average annual rate of subsidence are provided in **Section 4.4.1.2**. There are other publicly available data sets that measure subsidence using various methods. These datasets also have limitations. Most often they are limited historically (containing only relatively recent data or only select years) or geographically (having an inadequate density of measurement points to map changes over small areas such as AWD). While developing the GSP, AWD recognized data gaps concerning spatial distribution of the USBR's survey points within the District and added three additional monitoring points to the data set (**Figure 5-5**). Reclamation has assumed responsibility for monitoring 2 of the 3 points during their biannual survey and AWD measures the third independently on an annual basis.

DWR Monitoring Network. DWR, along with other agencies, monitors land subsidence in California's Central Valley. DWR has been working with NASA to acquire and process InSAR data to measure land subsidence in portions of the Central Valley and other locations in California. Data is available on the DWR Website:
http://www.water.ca.gov/groundwater/landsubsidence/LSmonitoring.cfm
https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub .

NASA Monitoring Network. NASA obtains subsidence data by comparing satellite images of Earth's surface over time. For the last few years, InSAR observations from satellite and aircrafts have been used to produce the subsidence maps. https://www.nasa.gov/jpl/nasa-california-drought-causing-valley-land-to-sink

San Joaquin River Restoration Program. As discussed previously, USBR obtains subsidence data twice yearly and publish maps of the results after every July and December survey as part of the SJRRP.

USGS Monitoring Network. USGS installed a subsidence monitoring network of 31 extensometers in the San Joaquin Valley in the 1950s. By the 1980s, the land subsidence monitoring efforts had decreased. A new monitoring network has since been developed. The new network includes refurbished extensometers from the old network, continuous Global Positioning System (CGPS) stations, and InSAR. https://ca.water.usgs.gov/land_subsidence/

There are areas of major subsidence several miles to the north of the District. The pumpage from the lower aquifer in neighboring areas may affect subsidence rates in AWD. The most significant subsidence is attributed to compression of the Corcoran Clay member of the Tulare Formation. The Corcoran Clay lies beneath the entire District. There are also semi-confining clay layers that may be affected by dewatering. There is evidence of some elastic subsidence as ground surface levels in the AWD see a positive gain in elevation during wet years.

It is the DMGB's position that subsidence can be mostly attributed to pumpage from the lower aquifer. It will be important in the future to analyze how areas that extract groundwater from the lower aquifer relate subsidence to lower aquifer pumping and to lower aquifer change in storage, as well as monitor changes in subsidence resulting from projects and management actions with AWD and surrounding neighbors.

5.1.3.6 Depletion of Interconnected Surface Water

Regulation Requirements:

§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.

Due to reasons stated below and described in Chapter 2 and 4, this depletion of interconnected surface water is not being monitored by the AWD GSA at this time as no measurable objectives or minimum thresholds have been set within the Subbasin. The Subbasin GSAs' plan to establish a monitoring network by the 5-Year interim goal (see Section 5.4.5 of the Common Chapter – Appendix B). The GSA will review data and collaborate with agencies as needed. This may change under future conditions.

<u>Surface Water Flow Conditions</u>

AWD is located along Reach 2 of the San Joaquin River. Groundwater in this reach has historically been disconnected from surface water due to past water management practices that diverted water from Millerton Lake in the Madera and Friant-Kern Canals. Historic management required a minimum of 5 cfs to be delivered past Gravelly Ford Weir at the end of Reach 1A. Since the construction of the Friant Dam the SJR has often been dry adjacent to AWD.

<u>Intermittent Flow and Temporal Changes</u>

Interconnected surface water has been defined in the California Code of Regulations Title 23, Division 2, Chapter 1.5, Subchapter 2 "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." Within the District, areas of saturated zones between the SJR and the shallowest underlying aquifer may exist semi-seasonally but not on a continuous basis as this stretch of the SJR does regularly go dry (i.e., is completely depleted). A river flow hydrograph for the SJB monitoring station showing sustained periods of no flows in the river is presented as **Figure 5-1**. The Bifurcation Structure location is shown on **Figure 5-2**.

The SJRRP was the result of a lawsuit requiring restoration efforts in the upper reaches of the SJR to receive an allocation of surface water to promote the reestablishment of fish populations. Restoration efforts have resulted in hydraulic connection between the SJR and the Sacramento-San Joaquin River Delta during non-critical water years. However, due to previous management practices establishing the diversion of surface water away from the upper reaches of the SJR except during instances of flood, the surface water will likely continue to be disconnected from the groundwater system. It is unknown how the SJRRP will change the groundwater-surface water interactions in the future. However, as a part of the settlement, the Restoration Program must monitor for seepage that could cause damage to property and crops adjacent to the river. The San Joaquin River is a losing stream along the reaches adjacent to AWD.

Surface water in the San Joaquin River adjacent to AWD is monitored at GRF and at the Chowchilla Bypass Bifurcation above and below the flood control structure. Surface water flow rates and stage are monitored by DWR and USBR and data is available on the CDEC website[1]. AWD is currently coordinating with SJRRP and will continue to coordinate with SJRRP to monitor groundwater surface water interactions and river flow losses in adjacent reaches of the river to ensure that surface water is unimpaired by groundwater users in AWD.

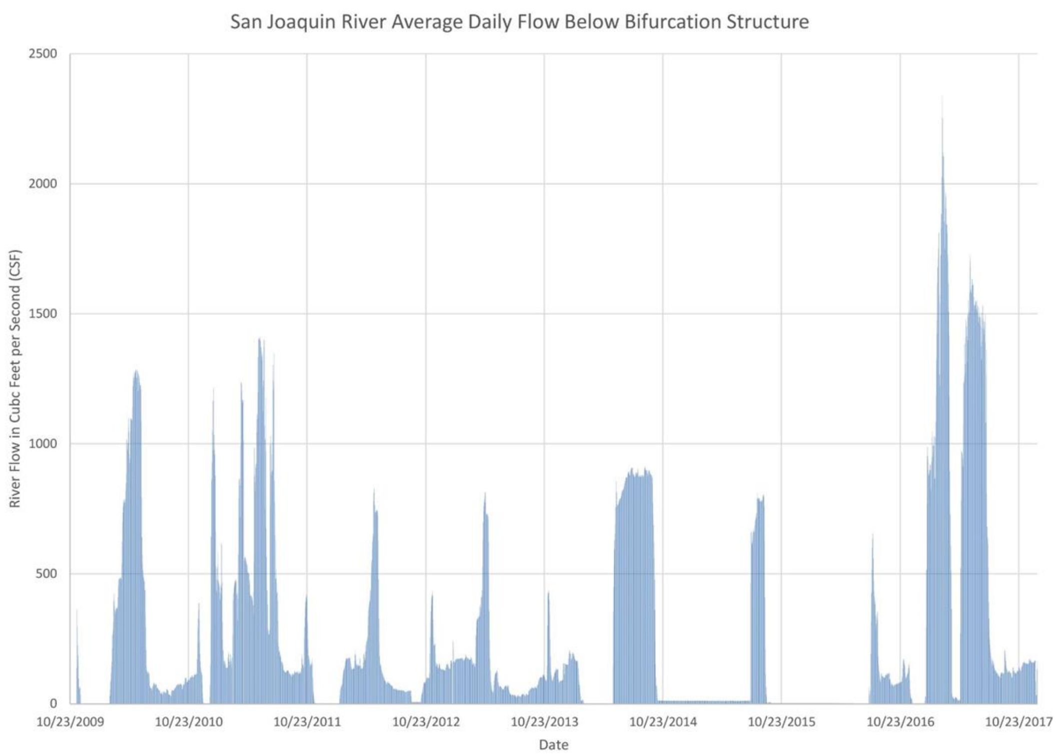


Figure 5-1: Intermittent Flow of the SJR

5.1.4 Adequacy of Monitoring Network

Regulation Requirements:

§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.

Groundwater Levels, Change in Storage, and Groundwater Quality

[1] http://cdec.water.ca.gov/

The existing private monitoring network for groundwater levels and groundwater quality within AWD is comprehensive. It is the intention of AWD to develop a monitoring program that incorporates data being gathered by private landowners into a single database that can be used for reporting to the DMGB. This will eventually include well pumpage and crop mapping. A map of well density is available for reference in **Chapter 3** and is considered adequate for internal monitoring and management.

Representative monitoring sites have been selected in each monitoring "zone." These zones were developed to ensure sufficient monitoring density and proximity to hydrogeological features of importance such as the SJR, areas of similar well construction, and areas where groundwater pumping is limited (**Table 4-3**). Groundwater levels and change in storage utilize the same representative monitoring wells for annual reporting (see for **Table 5-2** perforated Data). Water levels in inactive wells are preferred as monitoring sites to active wells. Water quality wells are only located in areas of active pumping. **Figure 5-3 & Figure 5-4** show the representative monitoring network for water levels/change in storage and water quality respectively.

Table 5-2. Groundwater Level Representative Well Description

Zone	DWR Well ID	DMS ID	Type	Total well depth (FT bgs)	Perforated interval (FT bgs)
1	12S16E31G001M[1]	09-002	Composite	510	210-510
2	13S16E30A001M	09-004	Upper	380	190-380
3	13S15E14M001M	09-003	Upper	304	180-304
4	12S15E32B002M	09-001	Upper	335	160-328

1. Composite Well to be evaluated for replacement at Year-5 Interim Milestone.

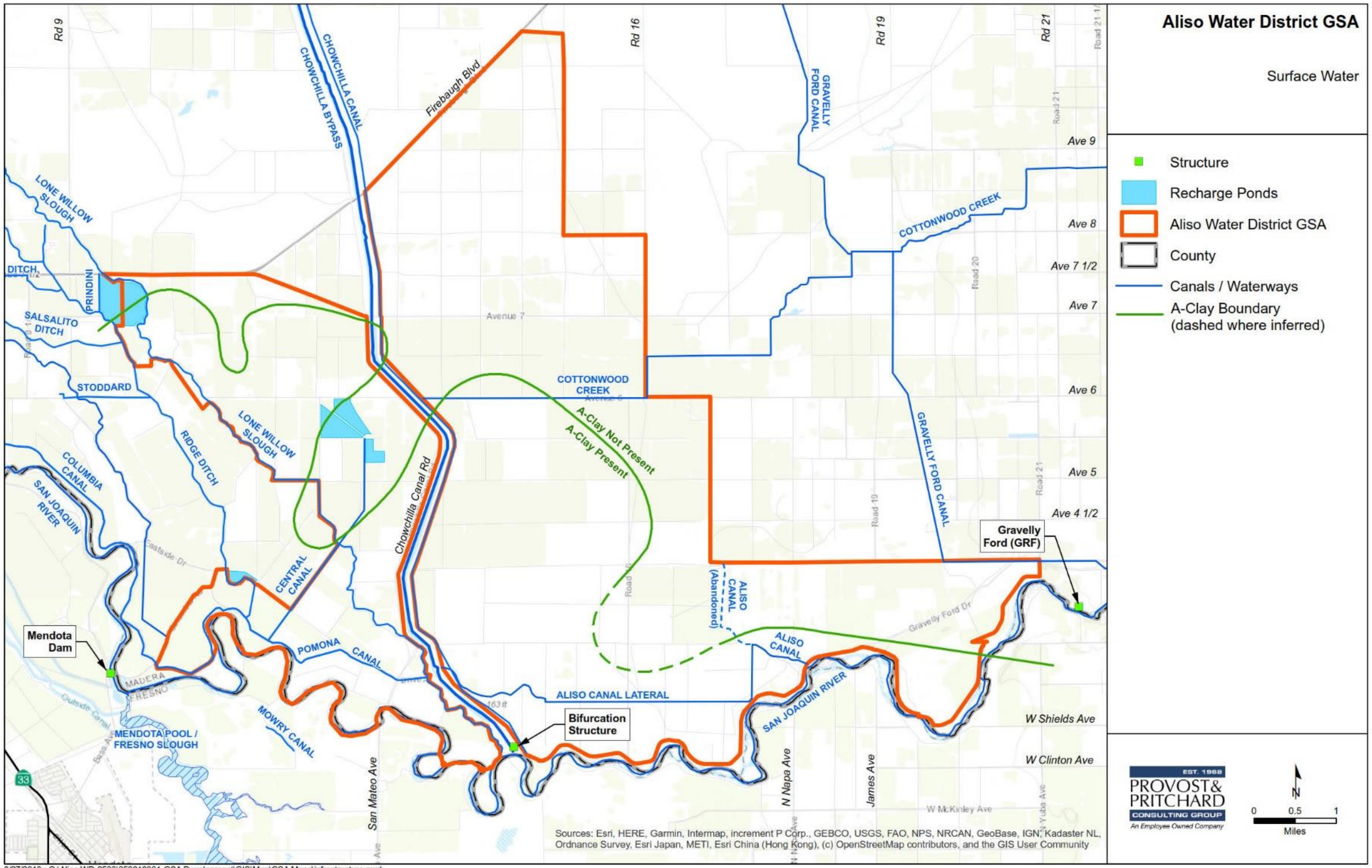


Figure 5-2: Aliso Water District Infrastructure Map

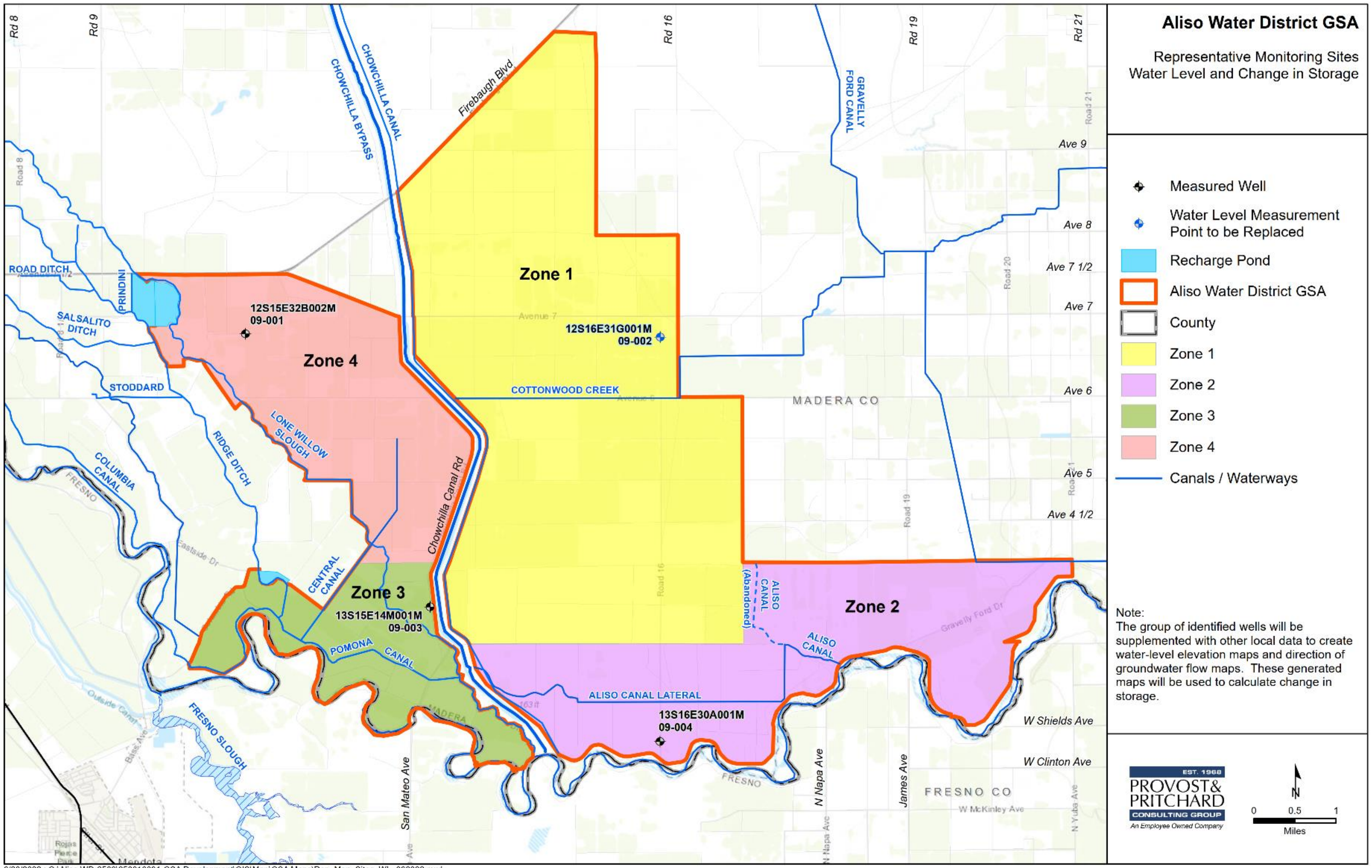
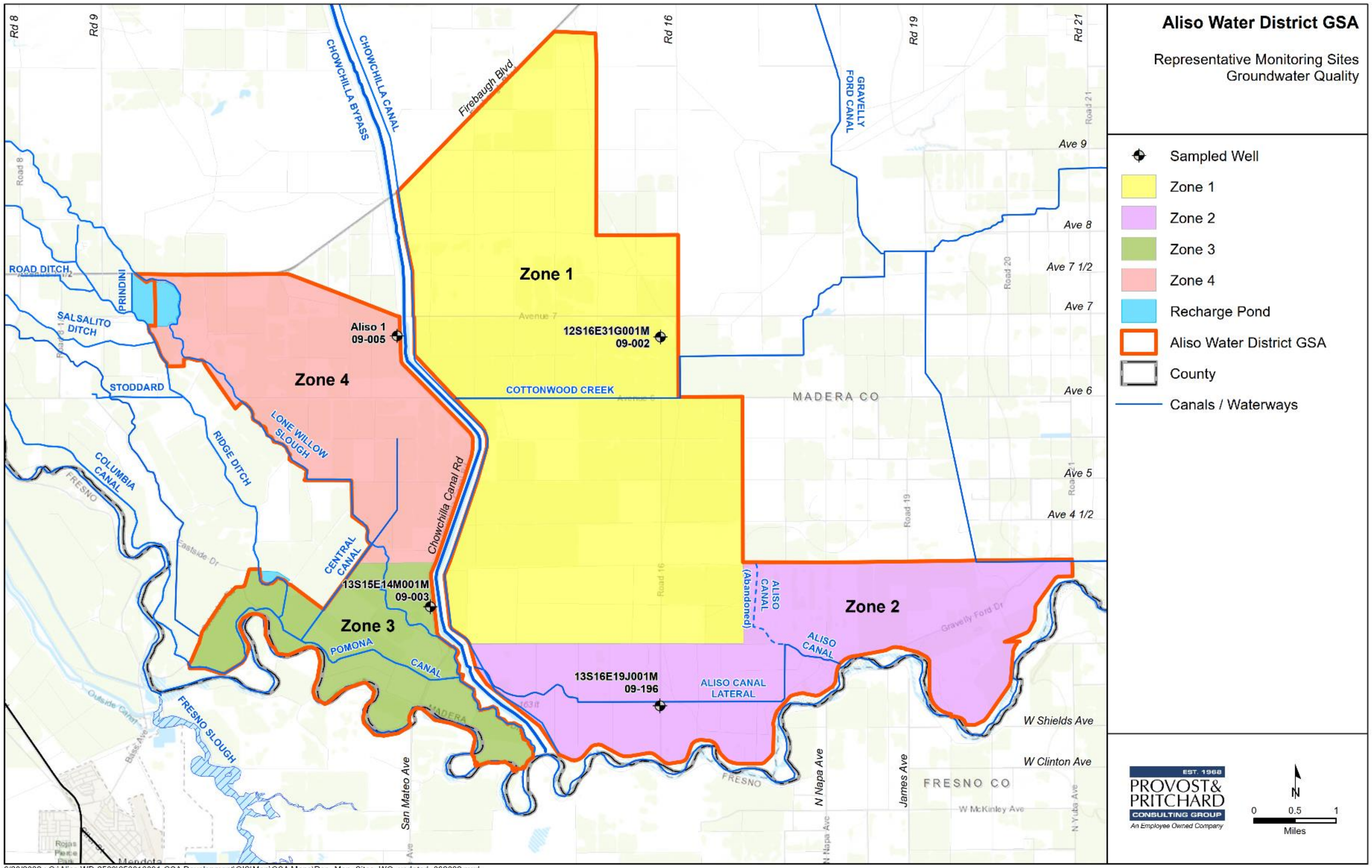


Figure 5-3: Representative Monitoring Network - Water Level & Change in Storage



6/28/2022 : G:\Aliso WD-2500\250016001-GSA Development\GIS\Map\GSA Maps\Rep_Mon_Sites_WQ_updated_062022.mxd

Figure 5-4: Representative Monitoring Sites - Water Quality

Subsidence

The District will continue to work with USBR and other public and private agencies to monitor subsidence biannually. AWD added three additional monitoring sites to address data gaps in the existing USBR monitoring network early in GSP development; these are considered sufficient and there are no plans to add additional surface subsidence monitoring points. AWD GSA will monitor the Yearout and Fordel extensometers to understand depth specific subsidence. The District will also consult with landowners to identify subsidence that may be occurring at specific locations within the District. If additional locations are identified, they will be inventoried, and additional monitoring efforts may be implemented.

Currently there are no known adverse effects of subsidence in the District. Inelastic subsidence in adjacent districts will be monitored to see how rates increase or decrease relative to AWD and implementation of SGMA. Subsidence rates and groundwater elevation levels will be compared to establish correlations and ensure sustainable management of the District and the prevention of undesirable results. **Figure 5-5** shows the representative subsidence monitoring points in the District.

Interconnected Surface Water

It has been established that Reach 2 of the SJR is not hydrologically connected to a continuous saturated zone. Due to the construction of the Friant Dam, the hydraulic connectivity of the surface water with the upper aquifer has been intermittently severed in Reach 2 of the SJR. Record-breaking drought in recent years has not helped the situation. Along the SJR, AWD will not be monitoring this criterion but rather has assumed that the monitoring network put in place for the SJRRP will be adequate for determining if the SJR hydraulically connects to groundwater in the future (**Figure 5-6**). Regarding SMCs, the DMGB has decided to monitor ISW collectively and has deferred to a limited network collected by SJRRP that is more thoroughly described in the Common Chapter Figure CC-70.

The SJRRP currently monitors surface water–groundwater interactions to prevent adverse impacts to lands adjacent to the SJR in the form of seepage and rising groundwater tables that cause crop damage. As a stipulation of the Settlement, the SJRRP must mitigate impacts to growers along the SJR that may be affected by river seepage through levees onto active agricultural lands. To monitor groundwater levels and the effects of the river on the upper aquifer and adjacent lands, the SJRRP has implemented the SJR Seepage Monitoring Plan (SJRRP, 2014). This study monitors a network of wells along the banks of the SJR. The interaction is currently considered a disconnected, losing stream. As the SJRRP is implemented, the interconnectivity of the groundwater and surface water may be altered. AWD will continue to coordinate with USBR and the SJRRP to protect beneficial users of surface water.

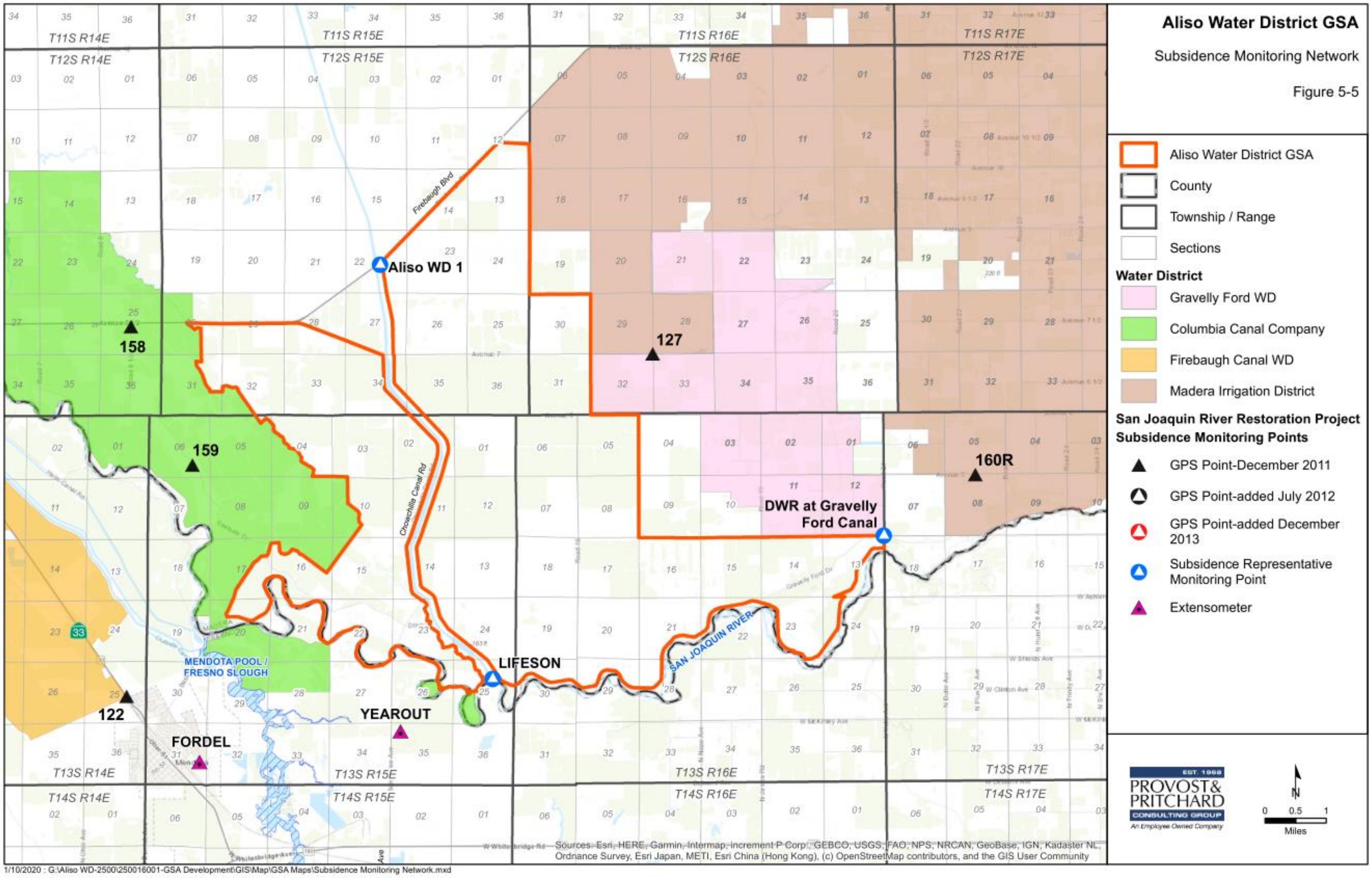


Figure 5-5: Representative Monitoring Network - Subsidence Points

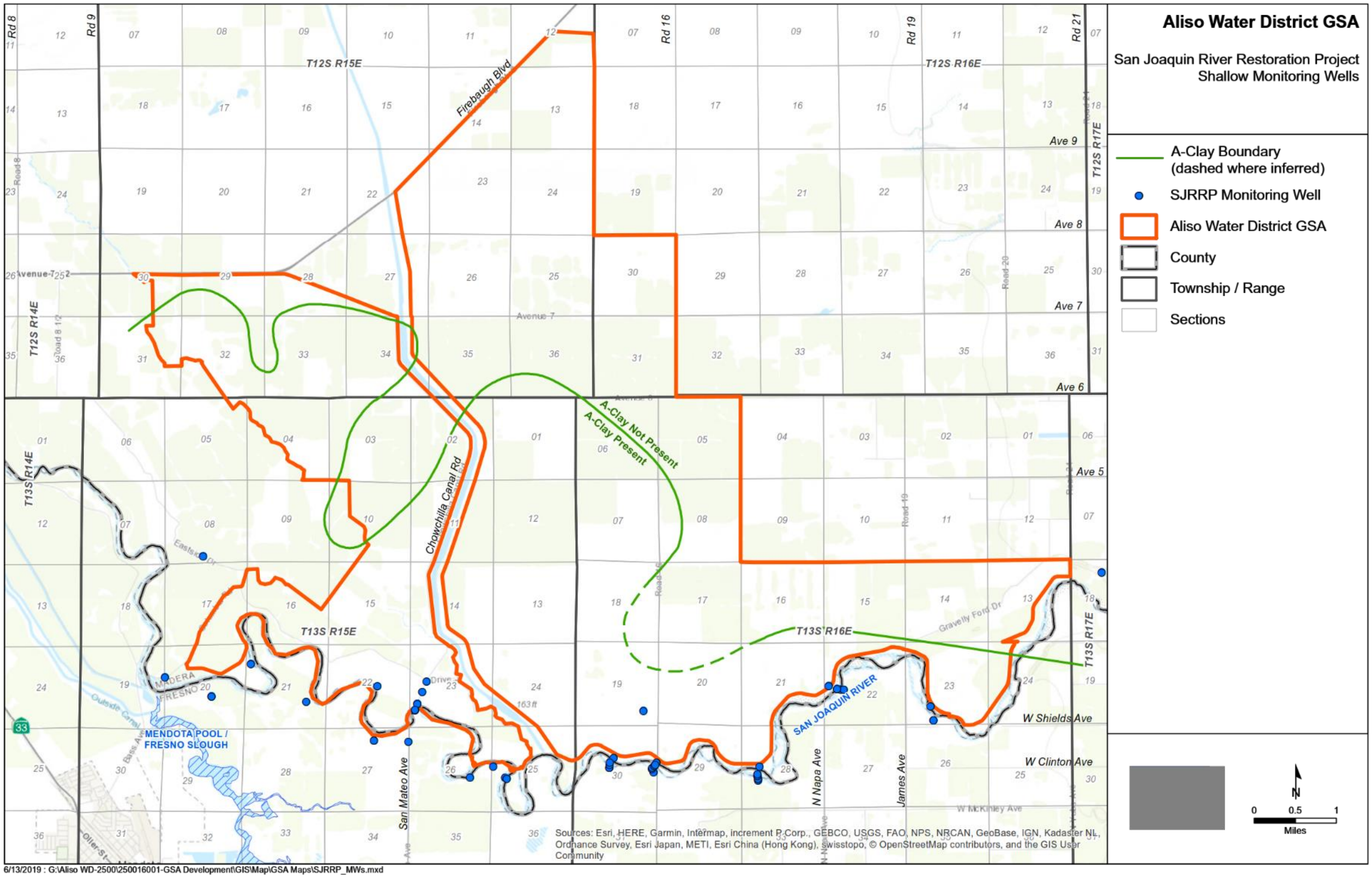


Figure 5-6: SJRRP Shallow Monitoring Wells

5.1.5 Density of Monitoring Sites and Frequency of Measurements

Regulation Requirements:

§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.

Groundwater Extraction

Groundwater extraction at this time will be calculated based on crop maps for the GSA, assumed ET values, and irrigation efficiencies. Surface water diversion will offset these values and will be based on flow measurement devises. As data is developed, it is envisioned that actual groundwater extraction at individual wells will be monitored.

Groundwater Levels

Groundwater level hydrographs in AWD have water level data going back to the 1950s in some instances. This data has enhanced understanding of long-term trends and the ability of the aquifer to respond to droughts and wet periods.

The groundwater levels will be monitored in the spring (February) and fall (October) of each year, consistent with the rest of the subbasin per the **Common Chapter (Appendix B)**. This differs slightly from historical measurements, but the AWD landowners have agreed to this schedule to provide consistency in the data for the District and the Subbasin. Spring measurements are designed to capture the recovery of the groundwater basin after agricultural irrigation demands have been met the previous year. Fall measurements capture a period after peak irrigation has ceased before any natural recovery has taken place. The two taken together are intended to show the full effects of groundwater use in a given year.

Hopkins and Anderson (2016) provide recommendations for groundwater-level monitor well densities. The densities range from 1 well per 150 square miles to 1 well per 25 square miles based on the quantity of groundwater pumped. A minimum density of 1 well per 25 square miles is recommended for areas using over 100,000 AF of groundwater per year. Groundwater use in AWD is unlikely to exceed 100,000 AF/year on average, as it is currently 85,000 AF (see water budget **Chapter 3.3**). This is a minimum monitoring density, and AWD is currently maintaining a much denser network. However, representative monitoring wells will be selected for reporting purposes. AWD currently has 3-4 monitoring points for each applicable sustainability indicator spread spatially across the District’s approximately 40 square miles to ensure maximum coverage of the area (i.e., 1 well/10 square miles).

AWD intends to provide wells with reliable access for water-level measurements each spring and fall, available information on well depth and perforated intervals, and sufficient depth to accommodate seasonal fluctuations. Wells that do not meet these guidelines will still be maintained in the network as they can still provide useful information. If selected as representative monitoring sites, efforts will be made to obtain access to information on well construction and exact location. During development of groundwater contours, those wells with and without well construction information will be labeled to assist with the analysis.

Groundwater Storage
Groundwater storage will be monitored using water levels as a proxy for volume of groundwater to ensure compliance with SMCs developed in **Chapter 4**. However, as explained previously, groundwater storage change will be estimated annually using spring groundwater levels from select wells. Density and frequency of measurements are detailed in the previous section. Groundwater storage changes will generally be reported as a volume over the 40-square mile District. The areas used are considered reasonable as overdraft is typically estimated on a regional scale; estimating overdraft on a very small or local scale may provide misleading results, either over or underestimating actual change. Only wells with reasonable and reliable data will be used to develop groundwater contours and estimate storage change.

Groundwater storage in the lower aquifer will be quantified using change in ground surface elevation (subsidence) contours. Methods for measuring subsidence are described later in this section.

Seawater Intrusion
The AWD western boundary lies approximately 100 miles from the ocean with mountain ranges between the coast and the District 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. Saline intrusion from up-coning of deep saline groundwater from below the base of freshwater is a potential problem and will be monitored as part of general water quality monitoring (see following section).

Groundwater Quality
Water quality monitoring is performed at wells used to gather groundwater level data. Testing frequency is done annually (June) in accordance with the **Common Chapter** (**Appendix B**). Representative monitoring sites for groundwater quality are wells that are reported to the DWR and the DMGB. These wells represent the general water quality being pumped for agricultural purposes in each “monitoring zone.” Should thresholds (defined in **Chapter 4**), be exceeded in any of the selected wells, water quality will be examined in the subsequent zone in adjacent wells to determine validity and extent of the potential issue.

Land Subsidence
The subsidence monitoring network has adequate density to determine land subsidence in AWD. The network will be surveyed annually in July to coincide with SJRRP subsidence monitoring surveys. The land subsidence monitoring program has three sites located within the District, which is a little more than 40 square miles, as well as several nearby. These sites sufficiently demonstrate boundary conditions in the District. Unfortunately, these points lack long-term data, but contours based on long term conditions at nearby benchmarks were used to set SMCs.

Depletion of Interconnected Surface Water
The SJRRP has dozens of monitoring wells along the SJR to monitor shallow groundwater levels (See **Figure 5-6**). The monitoring network includes wells at various distances from the river and at various depths that can be used to develop a full picture of the surface water – groundwater interface. Flow rates along the reach of the SJR adjacent to the District are available and can be used to determine losses. Loss rates as they relate to flow in the river can

be tracked and any extreme variations will be identified. AWD has calculated losses in the SJR using published loss rates developed for the Settlement Agreement. Furthermore, allowable losses for each reach of the SJR have been established by the Settlement Agreement. It is assumed that all losses are due to natural and unavoidable seepage. However, other factors beyond the control of AWD may contribute to losses in Reach 2.

Regarding SMCs, the DMGB has decided to monitor ISW collectively and has deferred to a limited network collected by SJRRP that is more thoroughly described in the Common Chapter Figure CC-70.

5.1.6 Monitoring Network Information

Regulation Requirements:

§354.34(g) Each Plan shall describe the following information about the monitoring network:

5.1.6.1 Scientific Rationale for Site Selection

Regulation Requirements:

§354.34(g)(1) Scientific rationale for the monitoring site selection process.

Groundwater Extraction

Groundwater extraction at this time will be calculated based on crop maps for the GSA, assumed ET values, and irrigation efficiencies, as this is the best available data. Surface water diversion will offset these values and will be based on flow measurement devices. As data is developed, it is envisioned that actual groundwater extraction at individual wells will be monitored. While some wells are currently metered, there are not enough to monitor the entire District.

Groundwater Levels

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

- The network meets the minimum density goal of 1 well per 25 square miles.
- All aquifer conditions are represented.
  - Wells have been chosen to represent areas with and without A-clay present.
  - Wells have been chosen to monitor various types of influences such as the SJR, neighboring districts and non-districted area, and boundary conditions.
- Wells have known construction information or will be videoed.
- Wells have quality long-term historic data.

The following scientific rationale will be used to add new wells:

- Avoid wells perforated across multiple aquifers where feasible.
- Select wells with available construction information (i.e., depth, perforated interval).

Groundwater Storage

Site selection for changes in groundwater storage in the upper aquifer follow the rationale described in the groundwater level portion of this section. Site selection for the lower aquifer follows rationale described in the subsidence portion of this section.

Groundwater Quality
The scientific rationale for the chosen water quality monitoring sites is based on an evaluation of constituents affecting agricultural production and existing differences in well construction and the hydrogeological features of the four zones within Aliso. Because there are no known contamination plumes, AWD will monitor groundwater quality in monitoring zones that contain similar features and well construction. It should also be noted that there is very little commercial or industrial land use, so any contamination is limited to agricultural processes. Since there is little to no industrial or commercial land use, groundwater quality sampling will be limited to sampling for agricultural constituents. Should any groundwater quality concerns become apparent either through sampling or other methods, AWD will reassess the current monitoring sites and provide rationale for incorporating additional sites into the program. AWD may work with other agencies such as the ESJWQC and SWRCB to utilize data and information from the ILRP and future CV-SALTS programs.

Land Subsidence
The USBR land subsidence monitoring program data was established using National Geodetic Survey (NGS) control points. The control points are the foundation for monitoring subsidence. Additional points have since been added that monitor critical infrastructure, locations of known subsidence, and interim points that assist in isolating areas to analyze limits of subsidence and show boundary conditions. Surveying selected control points is considered the best method to monitor subsidence since it involves direct measurements, as opposed to remote sensing which relies on indirect or inferred measurements.

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

- Add sites that are showing obvious signs of subsidence.
- 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.
- Add sites in areas where the confined aquifer pumping is present, confined aquifer water levels are falling, and clays are present in the subsurface that are compactible.

Depletion of Interconnected Surface Water
SJRRP has installed multiple wells along the SJR to monitor effects of the restoration program and the effects of increased surface water on adjacent lands. The SJRRP is required to monitor for impacts of surface water seepage on land use. Wells have been specifically installed at known depths and distances from the SJR to monitor groundwater levels as they relate to flow and river stage. More information on the selection of wells sites, depths, and distances is available in the SJRRP Tetra Tech Technical Study (Tetra Tech, 2013). No control points have been chosen for the representative monitoring network due to inability to set meaningful SMCs at the moment.

5.1.6.2 Consistency with Data and Reporting Standards

Regulation Requirements:

§354.34(g)(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 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, and the full section is included as **Appendix D**.

- Data reporting units (e.g., water volumes shall be reported in acre-feet, etc.)
- Monitoring site information (e.g., site identification number, description of site location, etc.)
- Well attribute reporting (e.g., CASGEM well identification number, casing perforations, etc.)
- Map standards (e.g., data layers, shapefiles, geodatabases shall be submitted in accordance with the procedures described in Article 4, etc.)
- Hydrograph requirements (e.g., hydrographs shall use the same datum and scaling to the greatest extent practical, hydrographs should show depth to water, etc.)
- Groundwater and surface water models (e.g., the model shall include publicly available supporting documentation, etc.)

5.1.6.3 Corresponding Sustainability Indicator, Minimum Threshold, Measurable Objective, and Interim Milestone

Regulation Requirements:

§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.

Table 5-3: Corresponding Sustainability Indicator, Minimum Threshold, Measurable Objective, and Interim Milestones

Sustainability Indicator	Threshold Description	Monitoring Site ID	DMS ID	Threshold Units	Interim Goal 2025	Interim Goal 2030	Interim Goal 2035	Measurable Objective at 2040	Minimum Threshold
Water Levels	Historical seasonal low prior to the end of Water Year 2016	12S15E32B002M	09-001	Feet above msl	≥114.3	≥114.3	≥114.3	≥114.3	40.5
		13S15E14M001M	09-003	Feet above msl	≥52.9	≥52.9	≥52.9	≥52.9	37.4
		13S16E30A001M	09-004	Feet above msl	≥51.9	≥51.9	≥51.9	≥51.9	37.7
		12S16E31G001M [1]	09-002	Feet above msl	≥17.1	≥17.1	≥17.1	≥17.1	-4.0
Groundwater Storage	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.								
Subsidence	The minimum threshold is set to not exceed 2 ft of additional inelastic land subsidence attributable to groundwater extraction.	Lifeson	09-008	Feet above msl	≥178.33	≥177.83	≥177.59	≥177.33	177.33
		Aliso WD 1 Reset	09-006	Feet above msl	≥157.52	≥157.02	≥156.77	≥156.52	156.52
		DWR at Gravelly Ford Canal	09-007	feet above msl	≥201.39	≥200.89	≥200.64	≥200.39	200.39
Water Quality	TDS – 1,000 mg/L based on drinking water standards	AWD-1	09-005	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		13S15E14M001M	09-003	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		13S16E19J001M	09-196	TDS (mg/L)	<1,000	<1,000	<1,000	<1,000	1,000
		12S16E31G001M[1]	09-002	TDS (mg/L))	<1,000	<1,000	<1,000	<1,000	1,000
Interconnected Surface Water	Identified data gap in the DMGB. The Chronic Lowering of Groundwater Levels Minimum Threshold is used as an interim minimum threshold.								
Seawater Intrusion	Not Applicable	N/A		N/A	N/A	N/A	N/A	N/A	N/A

1. *Composite Well to be evaluated for replacement at Year-5 Interim Milestone.*

5.1.7 Monitoring Locations Map

Regulation Requirements:

§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.

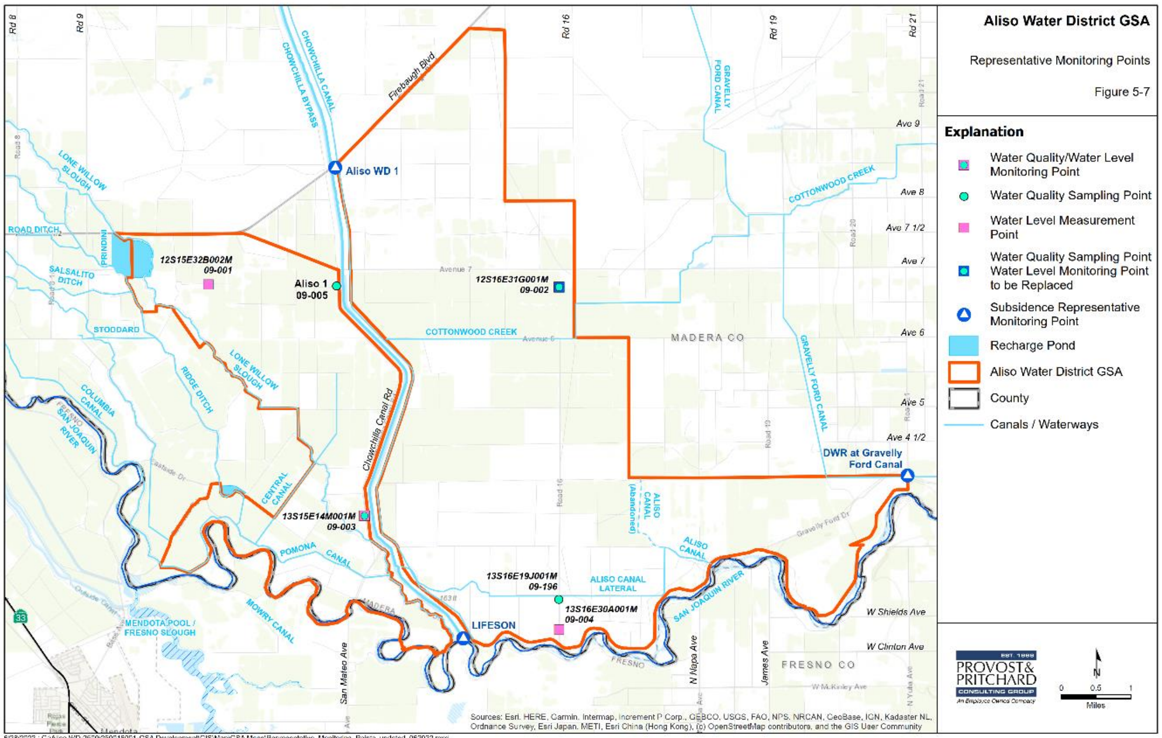


Figure 5-7: Representative Monitoring Points

Table 5-4: Monitoring Locations

Site ID	Site Type	Sustainability Indicator	Frequency of Measurement	Latitude, Longitude
12S15E32B002M	Well	Groundwater Levels & Storage (Upper) & ISW (interim)	Biannually - January & October	36.847966 / -120.35053
13S15E14M001M	Well	Groundwater Levels & Storage (Upper) & ISW (interim)	Biannually - January & October	36.7986 / -120.3092
		Groundwater Quality	Annually - July	36.7986 / -120.3092
13S16E30A001M	Well	Groundwater Levels & Storage (Upper) & ISW (interim)	Biannually - January & October	36.776138 / -120.259304
13S16E19J001M	Well	Groundwater Quality	Annually - July	36.78281477 / -120.2593768
12S16E31G001M	Well	Groundwater Levels & Storage	Biannually - January & October	36.8439 / -120.2611
		Groundwater Quality	Annually - July	36.8439 / -120.2611
AWD-1	Well	Groundwater Quality	Annually - July	36.848218 / -120.316652
LIFESON	Elevation Benchmark	Subsidence	Biannually – July & December	36.774092 / -120.284351
ALISO WD 1 RESET	Elevation Benchmark	Subsidence	Biannually – July & December	36.872325 / -120.317292
DWR at Gravelly Ford Canal	Elevation Benchmark	Subsidence	Biannually – July & December	36.807787 / -120.168872

5.2 Monitoring Protocols

Regulation Requirements:

§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.

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 E** for a copy of the Best Management Practice (BMP). The District may develop standard monitoring forms in the future if deemed necessary.

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 foot. The BMP suggests measurements to the nearest 0.01 foot; 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 the best one can achieve.
2. Wells will be surveyed to a horizontal accuracy of 0.5 foot.
3. Unique well identifiers will be labeled on all public wells and on private wells if permission is granted.
4. The BMP states that measurements each spring and fall should be taken "preferably within a 1 to 2-week period," which is consistent with current monitoring practices.
5. In the field, water level measurements will be compared to previous records; if there is a significant difference, then the measurement will be repeated.
6. For water quality monitoring, field parameters for pH, electrical conductivity, and temperature will only be collected when required for the particular parameter being monitored. Determining if a well has been purged adequately may be ascertained by calculating a run time before sampling. An irrigation well may require several days of pumping to obtain a representative sample.

5.3 Representative Monitoring

Regulation Requirements:

§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:

5.3.1 Description of Representative Sites

Regulation Requirements:

§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.

DWR has referred to representative monitoring as utilizing one well to represent an entire GSA or Management Area. AWD has not divided the district into management areas as the District will be managed as a whole. However, use of one representative well is not practical to cover the varying conditions of AWD nor to allow for accurate calculations of change in storage. Of the wells in AWD that are monitored, only a chosen few are used as representative of conditions in the GSA. Groundwater conditions can vary across AWD. Since well construction and proximity to hydrogeological features varies within the District, more than one representative monitoring site was chosen to reflect potential variations in groundwater conditions.

5.3.2 Use of Groundwater Elevations as Proxy for Other Sustainability Indicators

Regulation Requirements:

§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.

As noted, groundwater elevations will be used as a critical component of groundwater storage estimation and will be used to ensure compliance with SMCs developed in **Chapter 4**, track any minimum threshold exceedances, and track Plan effectiveness. However, it should be noted that GSP annual reporting requires quantification of groundwater storage as detailed in **Section 3.3.3**. Additional groundwater elevation data may be necessary for calculating the volume of groundwater storage.

Interconnected surface water is currently being identified as a data gap within the Subbasin. Therefore, the AWD GSP and other GSP groups in the Subbasin have decided to use water elevation SMCs as a proxy for interconnected surface water on an interim basis until replacement thresholds, based on a rate or volume of interconnected surface water losses, can be established for the Subbasin. The GSAs anticipate completing an interconnected surface water monitoring network to gather data and further develop unique SMCs for interconnected surface water.

5.4 Assessment and Improvement of Monitoring Network

5.4.1 Review and Evaluation of Monitoring Network

Regulation Requirements:

§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 monitoring network will continue to be developed and refined as data is gathered and analyzed. AWD will review the monitoring network in the District annually to ensure that the representative monitoring points identified are in fact representative of the variation within the District. Any proposed changes will be noted in the annual reporting and implemented prior to the next measurement period. It should be noted that the effectiveness of the monitoring network may not be apparent for several reporting periods.

5.4.2 Identification of Data Gaps

Regulation Requirements:

§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.

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

1. **Temporal**: Insufficient frequency or duration of monitoring. For instance, data may be available from a well only in the fall since it is rarely idle in the spring or measurements during a certain year may not be widely available.
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.

Following are discussions on these data gaps in each existing monitoring network:

Groundwater Levels and Groundwater Storage

Temporal Data Gaps: In the case of AWD there are several wells that were monitored frequently from the 1950s to the 1970s but are now only sporadically monitored or have been destroyed. Another limitation to temporal data is a lack of monitoring during the transition from the Water Data Library to the CASGEM program. It is anticipated that this data gap will decrease with the incorporation of private wells into the monitoring network; however, historic trends will be approximations as future water levels are compared to historic levels in nearby wells with assumed similar construction.

Spatial Data Gaps: Historically, it is difficult to analyze data on an annual basis or for a specific year due to temporally isolated spatial data gaps. Another spatial data gap facing AWD is aquifer-specific water level information. There are very few wells that lie solely within the deep aquifer, making monitoring of the lower aquifer difficult. Due to the abundance of composite wells east of the bypass it is assumed that this area functions as one aquifer.

Quality of Data: Currently, most of the wells monitored with long term historic data that is publicly available do not have construction information for depth and perforated interval. When well construction information is available it is often hard to match with specific wells, limiting the usefulness of long term, historic data. These wells do not provide ideal data points, but to maintain a historic record of water level data, the District will continue to collect publicly available data and seek further information on well construction logs.

Groundwater Quality

Temporal Data Gaps: None.

Spatial Data Gaps: None.

Insufficient Quality of Data: At this time the groundwater quality data analyzed by certified lab technicians and referenced by the District is deemed sufficient.

Land Subsidence

Temporal Data Gaps: The USBR started collecting data within the Central Valley decades ago; however, the comprehensive data used for this study is limited to data from 2011 to present. There is limited historic subsidence data within District boundaries to compare with current rates of subsidence at newly installed monitoring points.

Spatial Data Gaps: AWD addressed spatial data gaps in the subsidence monitoring network early in the Plan development process. Points are located along District boundaries to the north, south, and east. It has been deemed that the subsidence monitoring point density is sufficient to monitor subsidence in the District.

Insufficient Quality of Data: At this time the semi-annual subsidence data recorded and referenced by the USBR in accordance with the SJRRP is deemed sufficient.

Depletion of Interconnected Surface Water

There is limited historic groundwater level monitoring along the SJR to compare with current groundwater levels. It should also be noted that the intent of the existing monitoring program along the SJR is not to track reductions in surface water due to groundwater pumping, but surface water intrusion on lands adjacent to the river. How shallow water levels can be correlated with depletion of surface water is still being considered. Groundwater pumping near the river tends to decrease during wet years due to availability of surface water, which offsets groundwater requirements for irrigation. On the other hand, losses in the river also increase. This would give the appearance of an inverse relationship between pumping and losses.

Temporal Data Gaps: The USBR has been collecting data from the monitoring wells adjacent to the District boundary along the SJR in conjunction with the SJRRP since 2007. Data gaps prior to 2007 may exist, however, since the District is not setting criteria for interconnected surface water-groundwater systems it has been deemed unnecessary to further acquire historical data regarding groundwater elevation data recorded before the establishment of the SJRRP.

Spatial Data Gaps: Spatial data gaps may be present when referencing the monitoring wells utilized by the USBR for annual monitoring in accordance with the SJRRP. However, since AWD is not setting criteria for interconnected surface water-groundwater systems, further expansions of these networks in order to address these data gaps is not deemed applicable at this time.

Insufficient Quality of Data: At this time the annual groundwater elevation data recorded and referenced by the USBR in accordance with the SJRRP is deemed sufficient. AWD is not setting criteria for surface water groundwater interaction.

5.4.3 Plans to Fill Data Gaps

Regulation Requirements:

§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.

(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.

There are temporal, spatial, and qualitative data gaps in the monitoring network.

<u>Groundwater Levels</u>
The groundwater level network has spatial and data quality gaps. There is missing construction information for some of the wells and an insufficient number of wells spatially located that represent the upper and lower aquifer. The following steps will be followed to improve the data quality and identify wells that can be used to monitor both aquifers:

- **Collect well completion reports.** Well Completion Reports will provide the needed information. These could be collected from the landowner or DWR; however, several challenges exist. It has been found to be 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.
- **Perform a video inspection of wells 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 be more likely to agree since they would obtain a free well assessment. While DWR has technical services available to perform the surveys, the demand for the surveys is likely greater than the availability.

Every effort will be made to gain access to historic data sets for incorporation into the data management system to assist in developing a greater understanding of changing groundwater conditions for projections of future trends.

5.4.4 Monitoring Frequency and Density

Regulation Requirements:

§354.38(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:
(1) Minimum threshold exceedances.
(2) Highly variable spatial or temporal conditions.
(3) Adverse impacts to beneficial uses and users of groundwater.
(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

The frequency and density of the proposed monitoring programs are discussed in previous sections. The criteria are considered adequate to provide sufficient monitoring data and to satisfy SGMA requirements. Beginning in 2020, when groundwater conditions are to be compared to sustainability goals, the monitoring network may be modified or enhanced if deemed necessary. The monitoring network will be reviewed once a year for adequacy and any changes will be noted in the annual report and implemented the following year if possible.

5.5 Reporting Monitoring Data to the Department

Regulation Requirements:

§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.

Monitoring results of the representative monitoring sites showing seasonable variability will be made available for both the basin-wide monitoring effort and for inclusion in annual reports as required by DWR.

6 Projects and Management Actions to Achieve Sustainability

Projects and management actions will be implemented to avoid undesirable results and achieve groundwater sustainability goals by 2040. Several workshops were held with the Projects and Management Action Ad Hoc Committee in 2018 and 2019 to finalize project descriptions, develop district priorities, and score projects based on criteria developed. The District analyzed several project types and management programs during the Ad Hoc Committee planning process, which are summarized into the following categories.

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

The first priority of the AWD is to obtain rights to surface water to augment water supply and increase groundwater recharge. If project development alone is not able to achieve the sustainability required to prevent undesirable results, then management actions or programs will need to be employed. The projects described herein primarily focus on the capture, use, and recharge of available high-flow surface water supplies within the GSA to augment the existing water supply and reduce the impacts of groundwater pumping. Alternatively, management actions have been developed that primarily focus on increased data collection, system improvements, reduced water demand, and associated reduction of groundwater pumping through actions such as regulatory policies and incentive-based programs.

The District considered a number of potential projects and management actions that could be implemented to mitigate groundwater overdraft within the GSA and help achieve sustainability, but it was determined that not all of the identified potential projects and management actions were feasible for implementation in AWD. The projects and actions that are most feasible at this time are identified in **Table 6-1,**

Table 6-3, & Table 6-5 and have been ranked to assign priority. In addition, landowners within AWD are developing private projects to mitigate localized overdraft, the benefits of which could be shared with the District/GSA and will count toward the overall AWD water balance. The preferred projects and management actions discussed below may not be implemented in a strictly linear fashion as prioritized below, and management actions may not be implemented if sustainability is achieved through other actions.

6.1 Surface Water Acquisition Programs

AWD does not have long-term surface water supply permits or contracts, although some individual lands within the District do have private rights to surface water. In order to prevent undesirable results, it is the District's primary goal to obtain surface water rights to supplement underground storage/recharge and irrigation. Benefits to importing new sources of surface water 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.

The following table shows a numerical method for ranking potential surface water sources by likelihood of securing and the potential cost/AF. The higher the score the more desirable the source is to pursue. The projects are described further below. It should be noted that these acquisition projects are planned for implementation along with the infrastructure projects described in the next section. Furthermore, the source of water eventually secured will affect project ranking, making some projects more feasible than originally thought.

Table 6-1 Acquiring Access to Surface Water

Rank	Water Source	Likelihood of Securing	Cost per AF	Total Score
1	San Joaquin River and Chowchilla Bypass Flood Water	6	6	12
2	USBR 215 Flood Water	4	4	8
3	Banking Out-of-District Water	5	2	7
4	Latent Water Rights	1	5	6
5	Water Contracts	2	3	5
6	Water Exchanges/Transfers/Purchases	3	1	4

Likelihood: 1 unlikely, 6 likely
Cost: 1 most expensive, 6 least expensive

San Joaquin River and 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. State agencies (DWR, SWRCB) have been collaborating to encourage and streamline access to high-flow surface water (flood water) that would otherwise be diverted down flood control structures and potentially create flood risk for lands and infrastructure as it flows to the Delta. During years with significantly above-average precipitation, non-contracted water sourced from high-flow events is released into the San Joaquin River from Friant 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 District. Acquiring Water Rights for surplus flows in the San Joaquin River and Chowchilla Bypass will allow this previously abandoned and unutilized water to be put to beneficial use enabling groundwater sustainability in the Basin.

AWD has investigated two types of water rights that can be obtained from SWRCB; temporary and permanent. A temporary permit allows up to 180 days of diversion. After the 180-day permit term, the permit can be renewed as necessary. This allows agencies flexibility in securing water and prevents them from having to pay during years where flood flows are unlikely. There are two types of temporary permits, direct diversion and underground storage. Direct diversion allows for direct diversion and use for irrigation, while underground storage requires surface water to be infiltrated into the aquifer for later extraction by pumping. The direct diversion temporary permit is more expensive, but it allows more flexibility in use. The permanent water right is more expensive initially than the temporary permit; however, the water use is flexible, and cost is not governed by how water is applied or stored.

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.

Due to the inexpensive cost and abundant quantity, flood water is the optimal source for surface water supply when available.

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 these flows to be applied to lands that would otherwise not receive Federal water. This water would be accessed by the District from the San Joaquin River through existing turnouts if made available from the CVP Friant system.

Banking Out-of-District Water
There is potential for AWD to bank water on behalf of other entities. AWD's proximity to the Mendota Pool gives them a connection to various sources of water. This water could be banked within AWD via direct or in-lieu methods. Additionally, AWD's vast number of wells would have the capacity to return the banked water. AWD would bank the water through an unbalanced exchange. For example, they could take 3 AF of wet year water from an agency and return 1 AF in a dry year (3:1 exchange). This nets 2 AF of import available to AWD's sustainable yield. It is recognized that any banking projects within Madera County will need to be in compliance with groundwater exporting and banking regulations per Madera County.

Latent Water Rights
Cursory investigations indicate that prior to the formation of the AWD, water rights have historically existed in the area. This land was originally partially Miller and Lux land holdings. The lands were subsequently and progressively subdivided to their current state. An appropriative water right license (License 1986) originally served the Aliso Canal from a turnout on the San Joaquin River. With the development of the CVP Friant System, this appropriation

was sold to the USBR. Later court cases (Haines Decree, Rank Vs. Krug) awarded riparian water rights and groundwater to lands adjacent to the SJR. The District will consider investigating whether latent rights to water exist and to what extent.

Water Contracts

AWD's proximity to the SJR and the Mendota Pool makes it possible to receive CVP water from either the Friant or Westside systems. Purchasing an assignment of CVP contract water could provide a secure supply of water to the District on a long-term basis. It also streamlines access to Section 215 water and transfers with other contractors.

Water Exchanges/Transfers/Purchases

The GSA could exchange, transfer, or purchase water from other public or private agencies as opportunities arise. This water is likely to be expensive and would probably be negotiated on an annual basis. Water could be used within AWD for direct or indirect recharge to help alleviate overdraft conditions and establish 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 AWD. Water Use Projects/Management Actions

This section lists several project types that are necessary to utilize surface water and generate additional sustainable yield. These projects include facilities to deliver surface water into the District, distribute surface water throughout the District, recharge surface water, and manage water use. demonstrates the current priority of these projects after considering the factors discussed in **Table 6-2**.

This numerical ranking method assigns a value to each of the following categories: surface water access, dependence on other projects, feasibility, economic impacts, agricultural preservation and climate change adaptability. The projects were prioritized using the following matrix with 3 being the most favorable and 1 being the least. The categories were also weighted based on their importance to the District. The "Very high" importance rating received a 4x weighting factor, whereas the "low" rated categories only received a 1x weighing factor.

Table 6-2 Scoring Criteria for Projects to Access and Use Surface Water

Ranking Criteria	Importance Factor	Scoring Criteria
Surface water Access and utilization	4 - Very High	3 = Ability to utilize all water sources with proper infrastructure
		2 = Only effective with non-flood water
		1 = No new water imported
Dependence	3 - High	3 = Can be implemented Independently and provide benefit
		2 = Can be implemented Independently, but benefits are limited without other projects
		1 = Requires Additional Management Actions/Projects prior to benefit
Feasibility	2 - Medium	3 = In progress or can be done with little planning
		2 = Requires internal planning and coordination
		1 = Requires coordination and approvals of outside agencies
Minimizes Economic Impacts	2 -Medium	3 = No long-term decreases in revenue or increases in cost
		2 = Minimal Decreases in revenue or Increases in Fees/Costs
		1 = Noticeable loss of revenue or increased long term costs
Protects Agricultural Integrity	1 - Low	3 = No decreases in farming, protects personal property rights
		2 = Changes in ability to Farm, Protects Privacy/Personal Property Rights
		1 = Reduces ability to farm, or imposes requirements on landowners
Climate Change	1 - Low	3 = Directly increases groundwater Storage to offset drought period
		2 = Provides Access to Surface Water
		1 = No increases in drought resiliency

Table 6-3 Projects to Access and Use Surface Water

		Importance Factor→	Very High (4)	High (3)	Medium (2)	Medium (2)	Low (1)	Low (1)		
Rank	**Type**	**Project / Management Action**	**Surface Water Access and Utilization**	**Dependence on Implemen-tation of Other Projects**	**Feasibility**	**Minimizes Economic Impacts**	**Protects Agri-cultural Integrity [a]**	**Climate Change Adaptation [b]**	**Total Score**	**Total Score (with Importance Factor)**
1	Groundwater Recharge	Chowchilla Bypass Recharge Facility	3	3	1	2	3	3	15	33
1	Management Action	Incentives for Surface Water Use	3	3	2	2	2	2	14	33
3	Surface Water Access	Improving Aliso Canal Turnout on San Joaquin River	2	3	2	2	3	2	14	30
4	Groundwater Recharge	Aliso Lateral as Linear Recharge Ponds	2	1	3	3	3	3	15	29
5	Surface Water Access	Restoration of the Aliso Canal for Conveyance from SJR to Cottonwood Creek	3	2	2	1	2	2	12	28
5	Surface Water Access	Bypass Pipeline Crossing	2	3	1	2	3	2	13	28
5	Groundwater Recharge	Recharge in Bypass	2	2	1	3	3	3	14	28
8	Surface Water Access	Restoration of the Aliso Canal for Conveyance from Cottonwood Creek to Northerly Boundary	3	1	2	1	2	2	11	25
8	Groundwater Recharge	Groundwater Injection Wells	3	1	1	1	3	3	12	25
8	Management Action	Fallowing & Crop Conversion	1	3	3	1	1	3	12	25

a) The recent historical culture of the Aliso Water District GSA Plan Area has been defined by the dominance of agriculture. The GSA is interested in preserving the cultural integrity of the agricultural presence in and adjacent to the District.

b) Climate change in the San Joaquin Valley is projected to result in more extreme flooding and drought events. AWD is prioritizing projects that promote adaptations to the anticipated changes in climate.

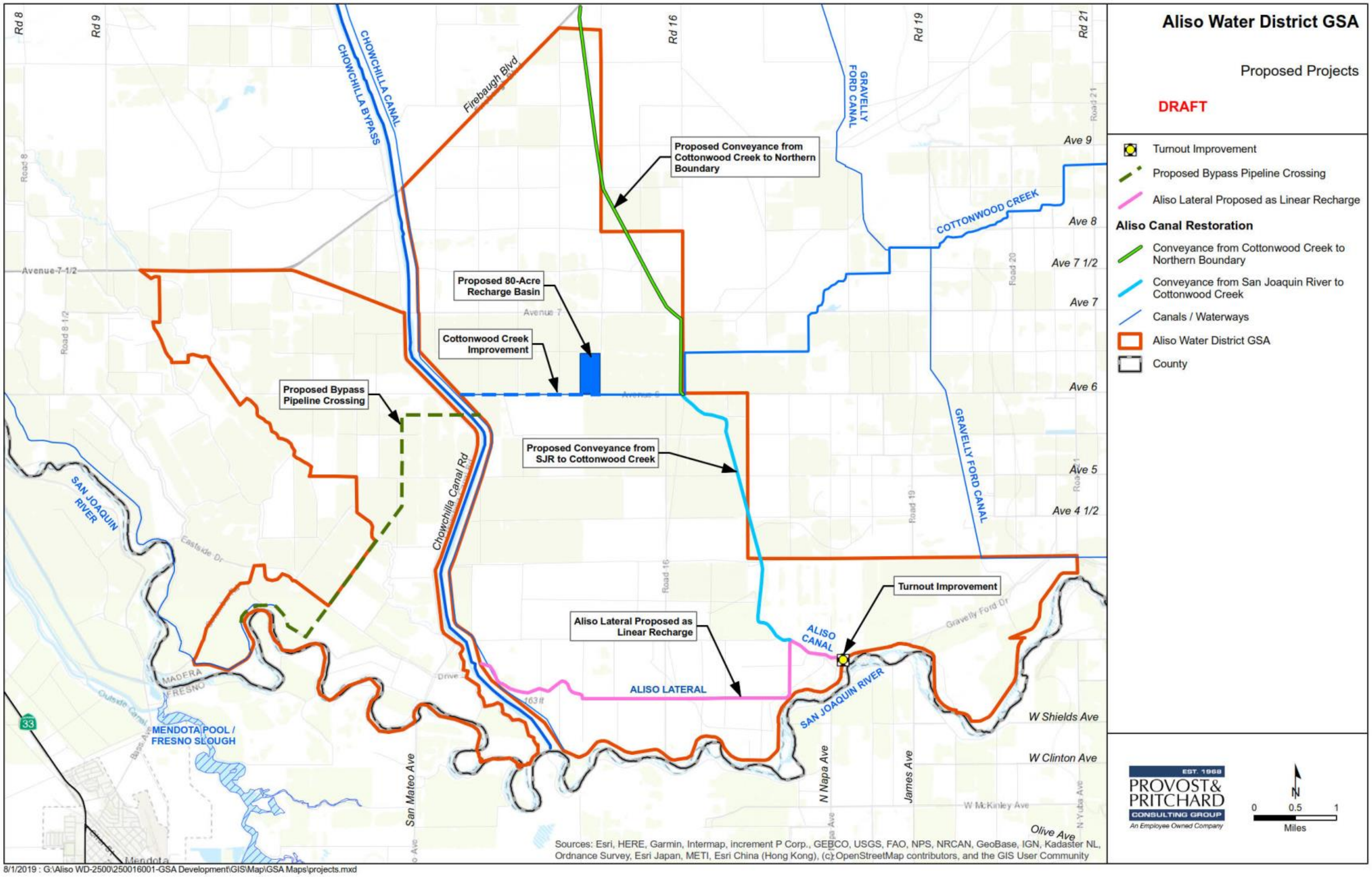


Figure 6-1: Potential Surface Water Access and Recharge Projects

6.1.1 Surface Water Delivery Projects

The District currently has limited access to surface water on the east side of the Chowchilla Bypass. However, efforts to obtain rights to surface water during high-flow years are underway and will continue to be developed and expanded. Infrastructure for transporting water into and around the east side of the District is limited, posing additional problems. Delivery systems are not connected between properties and there are few turnouts that can deliver surface water into existing canal systems. Assuming water rights are established, the water could be used within the GSA for groundwater recharge, in-lieu recharge, and flood relief. The benefits of these projects are flood damage reduction, groundwater recharge to improve groundwater levels, and creation of a dry year water supply.

Turnout from CBP into Cottonwood Creek
A turnout on the CBP to divert water into Cottonwood Creek would place surface water in the northern part of the District, where recharge is needed and conditions are favorable. The turnout concept is discussed more fully in **Section 2.4.2**, as a turnout is required to maximize use of the Chowchilla Bypass Recharge Facility.

Improving Aliso Canal Turnout on the San Joaquin River
The current condition of the Aliso Canal turnout does not allow for adequate flow through it except during extremely high flows. Presently, the district cannot physically divert water at this turnout until the flow in the SJR at the Gravelly Ford gaging station is 3,000 cfs. There are two reasons for this: 1) the turnout sits too high above the SJR invert to allow water to enter, and 2) lack of maintenance in the river has created an impediment prohibiting the water from reaching the turnout (illustrated in **Figure 6-2**). Improving the existing turnout on the San Joaquin River would allow AWD to access water at lower SJR flow rates which could facilitate access to non-flood water (e.g., transfers) as well as excess flood waters at lower SJR flow rates without relying on the CBP. Access to water from this location would also encourage the development of other projects such as restoration of the Aliso Canal and usage of the Aliso Lateral as a recharge facility.

Figure 6-2 Limitations of Diversion to Aliso Canal in Low vs High SJR Flow Rates

Restoration of the Aliso Canal from SJR to Cottonwood Creek
This project would reestablish use of the Aliso Canal from the SJR at the Aliso Turnout (southerly border) to Cottonwood Creek in order to provide landowners with access to surface water. The Aliso Canal once started at the SJR and terminated just south of the Fresno River. As the farmland in the area was subdivided, the channel was filled in and farmed on by

individual landowners. With the reestablishment of the Aliso Canal, properties on the easternmost side of the District would have opportunities to utilize surface water diverted from the CBP or the SJR for irrigation or recharge. This project has the potential to double the amount of acreage that can currently utilize surface water, essentially doubling the amount of surface water diverted into the district. This project will be feasible once the Aliso Canal turnout is improved and a turnout is established on the CBP at Cottonwood Creek.

Restoration of the Aliso Canal from Cottonwood Creek to Northerly Border
This project would reestablish use of the Aliso Canal from Cottonwood Creek to the northerly border of the District in order to provide landowners with access to surface water. The Aliso Canal once started at the SJR and terminated just south of the Fresno River. As the farmland in the area was subdivided, the channel was filled in and farmed on by individual landowners. With the reestablishment of the Aliso Canal, properties on the easternmost side of the District would have opportunities to utilize surface water diverted from the CBP or the SJR for irrigation or recharge. This project has the potential to double the amount of acreage that can currently utilize surface water, essentially doubling the amount of surface water diverted into the district. This project will be feasible once the Aliso Canal turnout is improved and a turnout is established on the CBP at Cottonwood Creek.

Bypass Crossing Pipeline
This project consists of construction of a buried pipeline across the Chowchilla Bypass in order to deliver non-flood water purchased from the Mendota pool to be wheeled through the Columbia Canal Company and New Columbia Ranch to the east side of the District. Water could be placed in recharge cells or used directly for irrigation. The benefit would depend on available supplies and capital costs would be higher than the other projects.

6.1.2 Groundwater Recharge Projects

When excess surface water is available, it can be diverted to recharge basins, which allow water to percolate to the groundwater table and replenish the upper aquifer. The surface water is stored underground and then extracted at a later time for 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 the lack of 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 limited ability to construct new infrastructure.

Water stored in recharge basins must be utilized in a timely manner or the benefits are lost due to outflow. The SWRCB recognizes a first-in, first-out policy. This means the volume of water diverted for storage below ground is counted as the first water extracted during irrigation. In AWD, there is little concern over losses once surface water is diverted to underground storage, because AWD uses more groundwater than is artificially recharged, and water will be extracted before it can migrate out of the District. There are approximately 230 acres of existing recharge basins within the AWD boundary which utilize private high-flow water rights for recharge. The cumulative capacity of these existing basins is approximately 6,000 – 7,000 acre-feet of water depending on recharge rates and ability to fill.

Chowchilla Bypass Recharge Facility

This project includes a turnout to divert water from the Chowchilla Bypass, earthwork modifications to the existing Cottonwood Creek, and an 80-acre recharge basin. The primary purpose of this facility is to divert unappropriated high-flow waters from the Chowchilla Bypass via a new turnout to be owned and operated by AWD. Water will be delivered from the Bypass to the proposed Facility via Cottonwood Creek. Ancillary benefits include using Cottonwood Creek as a linear recharge pond when not in use for conveying primary flows and providing surface water to Cottonwood Creek-adjacent landowners for in-lieu recharge or on-farm irrigation. The main objective of the project is to divert an average of approximately 10,000 AF of water per year during wet years. Once other conveyance projects are developed (Bypass Crossing Pipeline or Aliso Lateral), this project would also be able to utilize non-flood water.

Aliso Lateral Linear Recharge Ponds

Under this project, the existing Aliso Lateral would be utilized as a linear recharge pond. The Aliso Lateral is impacted during flood periods with relocated seepage water, meaning that usage of the Lateral as a recharge pond would only be feasible with non-flood water. There are no earthwork modifications or additional check structures necessary for the Lateral to operate as a linear recharge pond.

Recharge in Bypass

This project would recharge water in the Chowchilla Bypass when it is not in use conveying flood water. This would require coordination with the Lower San Joaquin Levee District for access and operations agreements. It would also require a non-flood source of water.

Recharge Water Outside of District

There is potential to recharge water on lands outside of AWD if suitable recharge pond locations cannot be found or acquired within the District. The District is open to partnering with other agencies in the Delta-Mendota, Madera, and Chowchilla Subbasins to establish a regional groundwater banking program. There are opportunities available to work with District neighbors with existing facilities capable of receiving water for recharge on behalf of AWD. Water could then be stored underground for use by others. There are several agencies in Madera and Chowchilla that are currently experiencing undesirable results due to overdependence on groundwater. Banking water in these areas would provide much needed upper aquifer storage while alleviating dependence on naturally occurring groundwater. All future recharge basin and banking projects within Madera County will be in compliance with groundwater exporting and banking regulations per Madera County.

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 as well as the upper. Injection wells have the same benefits as recharge basins, but they pose a vastly different set of challenges. Injection wells are not as limited by available land due to their small footprint and are not affected by evaporation losses. They are dependent on soil types for recharge rates, but not in the same way as recharge basins. Challenges unique to injection wells are the need to treat surface water prior to injection to protect aquifer water quality, variations in recharge rates due to differing water quality, the dangers of air content between injected water and groundwater, and the time and budget challenges associated with additional permitting. Existing water wells may be useable for retrofitting to injections wells.

6.1.3 Water Use Management Actions

Incentives to make changes to current management practices in order to reduce water demand may be implemented by the GSA to help alleviate current overdraft conditions. Incentives could be awarded to users who utilize surface water in lieu of groundwater, convert land use in order to reduce pumping, or make updates to their irrigation or monitoring system that improve data management or increase efficiency.

Incentives for Surface Water Use

There are many land parcels adjacent to surface water sources that could potentially have riparian claims to water. Increasing accessibility to surface water and encouraging surface water use will be imperative moving forward. Landowners with access to surface water could be incentivized to use surface water in place of groundwater. Direct diversion of surface water can be more costly than pumping groundwater, therefore, it will be necessary for the District to consider ways to incentivize surface water use without adding undue cost to landowners or the District.

Incentives could come in several forms. The District may reduce or reimburse annual assessments for landowners that import surface water. It may fund, in part or whole, improvements that benefit the entire GSA. When groundwater usage curtailment is necessary, the District may reduce the impacts to these lands. Additional ways to incentivize growers will be considered and may be developed into programs and included in future GSP updates.

Voluntary Land Fallowing and Crop Conversion

Voluntary land fallowing is contingent on the willingness of farmers to either temporarily or permanently fallow their land. Farmers could be offered incentives to volunteer to fallow their fields through subsidies, land purchases, and water credits for other fields. All farmers could pay into a GSA fund established by AWD, which could then be used as a subsidy to farmers who choose to fallow their land on a seasonal/annual basis. Farmers could take a portion of the water normally to be used on the fallowed acreage and apply it to different fields for a reduction in the fallow subsidy. For example, once an almond orchard has reached the end of its useful life, instead of the owner replanting, they would receive an incentive from the GSA not to replant. Another option could be incentives for crop conversion to lower demand crops. Replacing existing crops with lower-demand crops could increase basin sustainability and reduce groundwater overdraft through a reduction in extractions for irrigation.

6.2 Efficiency, Monitoring, and District Management

Efficiency, monitoring, and district management items are actions and projects that do not bring in or utilize surface water, but provide improvements to existing irrigation systems, data collections systems, and programs for District management. These efforts either result in better data to make management decisions or result in improved sustainability indicator scores. The proposed actions have been ranked (**Table 6-5**) using the scoring criteria in **Table 6-4**.

Table 6-4 Management Action Ranking Criteria

Cost to Implement	1	Expensive
	2	Moderately Expensive
	3	Low to No Costs
Contingent on Meter Installation	1	Is Contingent
	2	Is not Contingent
Informative or Effective	1	Purpose is to collect information and does not directly result in conservation
	2	Results in efficiency that could have positive effects on Sustainability Indicators

Table 6-5 Management Action Priorities

Rank	Management Action	Cost to Implement	Contingent on Meter installation	Informative or Effective	Total Score
1	Installing Meters on Existing Wells	2	2	2	6
1	Well Cataloging	3	2	1	6
1	Well Permit Review	3	2	1	6
4	Incentivize on-farm Irrigation Efficiency Improvements	1	2	2	5
4	Water Budget Monitoring	2	2	1	5
6	Fees for Groundwater Extraction	1	1	2	4
6	Internal Groundwater Marketing Program	1	1	2	4

Installing Meters on Wells

Groundwater pumping is currently the primary source of irrigation for AWD. Installing flow meters on all irrigation wells (current & future) 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, therefore also providing the GSA the data to determine additional areas of improvement. Monitoring and collecting volumetric groundwater extraction data will be necessary if pumping restrictions are implemented in the future, if penalties are developed and implemented for over-pumping. This data will also aid AWD in maintaining a balanced aquifer. Furthermore, meters will be necessary if the district were to develop a groundwater market system or implement extraction fees.

Well Cataloging

Aliso may require that all wells be cataloged and registered with the District. The District would keep a district-wide well database that would include information about well construction, pump sizes, extraction amounts, water quality, etc. Landowners would be asked for any information available on their wells (well logs, pump tests, water quality reports, etc.). If well construction information was not available, or wells are not metered, landowners would be required to provide or acquire other information in order to calculate pumping, such as video logging wells when pumps are removed during rehab work, testing well efficiency and power requirements, and providing PG&E power records for wells using electricity for the pumps.

Well Permit Review

The District may choose to aid the County in reviewing well permit requests. This would better allow AWD to manage the aquifer and avoid undesirable results. The District could provide a courtesy review of any well construction permit requests within the District and surrounding areas in order to oversee well depths, perforated intervals, and extractions from the upper and lower aquifers. This would also allow the District to ensure that any future wells are equipped with appropriate appurtenances for data monitoring (such as flow meters, sounding tubes, sample ports, etc.). This action may not directly reduce groundwater use, but it will improve data management and help maintain a database for wells within the GSA.

Incentivize On-Farm Irrigation Efficiency Improvements

AWD has an area of approximately 26,000 acres comprised mostly of farmland and irrigated primarily by private wells. However, some landowners have private surface water rights that allows them divert water for irrigation or recharge. Most of the wells in the District range from 350 feet in depth to 510 feet in depth. (KDSA, 2013) Typical irrigation methods include sprinklers, drip/micro irrigation, and surface/flood irrigation. The average on-farm irrigation system was estimated to be approximately 70% efficient over the 10-year historic water budget period (2003-2012) discussed in **Chapter 3**. However, actual irrecoverable losses due to irrigation efficiency may be underestimated. This number may not reflect current irrigation efficiencies, as there has been an ongoing transition in irrigation techniques from flooding to drip and micro irrigation.

Offering incentives to farmers for implementing projects that will increase on-farm efficiencies can promote aquifer sustainability by reducing or eliminating water that leaves the District via irrigation runoff, wind and spray loss, and leaks. Possible projects to incentivize may include installation of soil moisture sensors, utilization of high-efficiency irrigation methods, installation of meters, and updated delivery systems.

Increasing on-farm efficiencies may not directly impact aquifer sustainability if water is pumped from the upper aquifer because it is assumed that any water applied that is not used or evaporated will percolate and return to the upper aquifer. However, improving farms to become more water-efficient will potentially help prevent other undesirable results such as water quality issues or subsidence as a result of excess lower aquifer extractions. Growers may also see decreased operational and pumping costs and possible increases in yield per acre-foot of water applied as a result of raising irrigation efficiency.

Fees for Groundwater Extractions

The District could establish a fee schedule for groundwater extractions in order to mitigate overdraft condition within the basin. The District would establish an allocation program for groundwater extractions, and any groundwater pumped in exceedance of the allocated amount would result in a fee charge. The fees could be tiered so that any fees charged would be proportional to the extraction amount. For example, a large and excessive extraction amount over the allocation would result in an incrementally higher fee than a smaller extraction. In extreme cases, cease and desist orders may be issued for continual excessive extractions. Funds generated from this project could be used to implement other GSA projects intended to increase basin sustainability and mitigate overdraft conditions. The fee schedule would not be implemented provided that the district is able to achieve sustainability by other means.

Internal Groundwater Water Marketing Program

This project would establish a groundwater marketing program within the GSA. The GSA should acknowledge and discuss any other groundwater credit systems before creating a new one. The establishment of groundwater marketing programs require significant pre-planning, including establishing extraction policies and developing water quality standards. If implemented, this project would provide groundwater users with the flexibility to fairly and responsibly store groundwater allocations in order to reserve their allocation for later use or transfer their allocation to other parties.

6.3 Selected Projects and Actions to Achieve Sustainability

Regulation Requirements:

§ 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.

The following section discusses the project and management actions selected through the prioritization and selection process (See **Table 6-1,**

Table 6-3, and **Table 6-5**). The highest ranked items of each category (surface water acquisition, project, management action) have been selected and elaborated on in this section. These include:

1. *Water Rights on the Chowchilla Bypass*
2. *Chowchilla Bypass Recharge Facility*
3. *Well Permitting Review*
4. *Land Fallowing (low priority, but included to establish baseline)*

It is expected that AWD will further develop and craft management actions and projects in response to stakeholder input on parallel timelines and will adapt to the estimated schedules according to the best available information and science at any given time. AWD understands that there are varying levels of uncertainty with project and program implementation. It is common for project and program implementation to take longer than originally estimated and for the accrual of expected benefits to take multiple years to be individually realized as well as vary substantially year to year. Implementation timelines may fluctuate over time dependent upon the level of success of the initially implemented AWD projects and management actions.

The legal authority and basis for the management actions described in this chapter of the GSP are outlined in the SGMA Legislation and related provisions. The SGMA Legislation describes the powers and authorities, financial authority, and enforcement powers of GSAs in Chapters 5, 8, and 9 respectively. GSAs are granted the authority to adopt regulations, regulate groundwater extractions, impose fees, monitor data, enforce programs, and more. Though the law grants the GSA these powers, the pursuit and implementation of projects and management actions is the GSA's responsibility. The GSA must enforce their legal authority to the extent necessary to achieve sustainable groundwater management for all beneficial users within the GSA.

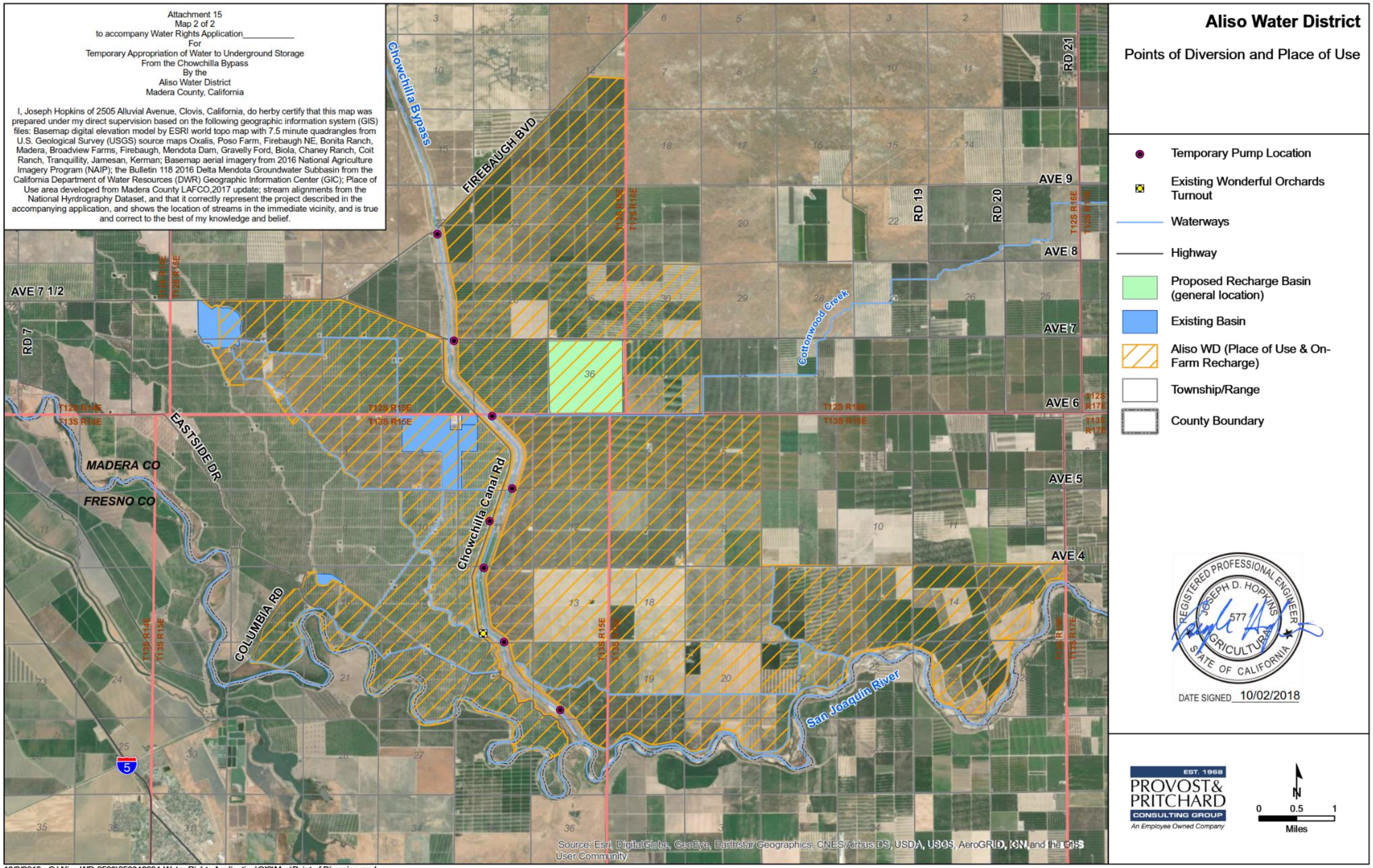
If basin sustainability thresholds are being continually exceeded after the implementation of projects and management actions chosen during the initial development process, then the lower ranking management actions and projects will be considered. The severity of the situation will dictate the actions taken. The District has listed their priorities as a part of this exercise, and maintaining private property rights were considered when developing this list of projects; however, if undesirable results are continually experienced and the situation becomes exceedingly severe, the District may reconsider more restrictive actions that were dismissed early in the project prioritization process and as a result are not listed in this chapter.

6.3.1 Water Rights on the Chowchilla Bypass

6.3.1.1 Project Description

During extreme wet years, non-contracted water sourced from high-flow events is released into the SJR. 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 bisects AWD. Diversions from the SJR to the Bypass occur at the bifurcation structure operated by the Lower San Joaquin Levee District. The Bypass diverts flood waters from the lower reaches of the SJR in order 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. The proposed points of diversion and place of use for water from the CBP are shown in **Figure 6-3:** (SWRCB, 2018).

Access to surface water is a critical first step for a number of subsequent projects. Acquiring temporary water rights to capture surface water during high-flow events from the Bypass would allow AWD to implement groundwater recharge, in-lieu recharge, and flood relief projects. This project proposes to acquire rights to divert unappropriated high-flow waters from the Bypass via existing flap gates, non-permanent pump stations, and future turnouts into the District. Water could be delivered from the Bypass to ponds and on-farm recharge areas within the District. Water would be applied directly to crops until land for a recharge basin can be acquired and developed. Temporary water rights would be applied for on an annual basis until permanent water rights can be acquired by the GSA.



10/2/2018 : G:\Aliso WD-2500\250018001-Water Rights Application\GIS\Map\Point of Diversion.mxd

Figure 6-3: Proposed Points of Diversion and Place of Use

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 as seen in **Figure 6-4:**. The Bypass typically flows every 4 years between mid-January to mid-July (**Figure 6-5:**). 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.

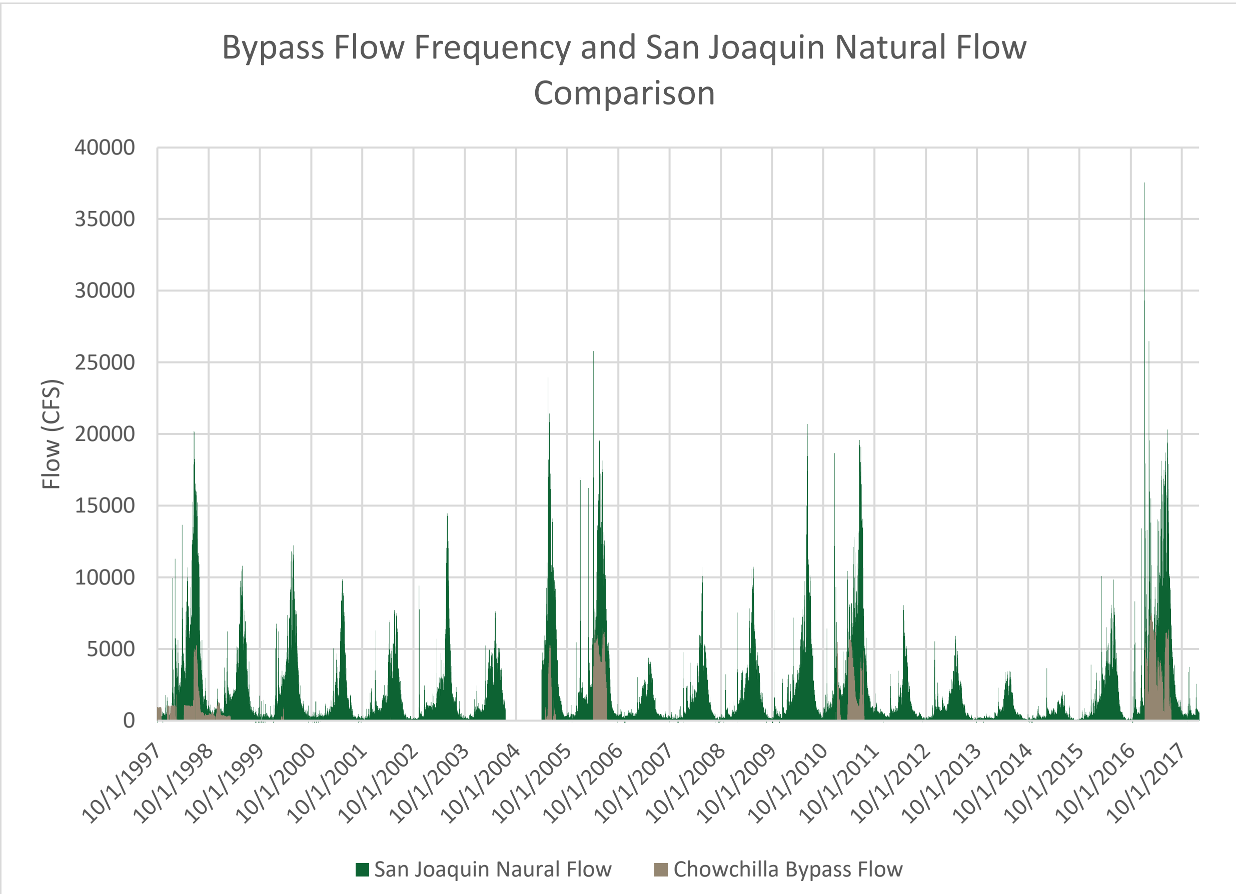


Figure 6-4: Chowchilla Bypass Flow

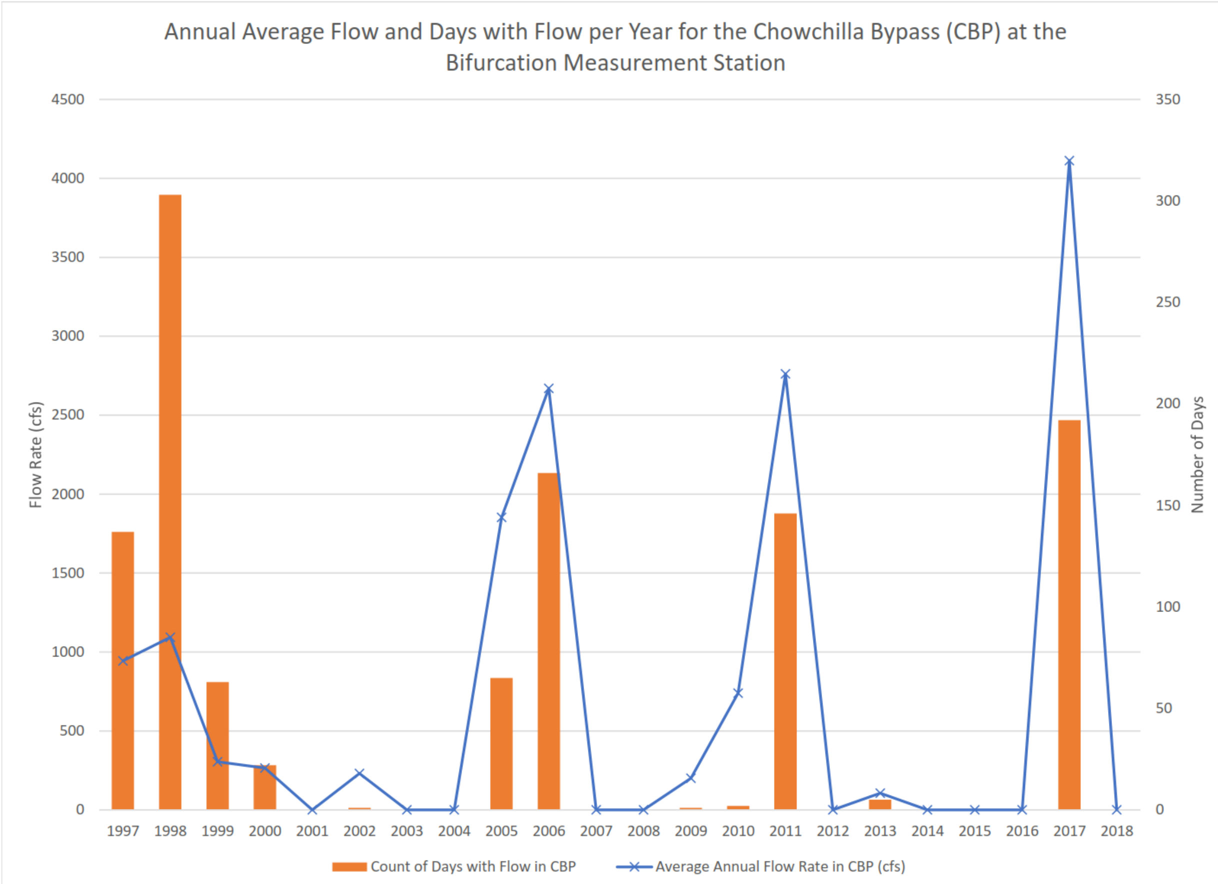


Figure 6-5: Chowchilla Bypass Flow Duration

The Bypass is operated and maintained 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 CBP) **(Table 6-6)**. 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, the Levee District is to operate the system at their discretion with the objective of minimizing damage. According to the Levee District, the Bypass only operates when flows in downstream reaches are expected to exceed 1,300 cfs due to additional constraints in SJR channel capacity below the Bifurcation Structure, (SWRCB, 2018). Since 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.

Table 6-6 Bypass Operations

Initial flow to the SJR		
Upstream flow SJR	Downstream flow SJR	Chowchilla Canal Bypass
0 - 2,500 cfs	0 - 2,500 cfs	0 cfs
2,500 - 8,000 cfs	2,500 cfs	0 - 5,500 cfs
8,000 - 12,000 cfs	2,500 - 6,500 cfs	5,500 cfs
Initial flow to the CCBP		
Upstream flow SJR	Downstream flow SJR	Chowchilla Canal Bypass
0 - 5,500 cfs	0 cfs	0 - 5,500 cfs
5,500 - 8,000 cfs	0 - 2,500 cfs	5,500 cfs
8,000 - 12,000 cfs	2,500 - 6,500 cfs	5,500 cfs

6.3.1.2 Measurable Objectives

The objective of this project is to acquire water rights for up to 10,000 acre-feet per year as available during wet years when high-flow water is released down the Bypass. It is estimated that water will be available every 4 years on average. During wet years, water could be diverted off the Bypass for an estimated 164 to 192 days from approximately January 15 to July 15. The GSA has an estimated annual groundwater deficit of 2,200-2,500 acre-feet per year, so if AWD can divert 10,000 acre-feet of water from the Bypass every 4 years, they should be able to correct their deficit and achieve sustainability.

All Bypass points of diversion used under this project will be metered and monitored with devices compliant with California Code of Regulations, title 23, chapters 2.7 and 2.8. Flow measurements will be converted to hourly volumes to be summed and reported monthly to the SWRCB as a statement of Diversion and Use. Incidental direct diversion of water applied for on-farm recharge, evaporation losses from recharge basins, and the beneficial use of the recovered stored water within the District will all be monitored by AWD.

6.3.1.3 Circumstances for Implementation

AWD lies within a DWR-defined critically overdrafted groundwater basin, which has been subject to basin-wide aquifer depletion, land subsidence, and unstable groundwater level decline. Securing new sources of water for GSAs that are groundwater-dependent is preferred to land fallowing or implementing water use restrictions. For the reasons stated, this is a high priority project and efforts are already underway to implement this project and secure a temporary water right permit. Temporary water rights will continue to be applied each year while the District moves forward with obtaining permanent water rights.

6.3.1.4 Permitting and Regulatory Process

An Application to Appropriate Water will be prepared and submitted to the SWRCB. Consultations have been held with DFW, DWR's FloodMAR program, the Levee District, and other authorities. The temporary water right will be established as a permit from SWRCB with restrictions and requirements of the permit. DFW will require a streambed alteration agreement for diversion of the water.

6.3.1.5 Project Schedule

6-30-2019	Temporary Permit term expires
1-2020	Submit Renewal Application
2-2020	Receive Temporary Permit to Divert Water for 2020 water year
2-2020 to 3-2020	Meet terms and conditions of permit
3-2020 to 6-30-2020	Divert and use high-flow water (if available)

A similar project schedule would be followed annually until permanent water rights can be secured by AWD.

6.3.1.6 Project Benefits

This project would secure up to 10,000 acre-feet of non-contracted water during years of above average precipitation from high-flow releases into the Bypass. When available, this water would be used by AWD for direct recharge, in-lieu recharge, and flood relief to improve basin sustainability.

6.3.1.7 Project Implementation

This project will be implemented annually by AWD as an integral piece of the GSA's overall effort to reach sustainability. It will be implemented and managed by AWD. Project benefits would be seen as soon as water becomes available in the Chowchilla Bypass for use. It has been listed as a high priority project based on the urgent need to mitigate overdraft. Note that all points of diversion used under this project must be metered.

6.3.1.8 Legal Authority

The State Water Resources Control Board is the legal authority that handles the approval of the Applications to Appropriate Water. AWD will be able to divert available water at their discretion provided the terms of the permit have been met.

6.3.1.9 Project Cost Estimate/Acre-Foot of Yield

The cost to submit an application for a temporary permit filed pursuant to water code §1425 to divert to underground storage during high-flow events is $6,000 (based on the $5000 standard temporary permit fee listed in the SWRCB 2018-2019 fiscal year fee schedule for a diversion of 10,000 acre-feet plus $0.10 per acre-foot of diversion applied for, totaling $6,000). Once the water rights are secured the only other costs to the GSA are annual renewal fees. For 10,000 acre-feet, the annual renewal fee is $1,500 plus $0.20/AF, or approximately $3,500.
Using the same fee schedule, the cost for a permanent 10,000 AF diversion application is $1,000 plus $15/acre-foot for every acre-foot over 10 AF. This equates to a total cost of $150,850 and a yield cost of approximately $15/AF. The annual fee is $225 plus $0.073/AF for a total of $954/yr, or about $0.10/AF/yr.

The fee schedule issued by the SWRCB changes annually, and therefore the annual project cost per acre-foot of yield will vary with each new temporary application and permit fees. Fees would be paid by the District, through funds generated by landowner assessments.

6.3.1.10 Management of Groundwater Extractions and Recharge

This project would be managed and operated by AWD, pending permit approval. When available, up to 10,000 acre-feet of high-flow water would be used within the GSA for recharge purposes (both direct and in-lieu). This would allow AWD to better manage and utilize groundwater supplies on their landowners' behalf. The GSA will be using a "last in - first out" method to track groundwater recharge and extraction. The water diverted from the Bypass will be the "last in" to the aquifer. The GSA has passed a resolution directing participating landowners to use this water first ("first out"), prior to using any existing overlying groundwater right. Groundwater extracted under this temporary permit will be limited to the Bypass diversion amount minus the incidental direct diversion and the evaporation losses. Landowners who participate will use flow meters to calculate and report amounts of groundwater pumping and delivery to their crops. Groundwater pumping meters will be read and tabulated monthly, or more frequently if necessary. Groundwater levels throughout AWD would be monitored to track changes in groundwater storage. Flows diverted off the Chowchilla Bypass would be metered as well for water balance purposes.

6.3.2 Chowchilla Bypass Recharge Facility

6.3.2.1 Project Description

Once a water right is established to the Chowchilla Bypass as described in **Section 6.3.1**, then this proposed projects become feasible and would be operated according to the availability of floodwater. The proposed projects would construct a turnout from the Bypass near the termination of Cottonwood Creek, construct improvements to Cottonwood Creek itself, and develop an approximately 80-acre recharge basin (collectively known as the Chowchilla Bypass Recharge Facility or Facility). This facility would allow AWD to implement groundwater recharge, in-lieu recharge, and flood relief projects. This project's primary purpose is to divert and recharge unappropriated high-flow waters from the Bypass via a new turnout owned and operated by AWD. Water will be delivered from the Bypass to the proposed Facility and on-farm recharge areas within AWD. The turnouts will be similar to others on the Bypass in the surrounding area and will divert water using a slide gate-controlled gravity pipeline turnout that will penetrate through the levee and end at a sump pump on the field side of the Bypass levee. Fish screens will be required at the inlet. A flashboard check structure at the downstream (western) end of Cottonwood Creek would be required to prevent diverted water from backflowing into an existing drainage ditch that parallels the Bypass. Water conveyance from the Bypass turnout to the Facility ponds could be achieved by raising the embankments of Cottonwood Creek. Due to existing topographic conditions, water for recharge would require pumping to reach the Chowchilla Bypass Recharge Facility ponds.

As a secondary benefit, additional groundwater recharge would also occur along Cottonwood Creek. Excess water beyond the capacity of the proposed recharge ponds could be stored in the Creek, turning it into a linear recharge pond and allowing water to recharge the groundwater table. The proposed check structure at the Bypass end of Cottonwood Creek could be used to check amounts of non-project water conveyed through Cottonwood Creek for recharge purposes, both within the creek and in the proposed Facility. Landowners adjacent to Cottonwood Creek could access the water for on-farm or in-lieu recharge. The new turnout could also provide access to flood water for other projects identified in the priority list.

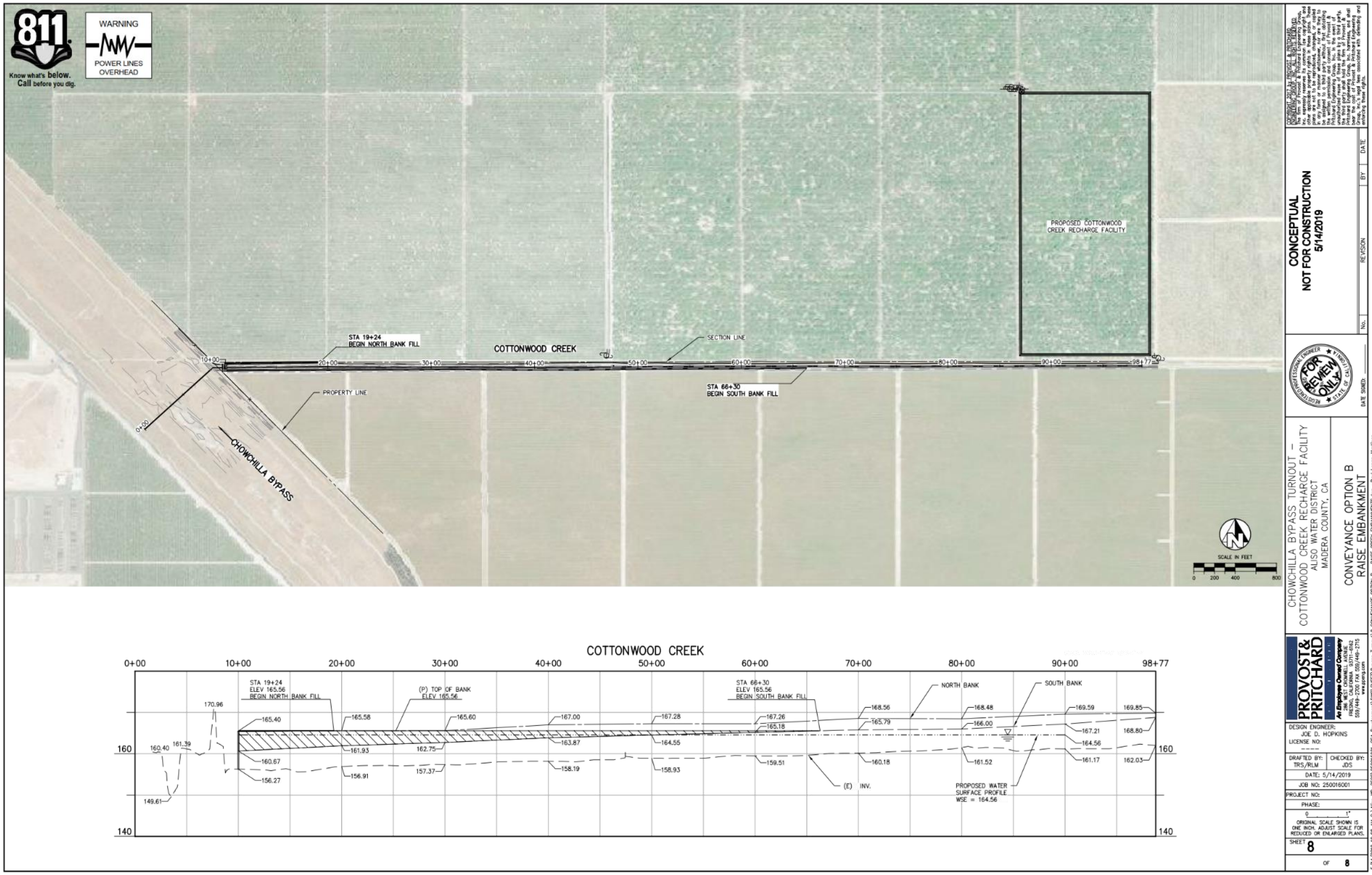


Figure 6-6: Chowchilla Bypass Recharge Facility

6.3.2.2 Measurable Objectives

The main objective of the project is to divert an average of approximately 10,000 acre-ft of water per wet year (1 in 4 years). The GSA has an estimated annual groundwater deficit of 2,200-2,500 acre-feet per year, so if AWD is able to divert 10,000 acre-feet 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 Chowchilla Bypass Recharge Facility via a new turnout and conveyance facilities. Water levels will be measured and water samples will be collected using existing wells in the area; including new monitoring wells. This data will be used to establish baselines for groundwater elevations and quality and will be updated and analyzed in order to quantify project impacts. Surface water delivered to Chowchilla Bypass Recharge Facility will be metered and sampled for water quality issues, although none are anticipated.

6.3.2.3 Circumstances for Implementation

AWD is located within a critically overdrafted groundwater basin, which suffers basin-wide aquifer depletion, land subsidence, and falling groundwater levels. Constructing a Bypass turnout and new recharge facility will play a vital role in remediating basin unsustainability. The location of the project introduces water to the northern part of the District, which is experiencing the steepest groundwater decline and should be considered a priority. Implementation will depend on the availability of water sources for recharge, land for new recharge basins, and sources of funding. The trigger for this project would be establishing a surface water source and being in a projected state of overdraft.

6.3.2.4 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 U.S.*
- *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, Streambed Alteration Agreement – for work within the CBP, a Water of the State.*
- *Madera County, Building Permit – for any electrical work to service facilities.*
- *Pacific Gas & Electric Company (PG&E), Application for Service – for electrical service to new and/or large pump stations.*
- *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 which disturbs a surface area of 5 acres or more.*
- *State Water Resources Control Board, Application to Appropriate Water – for the right to divert water off the Chowchilla Bypass.*
- *State Water Resources Control Board, Stormwater Pollution Prevention Plan (SWPPP) – for construction that disturbs more than five acres.*

6.3.2.5 Project Schedule

This project is in the conceptual phase. Once a source of water and project funding are secured, a comprehensive schedule including environmental review, design, permitting and construction will be developed. Environmental review, permitting, and project agreements could be completed in roughly 9 months, where design and construction could be completed on a similar timeline. It is anticipated that the turnout portion will need to be constructed outside of flood season. It is anticipated that AWD will start working to secure funding prior to or within the first 5 years of GSP implementation. Project benefits will not be realized until a wet year occurs that provides high-flow water in the bypass.

2-2020	District authorizes project
2-2020 to 12-2020	Secure permits
2-2020 to 12-2020	Complete design
1-2021 to 3-2021	Bidding
3-2021 to 8-2021	Construction
1-2022 to 7-2022	Project ready to accept floodwater during permit period

6.3.2.6 Project Benefits

Groundwater is the primary water supply within AWD, and this project will increase basin sustainability and the reliability of the groundwater supply. The benefits of this project are flood damage reduction, groundwater recharge, improving groundwater levels, and creation of a dry-year water supply. When water is diverted through the Bypass during high flows of the SJR, the proposed 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 project is planned to capture 10,000 AF every 4 years. In any given year, the amount of recharge will depend on the amount and duration of available water and the infiltration rate of the recharge facilities. In addition to recharge benefits, the necessary removal of approximately 80 acres of permanent crops for the Chowchilla BypassRecharge Facility will also reduce pumping in the District by about 216 AF annually (assuming a District average pumping rate of 2.7 acre-feet/acre).

6.3.2.7 Project Implementation

This project will be implemented by AWD 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 both the construction of recharge facilities and water conveyance systems, and the acquisition of secure water sources. Benefits would be seen as soon as water is utilized in the constructed recharge facilities. It has been listed as a high priority project based on the urgent need to correct critical overdraft.

6.3.2.8 Legal Authority

AWD would need to acquire the land necessary for the proposed groundwater recharge facilities and acquire easements for the new turnouts and any associated conveyance systems. The project would be owned and operated by AWD. An agreement with the CVFPB and the United States Army Corps of Engineers (USACE) will be required to construct the turnout in the Bypass levee system. Water rights will need to be established with the SWRCB.

6.3.2.9 Project Cost Estimate/Acre-Foot of Yield

Construction costs are based on similar projects for the conceptual level of design and include costs for permitting, turnout and basin construction, and modifications to existing channels for conveyance. The total cost of the project is estimated at about $3.9 million, including $1,425,000 for the purchase of 80 acres of land for dedicated recharge facilities. Assuming a

5% interest rate loan, annualized over a 30-year period, the annual repayment cost is expected to be $351,000. The materials required to complete this project are expected to last 30 years or more. The portion of the water cost due to capital expenditures, on an average annual basis, is expected to be about $140 per acre-foot for an annual yield of 2,500 AF. Costs will be further developed once the project proceeds to a more detailed level of design. Fees would be paid by the District, through funds generated by landowner assessments.

6.3.2.10 Management of Groundwater Extractions and Recharge

The project would be owned and operated by AWD as a necessary part of meeting groundwater sustainability goals. Management of groundwater extractions and recharge will be made possible by monitoring groundwater levels, recharge basin inflows, and diversions over time. Data would be reported to the GSA to make sure groundwater levels do not continue to decline beyond sustainable levels.

6.3.3 Well Permitting Review

6.3.3.1 Project Description

This project involves an agreement between AWD and Madera County to review any new well drilling permits submitted both within the GSA and outside of the District but within the County, white areas included. This will increase the ability of AWD to manage the aquifer and increase sustainability. The agreement will also benefit the County by alleviating the County's management workload as AWD steps into the additional responsibilities designated to GSAs by SGMA. AWD will be able to provide oversight on new well depths, perforated intervals, and extractions from the upper and lower aquifers, as well as ensure that future wells are equipped with appropriate appurtenances such as flow meters. Having the authority to review the locations and depths of new wells within and adjacent to the GSA is a crucial step to obtaining the information necessary to maintain basin sustainability, alleviate current overdraft conditions, and prevent continued over-extraction of the aquifer. While Madera County will ultimately be responsible for approving well permits, AWD's review of the permits will help ensure that new wells are compliant with current and future sustainable practices.

6.3.3.2 Measurable Objectives

The measurable success of the action is the acquisition of well information. This program will require the submittal of new well documentation to both the County and AWD, including information concerning well logs, e-logs, well owner, well location, information, and well construction data (depth, capacity, perforated intervals, etc.).

6.3.3.3 Circumstances for Implementation

AWD is located within a critically overdrafted groundwater basin, which suffers basin-wide aquifer depletion, land subsidence, and unstable groundwater levels as a result of overdraft. Having input into and approval of new wells is crucial to maintaining basin sustainability, alleviating current overdraft conditions, and preventing continued over-extraction of the aquifer. There is no trigger for this implementation, it will be pursued as a way to actively manager groundwater within the GSA.

6.3.3.4 Permitting and Regulatory Process

There are no permits needed to implement this project, but an agreement will need to be established between Madera County and the AWD outlining the extent of the GSA's role and power in reviewing permits. Final approval of permits will be handled by Madera County based on recommendations from AWD.

6.3.3.5 Project Schedule

The project can be implemented once a source of funding is secured and an agreement is established with Madera County. AWD would expect a 1-week period in which AWD would review and comment, and then receive submittals of as-built information within 30 days of completion.

6.3.3.6 Project Benefits

This project will allow AWD to have input on the amount, location, and depth of new wells within and adjacent to the GSA. This is crucial for basin management and will help with maintaining basin sustainability, alleviating current overdraft conditions, and preventing continued over-extraction of the aquifer.

6.3.3.7 Project Implementation

This project will be implemented by AWD in tandem with Madera County as an integral piece of the GSA's overall effort to reach long-term basin sustainability.

6.3.3.8 Legal Authority

The GSA will work in tandem with Madera County to review and approve future well drilling permits located both within and adjacent to the District. Madera County will continue to have final approval authority for all new well drilling permits.

6.3.3.9 Project Cost Estimate/Acre-Foot of Yield

There is no cost per AF associated with this action. The costs associated with this project are implementation and ongoing management costs. It is expected that review would require 2 hours of staff time at $150/hr. It is recommended that this cost be placed on the permittee when the proposed well is to be drilled within the AWD.

6.3.3.10 Management of Groundwater Extractions and Recharge

This project will allow the GSA to better manage groundwater extractions, both within and adjacent to the GSA, through the review of new well drilling permits.

6.3.4 Land Fallowing Rotation

6.3.4.1 Project Description

As a last resort, if additional surface water cannot be secured for recharge to stabilize groundwater levels, then land fallowing will be implemented. Although one of the most effective ways to remedy over-extraction is through the fallowing of land, it would also have a correspondingly detrimental impact to the culture and economy of this agricultural community.

Land fallowing is the practice of removing crops from production and allowing the field to remain unirrigated and bare. Because the GSA's major source of water is groundwater pumping, fallowing land would help to balance groundwater levels and increase basin stability by reducing the demands on the aquifer. If the fallowed land had been irrigated with composite or lower aquifer supply wells, fallowing would support land subsidence goals as well.

Fallowing could be performed on either a permanent or annual basis, and fallowed land could be used for artificial recharge if surface supplies become available. The AWD has an estimated annual groundwater deficit of 2,200-2,500 AF per year and balancing this deficit could be achieved either through volunteered fallowing with subsidies or through mandatory fallowing. Removing high water demand crops from production through fallowing will have a greater impact to groundwater sustainability than removing crops with lower water demands, so it might be more beneficial to focus any fallowing program on high water demand crops only. Assuming an average consumptive use of 2.65 acre-feet/acre, 31 acres per 1,000 acres would need to be fallowed for a total of approximately 830 acres District-wide.

Of the 26,600 acres in AWD, approximately 9,000 acres have rights to surface water that could be used to offset their fallowing requirements. This means that some of the approximately 17,600 remaining acres would need to fallow a portion of their lands to make up the 2,200 - 2,500-acre-foot deficit. Assuming an average consumptive use of 2.65 acre-feet/acre, 41 acres per 1,000 acres would need to be fallowed for a total of approximately 730 acres in order to mitigate annual overdraft.

6.3.4.2 Measurable Objectives

The main objective of this project is to increase stability of groundwater levels and to balance aquifer extractions to achieve a sustainable basin. Groundwater levels and changes in aquifer storage due to mandatory and voluntary land fallowing would be measured to ensure that groundwater levels remain above the minimum thresholds for the basin. Water that would normally be extracted from the aquifer to irrigate the fallowed lands would remain stored in the basin.

6.3.4.3 Circumstances for Implementation

The GSA is located within a critically overdrafted groundwater basin, which suffers basin-wide aquifer depletion, land subsidence, and unstable groundwater levels as a result of overdraft. If the state of critical overdraft is not corrected through other means, implementation of land fallowing might be inevitable.

6.3.4.4 Permitting and Regulatory Process

It is anticipated that no permitting or regulatory processes would be required for this project.

6.3.4.5 Project Schedule

Land fallowing is a low priority measure and is considered a last resort for the AWD. It will likely not be implemented until after 2035, if at all. However, it could be implemented sooner if undesirable results are not avoided.

6.3.4.6 Project Benefits

Land fallowing, especially with high water demand crops, can significantly reduce demands on groundwater supplies. Removing high water demand crops that require groundwater pumping for irrigation promotes groundwater sustainability and balanced groundwater levels. To balance their groundwater deficit, AWD needs to conserve approximately 2,200 – 2,500 acre-feet/year.

6.3.4.7 Project Implementation

This project would be implemented and managed by AWD. Project implementation would involve multiple factors and would occur in steps. If critical overdraft continues and minimum thresholds are not met, voluntary fallowing would be implemented first, followed by mandatory fallowing if needed.

Voluntary land fallowing will depend on the willingness of farmers to fallow their land, either permanently or temporarily. Famers could be incentivized to volunteer through subsidies, land purchase, and water credits for other fields. All farmers could pay into a GSA fund to be set up by AWD. This money could be used as a subsidy to farmers who choose to fallow their land on a seasonal/annual basis. Growers could take a portion of the water normally used on the fallowed acreage and apply it to different fields for a reduction in the fallow subsidy. Note that temporary fallowing is not feasible for permanent crops. Growers could however fallow their row crops, allowing for some of the saved water to be transferred to their land with permanent crops. The GSA fund could also be used by AWD to purchase fallowed land to permanently take it out of production, ultimately increasing the sustainable yield for the GSA's remaining irrigated acreage. This option would have a more significant impact to basin sustainability than temporary fallowing. If adequate acreage to maintain basin minimum thresholds is not secured through voluntary fallowing, the GSA would need to implement mandatory fallowing.

6.3.4.8 Project Cost Estimate/Acre-Foot of Yield

The only costs associated with this project would be implementation and management costs, plus any subsidies that might be included as incentives to growers. Any subsidies would likely be paid by the District, through funds generated by landowner assessments.

6.3.4.9 Legal Authority

This project would be coordinated and managed by AWD. No other legal authority's involvement is anticipated.

6.3.4.10 Management of Groundwater Extractions and Recharge

The impacts of land fallowing would be measured through continuous groundwater level monitoring throughout the GSA to ensure that they remain above minimum thresholds. Land fallowing does not directly involve any recharge activities, but fallowed land could be used as recharge facilities if excess surface water becomes available. Groundwater extractions would be reduced as an outcome of fallowing land, allowing for the water to remain stored in the aquifer. The amount of extracted groundwater reduction will rely on the acreage of fallowed land and the water demand of the crops removed from production.

7 Plan Implementation

The adoption of the GSP will be the official start of the Plan Implementation. The GSA will continue its efforts to engage the public and 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, the GSA will coordinate with various stakeholders and beneficial users to improve the monitoring networks and begin the implementation of projects and management actions.

The following chapter outlines the estimated proposed budget and implementation timeline for the suggested projects and management actions of the AWD GSP. All the projects discussed have been evaluated as potential investments that would assist in achieving the long-term goals of the GSA. Of the projects, the pursuit of the Chowchilla Bypass Water Rights and the Chowchilla BypassRecharge Project have already begun. The potential schedules and budgets outlined below are purely estimates and may be adapted or eliminated should the GSA board deem it necessary.

This chapter also describes the contents of both the annual reports and five-year GSP updates that must be provided to DWR as required by SGMA regulations.

7.1 Estimate of GSP Implementation Costs

Regulation Requirements:

§ 354.6. Agency Information
When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:
(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

There are two main types of expenses that require funding in order to successfully implement the AWD 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 potential staff expenses, audits, annual data collection and reporting, 5-year updates, DM coordination, 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.

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 ranked projects is dependent on both obtained funding and the availability of water (flood or purchased) to be utilized in many of the projects. Further discussion regarding projects and their individual components as well as their estimated timelines can be found in **Chapter 6**.

Table 7-1: Annual Budget for GSP Implementation at 5-Year Milestones

	2020	2025	2030	2035	2040	Description/ Assumptions
Administration						
Insurance	$3,000	$3,500	$4,100	$4,800	$5,600	Liability coverage for board. Will likely increase once facilities are in place
Audit	$5,000	$5,800	$6,700	$7,800	$9,000	Annual financial audit
Website	$2,000	$2,300	$2,700	$3,100	$3,600	Maintenance of website, including hosting and updating
Management	$50,000	$58,000	$67,200	$77,900	$90,300	Part-time manager to handle day-to-day functions of the district, attend meeting, etc.
Clerical	$10,000	$11,600	$13,400	$15,500	$18,000	Clerical support including preparing agendas, minutes, and billings
DMS Maintenance	$5,000	$5,800	$6,700	$7,800	$9,000	Hosting, upkeep, and on-going modifications
Professional On-going Consulting						
Legal	$25,000	$29,000	$33,600	$39,000	$45,200	Legal counsel available to district for miscellaneous issues, related to District actions. Also develop a reserve for potential litigation
Hydrogeology	$15,000	$17,400	$20,200	$23,400	$27,100	Hydrogeologist to review and consult on misc. groundwater issues
Engineering	$25,000	$29,000	$33,600	$39,000	$45,200	Engineer to review and consult on misc. water and engineering issues
Grant Writing	$25,000	$29,000	$33,600	$39,000	$45,200	Preparation and administration of grant applications
Well Permitting Review	$5,000	$5,800	$6,700	$7,800	$9,000	Providing timely reviews of well permits in association with Madera County
Monitoring Events						
January Depth to Water	$10,000	$11,600	$13,400	$15,500	$18,000	Anticipated cost for data collection upload to DMS
July Water Quality	$10,000	$11,600	$13,400	$15,500	$18,000	Anticipated cost for data collection upload to DMS
July Subsidence	$10,000	$11,600	$13,400	$15,500	$18,000	Anticipated cost for data collection upload to DMS
October Depth to Water	$10,000	$11,600	$13,400	$15,500	$18,000	Anticipated cost for data collection upload to DMS
Capital Projects						
Chowchilla Bypass Recharge Project	$216,000	$250,400	$290,300	$336,500	$390,100	Anticipated annualized cost of $2.5 million (6% @ 20 years) to construct the CBP turnout, Cottonwood Creek improvements, and recharge site modifications
Recharge Site Lease	$120,000	$139,100	$161,300	$187,000	$216,800	Anticipated annual lease cost based on appraisal of $1.4 million (6% @ 20 years)