during the development and implementation of their individual GSPs in order to assure coordination of the GSPs is in compliance with SGMA. The Technical Memoranda have been included as an appendix to this GSP as a part of the Common Chapter.

Plan Implementation and Submittal

Under the Coordination Agreement, the Parties have agreed to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda as appendices to the Common Chapter, the Parties intend that the described Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin. The Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

Each Party is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of Water Code Sections 10727.2 and 10727.4 by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones (IMs), and monitoring protocols that together provide a detailed description of how the Subbasin as a whole will be sustainably managed.

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. The Coordination Committee is responsible for assuring submittal of annual reports, five-year updates, and for providing assessments recommending any needed revisions to the Coordination Agreement.

Coordinated Data Management System

The Delta-Mendota Subbasin GSAs have developed and will maintain a coordinated Data Management System that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

The Parties may also develop and maintain separate Data Management Systems. Each separate Data Management System developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

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.

Legal Bindings of the Delta-Mendota Subbasin Coordination Agreement

The Coordination Agreement, as contained herein, is reflected in the same manner and form as in the six Subbasin GSPs. All parties understand that the Delta-Mendota Subbasin Coordination Agreement is part

of the GSPs for participating Subbasin GSAs and will be a primary mechanism by which the six Subbasin GSPs will be implemented in a coordinated fashion. Further, all parties to the Coordination Agreement understand that DWR will evaluate the agreement for compliance with the procedural and technical requirements of GSP Regulations §-357.4 (Coordination Agreement) 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.

The Coordination Agreement will continue to be the framework under which the six Delta-Mendota Subbasin GSPs will be implemented and will be reviewed as part of the five-year assessment and revised as necessary, dated, and signed by all parties.

2.1.3 Inter-basin Agreements

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, and the SJREC GSA executed inter-basin data sharing agreements with Westlands Water District (the lead entity encompassing the adjoining Westside Subbasin).- The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA. In this agreement, the parties agree to provide each other with recorded, measured, estimated, and/or simulated modeling data located within five (5) miles of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin. A list of data types to be shared between the parties to the agreement can be found in **Appendix D**.

Data provided under this agreement are understood to be shared with consultants and other stakeholders in the respective basins (Delta-Mendota Subbasin and Westside Subbasin), and that the information will be made public through the development of the respective Parties' (meaning SLDMWA/SJREC and Westlands Water District) GSPs and the supporting documentation of the GSPs. Other than publishing information for those purposes, neither Party will disclose the other Party's information to any third party, except if the other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information.

It is recognized that many of the sustainability indicators, notably groundwater quality, inelastic land subsidence and change in storage, are regional issues that may require future inter-basin discussions and coordination. Memorandum of Intent (MOI) are being discussed with the surrounding subbasins to demonstrate/confirm the subbasins' desires to coordinate during GSP implementation. These agreements, to be discussed further following submittal of GSPs, will allow for thoughtful consideration of the intent, structure, and need for future coordination with respect to data collection, reporting, regular meetings, and updates prior to annual reporting.

3. DELTA-MENDOTA SUBBASIN PLAN AREA

This section describes the Delta-Mendota Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of state lands (including wetlands), and geographic boundaries of surface water runoff areas. The reader is referred to the individual Subbasin GSPs for descriptions of existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the individual GSP Plan Areas. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

3.1 Plan Area Definition

The Plan Area for the six coordinated GSPs is the Delta-Mendota Subbasin (DWR Basin 5-022.07). As previously noted, the Delta-Mendota Subbasin is one of nine subbasins that lie completely within the San Joaquin Valley Hydrologic Region and adjoins the following subbasins (**Figure CC-8**~~**Figure CC-8**~~):

- Tracy
- Eastern San Joaquin
- Modesto
- Turlock
- Merced
- Chowchilla
- Madera
- Kings
- Westside

As described in *California's Groundwater*, DWR Bulletin 1188 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley and includes portions of San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera Counties. The northern boundary begins just south of Tracy in San Joaquin County, and the eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin, and the Subbasin is bounded on the west by the Coast Range. The Subbasin boundaries are further described in Section 4.1.5, Basin Boundaries, and is shown in relation to each of the six counties in **Figure CC-9**~~**Figure CC-9**~~.

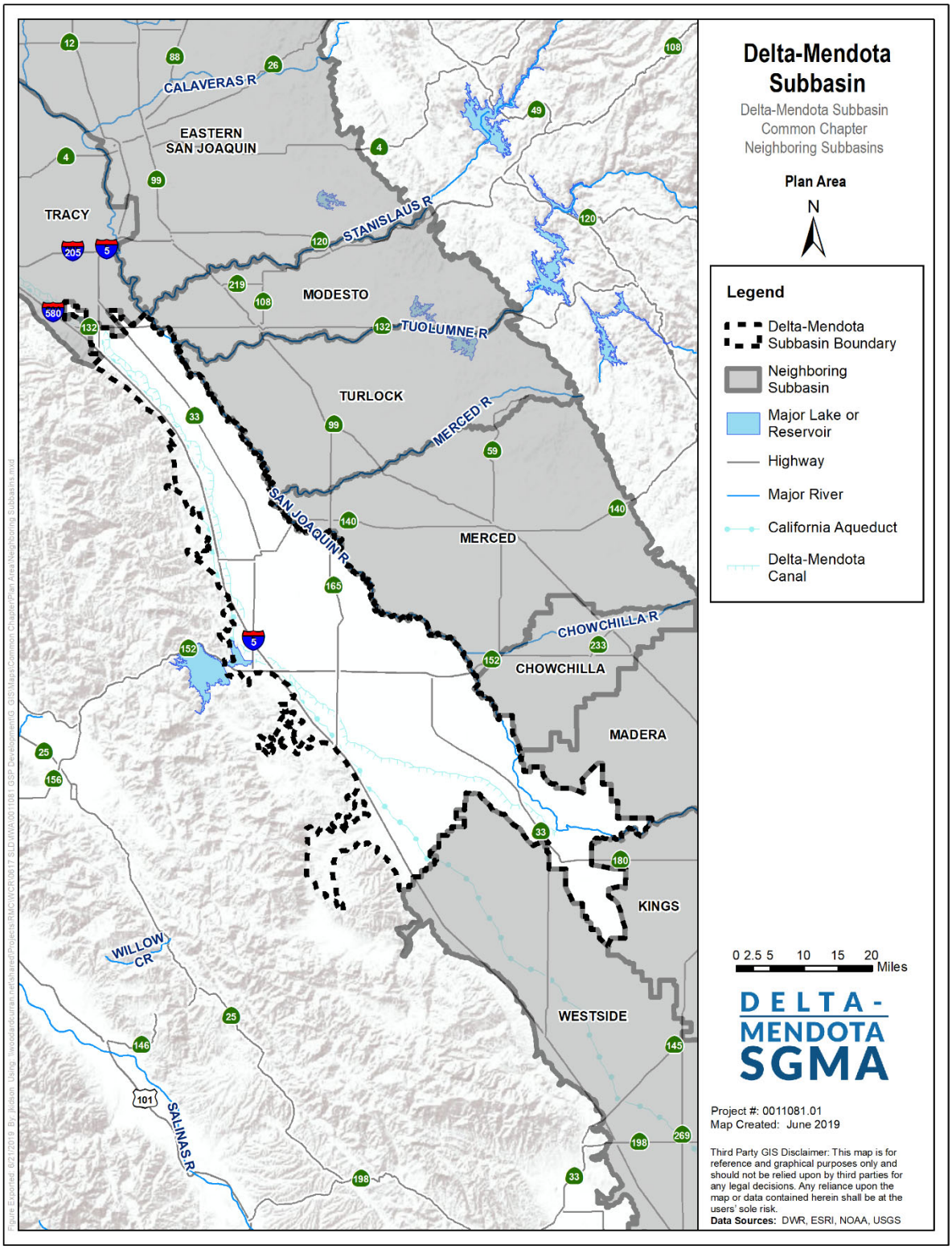


Figure CC-8: Neighboring Subbasins of the Delta-Mendota Subbasin

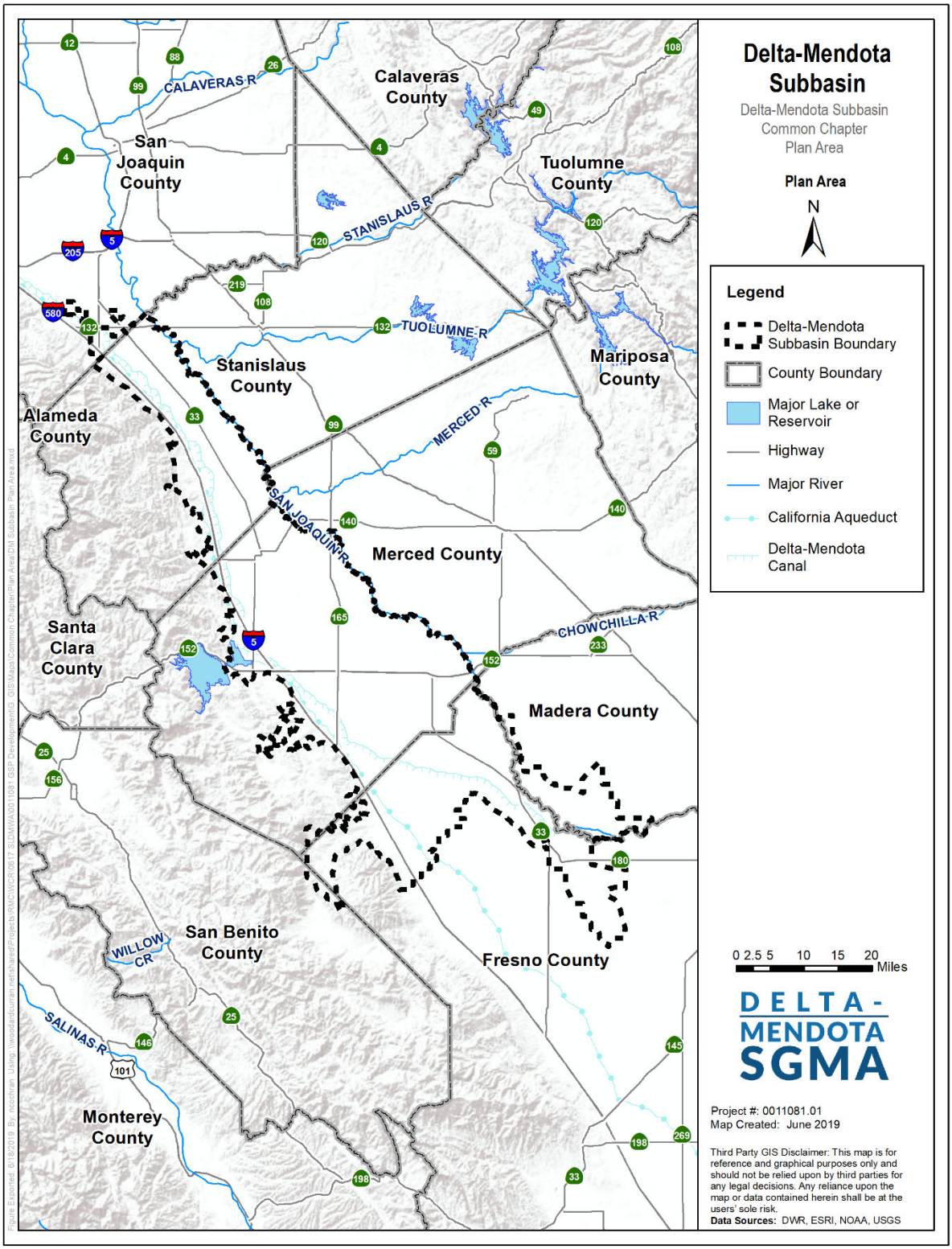


Figure CC-9: Delta-Mendota Groundwater Subbasin Plan Area

3.2 Plan Area Setting

As previously noted, the Delta-Mendota Subbasin lies along the western margin of the San Joaquin Valley. This valley is part of the large, northwest-to-southeast-trending asymmetric trough of the Central Valley, which has been filled with up to six vertical miles of sediment. This sediment includes both marine and continental deposits ranging in age from Jurassic to Holocene. The San Joaquin Valley lies between the Coast Range Mountains on the west and the Sierra Nevada on the east and extends northwestward from the San Emigdo and Tehachapi Mountains to the Sacramento-San Joaquin Delta (Delta) near the City of Stockton. The San Joaquin Valley is 250 miles long and 50 to 60 miles wide. The relatively flat alluvial floor is interrupted occasionally by low hills. Foothills adjacent on the west are composed of folded and faulted beds of mainly marine shale in the north and sandstone and shale in the south.

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. Alluvial plains cover most of the valley floor and comprise some of the most intensely developed agricultural lands in the San Joaquin Valley. In general, alluvial sediments of the western and southern parts of the San Joaquin Valley tend to have lower permeability than east side deposits.

This section provides additional information relating to water resources in and around the Delta-Mendota Subbasin.

Watersheds

The Delta-Mendota Subbasin lies in the Middle San Joaquin-Lower Merced-Lower Stanislaus watershed and the Middle San Joaquin-Lower Chowchilla watershed (**Figure CC-10~~Figure CC-10~~**). Historically, the San Joaquin Valley Basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Approximately 90 percent of the basin's wetlands have been lost, with approximately 58,000 flooded acres remaining on State, federal and private wildlife refuges. Approximately 100,000 acres of managed wetland, upland and riparian habitat is found within the Grassland Plan area, and together with the 12,000-acre Mendota Wildlife Area (found in the Fresno County Plan area), encompasses the vast majority of the remaining wetlands found in the basin (**Figure CC-11~~Figure CC-11~~**).

The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 13,513 square miles (mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus Rivers are the three major tributaries that join the mainstream San Joaquin River from the east before it flows into the Delta.

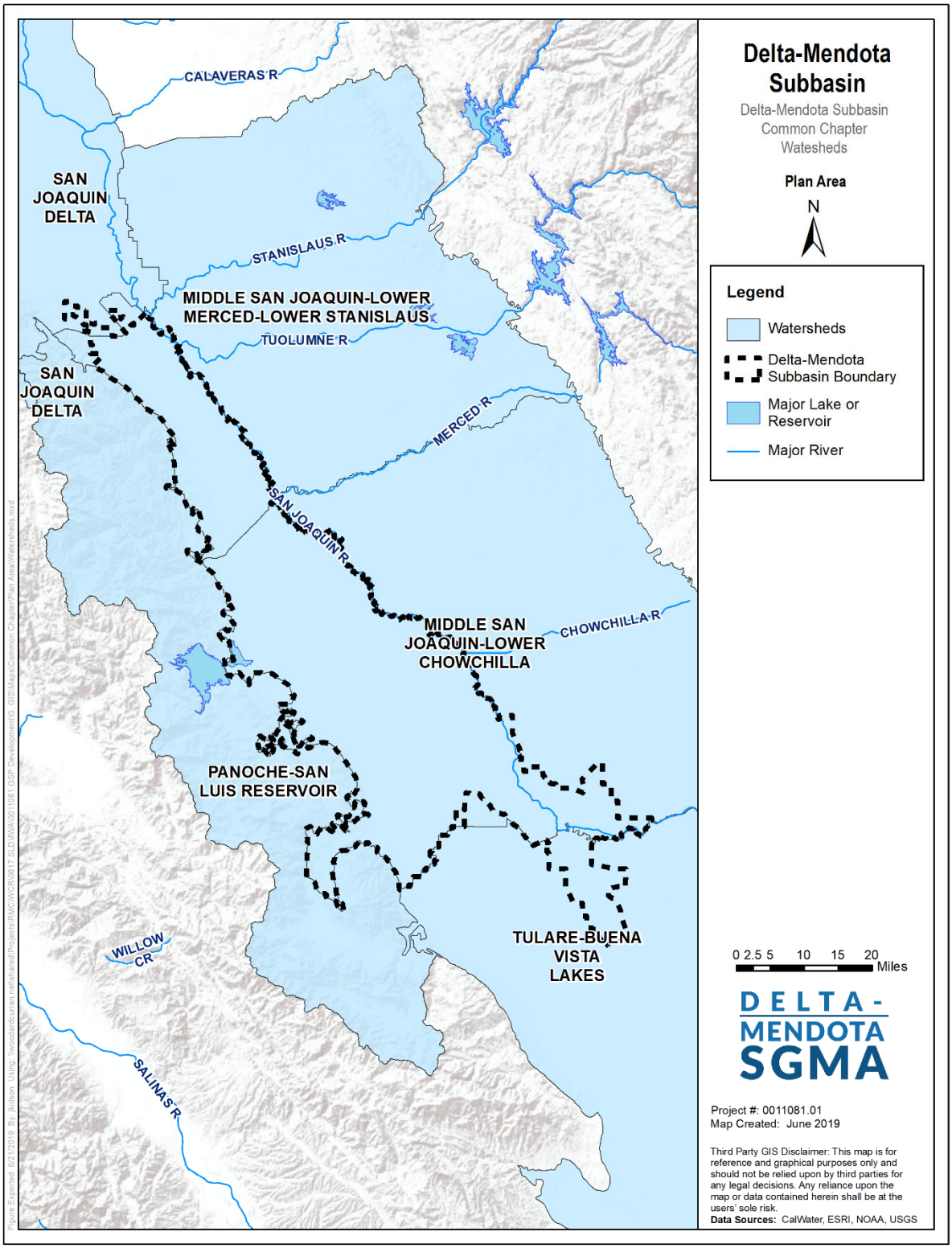


Figure CC-10: Local Watersheds

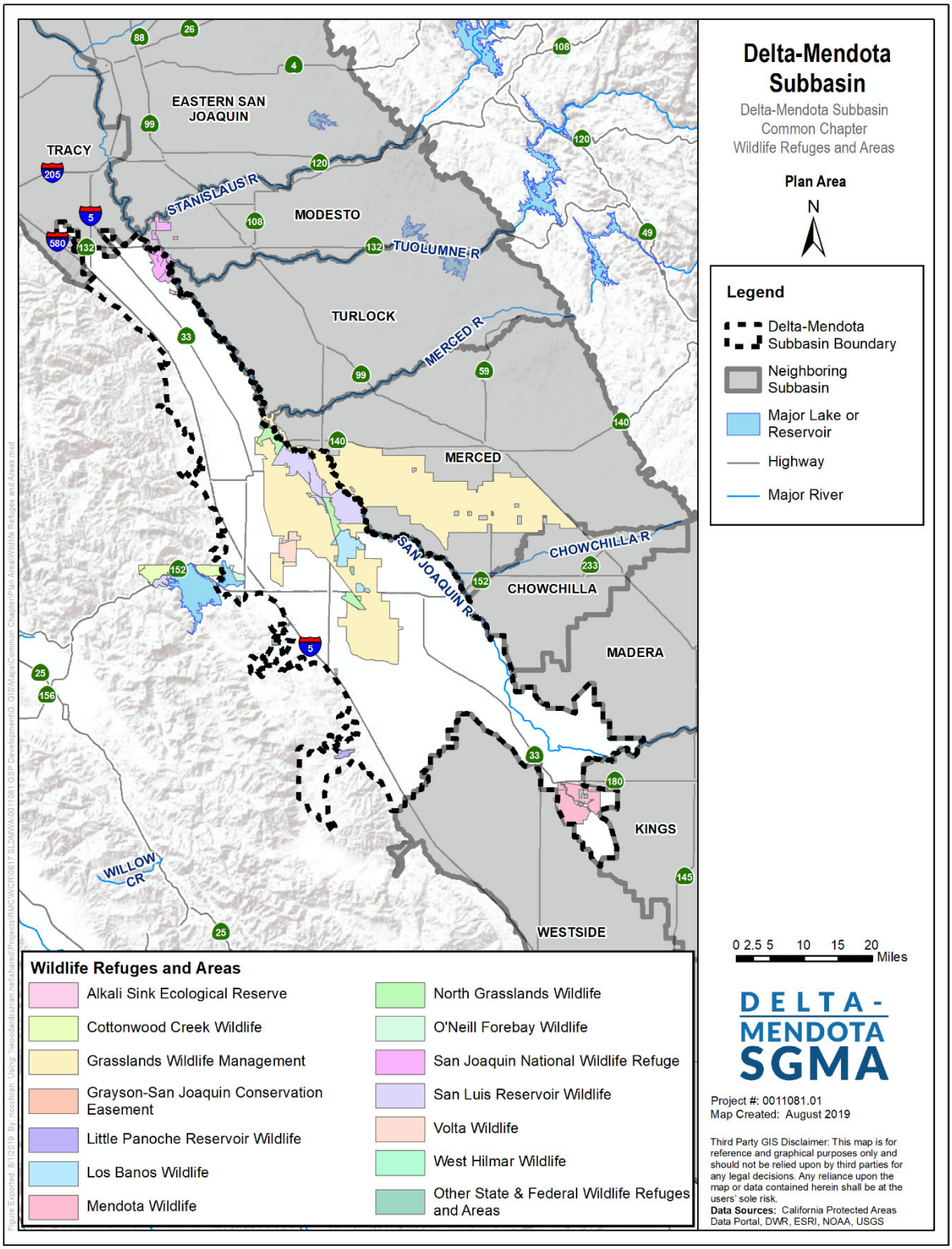


Figure CC-11: Wildlife Refuges and Wetland Habitat Areas in the Delta-Mendota Subbasin

Surface Water Use

Surface water is a primary water supply for agriculture within the Delta-Mendota Subbasin. Surface water supplies are brought into the Subbasin using an extensive series of water systems relied upon by multiple water agencies, cities, and private water users. Major water-related infrastructure in the Subbasin includes the facilities required to deliver Central Valley Project (CVP) supplies to CVP water supply contractors, in addition to key infrastructure of the State Water Project (SWP) utilized to deliver water to SWP water supply contractors and surface water diversions (e.g. intakes) to divert and distribute water from the San Joaquin and Kings Rivers.

The San Luis & Delta-Mendota Water Authority (SLDMWA) is a joint powers authority consisting of 28 member agencies that provide water to approximately 1.2 million acres of highly productive farmland, 2 million California residents, and millions of waterfowl dependent upon the nearly 200,000 acres of managed wetlands within this area of the Pacific Flyway. The SLDMWA operates and maintains portions of the CVP, including the Delta Cross Channel, the C.W. "Bill" Jones Pumping Plant, the Delta-Mendota Canal (DMC), O'Neill Pumping-Generating Plant, and the San Luis Drain, and provides emergency assistance when requested on the Delta Cross Channel and the Tracy Fish Collection Facility. The California Department of Water Resources (DWR) operates and maintains the SWP facilities, designed to deliver nearly 4.2 million acre-feet of water per year to 29 long-term SWP water supply contractors. Joint federal-state facilities include the California Aqueduct, Banks Pumping Plant, O'Neill Dam and Forebay, Sisk Dam and San Luis Reservoir, and Dos Amigos Pumping Plant. Surface water diversion facilities are owned and operated by individual water and irrigation districts and typically include some form of intake (e.g. fish screen, open water intake, flumes) plus facilities to convey the diverted surface water to a distribution system.

Groundwater Use

Groundwater is a key component of water supplies in the Delta-Mendota Subbasin. To protect the long-term sustainability of groundwater resources, pumping has significantly reduced in past years (2017-2019), allowing the groundwater levels in the Subbasin to recover to some extent. During the most recent drought period, groundwater was heavily relied upon throughout the Subbasin for irrigation as surface water deliveries were significantly severely reduced for many water users (especially those with junior surface water rights), resulting in increased groundwater pumping.

There are many communities within the Subbasin that are partially or completely reliant on groundwater for municipal and domestic water supplies, including the cities of Patterson, Newman, Gustine, Los Banos, Firebaugh, and Mendota and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, and Tranquillity (Figure CC-12~~Figure CC-12~~). Other unincorporated areas of the Subbasin also rely on groundwater as the sole water supply source. There are several areas of *de minimis* groundwater extractors in the Subbasin, which are defined as well owners who extracts two acre-feet or less per year from a parcel for domestic purposes (SWRCB, n.d. (a)).

Figure CC-13~~Figure CC-13~~, Figure CC-14~~Figure CC-14~~, and Figure CC-15~~Figure CC-15~~ show the density per square mile (PLSS Section) of domestic, production, and public wells in the Delta-Mendota Subbasin as identified by DWR's Well Completion Report Map Application. Domestic wells are defined as individual domestic wells which supply water for the domestic needs of an individual residence or systems of four or less service connections (DWR, 1981). Within the Delta-Mendota Subbasin, the majority of PLSS Sections contain five or fewer domestic wells (Figure CC-13~~Figure CC-13~~). Production well statistics include wells that are designated as irrigation, municipal, public, and industrial on well completion reports, generally indicating wells designed to obtain water from productive zones

containing good-quality water (DWR, 1991). The majority of PLSS Sections in the Subbasin contain only zero, one, or two production wells (**Figure CC-14**~~**Figure CC-14**~~). The highest concentration of production wells can be found in the south of the Subbasin, near Mendota. Public wells are defined as wells that provide water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (SWRCB, n.d. (b)). Compared to domestic and production wells, public wells are less common in the Subbasin. The status of the wells (e.g. active, abandoned, destroyed) contained in the DWR Well Completion Report Map Application has not been independently confirmed. Additionally, the reader is referred to each of the six Subbasin GSPs for more information regarding wells in the Delta-Mendota Subbasin.

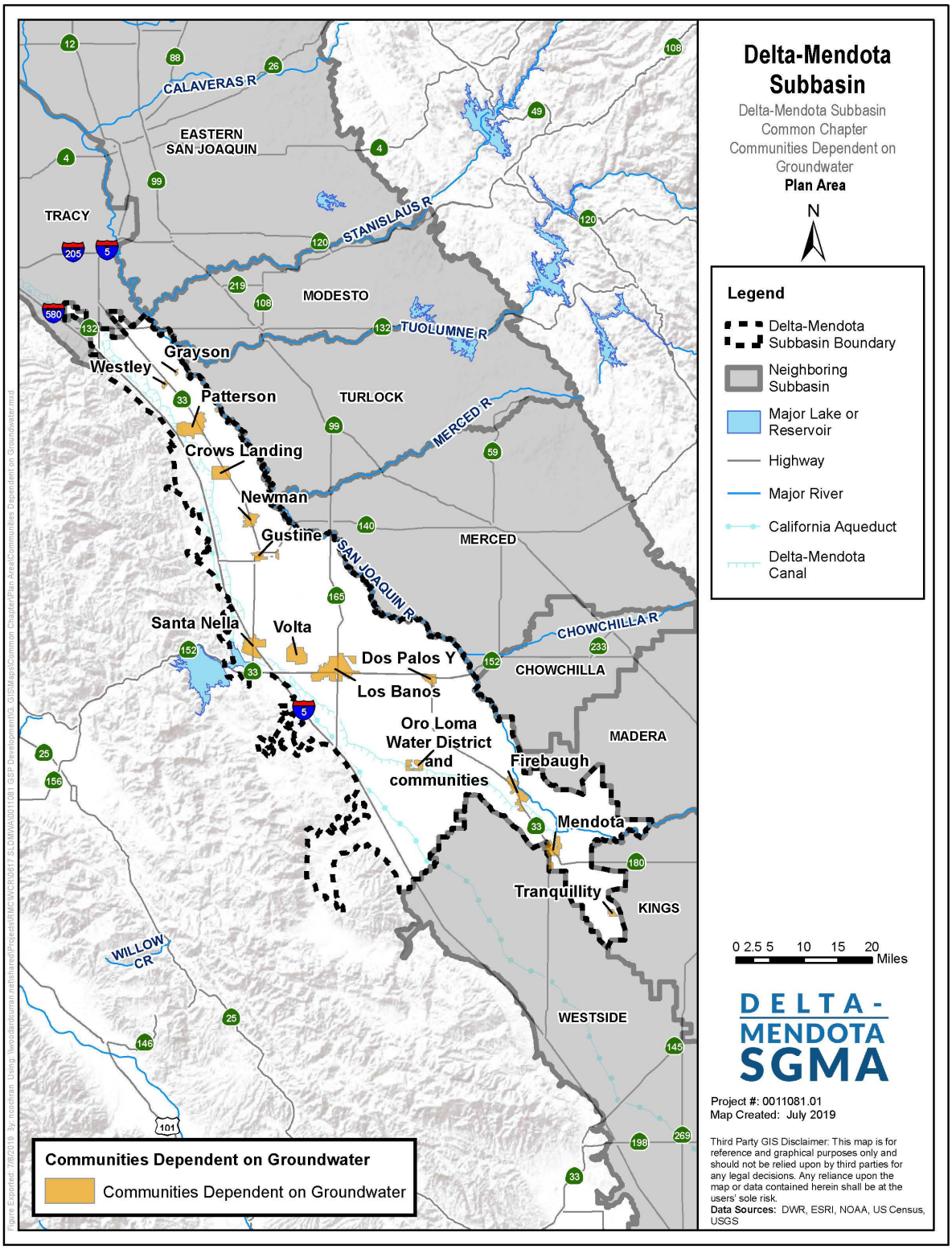


Figure CC-12: Communities Dependent on Groundwater

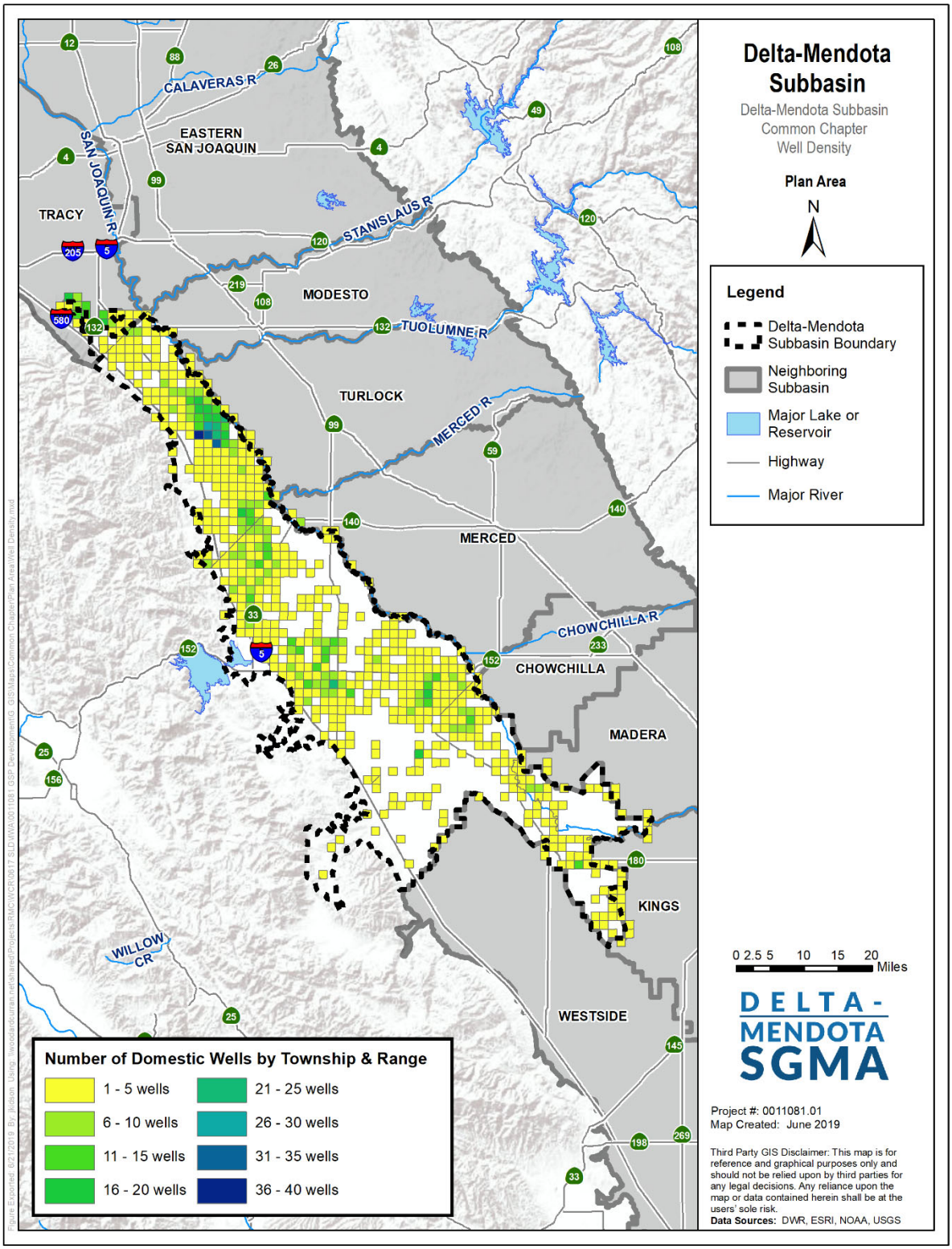


Figure CC-13: Domestic Well Density in the Delta-Mendota Subbasin

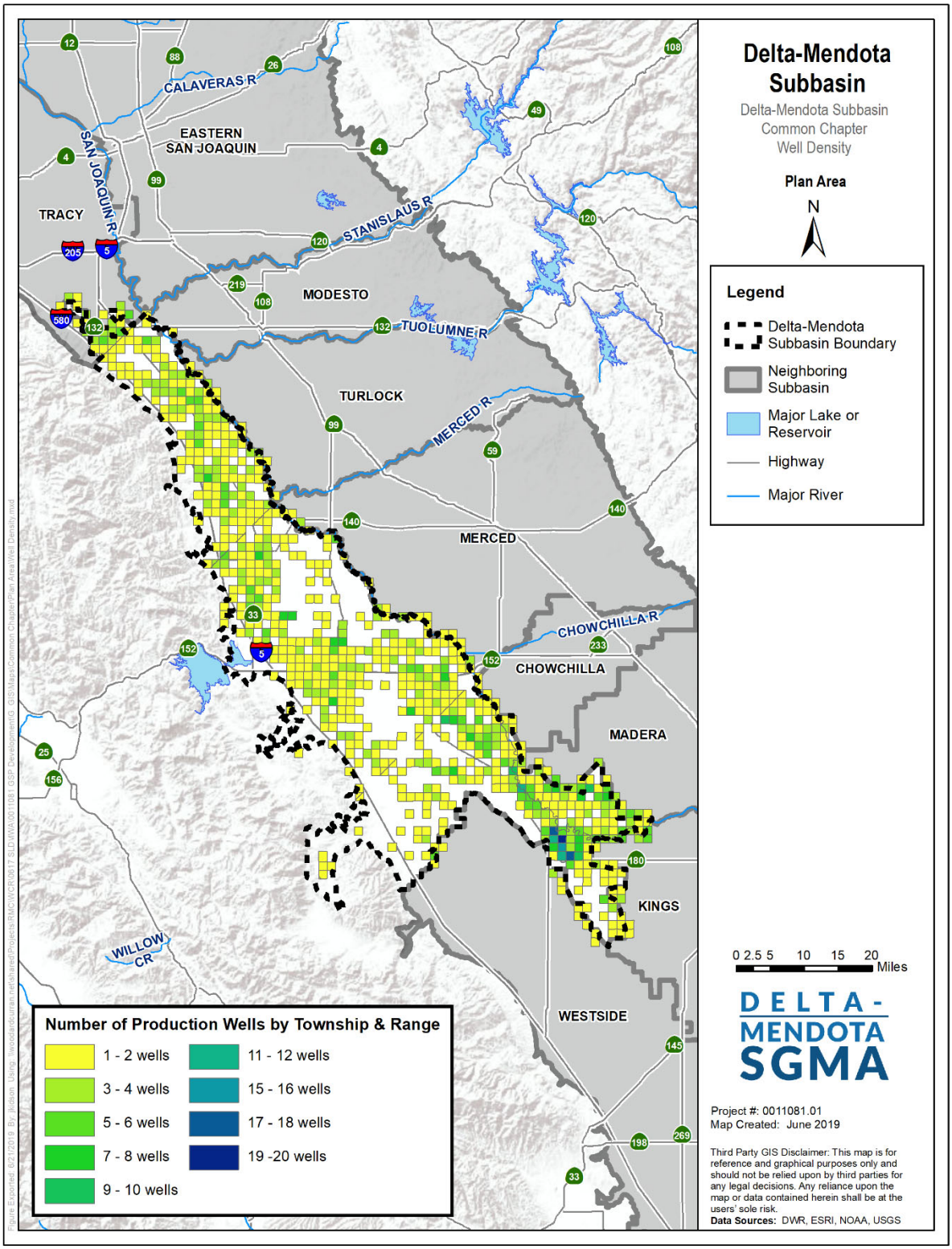


Figure CC-14: Production Well Density in the Delta-Mendota Subbasin

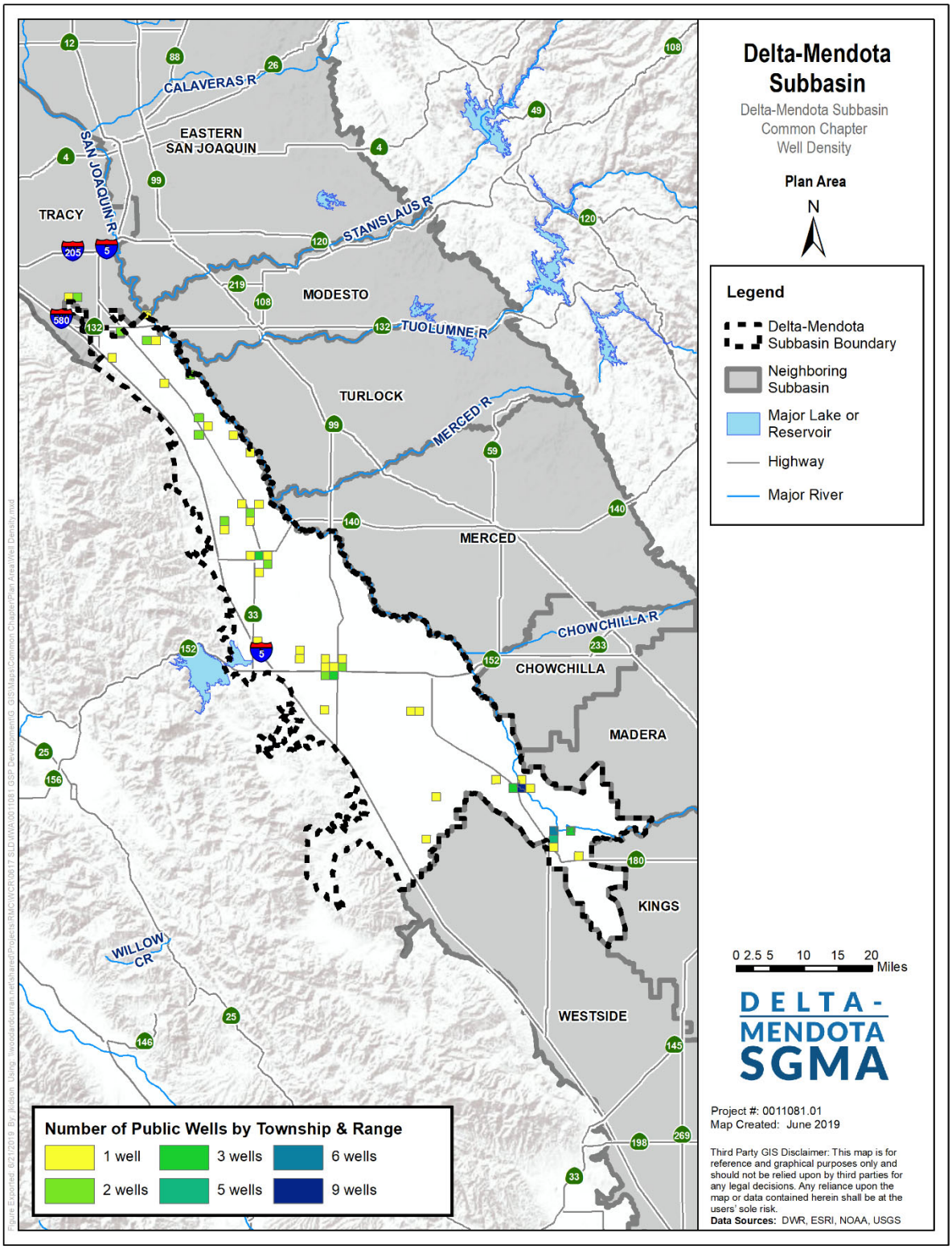


Figure CC-15: Public Well Density in the Delta-Mendota Subbasin

Flood Management

In general, the Delta-Mendota Subbasin slopes toward the San Joaquin River with steeper slopes along the western boundary (near the Coast Range), tapering off closer to the San Joaquin River. The flood management system in the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations greater than 5,000 feet, bypasses at lower elevations, and levees that line major rivers.

Severe rain events in 1997/98, 2005/2006, 2011 and 2017 flooded communities, agricultural lands and refuges adjacent to the San Joaquin River in the Delta-Mendota Subbasin (specifically the communities of Firebaugh, Newman, Gustine and Mendota) and produced some localized flooding of farmland and refuges caused by runoff impoundment by elevated canal banks. Based on the recent historical events, the primary threat of flooding to urban areas will be for those along (and immediately adjacent to) the San Joaquin River. Areas within the 100-year floodplain within the Subbasin are shown in **Figure CC-16**~~**Figure CC-16**~~.

Major Land Use Divisions

The Delta-Mendota Subbasin consists mostly of agricultural land use types (**Figure CC-17**~~**Figure CC-17**~~). Typical land uses are described in the following sections and consist predominantly of the following:

- Pasture/Rangeland
- Agricultural Land (including rice, field crops and grains)
- Deciduous Forest
- Idle and Retired Farmland/Rangeland
- Riparian/Wetland
- Urban

The primary land use planning entities in the Delta-Mendota Subbasin include San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties, as well as the cities of Patterson, Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota, and Community of Santa Nella, as shown in **Figure CC-18**~~**Figure CC-18**~~.

Pasture/Rangeland

Grasslands in the Central Valley were originally dominated by native perennial grasses such as needlegrass and alkali sacaton. Currently, grassland vegetation is characterized by a predominance of annual or perennial grasses in an area with few or no trees and shrubs. Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Pastures can consist of both irrigated and unirrigated lands dominated by perennial grasses used predominantly for grazing.

Rangeland communities are composed of similar grasses, grass-like plants, forbs, or shrubs which are grazed by livestock. Rangelands are classified into three basic types: shrub and brush rangeland, mixed rangeland, and herbaceous rangeland. The shrub and brush rangeland is dominated by woody vegetation and is typically found in arid and semiarid regions. Mixed rangelands are ecosystems where more than one-third of the land supports a mixture of herbaceous species and shrub or brush rangeland species.

Herbaceous rangelands are dominated by naturally occurring grasses and forbs as well as some areas that have been modified to include grasses and forbs as their principal cover. Rangelands are, by definition, areas where a variety of commercial livestock are actively maintained.

Agricultural Land

General agricultural types occurring in the Delta-Mendota Subbasin include row crops, grains, orchards, and vineyards. Management of agricultural lands often includes intensive management, including soil preparation activities, crop rotation, grazing, and the use of chemicals.

Row Crops

Most row crops grown in the San Joaquin Valley and harvested for food are annual species and are managed with a crop rotation system. During the year, several different crops may be produced on a given parcel of land either concurrently or in succession. Typical crops grown in the Delta-Mendota Subbasin include tomatoes, melons, grain crops (such as barley, wheat, corn, and oats), rice, cotton, and beans.

Orchards and Vineyards

Orchard and vineyards consist of cultivated fruit or nut-bearing trees or grapevines. Orchards are typically open, single-species, tree-dominated habitats and are planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse. Vineyards are typically managed in a similar manner for producing grapes for wine and/or direct consumption.

Deciduous Forest

Deciduous forests are composed of trees that lose their leaves in the winter. These include species such as the various California oaks, California buckeye, Fremont Cottonwoods, Goodding Willows, and California Sycamores. The interior live oak, which is not deciduous, is also found in deciduous forests. Valley oak woodlands are found in the Sacramento and San Joaquin Valleys and usually occur below elevations of 2,000 feet.

Idle or Retired Farmland/Rangeland

Lands of this category are similar to abandoned farmlands in ruderal (disturbed) areas. Plants on these parcels may consist of either native and/or non-native species.

Riparian/Wetland

Riparian and wetland communities are both natural and man-made. Managed wetlands are classified as riparian and are flooded for overwintering migratory bird habitat. In the spring the wetlands are drained to promote grasses such as swamp timothy and watergrass which are an important waterfowl food supply. Although some grazing continues on managed wetlands, historically, many of these lands were irrigated and used as rangeland throughout the summer months. Today, managed wetlands are irrigated in the spring to maximize wetland productivity and provide nesting and sensitive species habitat. Managed wetlands also contain emergent vegetation such as cattail and tule and are often adjacent to riparian corridors.

Urban

Urban land uses include cities and smaller communities, in addition to other lands used for industrial and/or commercial practices.

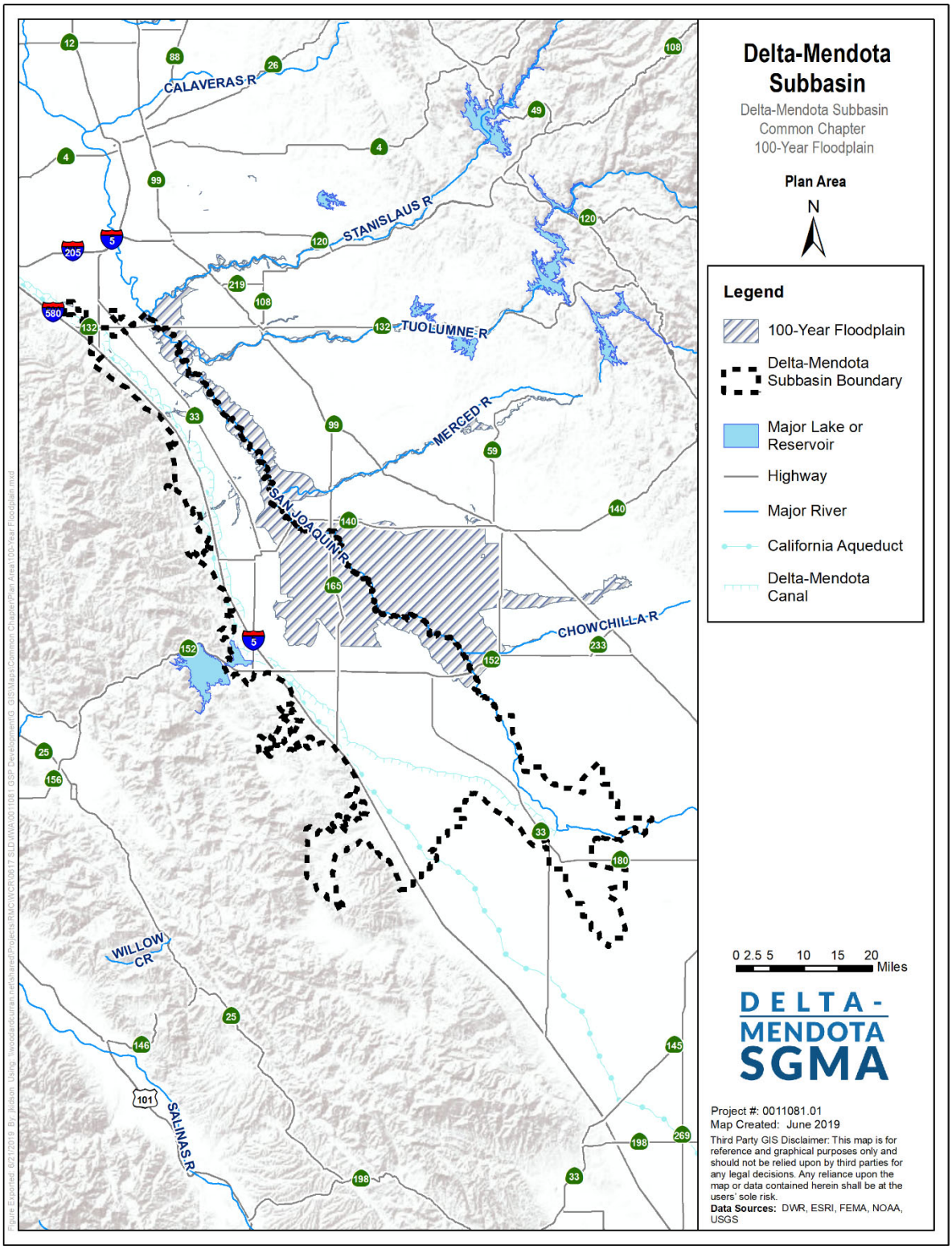


Figure CC-16: 100-Year Floodplain, Delta-Mendota Subbasin

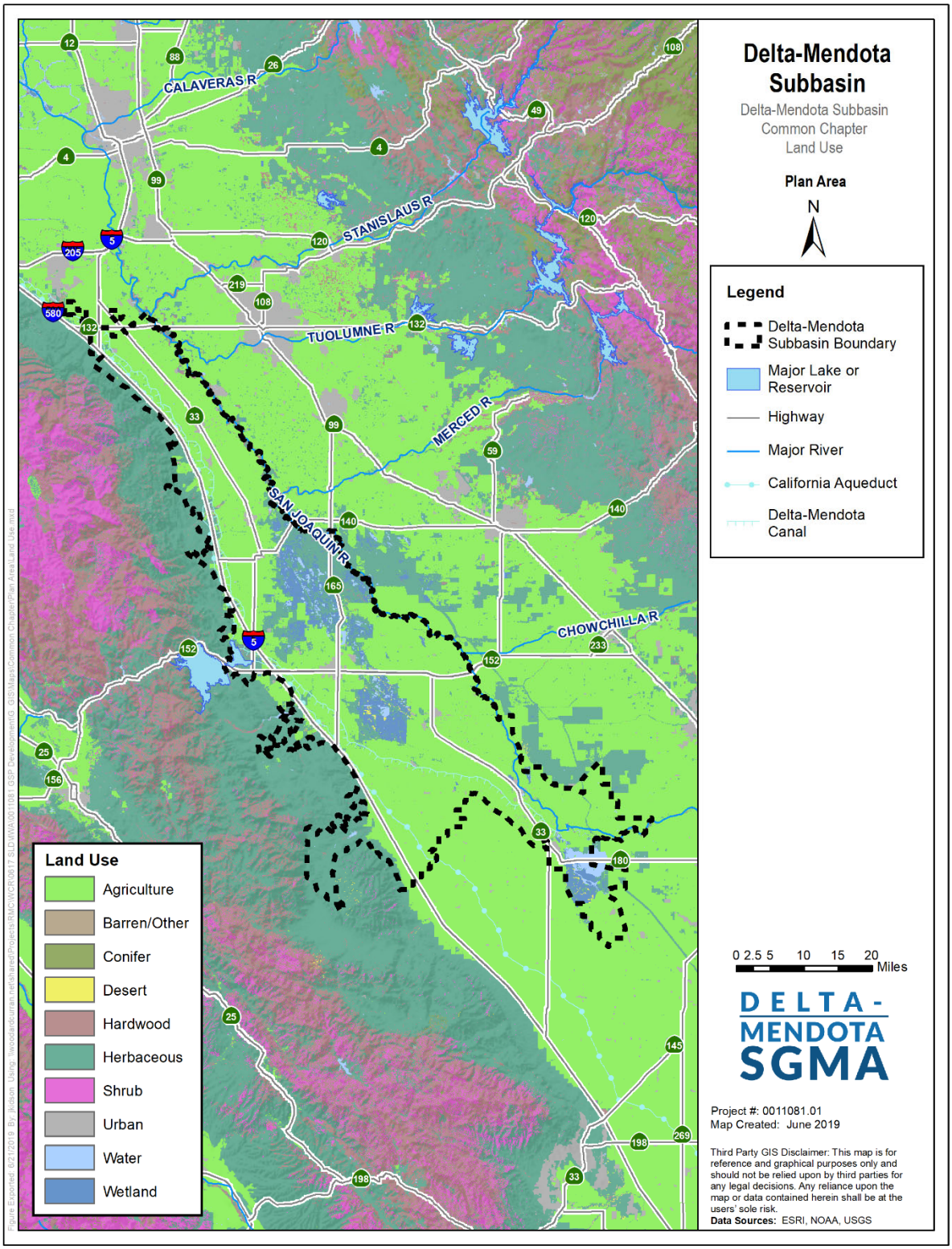


Figure CC-17: Typical Land Use

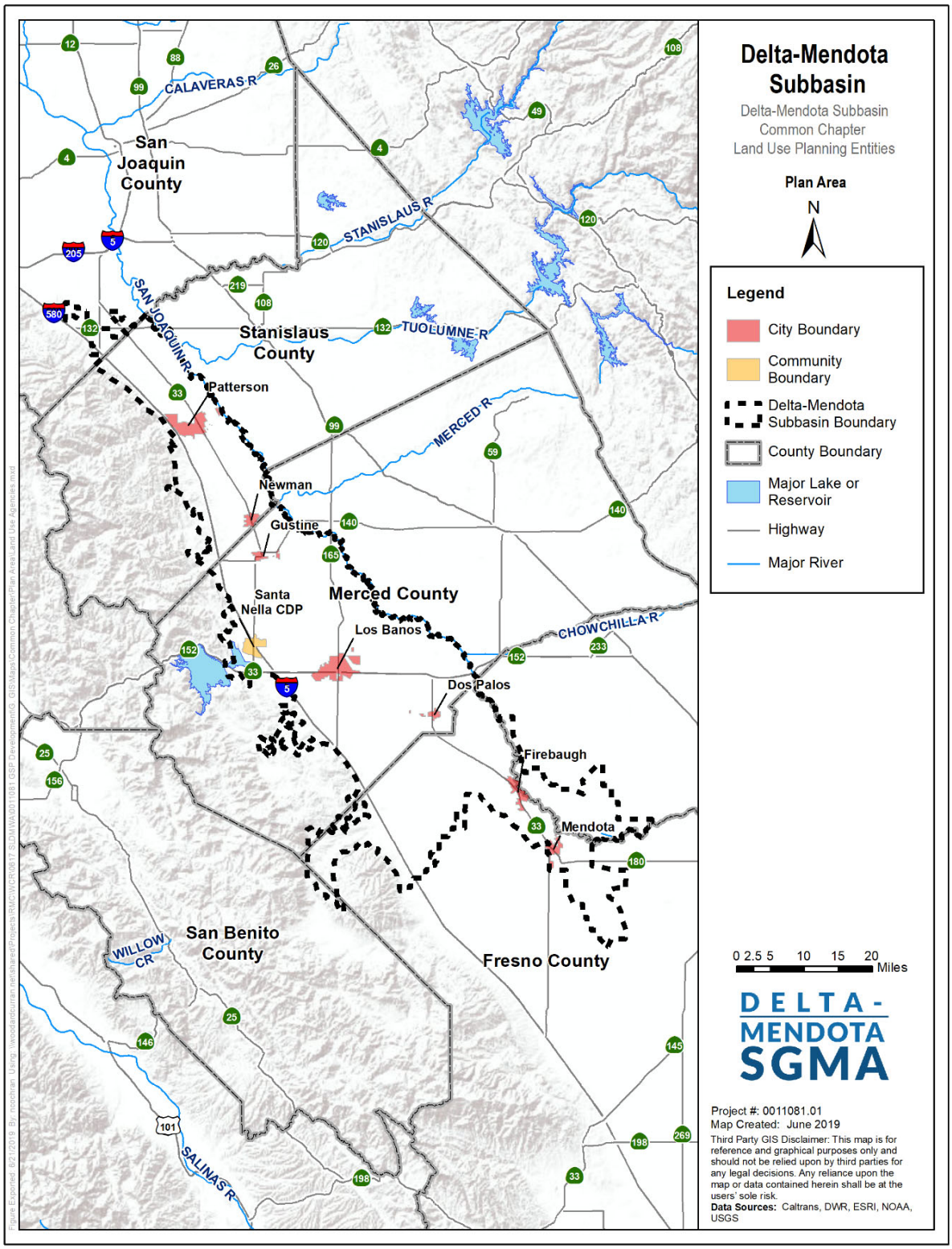


Figure CC-18: Land Use Planning Entities

Regional Economic Issues and Trends

The western San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the Subbasin to provide an alternative economic base. The economy of this region is predominately driven by agricultural production and therefore, the availability of surface water supplies (predominantly in the form of CVP agricultural water and diversions from the San Joaquin and Kings Rivers) is an essential element to the economic health of the region. Other uses of surface water in the Subbasin are used for M&I purposes and wildlife refuge water supply.

Depending on water supply conditions, about 800,000 acres in the Delta-Mendota Subbasin are partially or solely irrigated with surface water. Other economic base industries include travel on the Interstate 5 (I-5) corridor, some petroleum extraction, and tourism. State, federal, and private wildlife refuges benefit local economies by attracting hunters, anglers, outdoor recreationists to the region. Managed wetland water conveyance infrastructure is maintained and improved by many contractors and local agency staff. Large scale conveyance improvements and habitat restoration projects, including mitigation banks, are also common throughout the Subbasin. M&I water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and smaller communities. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2018 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 22,352) and Los Banos (population 30,074) (U.S. Census Bureau, 2017).

All communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Tranquillity, Grayson, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, and Westley. All of these communities are strongly affected by the reliability of agricultural water supplies. Some of them are dependent upon groundwater for M&I use.

Plan Area Jurisdictional Boundaries

Jurisdictional areas within the Delta-Mendota Subbasin include counties, cities, water districts, irrigation districts, mutual water companies, and federal and state agencies. There are no federal- or state-recognized tribal communities in the Subbasin. Federal and State Lands are shown in **Figure CC-19**~~**Figure CC-19**~~. More detail on specific jurisdictional areas within each GSP area can be found in the respective GSP.

In general, all municipal, water/irrigation districts and counties within the Delta-Mendota Subbasin are participating in GSP development either as a separate GSA or as members of a GSA. The California Department of Fish and Wildlife boundaries and the U.S. Fish and Wildlife Service boundaries overlay the wildlife refuges and areas and state parks within the Subbasin. DWR manages the SWP and the California Aqueduct, and the U.S. Bureau of Reclamation (USBR), through the SLDMWA, manages the CVP and the Delta-Mendota Canal. The California Department of Transportation (Caltrans) is responsible for managing the State and Interstate highways in the Subbasin, including Interstate- (I-) 5, and State Highways 132, 33, 140, 152, and 165.

Figure CC-9~~**Figure CC-9**~~ depicts the Subbasin's extent relative to the boundaries of the various counties that overlie the Subbasin. Merced County has jurisdiction over the largest portion of the Subbasin (525 square miles), in the central portion of the Subbasin. Stanislaus County has jurisdiction over most of the area on the northern end of the Subbasin (covering 223 square miles). Fresno and Madera Counties have jurisdiction over the southern extent of the Delta-Mendota Subbasin (400 square miles). Finally, San Benito County covers the smallest portion of the Subbasin (5 square miles) in the southwestern portion of the Subbasin near San Luis Reservoir.

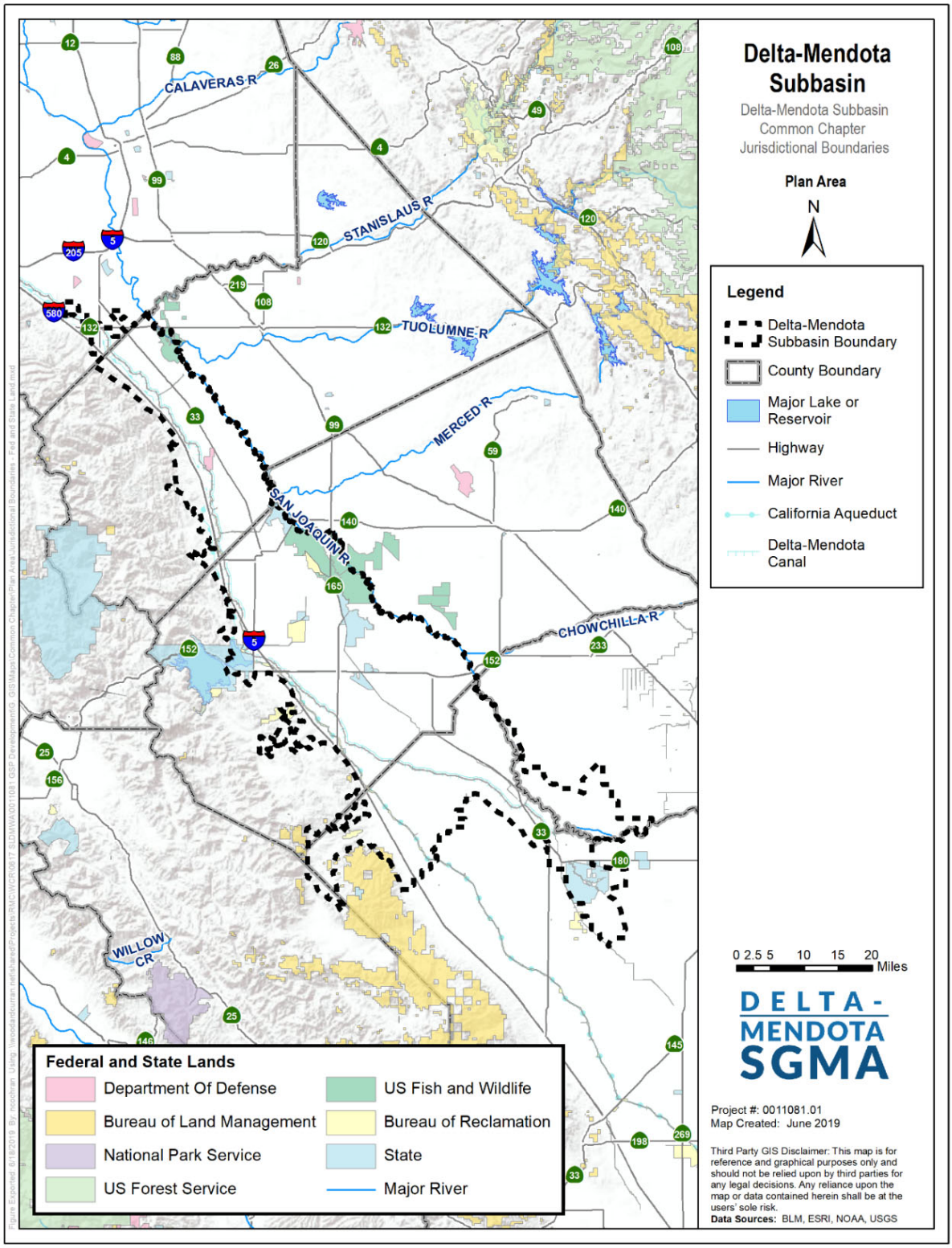


Figure CC-19: Federal and State Lands

Land Use Elements

Land use in the Delta-Mendota Subbasin is predominantly agricultural with wildlife habitat areas and areas of municipal, industrial, and commercial use. Predominant crops grown in the region include grain and hay crops, nut and fruit trees, and row crops. Figure CC-20~~Figure CC-20~~ shows the distribution of different land use types across the Delta-Mendota Subbasin.

Conjunctive use of surface water and groundwater is practiced throughout much of the Delta-Mendota Subbasin. Urban centers, such as the City of Patterson, and most unincorporated county areas rely solely on groundwater for their water supplies. Several water and irrigation districts hold water rights to divert from the San Joaquin River and/or the Kings Rivers. Other water purveyors receive water from the CVP and use groundwater and non-CVP-acquired surface waters to supplement demand, while some water districts rely solely on groundwater for their supplies. Refer to each GSP for detailed discussions of the water sources used by each agricultural, wetland, and urban water supplier.

Agriculture is the predominant water use sector throughout the Delta-Mendota Subbasin (Figure CC-20~~Figure CC-20~~). Urban water uses are mostly concentrated within and surrounding cities (such as Patterson and Los Banos). Non-irrigated land includes any idle or native riparian land classifications, which are scattered throughout the Regions.

3.3 General Plans in Plan Area

Within each GSP, General Plans and/or Community Specific Plans overlie the area. These include County general plans for Fresno, Merced, San Benito, San Joaquin, Stanislaus, and Madera Counties, and specific plans for cities and communities. Each GSP contains a detailed list of General Plan policies and objectives relevant to water resources management in the applicable GSP area. Refer to discussions in the individual GSPs which satisfy §354.8(f) of the GSP Emergency Regulations under SGMA.

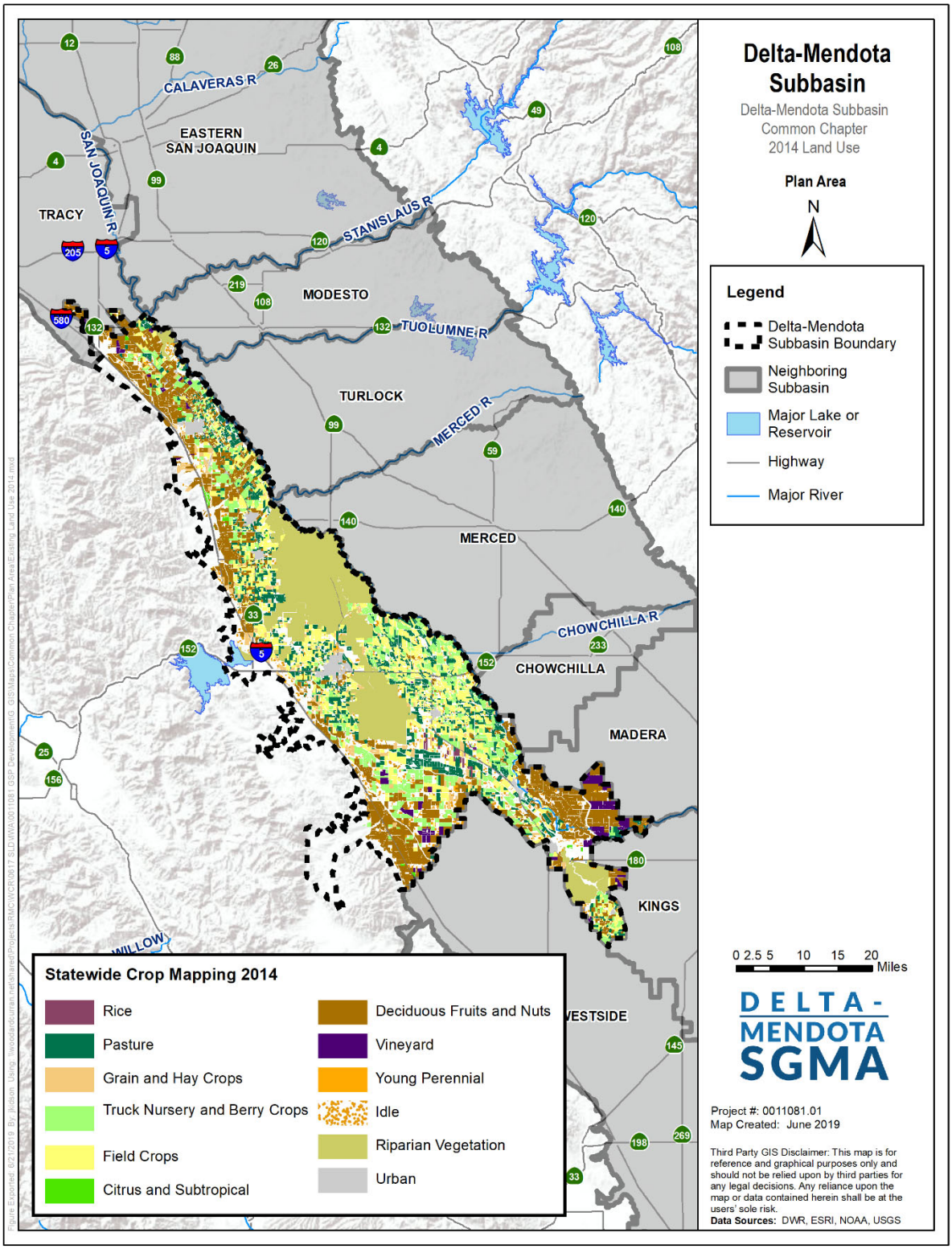


Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin

3.4 Existing Land Use Plans and Impacts to Sustainable Groundwater Management

Numerous policies in each County's and Community's General Plan compliment the GSPs' plans to conserve and sustainably manage groundwater resources. In general, the County and City General Plans guide future growth and development (and associated demands) within their respective jurisdictional areas. This additional growth may impact groundwater sustainability by placing additional demands on groundwater resources in an area where surface water resources are scarce or are otherwise unavailable. The General Plans also promote water conservation (in both the urban and agricultural sectors), which could potentially offset the additional demands associated with future urban development. In addition to conservation, some (though not all) General Plans promote groundwater recharge, the protection of recharge areas and wetlands, and the use of water transfers to further benefit groundwater sustainability.

Most General Plans within the Delta-Mendota Subbasin include goals focused on preserving agriculture, efficient use of existing and future water sources in both the urban and agricultural sectors, connecting smaller rural communities to larger water systems, and water quality protection. With respect to the protection of water quality and groundwater dependent ecosystems, the General Plans generally protect riparian and wetland habitats, encourage the protection of water quality (including through the remediation of contamination that may impact groundwater quality, requiring the use of septic systems in rural areas that are designed to be protective of groundwater quality and/or the use of community wastewater systems in urban areas), and promote flood control and management (including the associated impacts of erosion and sedimentation of surface water-courses).

The Fresno County General Plan, in particular, promotes sustainability by managing new wells in urban areas, supporting monitoring of water resources and associated habitats, and through the formation of a water resources document repository.

While the magnitude of impacts of these policies over the planning and implementation horizon are not known, such policies have been considered in this GSP, primarily through the use of the General Plans and associated zoning maps to identify future land use types and projected growth areas. These General Plans and mapping were used along with available water master plans, urban water management plans, agricultural water management plans, and other relevant planning documents to determine projected future land use and estimate future water demands by land use sector for use in the projected future water budgets.

Just as the General Plans complement the GSPs, the GSPs in the Delta-Mendota Subbasin may influence the General Plans' goals and policies. Sustainable management of groundwater resources through a GSP may change the pace, location, and type of development and/or land use that will occur in the Subbasin. GSP implementation is anticipated to be consistent with the General Plans' goals to sustainably manage land development and water resources in the Subbasin.

3.5 Existing Water Resources Monitoring and Management Programs

As required by §354.8~~(c)~~I and (d) of the GSP Emergency Regulations, the following section describes key existing water resources-related management and monitoring programs, and a discussion of how these programs will either impact GSP implementation and/or will be incorporated into the GSPs. The information shown below is a high-level summary of key existing programs; please see the individual GSPs for additional relevant management and monitoring programs.

Irrigated Lands Regulatory Program (ILRP)

In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver of water quality regulations for agricultural waste discharges. The Bill required the Regional Water Quality Control 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 (CV-RWQCB) issued an order that sets Waste Discharge Requirements (WDRs) for irrigated lands to protect both surface and groundwater throughout the Central Valley, primarily to address nitrates, pesticides, and sediment discharge. The resulting Irrigated Lands Regulatory Program (ILRP) regulates wastes from commercial irrigated lands that discharge into surface and groundwater. The program is administered by the CV-RWQCB working directly with a regional or crop-based coalition as well as directly with irrigators. 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. As a result of the ILRP, monitoring reports, assessment reports, management plans, surface water quality data, and groundwater quality data are made available to the public.

Implementation of the IRLP in the Delta-Mendota Subbasin is managed primarily by the Westside San Joaquin River Watershed Coalition and the Grassland Drainage Area Coalition under the San Joaquin Valley Drainage Authority, a California Joint Powers Authority (JPA). This region specifically emphasizes nitrogen, sediment, and erosion control.

CV-SALTS

The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is an initiative to reduce salt and nitrate impacts, restore groundwater quality, and provide safe drinking water supplies. Developed by a group of stakeholders (federal, state, and local agencies, dischargers and growers, and environmental groups) called the Central Valley Salinity Coalition, the Central Valley Salt and Nitrate Management Plan (SNMP) was released in 2017.

The Central Valley SNMP recommends revised and flexible regulations for existing Basin Plans and includes recommended interim solutions for salt and nutrient management in high priority basins in addition to long-term salt management strategies. Under the Central Valley SNMP, dischargers are provided two compliance pathways: (1) traditional permitting as an individual discharger or as a coalition (i.e. irrigated lands coalition), or (2) groundwater management zone permitting. Zone permitting allows dischargers to work as a collective in collaboration with the CV-RWQCB to provide safe drinking water with the option to extend time to achieve nitrogen balance. At this time, the Central Valley SNMP is not currently enforced.

Integrated Regional Water Management Program

Three Integrated Regional Water Management Plans (IRWMPs) overlie the Delta-Mendota Subbasin. The Westside-San Joaquin IRWMP covers most of the Subbasin, while smaller portions of the Subbasin are covered by the East Stanislaus and Madera IRWM Plans.

Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. Developed by Regional Water Management Groups, the IRWMPs seek to deliver higher value for investments in water resources and management by considering all interests, providing multiple benefits, and working across jurisdictional boundaries. Examples of multiple benefits include improved water quality, better flood

management, restored and enhanced ecosystems, and more reliable surface and groundwater supplies. Please see the individual GSPs for additional details regarding the IRWM program in their GSP Plan areas.

California State Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. The program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of ~~California's~~California's alluvial groundwater basins. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under the Sustainable Groundwater Management Act (SGMA) with mandatory annual water elevation monitoring and reporting.

San Joaquin River Restoration Program (SJRR)

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from Restoration Flows. The program has two general goals resulting from the San Joaquin River Restoration Settlement reached in 2006:

- **Restoration:** To restore and maintain fish populations in "good condition" in the main stem of the 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:** To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The program includes the implementation of projects, reintroduction activities and associated monitoring to assess progress towards achieving the Settlement goals.

USGS Land Subsidence Monitoring

The USGS maintains and monitors a large system of monitoring locations nationwide using interferometric synthetic aperture radar (InSAR), continuous GPS (CGPS) measurements, campaign global positioning system (GPS) surveying, and spirit-leveling surveying. Aquifer-system compaction is measured by using extensometers to aid in the understanding of the depths at which compaction is occurring. The USGS shares these results to support decision making relative to groundwater basin management with the goal of minimizing future inelastic land subsidence.

3.6 County Well Construction/Destruction Standards and Permitting

DWR has developed well standards for the state per California Water Code Sections 13700 to 13806. These standards have been adopted by the State Water Resources Control Board (SWRCB) into a statewide model well ordinance (Resolution No. 89-98) for use by the Regional Boards for enforcing well construction standards where no local well design ordinance exists that meets or exceeds the DWR standards. DWR's Well Standards are presented in Bulletin 74-81 and Bulletin 74-90.

Each GSP lists the counties within their GSP Plan areas and the respective permitting agencies and local ordinances for well construction and destruction standards. Discussion of these standards and the respective permitting process as well as well abandonment and destruction procedures can be found in the individual GSPs.

3.7 Existing and Planned Conjunctive Use Programs

Conjunctive use programs in the Subbasin are currently implemented and planned by single agencies as well as through multi-agency partnerships. Maximizing the beneficial use of surface water, groundwater, and recycled water resources is of critical concern to water managers throughout the Delta-Mendota Subbasin with the ultimate goal of using all of these water sources more efficiently to avoid overdraft and to sustainably manage groundwater resources. Each GSP describes efforts to utilize existing water resources conjunctively and demonstrate feasibility to continue to implement conjunctive use projects in the future. These may include projects such as groundwater recharge and conveyance facilities, new wells, improved monitoring systems, improved delivery efficiency, water recycling, and water quality improvements and treatment.

Underground recharge and storage occurs throughout the Delta-Mendota Subbasin through stormwater applied water and managed wetland recharge. Stormwater collects both naturally and artificially and eventually percolates through the ground and into aquifers for beneficial use for both urban and agriculture. Recharge from agricultural and wetland water conveyance and irrigation percolates into the ground and eventually into aquifers where it can be pumped again for use. This natural and unmanaged recharge creates future opportunities for conjunctive use programs; however, this recharge may decline as farmers move toward more precise and water efficient irrigation methods.

3.8 Plan Elements from California Water Code Section 10727.4

Each GSP may contain, as deemed appropriate, a detailed discussion of the additional plan elements as identified in California Water Code (CWC) Section 10727.4. These elements are:

- Control of saline water intrusion
- Wellhead protection areas and recharge areas
- Migration of contaminated groundwater
- Well abandonment and well destruction programs
- Activities implementing, opportunities for, and removing impediments to conjunctive use or underground storage
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects
- Efficient Water Management Practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risk to groundwater quality or quantity
- Impacts on Groundwater Dependent Ecosystems

4. SUBBASIN SETTING

This Delta-Mendota Subbasin Settings section contains three main subsections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 4.1) provides the geologic information needed to understand the framework that water moves through in the Subbasin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 4.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 4.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions

4.1 Hydrogeologic Conceptual Model

This section describes the hydrogeologic conceptual model (HCM) for the Delta-Mendota Subbasin based on technical studies and qualified maps that characterize the physical components and interaction of the surface water and groundwater systems, pursuant to Article 5, Plan Contents, Subarticle 2, Basin Setting, § 354.14 Hydrogeologic Conceptual Model of the GSP Emergency Regulations. The physical description of the Delta-Mendota Subbasin is based on information originally published in the *Western San Joaquin River Watershed Groundwater Quality Assessment Report* (GAR) (LSCE, 2015), *Grassland Drainage Area Groundwater Quality Assessment Report* (LSCE, 2016), and *Groundwater Overdraft in the Delta-Mendota Subbasin* (KDSA, 2015).

4.1.1 Regional Geologic and Structural Setting

The Delta-Mendota Subbasin is located in the northwestern portion of the San Joaquin Valley Groundwater Basin within the southern portion of the Central Valley (**Figure CC-21**~~**Figure CC-21**~~). The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains, respectively (DWR, 2006). Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes which mark the current and historic axis of surface drainage in the San Joaquin Valley.

The Delta-Mendota Subbasin (DWR Basin No. 5-22.07) is bounded on the west by the tertiary and older marine sediments of the Coast Ranges, on the north generally by the San Joaquin-Stanislaus County line, on the east generally by the San Joaquin River and Fresno Slough, and on the south by the Tranquillity Irrigation District boundary near the community of San Joaquin. Surface waters converge from the Fresno, Merced, Tuolumne, and Stanislaus Rivers into the San Joaquin River, which drains to the north toward the Sacramento-San Joaquin Delta.

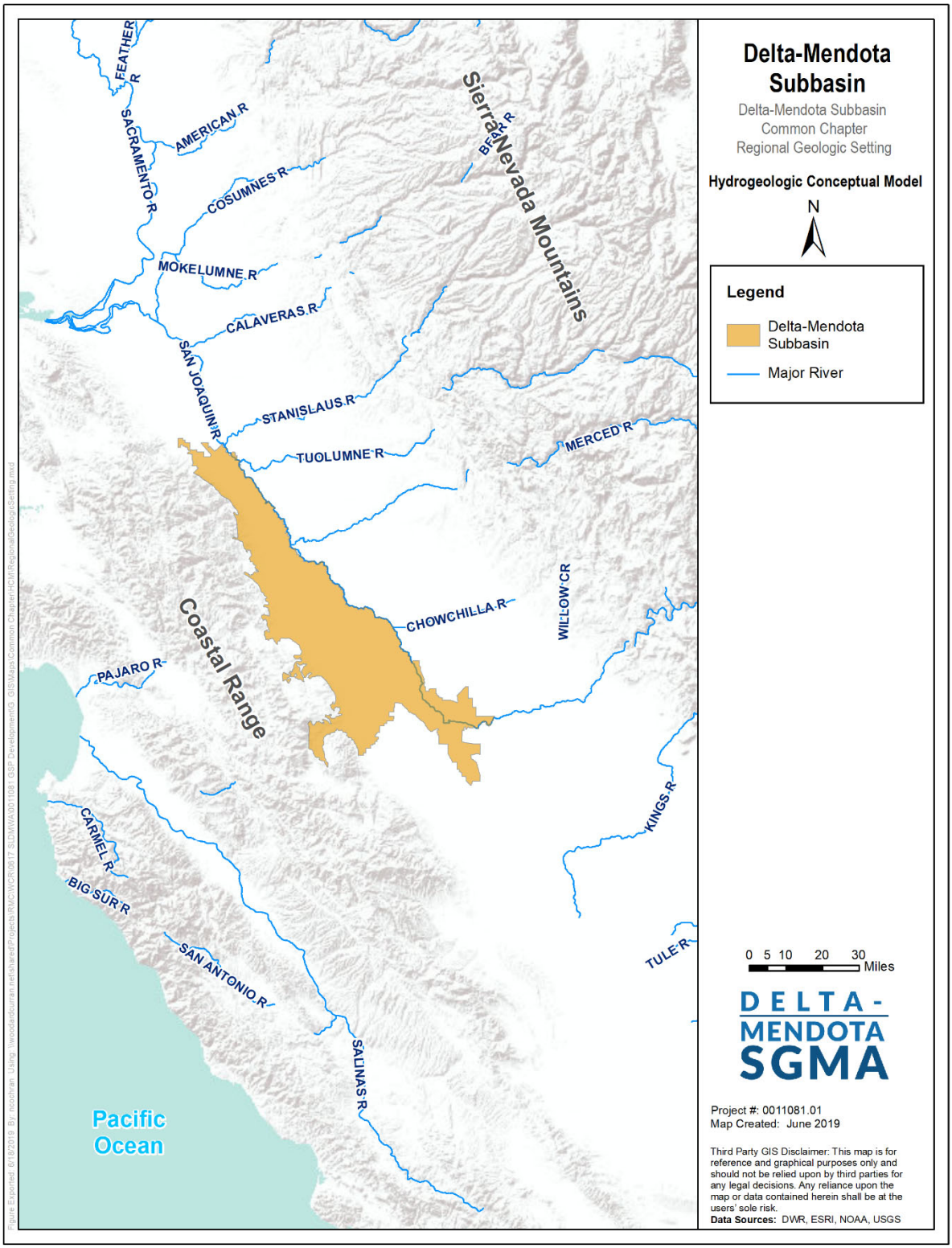


Figure CC-21: Regional Geologic Setting

4.1.2 Geologic History

Approximately three million years ago, tectonic movement of the Oceanic and Continental plates associated with the San Andreas Fault system resulted in the formation of the Coast Range which sealed off the Central Valley from the Pacific Ocean (LSCE, 2015). As this occurred, the floor of the San Joaquin Valley began to transition from a marine depositional environment to a freshwater system with ancestral rivers bringing alluvium to saltwater bodies (Mendenhall et al., 1916). The Coast Ranges on the western side of the San Joaquin Valley consist mostly of complexly folded and faulted consolidated marine and non-marine sedimentary and crystalline rocks ranging from Jurassic to Tertiary age, dipping eastward and overlying the basement complex in the region (Croft, 1972; Hotchkiss and Balding, 1971). The Central Valley Floor, in which the Delta-Mendota Subbasin lies, consists of Tertiary and Quaternary-aged alluvial and basin fill deposits (**Figure CC-22**~~**Figure CC-22**~~). The fill deposits mapped throughout much of the valley extend vertically for thousands of feet, and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley created by the continuous shifting of distributary stream channels over time. This process has led to the development of thick fans of generally coarse texture along the margins of the valley and a generally fining texture towards the axis of the valley (Faunt et al., 2009 and 2010).

Deposits of Coast Range and Sierra Nevada sources interfinger within the Delta-Mendota Subbasin. Steeper fan surfaces, with slopes as high as 80 feet per mile, exist proximal to the Coast Range, whereas more distal fan surfaces consist of more gentle slopes of 20 feet per mile (Hotchkiss and Balding, 1971). In contrast to the east side of the valley, the more irregular and ephemeral streams on the western side of the valley floor have less energy and transport smaller volumes of sediment resulting in less developed alluvial features, including alluvial fans which are less extensive, although steeper, than alluvial fan features on the east side of the valley (Bertoldi et al., 1991). Lacustrine and floodplain deposits also exist closer to the valley axis as thick silt and clay layers. Lakes present during the Pleistocene epoch in parts of the San Joaquin Valley deposited great thicknesses of clay sediments.

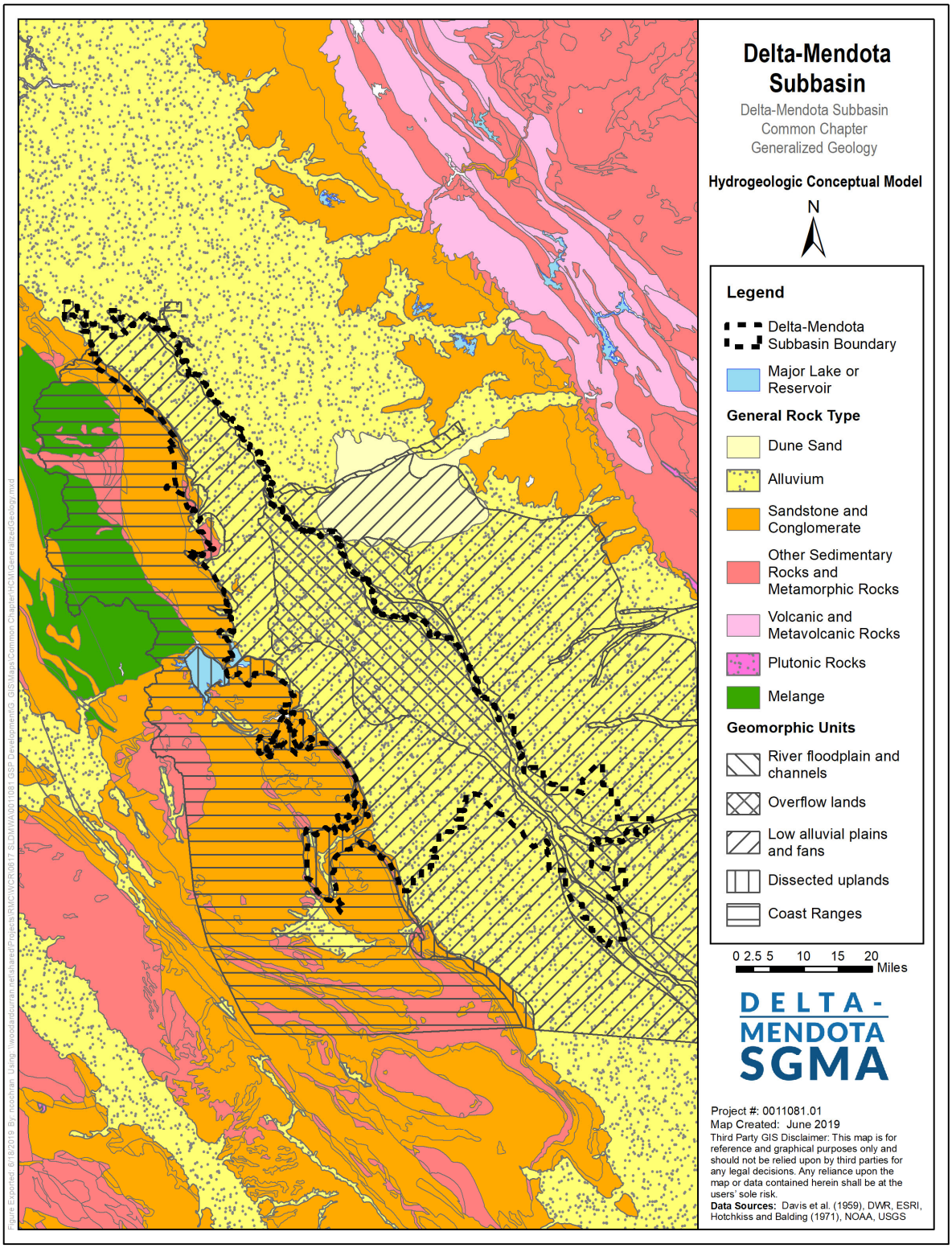


Figure CC-22: Generalized Geology

4.1.3 Geologic Formations and Stratigraphy

Distinct geomorphic units exist within the Delta-Mendota Subbasin defining areas of unique hydrogeologic environments. The geomorphic units are mapped and described by Hotchkiss and Balding (1971) and Davis et al. (1959) and are shown in Figure CC-22~~Figure CC-22~~. The two primary geomorphic units within the Central Valley Floor area of the Delta-Mendota Subbasin include the overflow lands geomorphic unit and the alluvial fans and plains geomorphic unit. Overflow lands are defined as areas of relatively poorly draining soils with a shallow water table. The overflow lands geomorphic unit is located in the southeastern portion of the Subbasin and is dominated by finer-grained floodplain deposits that are the result of historical episodic flooding of this low-land area. This has formed poorly-draining soils with generally low hydraulic conductivity characteristics. In contrast, the alluvial fans and plains geomorphic unit is characterized by relatively better drainage conditions, with sediments comprised of coalescing and somewhat coarser-grained alluvial fan materials deposited by higher-energy streams flowing out of the Coast Range (Hotchkiss and Balding, 1971). The alluvial fans and plains geomorphic unit covers much of the Delta-Mendota Subbasin along the western margins of the Central Valley Floor at the base of the Coast Range.

The primary groundwater bearing units within the Delta-Mendota Subbasin consist of Tertiary and Quaternary-aged unconsolidated continental deposits and older alluvium of the Tulare Formation. Subsurface hydrogeologic materials covering the Central Valley Floor consist of lenticular and generally poorly sorted clay, silt, sand, and gravel that make up the alluvium and Tulare Formation. These deposits are thickest along the axis of the valley with thinning along the margins towards the Coast Range mountains (DWR, 2003; Hotchkiss and Balding, 1971). A zone of very shallow groundwater, generally within 25 feet of the ground surface, exists throughout large areas of the Subbasin, with considerable amounts (greater than 50 percent) of farmland in the area estimated to have very shallow depths to groundwater of less than 10 feet (Hotchkiss and Balding, 1971). Many of these areas are naturally swampy lands adjacent to the San Joaquin River.

The Tulare Formation extends to several thousand feet in depth and to the base of freshwater throughout most of the area and consists of interfingered sediments ranging in texture from clay to gravel of both Sierra Nevadan and Coast Range origin. The formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternatively deposited in oxidizing and reducing environments (Hotchkiss and Balding, 1971).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds and are comprised of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss and Balding, 1971). The water table generally lies below the bottom of the terrace deposits; however, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites. Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic material with locally high concentrations of salt and alkali. Stream channel deposits of coarse sand and gravel are also included.

The Tulare Formation also includes the Corcoran Clay (E-Clay) member, a diatomaceous clay or silty clay of lake bed origin which is a prominent aquitard in the San Joaquin Valley, separating the upper zone from the lower zone and distinguishing the semi-confined Upper Aquifer from the confined Lower Aquifer (Hotchkiss and Balding, 1971). The depth and thickness of the Corcoran Clay are variable within the Central Valley Floor, and it is not present in peripheral areas (outside the Central Valley Floor) of the Subbasin. Within the Upper Aquifer, additional clay layers exist and also provide varying degrees of confinement, including other clay members of the Tulare Formation and layers of white clay identified by

Hotchkiss and Balding (1971). These clays are variable in extent and thickness, but the white clay is noted to be as much as 60 feet thick in areas providing very effective confinement of underlying zones (Croft, 1972; Hotchkiss and Balding, 1971). The Tulare Formation is hydrologically the most important geologic formation in the Delta-Mendota Subbasin because it contains most of the fresh water-bearing deposits. Most of the natural recharge that occurs in the Subbasin is in the alluvial fan apex areas along Coast Range stream channels (Hotchkiss and Balding, 1971).

4.1.4 Faults and Structural Features

The valley floor portion of the Delta-Mendota Subbasin contains no known major faults and is fairly geologically inactive. There are few faults along the western boundary of the Subbasin within the Coast Range mountains, but they are not known to inhibit groundwater flow or impact water conveyance infrastructure (**Figure CC-23**~~**Figure CC-23**~~).

4.1.5 Basin Boundaries

The Delta-Mendota Subbasin is defined by both geological and jurisdictional boundaries. The Delta-Mendota Subbasin borders all subbasins within the San Joaquin Valley Hydrologic Region with the exception of the Cosumnes Subbasin. The following subsections describe the lateral boundaries of the Subbasin, boundaries with neighboring subbasins, and the definable bottom of the Delta-Mendota Subbasin.

Lateral Boundaries

The Delta-Mendota Subbasin is geologically and topographically bounded to the west by the Tertiary and older marine sediments of the Coast Ranges, and to the east generally by the San Joaquin River. The northern, central, and southern portion of the eastern boundary are dictated by jurisdictional boundaries of water purveyors within the Delta-Mendota Subbasin.

As described in *California's Groundwater*, DWR Bulletin 118 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin. The subbasin is bounded on the west by the coast range. The Subbasin boundary is defined by 20 segments detailed in the descriptions below. The Delta-Mendota Subbasin extends into six (6) counties: San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera and is shown in relation to each of the six counties in **Figure CC-9**~~**Figure CC-9**~~.

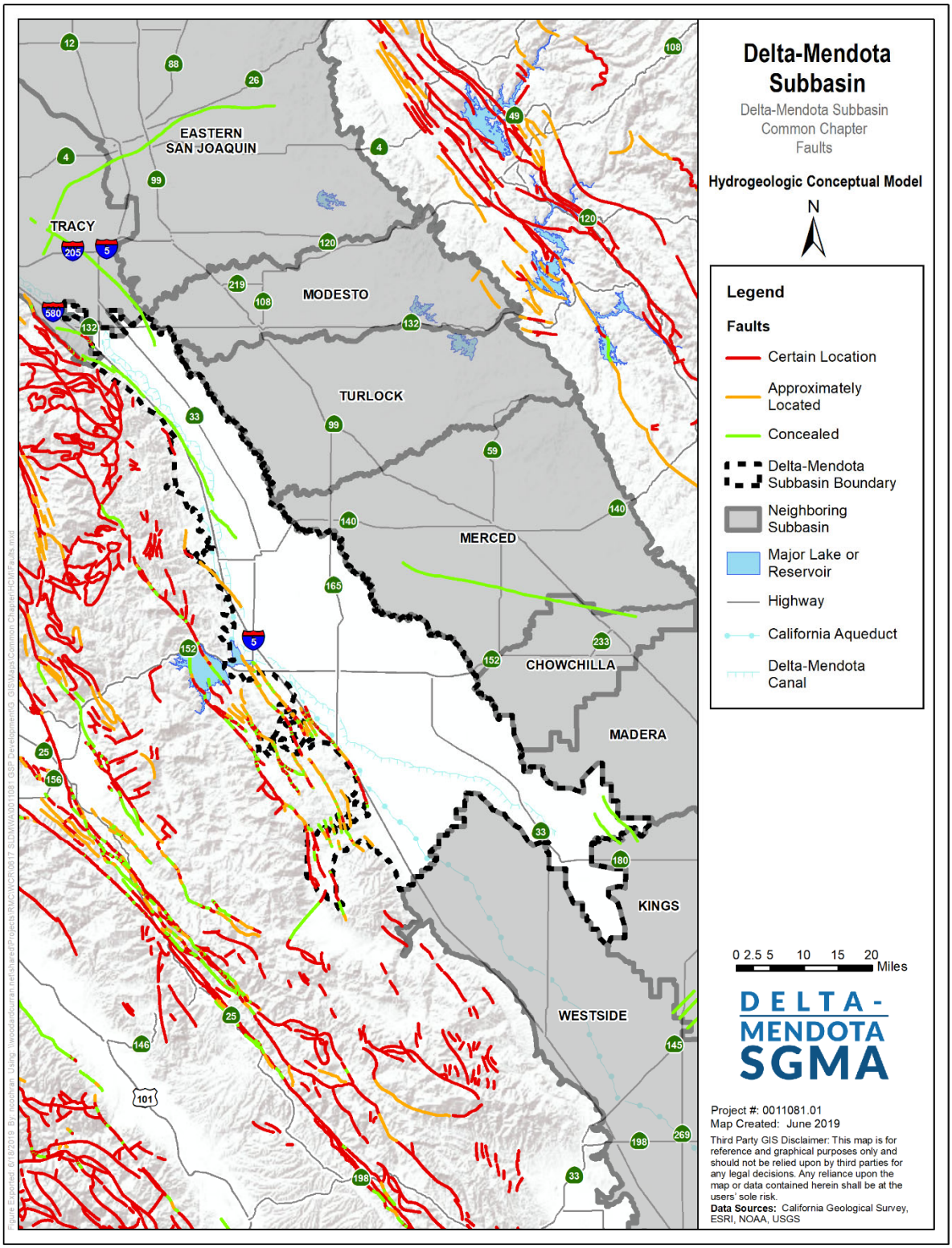


Figure CC-23: Subbasin Faults

4.1.6 Definable Bottom of Basin

In the San Joaquin Valley, the bottom of the Delta-Mendota Subbasin is defined as the interface of saline water of marine origin (base of fresh water) within the uppermost beds of the Tulare Formation. The Tulare Formation is characterized by blue and green fine-grained rocks and principally composed of fine-grained silty sands, silt, and clay (Foss and Blaisdell 1968). The Tulare Formation is predominantly marine in origin and is considered late Pliocene and possibly early Pleistocene in age. This formation is the upper shaley part of the Pliocene sequence. The top of the Tulare Formation is generally encountered around -2,000 feet mean sea level throughout the Delta-Mendota Subbasin. As agreed upon by the Delta-Mendota Subbasin GSP Groups, the base of freshwater is specifically defined by an electrical conductivity of 3,000 micromhos per centimeter at 25 °C, as presented by Page (1973). If and when significant use of water beyond the defined bottom takes place, the definition of the bottom will be revised appropriately.

4.1.7 Principal Aquifers and Aquitards

DWR's Groundwater Glossary defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells, and springs". There are two primary aquifers within the Delta-Mendota Subbasin: a semi-confined aquifer above the Corcoran Clay and a confined aquifer below the Corcoran Clay, with the Corcoran Clay acting as the principal aquitard within the Delta-Mendota Subbasin. Figure CC-24~~Figure CC-24~~ shows the locations of the representative cross-sections for the Delta-Mendota Subbasin, where Figure CC-25~~Figure CC-25~~ through Figure CC-30~~Figure CC-30~~ show the hydrostratigraphy of the representative cross-sections.

While the two-aquifer system described above is generally true across the Delta-Mendota Subbasin, there are portions of the Subbasin where the Corcoran Clay does not exist (predominantly along the western margin of the Subbasin) and hydrogeology is generally controlled by localized interfingering clays, and/or where local hydrostratigraphy results in shallow groundwater conditions that differ, to some extent, from that seen in the Subbasin as a whole. Additionally, in the southern portion of the Subbasin in the Mendota, Aliso and Tranquillity areas, there are A and C Clay layers in addition to the Corcoran Clay that inhibit vertical groundwater flow. However, while there are localized complexities throughout the Subbasin, the Corcoran Clay (or E Clay) extends through much of the Delta-Mendota Subbasin, generally creating a two-aquifer system.

Principal Aquifers

In the Delta-Mendota Subbasin, there are two primary aquifers composed of alluvial deposits separated by the Corcoran Clay (KDSA, 2015): a semi-confined Upper Aquifer (generally the ground surface to the top of the Corcoran Clay), and a confined Lower Aquifer starting at the bottom of the Corcoran Clay to the base of fresh water. However, as previously described, the localized presence of the A and C Clay layers in the southern portion of the Subbasin, the absence of the Corcoran Clay at the western margin of the Subbasin, and/or local hydrostratigraphy result in differing shallow groundwater conditions and/or perched groundwater conditions in some portions of the Subbasin. See the individual GSPs for more detailed descriptions of hydrostratigraphy in the respective Plan areas.

Upper Aquifer

The Upper Aquifer is represented by materials extending from the upper groundwater table to the top of the Corcoran Clay. The Upper Aquifer includes shallow geologic units of younger and older alluvium and upper parts of the Tulare Formation. Sediments within the upper Tulare Formation have variable sources, and subdivision of units can be distinguished between eastern and western sourced materials. Alluvial fan materials above the Corcoran Clay in the Delta-Mendota Subbasin are generally more extensive than older alluvial fan deposits within the Tulare Formation below the Corcoran Clay. As shown in Figure CC-31~~Figure CC-31~~ by the depth to the top of the Corcoran Clay, the Upper Aquifer extends to depths ranging between approximately 150 feet and greater than 350 feet. Other notable mapped clay units also exist within the upper part of the Tulare Formation in the Delta-Mendota Subbasin, including the A and C Clay members of the Tulare Formation and a white clay mapped by Hotchkiss and Balding (1971).

Lower Aquifer

The Lower Aquifer is the portion of the Tulare Formation that is confined beneath the Corcoran Clay, extending downward to the underlying San Joaquin Formation and the interface of saline water of marine origin within its uppermost beds. The Lower Aquifer is generally characterized by groundwater that tends to be dominantly sodium-sulfate type, which is often of better quality than the Upper Aquifer (Davis et al., 1957; Hotchkiss and Balding, 1971). Exceptions to this quality do exist in the Subbasin, particularly in the southwestern portion of the Subbasin. Because of its relatively shallow depth within the Delta-Mendota Subbasin and lower salinity in areas when compared to other groundwater resources, the Lower Aquifer is heavily utilized as a source of groundwater for agricultural and drinking water uses within the Subbasin.

The base of the Lower Aquifer generally decreases from south to north, changing in depth from about 1,100 to 1,200 feet deep in the south to about 600 feet to the north. Depth to the top of the Corcoran Clay ranges from less than 100 feet on the west near Interstate 5 (I-5) to more than 500 feet in the area near Tranquillity. The Corcoran Clay pinches out or is above the water level near the California Aqueduct in the western part of the Subbasin, where the Upper and Lower Aquifers merge into interfingered layers of sand, gravel, and clay.

Corcoran Clay

The Corcoran Clay, as a regional aquitard, is a notable hydrogeologic feature throughout most of the Delta-Mendota Subbasin, impeding vertical flow between the Upper and Lower Aquifers. The Corcoran Clay is present at varying depths across most of the Central Valley floor (**Figure CC-31**~~**Figure CC-31**~~ and **Figure CC-33**~~**Figure CC-33**~~). The depths to the top of the Corcoran Clay ranges between approximately 100 and 500 feet below the ground surface throughout most of the Subbasin, with a general spatial pattern of deepening to the south and east. In the far southeastern area of the Subbasin, in the vicinity of Mendota and Tranquillity, the top of the Corcoran Clay is at depths of greater than 350 feet (**Figure CC-31**~~**Figure CC-31**~~). The thickness of the Corcoran Clay, which likely influences the degree of hydraulic separation between the Upper and Lower Aquifers, is greater than 50 feet across most of the Delta-Mendota Subbasin with thicknesses of more than 75 feet in central Subbasin areas in the vicinity of Los Banos and Dos Palos, and 140 feet in the eastern portions of the Subbasin. The Corcoran Clay appears thinner in areas north of Patterson, between Patterson and Gustine, and also in the vicinity of Tranquillity to the south (**Figure CC-33**~~**Figure CC-33**~~). Along the westernmost portions of the Delta-Mendota Subbasin, the Corcoran Clay layer is generally non-existent or it exists as Corcoran-equivalent clays (clays existing at the same approximate depth but not part of the mapped aquitard).

Aquifer Properties

The following subsections include discussion of generalized aquifer properties within the Delta-Mendota Subbasin. These include hydraulic conductivity, transmissivity, specific yield and specific storage.

DWR defines hydraulic conductivity as the "measure of a rock or sediment's ability to transmit water" and transmissivity as the "aquifer's ability to transmit groundwater through its entire saturated thickness" (DWR, 2003). High hydraulic conductivity values correlate with areas of transmissive groundwater conditions with transmissivity generally equaling hydraulic conductivity times the saturated thickness of the formation. Storage of water within the aquifer system can be quantified in terms of the specific yield for unconfined groundwater flow and the storage coefficient for confined flow, respectively (Faunt et al., 2009). Specific yield represents gravity-driven dewatering of shallow, unconfined sediments at a declining water table, but also accommodates a rising water table. The specific yield is dimensionless and represents the volume of water released from or taken into storage per unit head change per unit area of the water table. Specific yield is a function of porosity and specific retention of the sediments in the zone of water-table fluctuation.

Where the aquifer system is confined, storage change is governed by the storage coefficient, which is the product of the thickness of the confined-flow system and its specific storage. The specific storage is the sum of two component specific storages – the fluid (water) specific storage and the matrix (skeletal) specific storage, which are governed by the compressibility of the water and skeleton, respectively (Jacob, 1940). Specific storage has units of 1 over length and represents the volume of water released from or taken into storage in a confined flow system per unit change in head per unit volume of the confined flow system (Faunt et al., 2009). Therefore, the storage coefficient of a confined flow system is dimensionless and, similar to specific yield, represents the volume of water released from or taken into storage per unit head change.

Hydraulic Conductivity

Figure CC-34~~Figure CC-34~~ shows the saturated C-horizon hydraulic conductivity of surficial soils within the Delta-Mendota Subbasin based on the National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). Soil survey data for counties within the Subbasin were combined using the weighted harmonic mean of these representative layers to depict the saturated hydraulic conductivity of the C-horizon for each soil map unit. The soil profile represented by these data is variable but commonly extends to a depth of six or more feet.

Floodplain deposits are evident as soils with relatively low hydraulic conductivity (less than 0.5 feet per day [ft/day]) blanket much of the Central Valley Floor, although localized areas of soils with higher hydraulic conductivity are present in association with modern and ancient surface waterways and alluvial fan features (Figure CC-34~~Figure CC-34~~). Coarse soils of distributary alluvial fan sediments deposited by Del Puerto Creek, Orestimba Creek, Los Banos Creek, Ortigalita Creek, and Little Panoche Creek, in addition to other ephemeral northeasterly creek flows off the Coast Ranges, are notably apparent as areas of soils of high hydraulic conductivity located along active and inactive stream channels extending eastward from the fan apex areas along the Valley Floor margins to the current alignment of the San Joaquin River in the valley axis. Additionally, soils in areas adjacent to the active channel of the San Joaquin River also exhibit high hydraulic conductivities, including values of greater than 4 ft/day which are particularly apparent in an area north of Mendota. Soils of similarly high hydraulic conductivity trending as linear features in a general northwest-southeast alignment to the north of Dos Palos and Los Banos are likely the result of historical depositional processes and paleochannels associated with the San Joaquin River (Figure CC-34~~Figure CC-34~~). In areas peripheral to the Central Valley floor, soils tend to

be characterized by relatively low hydraulic conductivity, although soils of somewhat higher hydraulic conductivity associated with distinct geologic units are mapped across much of the peripheral area to the west of Patterson and Gustine and also in localized bands associated with surface water courses.

Transmissivity

Transmissivity varies greatly above the Corcoran Clay, within the Corcoran Clay, and below the Corcoran Clay within the Delta-Mendota Subbasin, with transmissivities in the confined Lower Aquifer generally being larger than those in the semi-confined Upper Aquifer. Based on testing conducted at multiple locations within both the Upper and Lower Aquifers of the Delta-Mendota Subbasin, average transmissivities in the Subbasin are approximately 109,000 gallons per day per square foot (gpd/ft^2) (KDSA, 1997b).

Specific Yield

DWR defines specific yield as the "amount of water that would drain freely from rocks or sediments due to gravity and describes the proportion of groundwater that could actually be available for extraction" (DWR, 2003). Specific yield is a measurement specific to unconfined aquifers.

The estimated specific yield of the Delta-Mendota Subbasin is 0.118 (DWR, 2006). Within the southern portion of the Delta-Mendota Subbasin, specific yield ranges from 0.2 to 0.3 (Belitz et al., 1993). Specific yield estimates for the Delta-Mendota Subbasin are fairly limited in literature since the Upper Aquifer above the Corcoran Clay is semi-confined and the Lower Aquifer below the Corcoran Clay is confined. Therefore, specific yield values only characterize the shallow, unconfined groundwater within the Subbasin.

Specific Storage

Values for specific storage were extracted from the Central Valley Hydrologic Model 2 (CVHM2), which is currently under development by the United States Geological Survey (USGS) and includes refinements for the Delta-Mendota Subbasin. Specific storage varies above, within, and below the Corcoran Clay with CVMH2. Above the Corcoran Clay, specific storage ranges from 1.34×10^{-6} to 6.46×10^{-2} $meters^{-1}$ (m^{-1}) with average values ranging from 6.16×10^{-3} to 1.97×10^{-2} m^{-1}. Specific storage within the Corcoran Clay is considerably smaller than above the Corcoran Clay, ranging between 1.41×10^{-6} and 2.35×10^{-6} m^{-1} and average values between 1.96×10^{-6} and 2.02×10^{-6} m^{-1}. Below the Corcoran Clay, specific storage is comparable to within the Corcoran Clay with overall ranges the same as within the Corcoran Clay and average values ranging from 1.86×10^{-6} to 2.01×10^{-6} m^{-1}. Therefore, specific storage is greatest within the semi-confined aquifer overlying the Corcoran Clay layer, with considerably smaller specific storage values within the low permeability Corcoran Clay and confined aquifer underlying the Corcoran Clay layer.

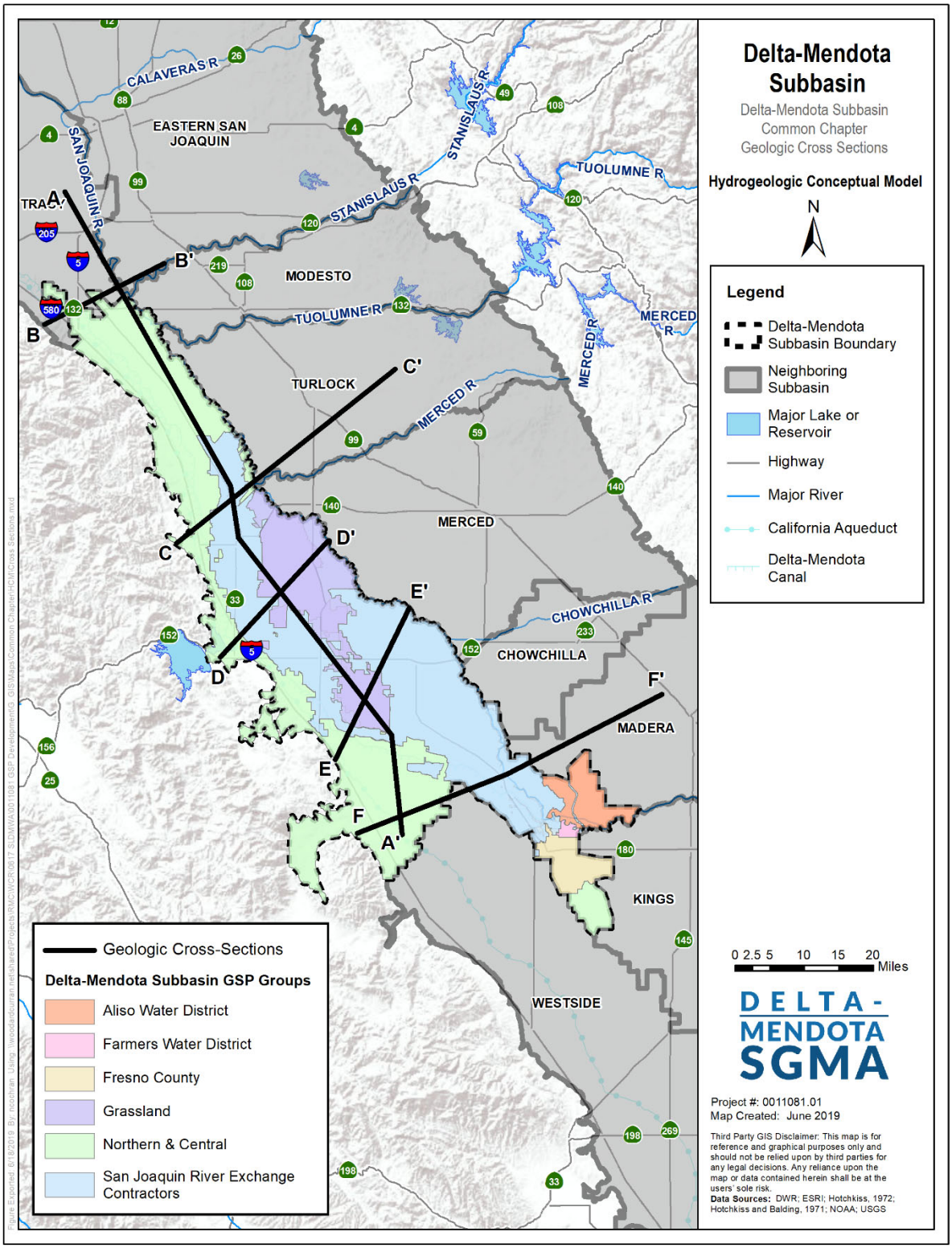


Figure CC-24: Representative Cross-Sections

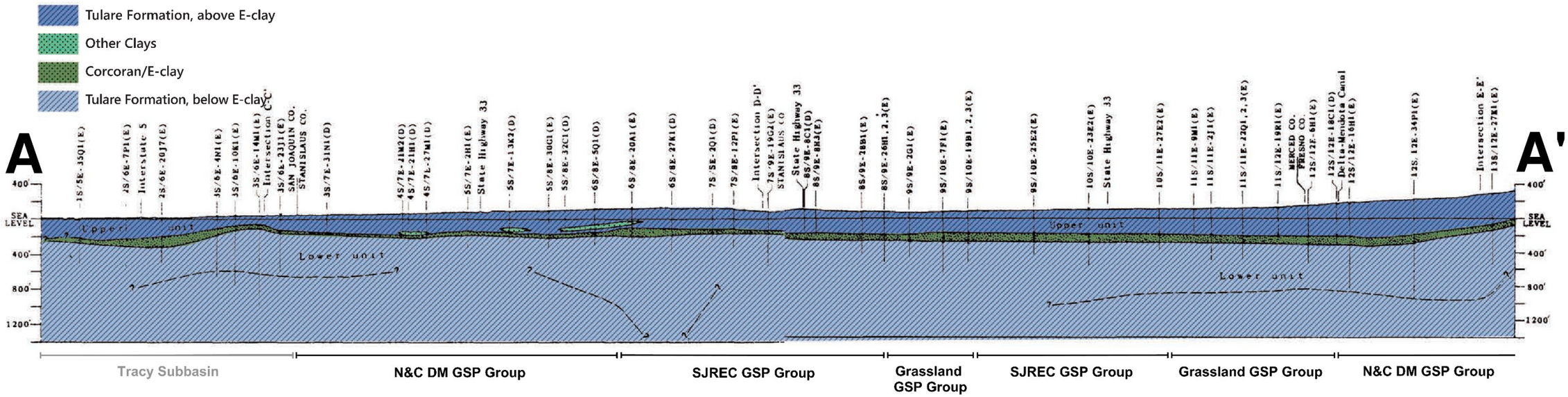


Figure CC-25: Cross-Section A-A' (Hotchkiss, 1972)

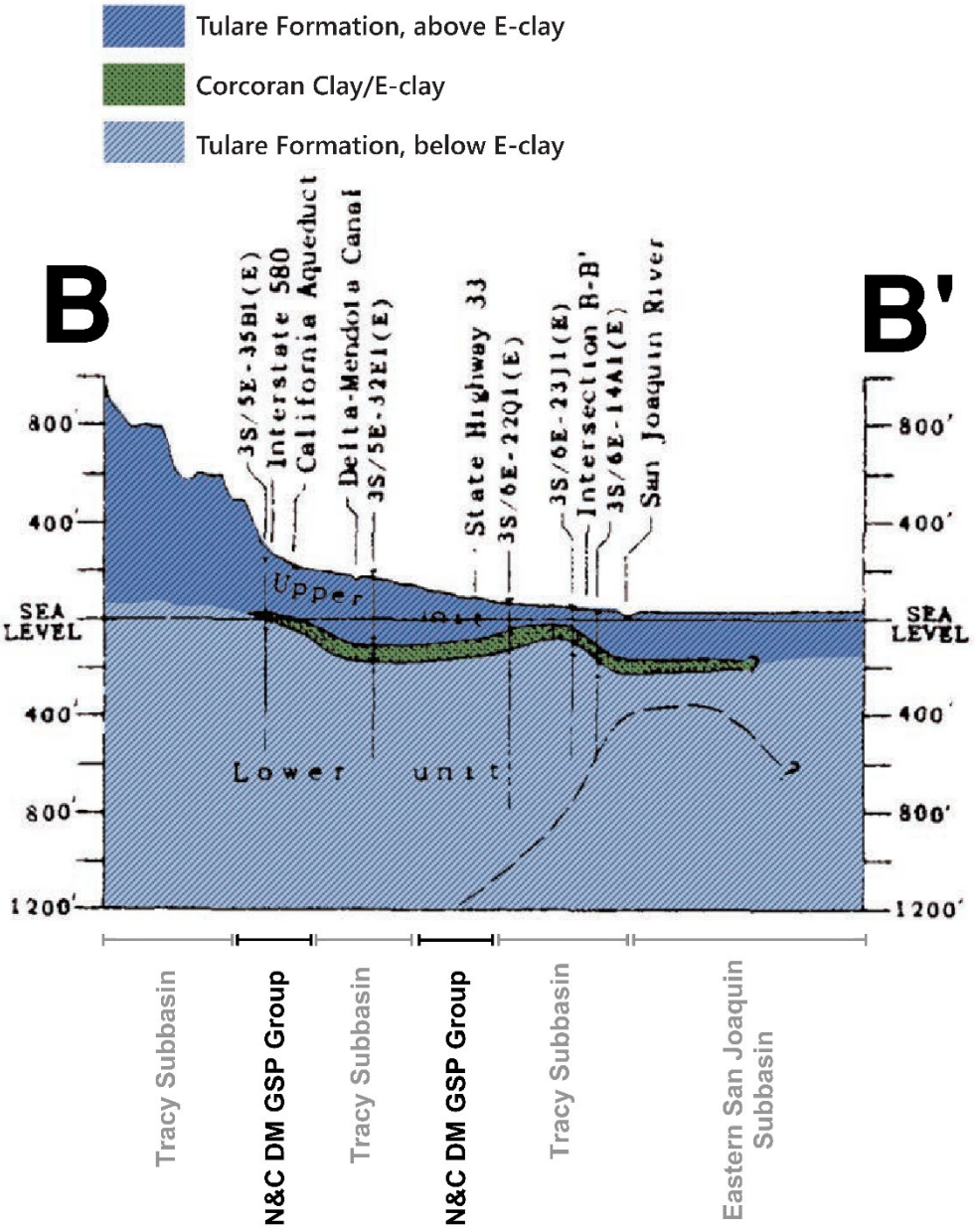


Figure CC-26: Cross-Section B-B' (Hotchkiss, 1972)

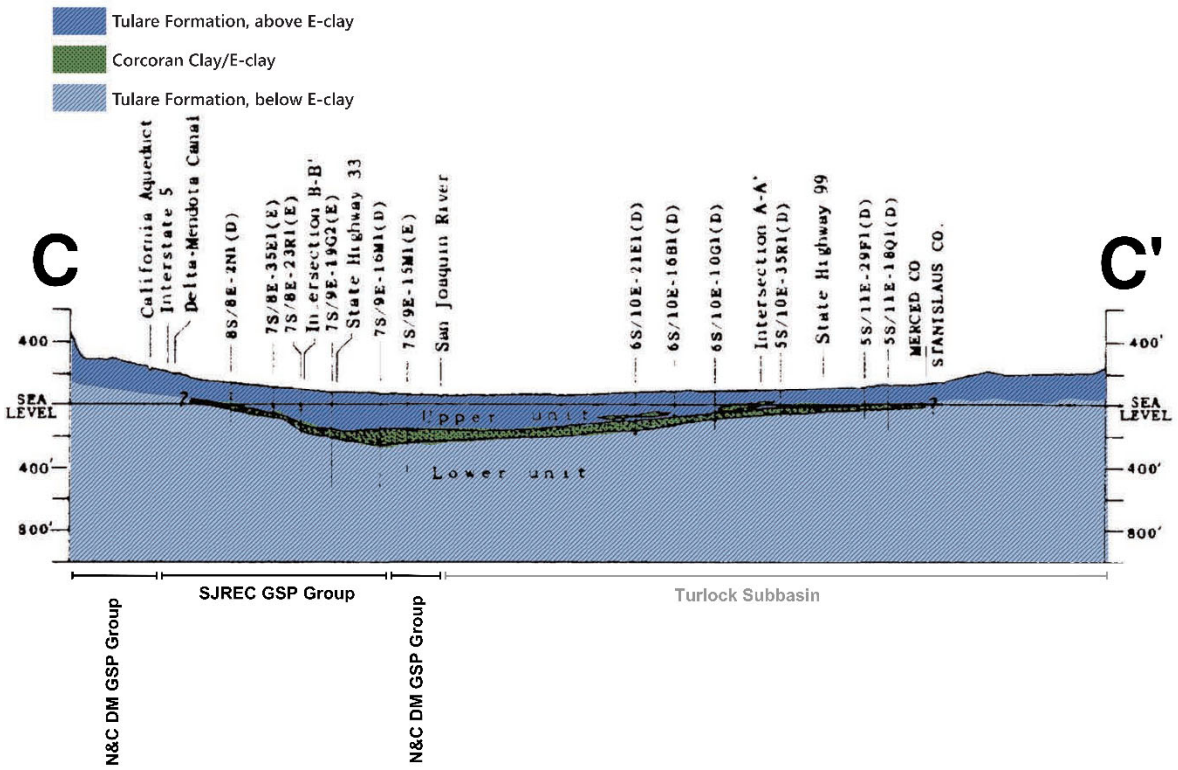


Figure CC-27: Cross-Section C-C' (Hotchkiss, 1972)

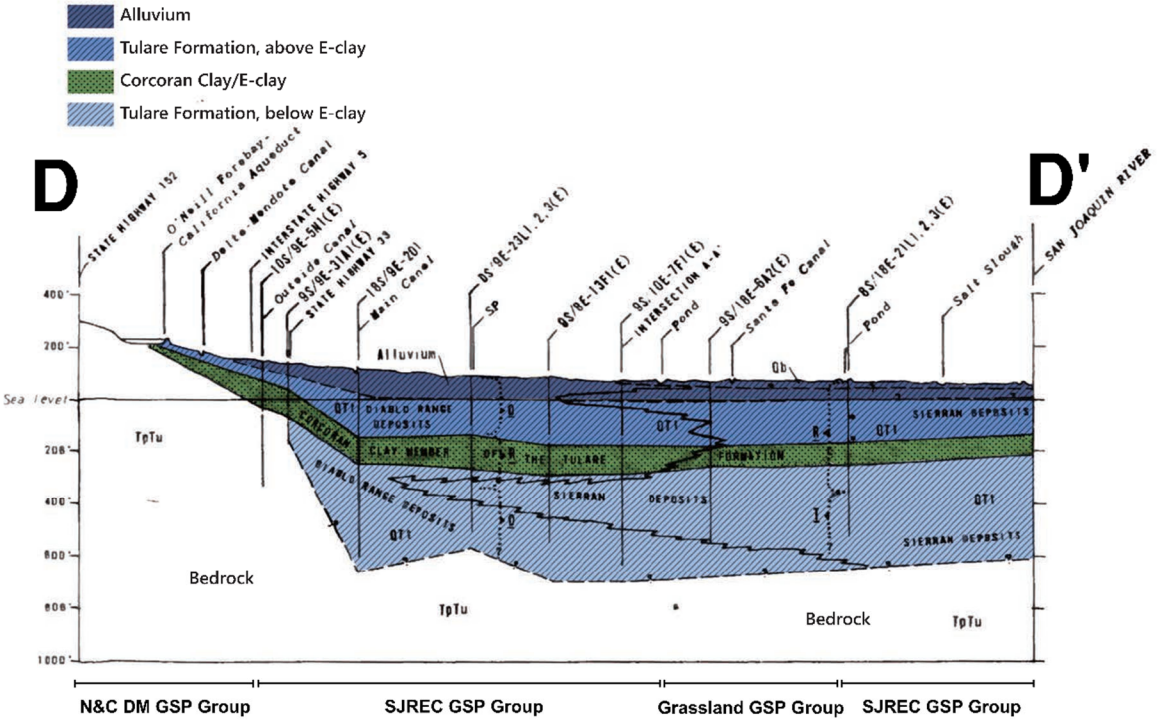


Figure CC-28: Cross-Section D-D' (Hotchkiss & Balding, 1971)

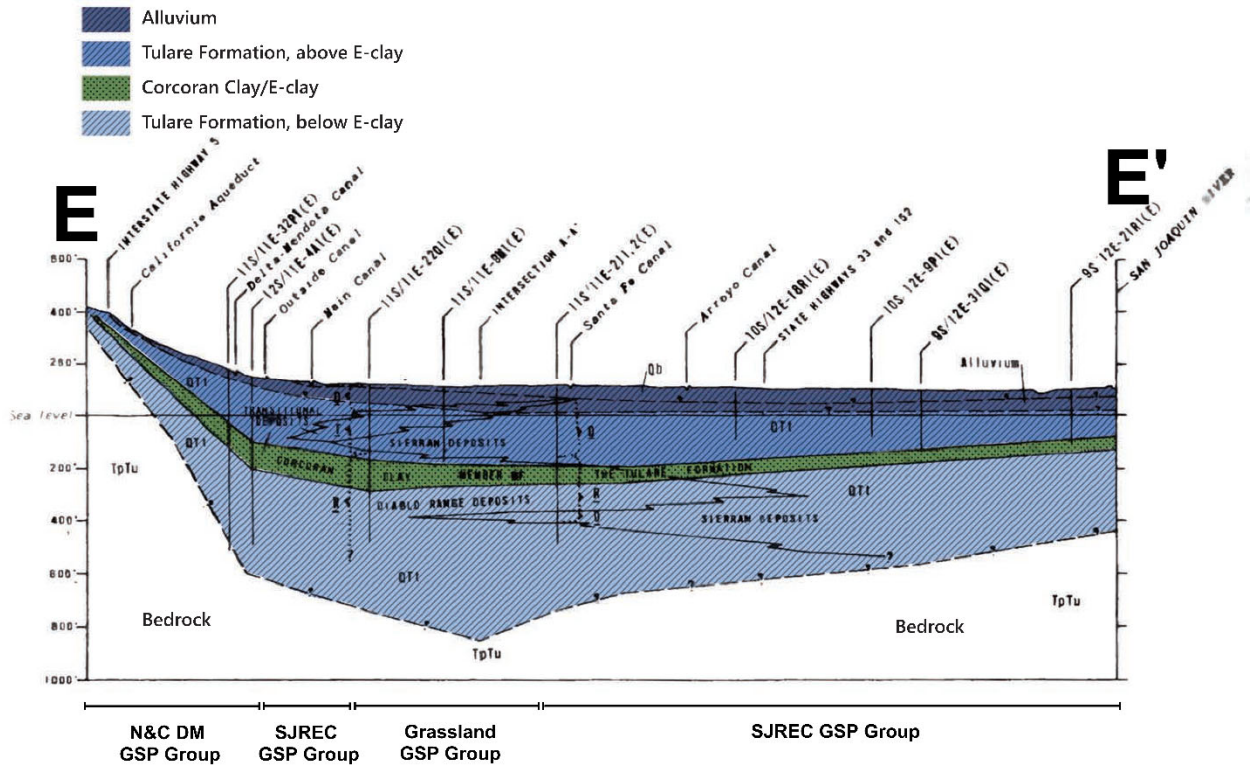


Figure CC-29: Cross-Section E-E' (Hotchkiss & Balding, 1971)

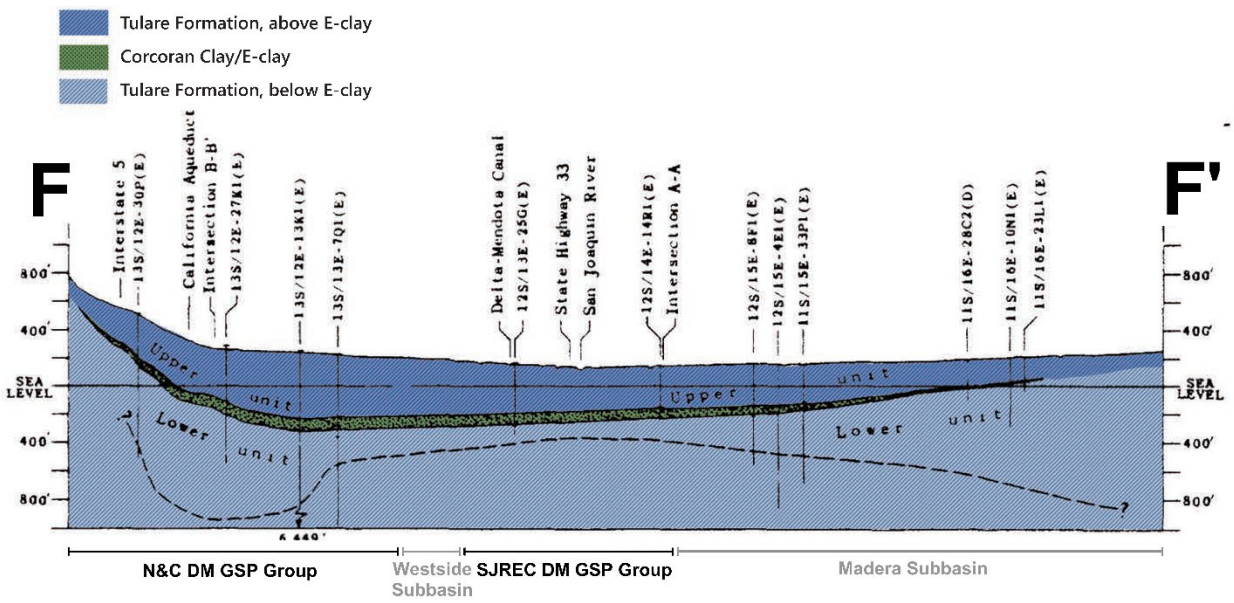


Figure CC-30: Cross-Section F-F' (Hotchkiss, 1972)

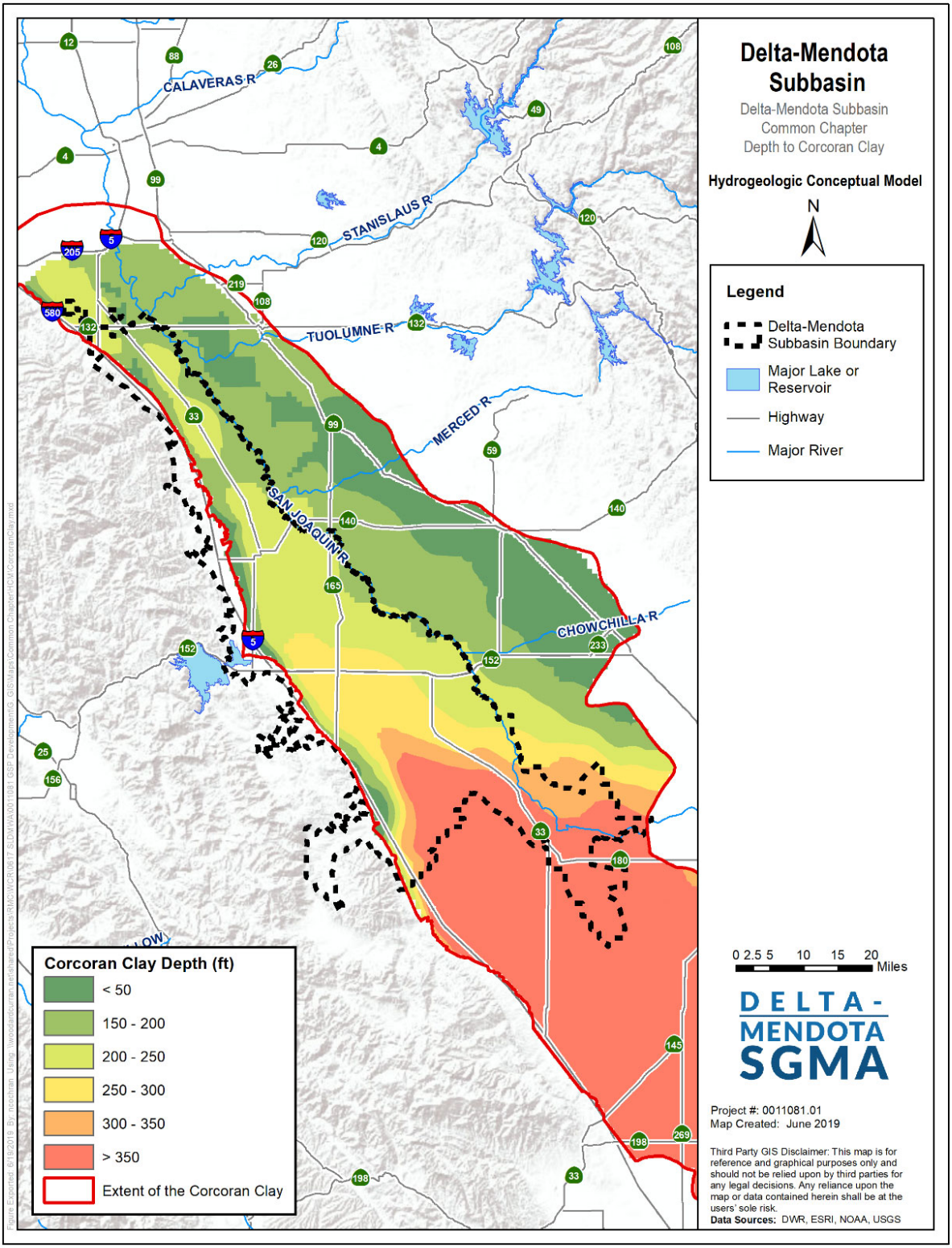


Figure CC-31: Depth to Corcoran Clay

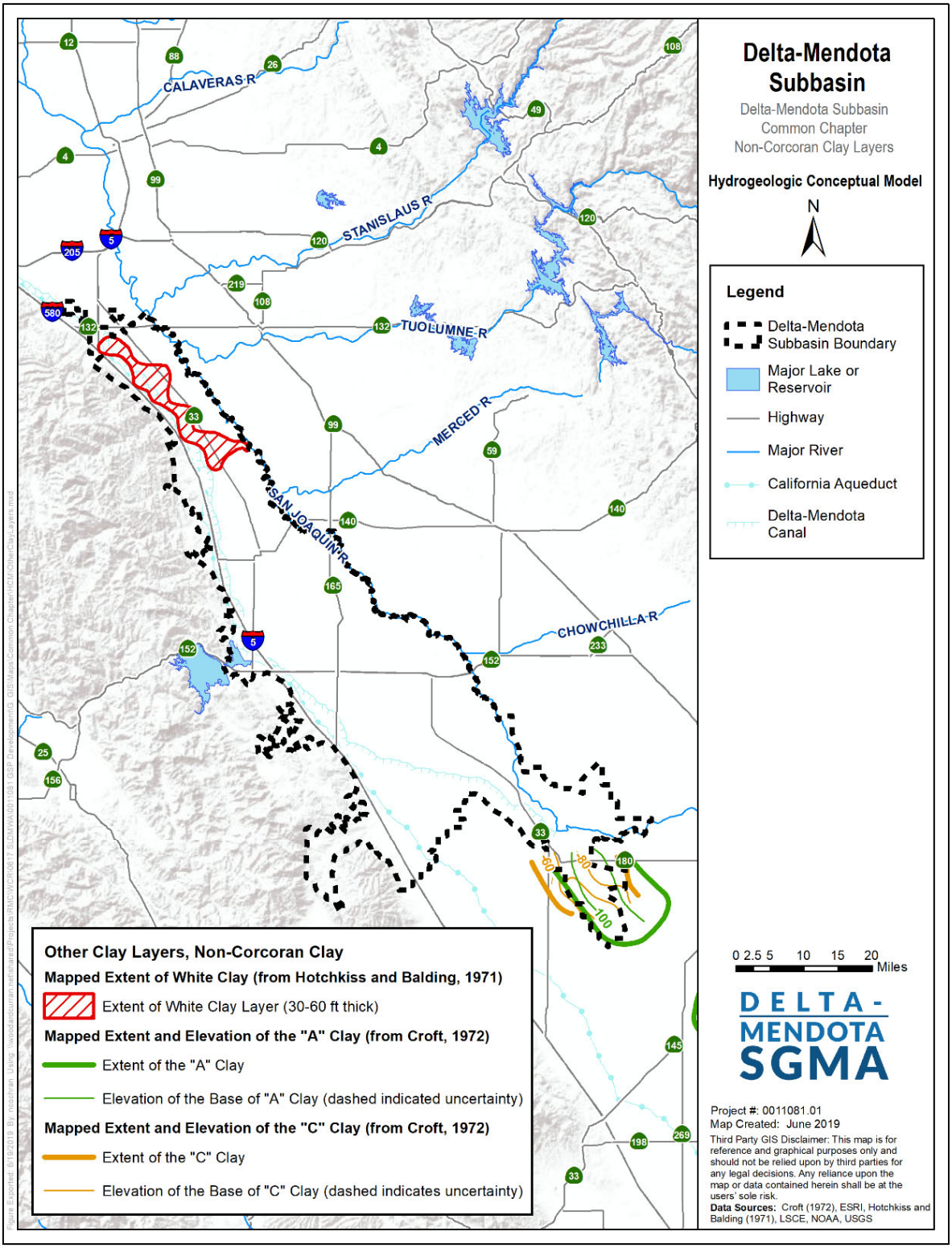


Figure CC-32: Non-Corcoran Clay Layers

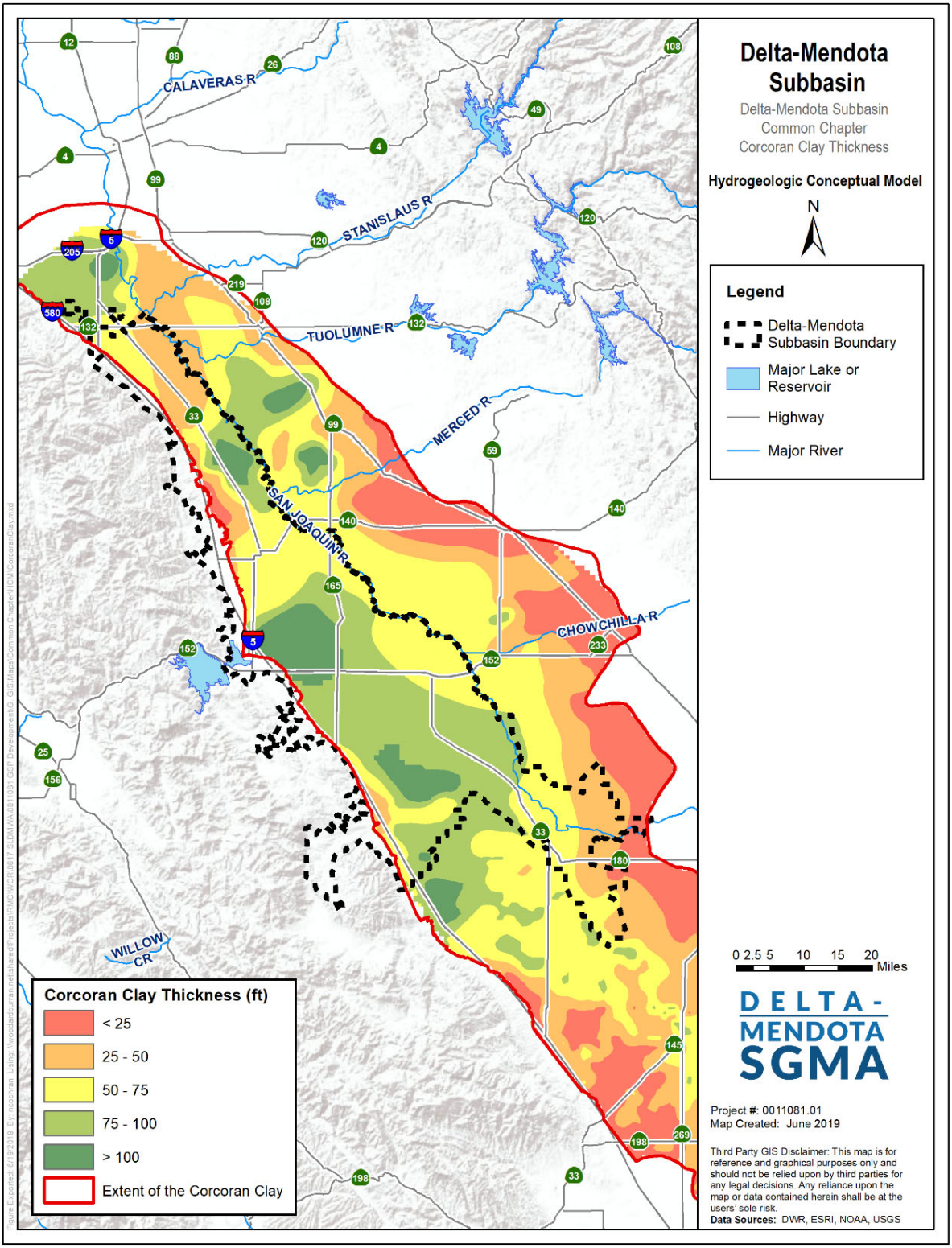


Figure CC-33: Thickness of Corcoran Clay

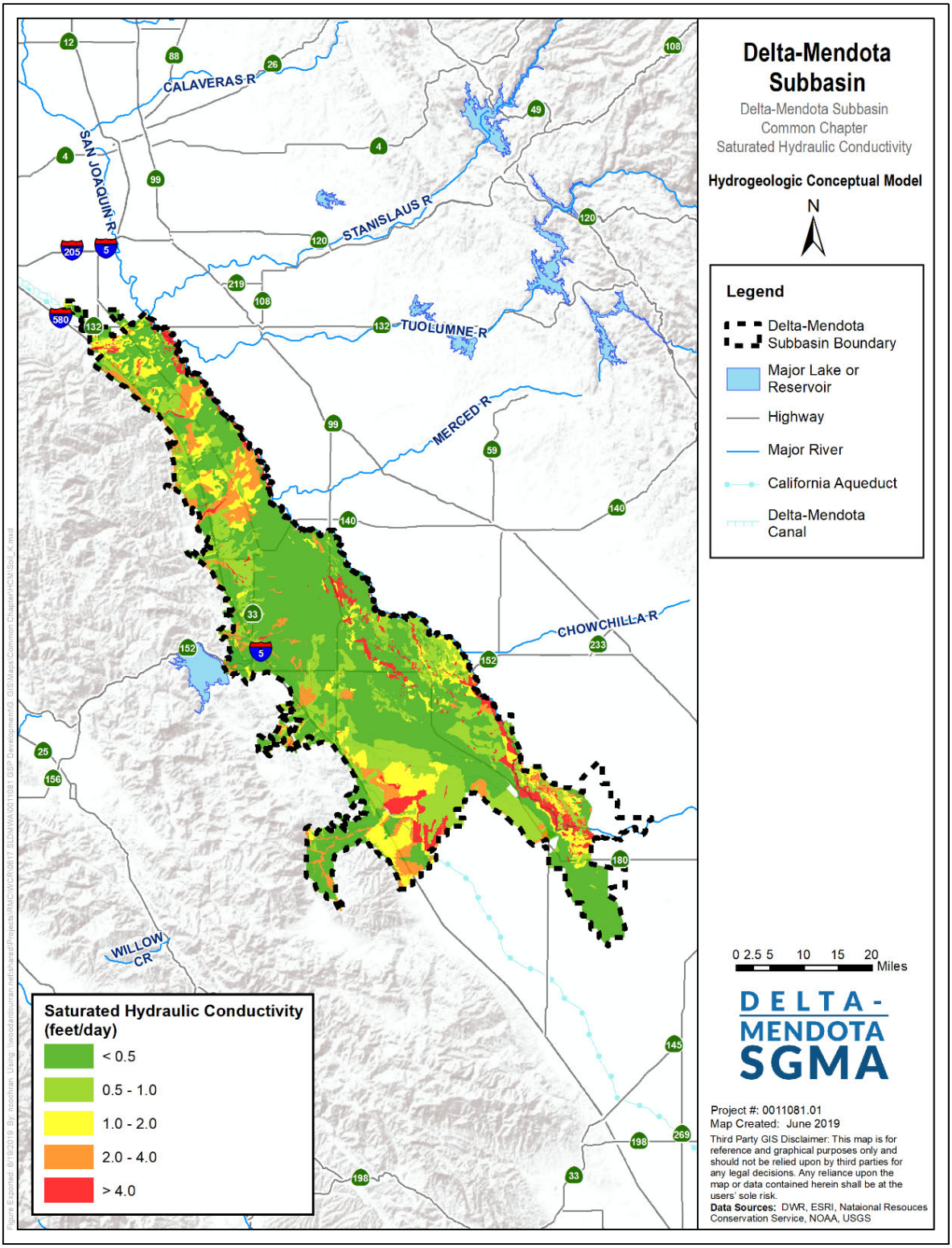


Figure CC-34: Soil Hydraulic Conductivity

4.1.8 Structural Properties and Restricted Groundwater Flow

Under natural (pre-development) conditions, the prevailing groundwater flow within the Upper and Lower Aquifer systems of the western San Joaquin Valley was predominantly in a generally northeasterly direction from the Coast Range towards and parallel to the San Joaquin River and the Sacramento-San Joaquin Delta (LSCE, 2015; Hotchkiss and Balding, 1971; KDSA, 2015). Historically, numerous flowing artesian wells within the Lower Aquifer existed throughout the Delta-Mendota Subbasin (Mendenhall et al., 1916) and the pressure gradient for groundwater flow was upward from the Lower Aquifer to the Upper Aquifer. These flowing artesian conditions have disappeared in many areas as a result of increased development of groundwater resources within the Tulare Formation (Hotchkiss and Balding, 1971). Additionally, the Delta-Mendota Subbasin has experienced periods of considerable decline in groundwater levels during which hydraulic heads in the Lower Aquifer decreased considerably in some areas due to heavy pumping (Bertoldi et al., 1991).

Despite the presence of local pumping depressions within parts of the Subbasin, the prevailing northeastward flow direction for groundwater in the Upper Aquifer within the region has remained (AECOM, 2011; DWR, 2010; Hotchkiss and Balding, 1971). Groundwater generally flows outward from the Delta-Mendota Subbasin, except along the southern and western margins where there is some recharge from local streams and canal seepage (KDSA, 2015), in addition to northward subbasin boundary flows. Within the Upper Aquifer, there are similar groundwater flow directions in most of the Subbasin with groundwater outflow to the northeast or towards the San Joaquin River in much of the Subbasin during wet and normal periods. One exception is in the Orestimba Creek area west of Newman where groundwater flows to the west during drought conditions and east during wet periods. Calculations based on aquifer transmissivity indicate the net groundwater outflow in the Upper Aquifer has been about three times greater during drought periods than during normal periods (KDSA, 1997a and 1997b).

Within the Lower Aquifer, there is a groundwater divide generally in the area between Mendota and the point near the San Joaquin River in the Turner Island area, northeast of Los Banos. Groundwater southwest of this divide generally flows southwest toward Panoche Water District and Westlands Water District. Groundwater northeast of this divide flows to the northeast into Madera and Merced Counties. Net groundwater outflow in the Lower Aquifer under drought conditions has been about two and a half times greater than for normal conditions (KDSA, 1997a and 1997b). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the Delta-Mendota Subbasin (DWR, 2006).

The combined effect of pumping below the Corcoran Clay and increased leakage from the Upper Aquifer to the Lower Aquifer where the Corcoran Clay does not exist or has been perforated has developed a generally downward flow gradient in the Tulare Formation which changes with variable pumping and irrigation over time (Bertoldi et al., 1991). Periods of great groundwater level declines have also resulted in inelastic compaction of fine-grained materials in some locations, particularly between Los Banos and Mendota, potentially resulting in considerable decreases (between 1.5 and 6 times) in permeability of clay members within the Tulare Formation, including the Corcoran Clay (Bertoldi et al., 1991). However, the number of wells penetrating the Corcoran Clay may be enabling vertical hydraulic communication across the Corcoran Clay aquitard and other clay layers (Davis et al., 1959; Davis et al., 1964).

4.1.9 Water Quality

Groundwater in the Delta-Mendota Subbasin is characterized by mixed sulfate to bicarbonate water types in the northern and central portion of the Subbasin, with areas of sodium chloride and sodium sulfate waters in the central and southern portions (DWR, 2003). Total Dissolved Solids (TDS) values range

from 400 to 1,600 mg/L in the northern portion, and 730 to 6,000 mg/L in the southern portion of the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971). The Department of Health Services (currently the Division of Drinking Water), which monitors Title 22 water quality standards, reports TDS values in 44 public supply wells in the Subbasin ranging in value from 210 to 1,750 mg/L, with an average value of 770 mg/L. Shallow, saline groundwater also occurs within about 10 feet of the ground surface over a large portion of the Delta-Mendota Subbasin. There are also localized areas of high iron, fluoride, nitrate, selenium, and boron in the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971).

Alluvial sediments derived from west-side streams are composed of material from serpentine, shale, and sandstone parent rock, which results in soil and groundwater types entirely different from those on the east side of the San Joaquin Valley (LSCE, 2015). In contrast with the siliceous mineralogy of the alluvial sands and gravels on the eastern side of the Central Valley that are derived from the Sierra granitic rocks (which are coarser and more resistant to chemical dissolution), the sulfate and carbonate shales and sandstones of Coast Range sediments on the western side are more susceptible to dissolution processes. Some soils and sediments within the western San Joaquin Valley that are derived from marine rocks of the Coast Range have notably high concentrations of naturally-occurring nitrogen, with particularly higher nitrate concentrations in younger alluvial sediments (Strathouse and Sposito, 1980; Sullivan et al., 1979). These naturally-occurring nitrogen sources may contribute to nitrate concentrations in groundwater within the Delta-Mendota Subbasin, although it is not well known where this may occur and to what degree. Naturally-high concentrations of TDS in groundwater are known to have existed historically within parts of the Subbasin due to the geochemistry of the Coast Range rocks and the marine depositional environment, the resulting naturally-high TDS of recharge derived from Coast Range streams, the dissolvable materials within the alluvial fan complexes, and the naturally-poor draining conditions which tend to concentrate salts in the system. The chemical quality of waters in the Coast Range streams can be closely correlated with the geologic units within their respective catchments. Groundwater flows discharging from these marine and non-marine rocks into streams introduce a variety of dissolved constituents resulting in variable groundwater types. The water quality and chemical makeup in westside streams can be highly saline, especially in more northern streams, including Corral Hollow, Panoche and Del Puerto Creeks, where historical baseflow TDS concentrations have typically exceeded 1,000 mg/L with measured concentrations as high as 1,790 mg/L (Hotchkiss and Balding, 1971). This is in contrast with TDS concentrations typically below 175 mg/L in streams draining from the Sierras. The contribution of water associated with these Coast Range sediments has resulted in naturally-high salinity in groundwater within and around the Delta-Mendota Subbasin, which has been recognized as early as the 1900s (Mendenhall et al., 1916). Groundwater in some areas within the immediate vicinity of the San Joaquin River is influenced by lower-salinity surface water discharging from the east side of the San Joaquin Valley Groundwater Basin (Davis et al., 1957).

Areas of historical high saline groundwater documented by Mendenhall *et al*. (1916) indicate somewhat high TDS concentrations approaching or greater than 1,000 mg/L in wells sampled throughout many parts of the Delta-Mendota Subbasin. Areas of locally higher TDS concentrations (1,500-2,400 mg/L) have existed between Mendota and Los Banos; whereas the trend in deeper groundwater (average well depth of 450 feet) south of Mendota near Tranquillity indicates slightly lower historical salinity conditions, but still somewhat high with an average TDS concentration of greater than 1,000 mg/L. In the northern part of the Subbasin, north of Gustine, the average historical TDS concentration of wells was also relatively high (930 mg/L). Historically low TDS concentrations (<500 mg/L) existed in groundwater from wells with an average depth of 209 feet in the central Subbasin area between Los Banos and Gustine.

The general chemical composition of groundwater in the Subbasin is variable based on location and depth. Groundwater within the Upper Aquifer is largely characterized as transitional type with less area characterized as predominantly of chloride, bicarbonate, and sulfate water types. Transitional water types,

in which no single anion represents more than 50 percent of the reactive anions, occurs in many different combinations with greatly ranging TDS concentrations. Chloride-type waters occur generally in grassland areas east of Gustine and around Dos Palos, with sodium chloride water present in northern areas near Tracy and also extending south from Dos Palos. These waters also exhibit greatly varying salinity with typical TDS concentrations, ranging from less than 500 mg/L to greater than 10,000 mg/L and of high sodium makeup (50-75 percent of cations present) (Hotchkiss and Balding, 1971). Areas of bicarbonate groundwater within the Upper Aquifer of relatively lower TDS concentrations are directly associated with intermittent streams of the Coast Range near Del Puerto, Orestimba, San Luis, and Los Banos Creeks. Sulfate water in the central and southern Subbasin areas has TDS concentrations decreasing from west (1,200 mg/L) to east (700 mg/L) towards the San Joaquin River, similar to the bicarbonate water areas, although areas of sulfate water south of Dos Palos have much higher TDS concentrations (1,900 to 86,500 mg/L) (Hotchkiss and Balding, 1971).

Groundwater in the Lower Aquifer below the Corcoran Clay is also spatially variable, consisting of mostly transitional sulfate waters in the northern part of the Delta-Mendota Subbasin to more sodium-rich water further south in the grassland areas. In the northern part of the Delta-Mendota Subbasin, the Lower Aquifer exhibits relatively lower TDS concentrations, ranging from 400 to 1,600 mg/L, with a sulfate-chloride type makeup near the valley margin trending to sulfate-bicarbonate type near the valley axis. Farther south, TDS concentrations in the Lower Aquifer increase (Hotchkiss and Balding, 1971).

Natural conditions of groundwater salinity exist throughout the Upper and Lower Aquifers as a result of the contribution of salts from recharge off the Coast Range mountains. Surface water and groundwater flowing over and through Coast Range sediments of marine origin have dissolved naturally-occurring salts, contributing to the historical and current presence of salinity in groundwater within the Delta-Mendota Subbasin. In addition to natural salinity contributed from the Coast Range sediments, a number of other mechanisms are believed to further contribute to increased salinity in the groundwater in the region. Poorly draining soil conditions are extensive within some of the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine, and these types of soil, combined with a shallow water table, contribute to a build-up of soil salinity.

4.1.10 Topography, Surface Water, Recharge, and Imported Supplies

This section describes the topography, surface water, soils, and groundwater recharge potential in the Delta-Mendota Subbasin.

Topography

As previously described, the Delta-Mendota Subbasin lies on the western side of the Central Valley and extends from the San Joaquin River on the east, along the axis of the Valley, to the Coast Range on the west side (LSCE, 2015). The Subbasin has ground surface elevations ranging from less than 100 feet above mean sea level (msl) along parts of the eastern edge to greater than 1,600 feet msl in the Coast Range mountains (**Figure CC-35**~~**Figure CC-35**~~). Most of the lower elevation areas occur east of Interstate 5, in the eastern parts of the Delta-Mendota Subbasin; although some lower elevation areas also extend westward into the Coast Range, such as in Los Banos Creek Valley. Low elevation areas generally coincide with the extent of the Central Valley floor. Topography within the Delta-Mendota Subbasin consists largely of flat areas across the Central Valley floor, where slopes are generally less than 2 percent, with steepening slopes to the west. The topography outside of the Central Valley floor in the Coast Range mountains is characterized by steeper slopes, generally greater than 6 percent.

Surface Water Bodies

The San Joaquin River and its tributaries is the primary natural surface water feature within the Delta-Mendota Subbasin, flowing from south to north along the eastern edge of the Subbasin (LSCE, 2015). During the 1960s, the San Joaquin River exhibited gaining flow conditions through much of the Subbasin (Hotchkiss and Balding, 1971). Numerous intermittent streams from the Coast Range enter the Delta-Mendota Subbasin from the west; however, none of these maintain perennial flow and only Orestimba Creek, Los Banos Creek and Del Puerto Creek have channels that extend eastward to a junction with the San Joaquin River. Most of the flow in other notable west-side creeks, including Quinto Creek, San Luis Creek, Little Panoche Creek, and Ortigalita Creek, is lost to infiltration (Hotchkiss and Balding, 1971). Flow from Los Banos and San Luis Creeks are impounded by dams on their respective systems. When flood releases are made from Los Banos Creek Reservoir, the vast majority of flows pass through Grassland Water District to the San Joaquin River as they tend to occur during times when agricultural and wetland demand is low. San Luis Reservoir on San Luis Creek, which is located along the western boundary of the Delta-Mendota Subbasin, is an artificial water storage facility for the Central Valley Project and California State Water Project and has no notable natural surface water inflows. Outflows from the reservoir go into the system of federal- and state-operated canals and aqueducts comprising the Central Valley and State Water Projects. Surface water use within the Delta-Mendota Subbasin is derived largely from water deliveries provided by these projects, including from the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and Delta-Mendota Canal, and also from the San Joaquin River (**Figure CC-36**~~**Figure CC-36**~~).

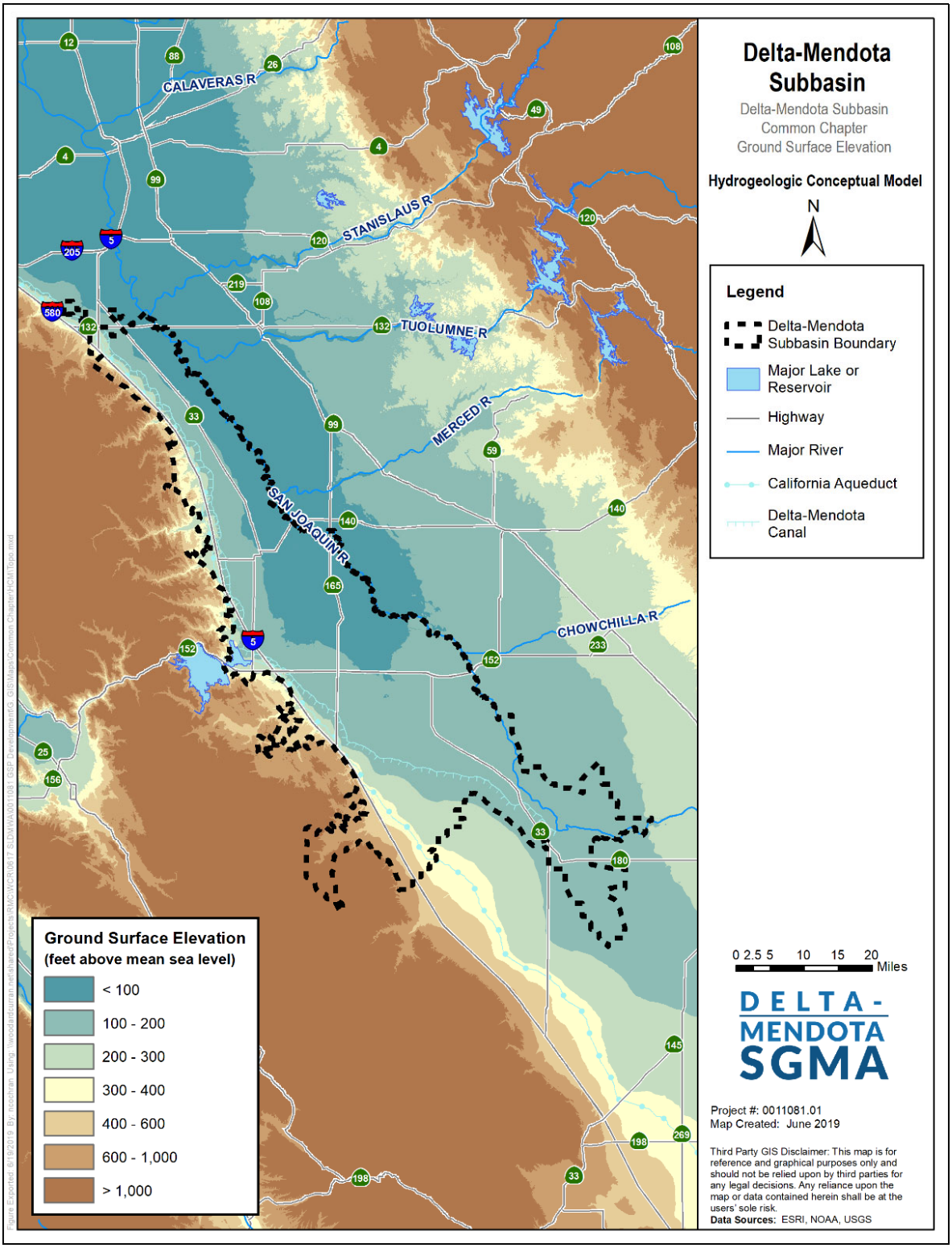


Figure CC-35: Ground Surface Elevation

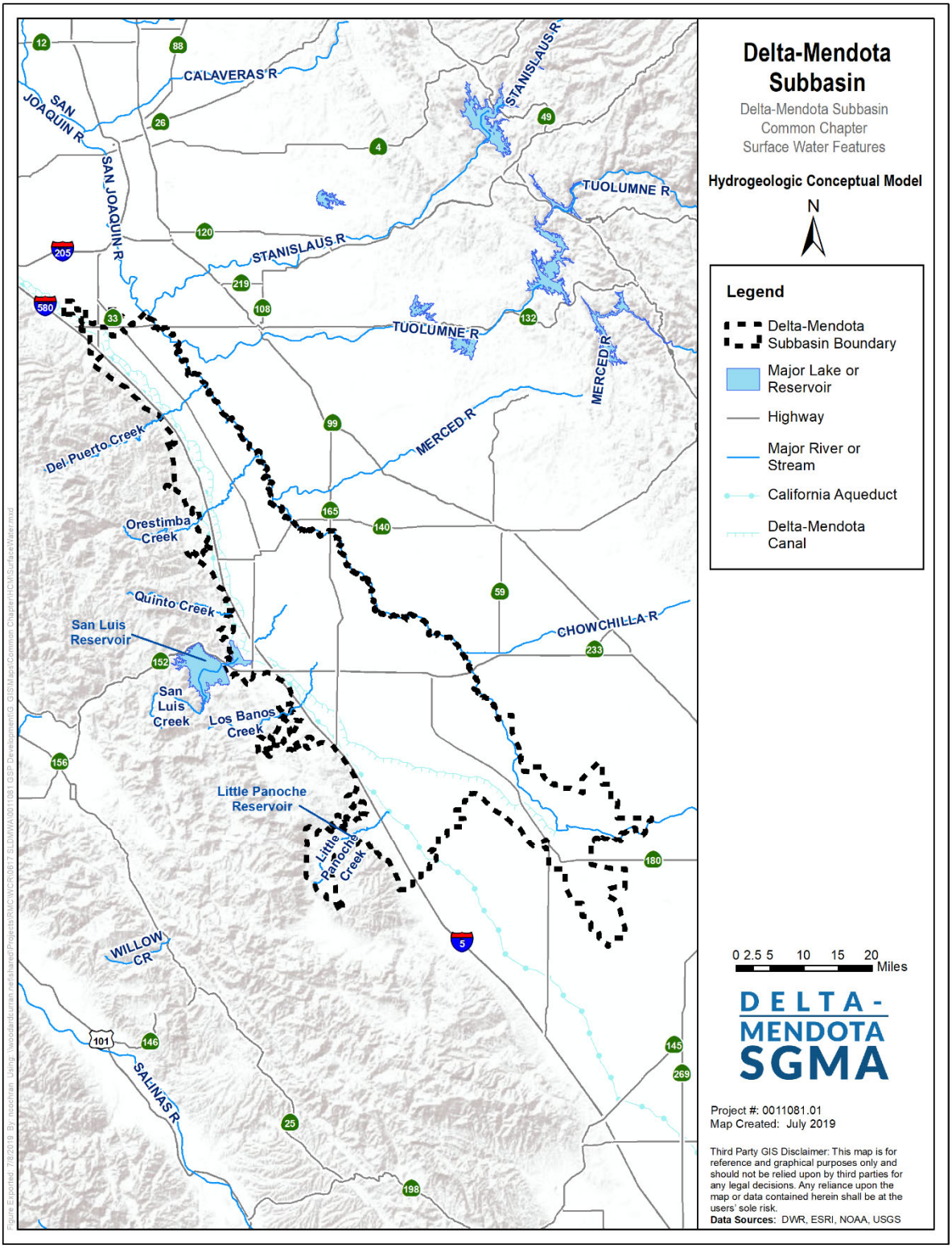


Figure CC-36: Surface Water Features

Soils

The NRCS provides soil mapping in the region. One of the combining soil groupings mapped includes hydrologic groups. The predominant soil hydrologic groups within the Delta-Mendota Subbasin are soil types C and D (Figure CC-37~~Figure CC-37~~). Group C soils have moderately high runoff potential when thoroughly wet (NRCS, 2009) with water transmission through the soil somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have a high runoff potential when thoroughly wet and water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Soil hydraulic conductivity groups are closely related to soil drainage characteristics and hydraulic conductivity. The fine-grained floodplain deposits present across much of the southeastern area of the Subbasin are evidenced as soils with lower hydraulic conductivity in Figure CC-37~~Figure CC-37~~ and accordingly, these characteristics also make these areas poorly drained. Poorly draining soil conditions are extensive within the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine (Fio, 1994; Hotchkiss and Balding, 1971). Soils in the northern and western parts of the Delta-Mendota Subbasin exhibit better drainage characteristics, although areas of poorly drained soils are also present in the north and west in proximity to surface water courses, including most notably directly adjacent to portions of the San Joaquin River and Los Banos Creek channels. Many of the upland soils, which are of generally coarser texture and located proximal to sediment sources derived from the Coast Range hill slopes, are characterized as moderately well drained.

In areas with low hydraulic conductivity, corresponding to areas without adequate natural drainage, tile drains are present to remove shallow groundwater from the rooting zone. Known tile drain locations are shown in Figure CC-38~~Figure CC-38~~**,** which are primarily located along the eastern boundary of the Delta-Mendota Subbasin as well as the southern portion of the Subbasin in the Grassland Drainage Area. The Grassland Drainage Area contains a tile drainage system connected to the San Joaquin River Improvement Project, which uses tile drainage water for irrigated agriculture with a high salinity tolerance.

Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

The primary process for groundwater recharge within the Central Valley floor area is from percolation of applied irrigation water and seepage from canals and stream beds, although some groundwater recharge does occur in the Delta-Mendota Subbasin along the western boundary of the Subbasin due to mountain front recharge. In sandier areas, recharge ponds have been constructed within certain districts (CCC, Aliso Water District, CCID and Del Puerto Water District) to promote managed aquifer recharge.

Groundwater recharge potential on agricultural land based on the Soil Agricultural Groundwater Banking Index (SAGBI) is shown in Figure CC-39~~Figure CC-39~~. The SAGBI is based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. Within the Delta-Mendota Subbasin, SAGBI data categorizes 160,248 acres out of 744,237 acres (21%) of agricultural and grazing land within the regions as having Excellent, Good, and Moderately Good (Figure CC-39~~Figure CC-39~~) recharge properties, and 571,573 acres out of 744,237 acres (or 77%) of agricultural and grazing land as having Moderately Poor, Poor, or Very Poor recharge properties. "Modified" SAGBI data shows higher potential for recharge than unmodified SAGBI data because the modified data assumes that soils have been or will be ripped to a depth of six feet, which can break up fine grained materials at the surface to improve percolation. The modified data set was determined to

more accurately represent the Delta-Mendota Subbasin due to the heavy presence of agriculture. In almost all cases, recharge from applied water on irrigated lands recharges the Upper Aquifer of the Subbasin. However, the use of percolation ponds and other managed aquifer recharge techniques must consider existing water quality in addition to soil composition and may be limited in areas where poor water quality currently exists.

The Corcoran Clay is a known barrier restricting vertical flow between the Upper and Lower Aquifers; therefore, natural recharge of the Lower Aquifer from downward percolating water is most likely restricted where the Corcoran Clay is present, including across most of the Central Valley floor. Primary recharge areas to the Lower Aquifer are most likely in western parts of the Central Valley floor where percolating water can enter formations feeding the Lower Aquifer, particularly in the vicinity and west of Los Banos, Orestimba, and Del Puerto Creeks, along the western margin of the Subbasin.

Groundwater discharge areas are identified as springs located within the Delta-Mendota Subbasin and the San Joaquin River. **Figure CC-39**~~**Figure CC-39**~~ shows the location of historic springs identified by USGS. There are only six springs/seeps identified by USGS in their National Hydrograph Dataset, which are located in the southwestern corner of the Subbasin. The springs shown represent a dataset collected by USGS and are not a comprehensive map of springs in the Subbasin.

Imported Supplies

Both the California Aqueduct and Delta-Mendota Canal run the length of the Delta-Mendota Subbasin, primarily following the Interstate 5 corridor (**Figure CC-40**~~**Figure CC-40**~~). The following water purveyors in the Delta-Mendota Subbasin are SLDMWA Member Agencies and thus receive water from the Central Valley Project via the Delta-Mendota Canal: California Department of Fish and Wildlife, Central California Irrigation District, Columbia Canal Company, Del Puerto Water District, Eagle Field Water District, Firebaugh Canal Water District, Fresno Slough Water District, Grassland Water District, Laguna Water District, Mercy Springs Water District, Oro Loma Water District, Pacheco Water District, Panoche Water District, Patterson Irrigation District, San Luis Canal Company, San Luis Water District, Tranquillity Irrigation District, Turner Island Water District, U.S. Fish and Wildlife Service, and West Stanislaus Irrigation District. Oak Flat Water District is the only recipient of State Water Project (SWP) water in the Delta-Mendota Subbasin; Oak Flat Water District initially bought into the SWP in 1968.

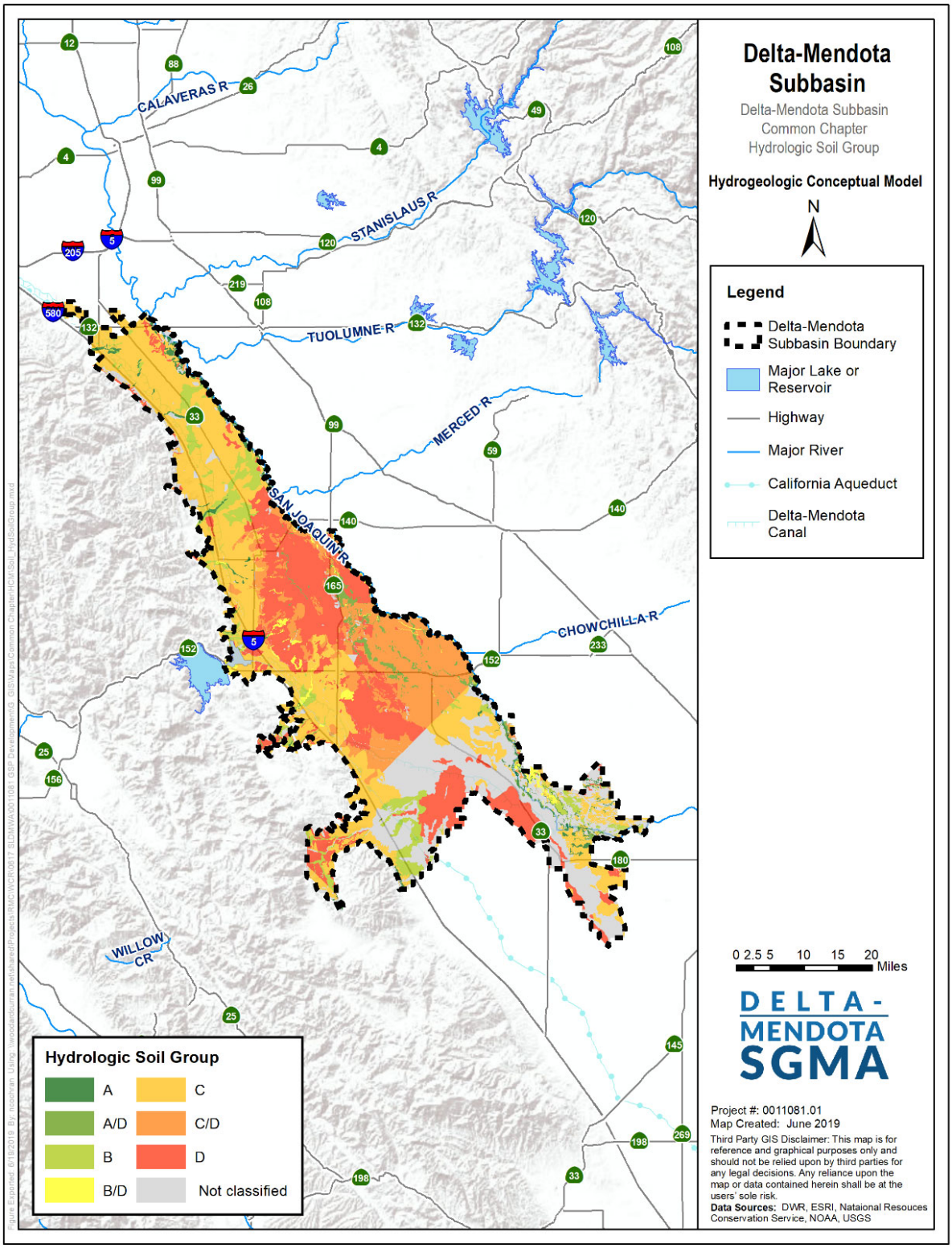


Figure CC-37: SAGBI Soils Map

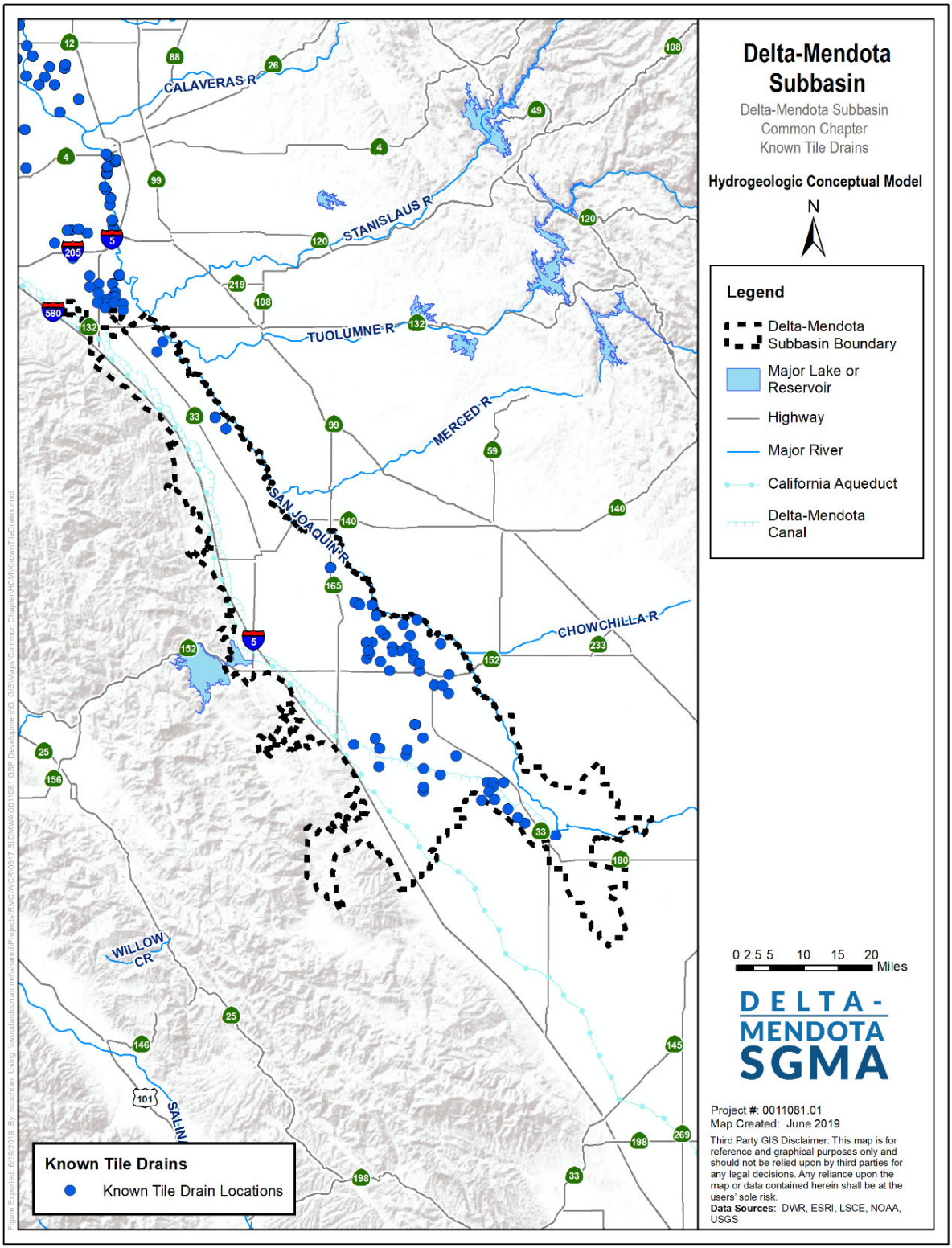


Figure CC-38: Tile Drains

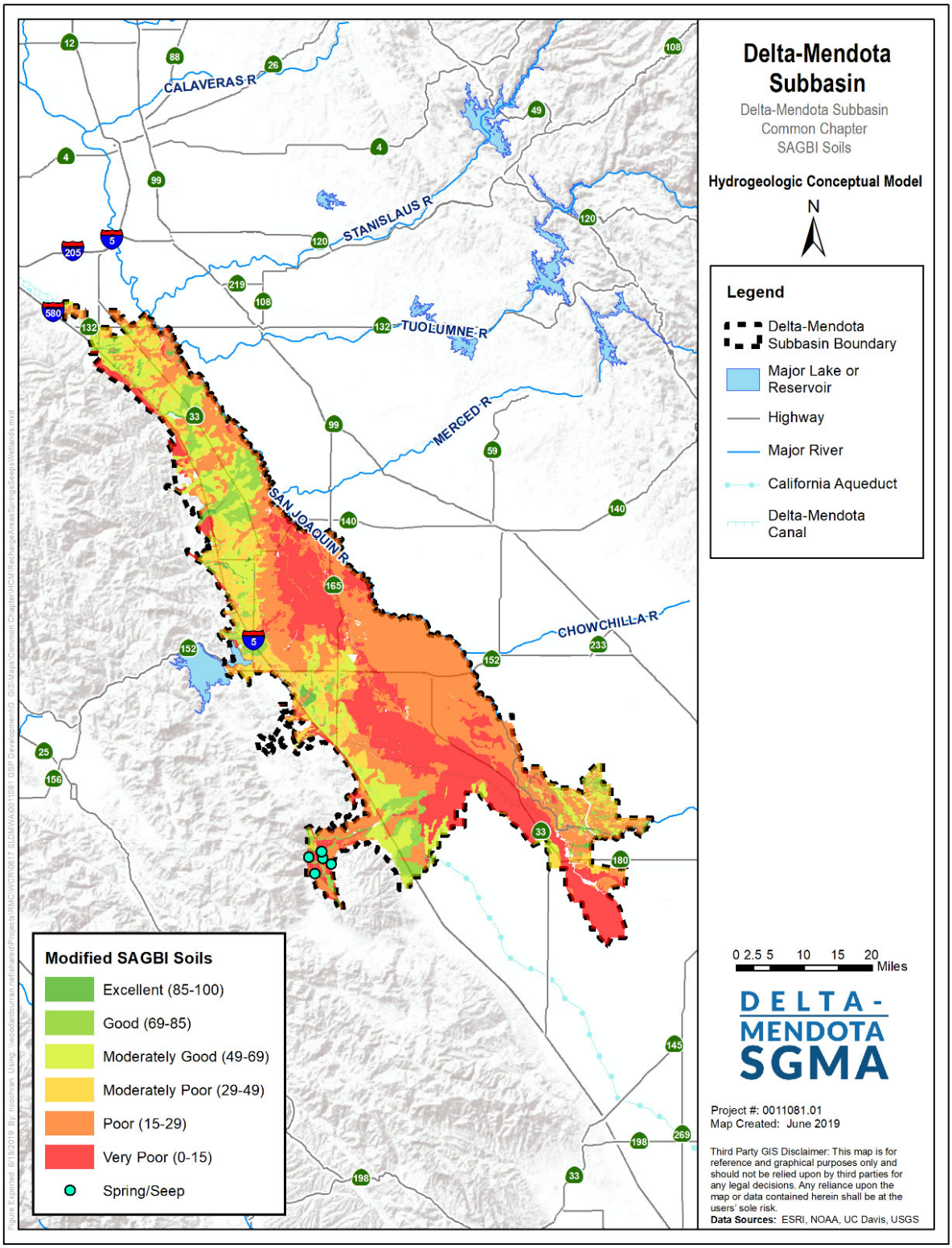


Figure CC-39: Recharge Areas, Seeps and Springs

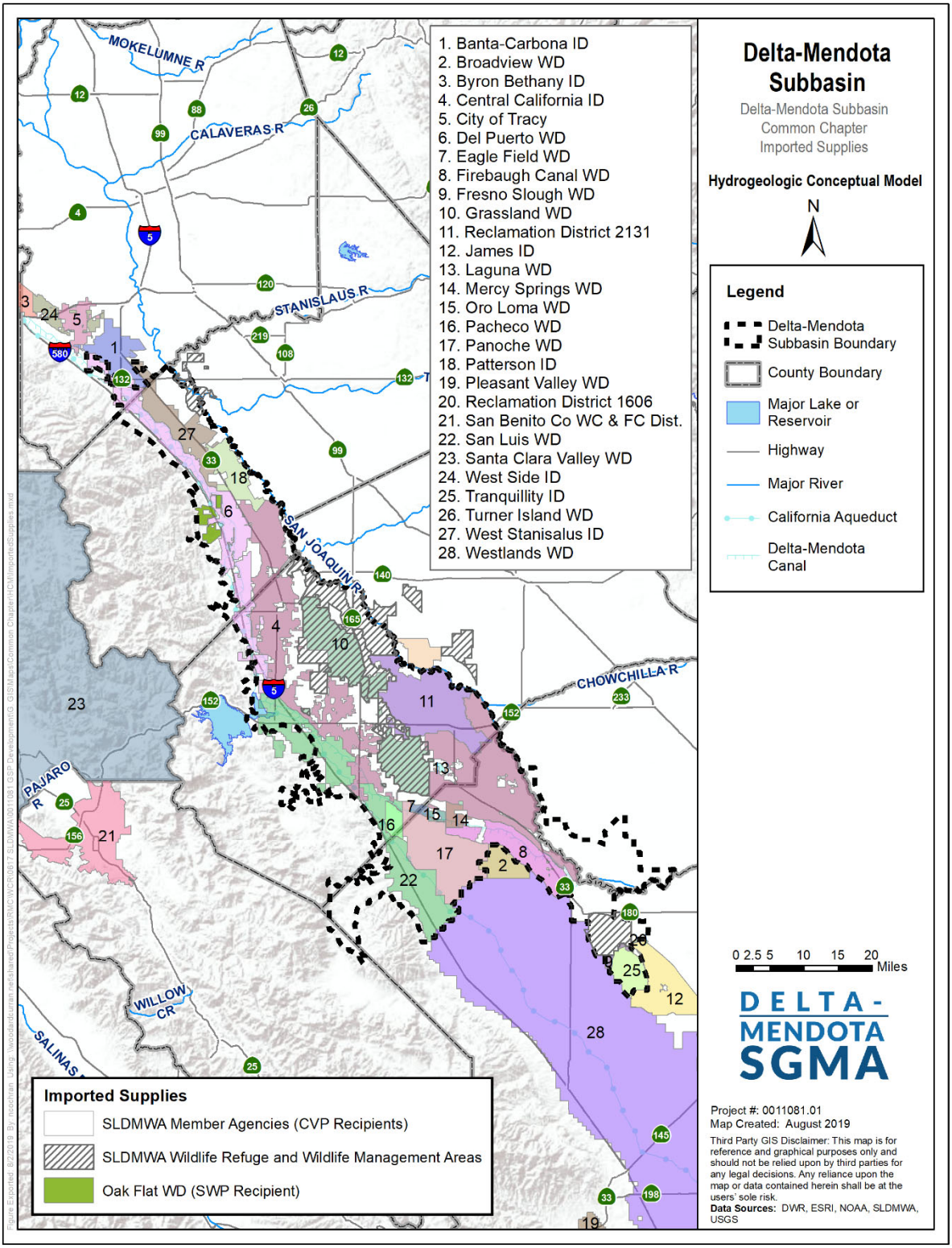


Figure CC-40: Imported Supplies

4.2 Delta-Mendota Subbasin Groundwater Conditions

This section describes the current and historic groundwater conditions in the Delta-Mendota Subbasin, including data from January 1, 2015 to recent conditions for the following parameters: groundwater elevations, groundwater storage, groundwater quality, land subsidence, interconnected surface water systems, and groundwater dependent ecosystems (GDEs) (pursuant to Article 5 Plan Contents, Subarticle 2 Basin Setting, § 354.16 Groundwater Conditions of the GSP Emergency Regulations). Seawater intrusion is not discussed herein as the Delta-Mendota Subbasin is inland and is not impacted by seawater intrusion. For the purposes of this GSP, "current conditions" is represented by Water Year (WY) 2013 conditions, which is consistent with the year representing the Current Conditions Water Budget (see Section 4.3 for more information about Water Budgets). Data post-WY 2013 through present day are presented when available.

The purpose of describing groundwater conditions, as contained in this section and described in the individual GSPs, is to establish baseline conditions that will be used to monitor changes relative to measurable objectives (MOs) and minimum thresholds (MTs). Therefore, these established baseline conditions will help support monitoring to demonstrate measurable efforts in achieving the sustainability goal for the Delta-Mendota Subbasin.

4.2.1 Useful Terminology

This groundwater conditions section includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and a description of the terms are listed below. The terms and their descriptions are identified here to guide readers through the section and are not a definitive definition of each term:

- **Depth to Groundwater** – The distance from the ground surface to first-detected non-perched groundwater, typically reported at a well.
- **Upper Aquifer** – The alluvial aquifer above the Corcoran Clay (or E-clay) layer.
- **Lower Aquifer** – The alluvial aquifer below the Corcoran Clay (or E-clay) layer.
- **Horizontal gradient** – The slope of the groundwater surface from one location to another when one location is higher or lower than the other. The gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – Describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground towards deeper aquifers and an upward gradient is one where groundwater is upwelling towards the ground surface.
- **Contour Map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which represents groundwater being at the indicated elevation along the contour line. Contour maps can be presented in two ways:
    - Elevation of groundwater above mean sea level (msl), which can be used to identify the horizontal gradients of groundwater, and
    - Depth to water (i.e. the distance from the ground surface to groundwater), which can be used to identify areas of shallow or deep groundwater.

- **Hydrograph** – A graph that shows the changes in groundwater elevation or depth to groundwater over time at a specific location. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.
- **Maximum Contaminant Level (MCL)** – MCLs are standards that are set by the State of California and the U.S. Environmental Protection Agency for drinking water quality. MCLs are legal threshold limits on the amount of an identified constituent that is allowed in public drinking water systems. At both the State and Federal levels, there are Primary MCLs, set to be protective of human health, and Secondary MCLs for constituents that do not pose a human health hazard but do pose a nuisance through either smell, odor, taste, and/or color. MCLs are different for different constituents and have not been established for all constituents potentially found in groundwater.
- **Elastic Land Subsidence** – Reversible and temporary fluctuations in the elevation of the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic Land Subsidence** – Irreversible and permanent decline in the elevation of the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system. This form of subsidence is what is required by SGMA to be monitored and reported.
- **Gaining Stream** – A stream in which groundwater flows into a streambed and contributes to a net increase in surface water flows across an identified reach.
- **Losing Stream** – A stream in which surface water is lost through the streambed to the groundwater, resulting in a net decrease in surface water flows across an identified reach.
- **Conjunctive Use** – The combined use of surface water and groundwater supplies, typically with more surface water use in wet years and more groundwater use in dry years.

4.2.2 Groundwater Elevations

This section describes groundwater elevation data utilized and elevation trends in the Delta-Mendota Subbasin. Groundwater conditions vary widely across the Subbasin. Historic groundwater conditions through present day conditions, the role of imported surface water in the Subbasin, and how conjunctive use has impacted groundwater trends temporally and spatially are discussed. Groundwater elevation contour maps associated with current seasonal high and seasonal low for each principal aquifer, as well as hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients (both horizontal and vertical), are also described.

Available Data

Groundwater elevation data, and accompanying well construction information, within the Delta-Mendota Subbasin from the following sources and associated programs were utilized in the development of the Delta-Mendota Subbasin GSPs:

- California Department of Water Resources (DWR)
    - California Statewide Groundwater Elevation Monitoring Program (CASGEM)
    - Water Data Library (WDL)
- Water level data from local monitoring programs

Data provided by these sources included well information (such as location, well construction, owner, ground surface elevation and other related components), as well as groundwater elevation data (including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments). At the time that these analyses were performed, groundwater elevation data were available for the time period from 1930 through 2018. There are many wells with monitoring data from some time in the past but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years.

Not all groundwater elevation data received were used in preparing the groundwater elevation contour maps for both principal aquifers (defined in this Common Chapter as the Upper and Lower Aquifers which are divided by the Corcoran Clay or E-clay layer). Some groundwater elevation data were associated with wells with unknown screened depths and/or composite well screens constructed across the Corcoran Clay. Groundwater elevation data associated with wells with composite screens and/or unknown screened depths were removed from the data set in most instances, along with any data point that appears to be an outlier when compared with surrounding data from the same period. Select wells with unknown construction were evaluated for inclusion in contour mapping efforts in areas of limited data. Duplicate well measurements were also removed prior to contouring and only one observation for a given well was used for the identified season, rather than averaging all measurements at a given well during the same season.

Figure CC-41~~Figure CC-41~~ shows the locations of wells with known screened depths within the Delta-Mendota Subbasin as well as known spatial gaps where no well information is currently available. These wells include those monitored under CASGEM, the Delta-Mendota Canal Well Pump-in Program, and by local owners or agencies. Monitoring data available for these wells varies by local owner and agency. Well locations were provided by local agencies to the best of their knowledge at the time of writing and may include wells that have been destroyed or are no longer in service.

Historic Conditions

Historic groundwater trends changed significantly with the first deliveries of imported water deliveries to the Delta-Mendota Subbasin. Construction of the Delta-Mendota Canal and the California Aqueduct heralded the introduction of significant surface water supplies into the Subbasin and reduced dependence on groundwater as the primary water supply. These conveyance systems have resulted in significant increases in the conjunctive use of surface water and groundwater throughout the Subbasin. Various drought periods and regulations reducing delivery of supplies from the Sacramento-San Joaquin Delta also punctuate critical understandings of groundwater use patterns throughout the Subbasin, as well as what is known regarding response and recovery of groundwater levels following notable droughts.

Prior to Imported Water Deliveries (1850-1950s)

Prior to 1850, the majority of agriculture and development in the San Joaquin Valley consisted of rain-fed grain and cattle production, with irrigated development beginning sporadically during this time via river (primarily San Joaquin River) and perennial stream diversions (SWRCB, 2011). Construction of the railroad through the San Joaquin Valley from 1869 through 1875 increased demand for more extensive agriculture, making markets in larger coastal cities more accessible to valley farmers. Significant irrigation sourced from surface water and resulting production began in the western side of the San Joaquin Valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno (DWR, 1965). By the 1890s and early 1900s, sizable areas of the southern San Joaquin Valley were being forced out of production by salt accumulation and shallow water tables. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power

them accelerated the expansion of irrigated agriculture with the availability of vast groundwater resources. The resultant groundwater pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed the leaching of salts, particularly near the valley trough and western side of the valley. Groundwater pumping for irrigation from around 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing higher pumping costs and land subsidence, and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies, which would be fulfilled by the Central Valley Project.

Post-Imported Water Deliveries (1950s-2012)

Surface water deliveries from the Central Valley Project via the DMC began in the early 1950s, and from the State Water Project via the California Aqueduct in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Delta-Mendota Subbasin, where only Oak Flat Water District receives deliveries from the SWP. Introduction of imported water supplies to the Delta-Mendota Subbasin resulted in a decrease in groundwater pumping from some parts of the Subbasin and the greater Central Valley, which was accompanied by a steady recovery of water levels. During the droughts of 1976-1977 and 1987-1992, diminished deliveries of imported surface water prompted increased pumping of groundwater to meet irrigation demands, bringing water levels to near-historic lows. Following periods of drought, recovery of pre-drought water levels has been rapid, especially in the Upper Aquifer. This trend has been observed in historic hydrographs for wells across the Subbasin.

Current Conditions

Trends similar to historic drought and subsequent recovery conditions were observed during the 2012 to 2016 drought and the 2016 to present recovery period.

Recent Drought (2012-2016)

During the most recent drought, from 2012 through 2016, similar groundwater trends were observed as during the 1976-1977 and 1987-1992 droughts. With diminished imported surface water deliveries, groundwater pumping increased throughout the Subbasin to meet irrigation needs. This resulted in historic or near-historic low groundwater levels during the height of the drought in 2014 and 2015, when CVP and SWP allocations for agricultural water service contractors were 0%, Exchange Contractors and refuge deliveries were less than 75%, and post-1914 surface water rights in the San Joaquin River watershed were curtailed. In June 2015, senior water rights holders with a priority date of 1903 or later in the San Joaquin and Sacramento watersheds and the Delta were ordered by the State Water Resources Control Board to curtail diversions (State of California, 2015). This marked the first time in recent history that pre-1914 water rights holders were curtailed.

Post-Drought (2016-present)

With wetter conditions following the 2012-2016 drought, groundwater levels began to recover. This was largely a result of increased surface water availability with CVP allocations reaching 100% and full water rights supplies available for diversion from the San Joaquin River in 2017. Additionally, inelastic land subsidence rates also drastically decreased in 2017 as imported water supplies were once again available, resulting in decreased groundwater pumping particularly from the Lower Aquifer. This pattern of increased drought-driven groundwater pumping, accompanied by declining groundwater elevations, followed by recovery is a predominant factor to be considered in the sustainable management of the Delta-Mendota Subbasin. Furthermore, subsidence mitigation projects were developed which drastically reduced the observed subsidence rate on the eastern and southern boundaries of the Subbasin.

Groundwater Trends

Groundwater levels can fluctuate greatly throughout time due to various natural and anthropogenic factors, including long-term climatic conditions, adjacent well pumping, nearby surface water flows, and seasonal groundwater recharge or depletion (LSCE, 2015). As discussed in the Hydrogeologic Conceptual Model section of this Common Chapter (Section 4.1), the Delta-Mendota Subbasin is generally a two-aquifer system consisting of an Upper and Lower Aquifer that are subdivided by the Corcoran Clay layer, a regional aquitard. The Corcoran Clay layer, or E-Clay equivalent, restricts flow between the upper semi-confined aquifer and lower confined aquifer. The presence of a tile drain network along the Grassland Drainage Area and the Subbasin's eastern boundary affects the lateral and vertical water movement in the shallow groundwater zone (LSCE, 2016).

The Delta-Mendota Subbasin has a general flow direction to the east in the Upper Aquifer, where it loses groundwater to the San Joaquin River and its neighboring subbasins. Most recharge throughout the Subbasin is attributed to applied irrigation water, where other sources of recharge include local streams, canal seepage, and infiltration along the western margin of the Subbasin from the Coast Range. The figures that follow were developed for inclusion in the Western San Joaquin River Watershed Groundwater Quality Assessment Report (LSCE, 2015) and the Grassland Drainage Area Groundwater Quality Assessment Report (LSCE, 2016) and are included herein with the intent of demonstrating general trends in groundwater elevations around the Delta-Mendota Subbasin. These figures are not to scale.

Please see the individual GSPs for more specific information relating to similar trends in those respective GSP Plan areas. Additionally, it is important to note that groundwater trends, such as these, are dependent on climatic conditions and are not necessarily representative of the historic and current water budgets for those respective GSP Plan areas.

Upper Aquifer

For the Upper Aquifer, Figure CC-42~~Figure CC-42~~ presents select hydrographs illustrating temporal groundwater level trends in the Upper Aquifer wells within the Subbasin. Hydrographs shown on Figure CC-42~~Figure CC-42~~ are displayed with different ranges of elevation values on the vertical axes. Wells in the Upper Aquifer exhibit decreasing trends to somewhat stable water levels until the mid-1980s, and increasing or stable water levels thereafter.

Similarly, Figure CC-43~~Figure CC-43~~ presents select hydrographs illustrating temporal groundwater level trends in the areas covered by the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSAs in the Northern & Central Delta-Mendota Region GSP Group at various depths. The three select hydrographs representing wells in the Upper Aquifer each show less than 10 years of available data with two wells showing slight declines of about 10 feet or less from about 2003 through 2013, and one well showing a more drastic elevation change, ranging from 100 feet above mean sea level (ft msl) to -20 ft msl over a 5-year period from 2010 to 2016.

Lower Aquifer

Figure CC-44~~Figure CC-44~~ presents select hydrographs illustrating temporal groundwater level trends in Lower Aquifer wells within the Subbasin. Note, hydrographs shown on Figure CC-44~~Figure CC-44~~ displayed different ranges of elevation on the vertical axes. In the Lower Aquifer, piezometric head typically increased or remained relatively stable during the period from the 1980s through the early 2000s.

Again, similarly, Figure CC-43~~Figure CC-43~~ presents select hydrographs illustrating temporal groundwater level trends in the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSA areas of the Northern & Central Delta-Mendota Region GSP Group at various depths. The two select hydrographs representing wells in the Lower Aquifer each show similar elevation patterns post-2010 with a total elevation change of 50 ft msl or more. USGS1000489 shows stable and increasing groundwater elevation trends from the late 1950s through the mid-1980s with a data gap from the mid-1980s through 2010, whereafter 2010 groundwater levels have a steep decline through 2016.

Vertical Gradients

Throughout most of the Delta-Mendota Subbasin, the Corcoran Clay layer acts as a regional aquitard, limiting the vertical migration of groundwater. ~~-~~In areas outside the Corcoran Clay layer (along the western margin of the Subbasin), localized interfingered clays minimize the downward migration of groundwater; although in areas where the clay layers are not competent or non-existent, groundwater migrates from shallower to deeper groundwater zones. Similarly, in areas where the Corcoran Clay has been compromised (due to well construction across the clay), groundwater generally flows from the Upper Aquifer to the Lower Aquifer, especially in areas where the Lower Aquifer is actively used as a water supply (lowering the potentiometric head in that zone).

Groundwater Contours

The Subbasin-wide groundwater contours reflected in Figure CC-45~~Figure CC-45~~ and Figure CC-46~~Figure CC-46~~ evaluate the seasonal high (Spring 2013) and seasonal low (Fall 2013) conditions of the current year (defined as WY2013 for the GSP analyses) for the Upper Aquifer. Spring is defined as groundwater surface elevation measurements collected between January 1 and April 8; where Fall is defined as groundwater surface elevation measurements collected between September 1 and October 31. For wells where multiple Spring 2013 or Fall 2013 measurements were available, the highest elevation for each season was used for contouring. Gaps in data and contours can be attributed to a lack of wells present, level measurements, or requirements to report level readings groundwater level data. Consistent with traditional contouring efforts, the quality of outlier water level data was investigated. In instances of poor quality data, the associated data was eliminated for the groundwater contouring effort. Furthermore, implementation of the CASGEM program in 2014 has reduced temporal and spatial gaps in groundwater level datasets, and implementation of the Delta-Mendota Subbasin GSPs' monitoring programs will add to the improved data quantity and quality.

In the Upper Aquifer, during Spring 2013, the general flow of groundwater in the Delta-Mendota Subbasin was from the Coast Range along the western boundary of the Subbasin toward the San Joaquin River along the eastern boundary. Groundwater elevations tend to increase moving south throughout the Subbasin. Within Stanislaus County, groundwater elevations are the lowest, ranging between 40 and 80 feet above msl, becoming increasingly higher in Madera County, ranging between 80 and 100 feet above msl, and in Merced and Fresno counties, ranging between 80 and 140 feet above msl (Figure CC-45~~Figure CC-45~~). Similar flow directions (west to east and northeast) are observed in the Fall 2013. Within Stanislaus County, groundwater elevations are the lowest ranging between 40 and 80 feet above msl, showing little difference compared to Spring 2013; become increasingly higher in Madera County ranging between 60 and 100 feet above msl; in Merced County ranging between 60 and 140 feet above msl; and in Fresno County ranging from 60 and 120 feet above msl (Figure CC-46~~Figure CC-46~~). Both maps indicate a prevailing southwest to northeast flow gradient above the Corcoran Clay. In general, little variation is apparent in groundwater elevation between seasonal high and low periods in 2013.

Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the seasonal high and low (Spring 2013 and Fall 2013, respectively) could not be accurately prepared. Figure CC-

47~~Figure CC-47~~ and Figure CC-48~~Figure CC-48~~ show the available groundwater elevation measurements for Spring 2013 and Fall 2013. Available Spring 2013 measurements range from -127 to 12 feet above msl in Stanislaus County, -65 to 124 feet above msl in Merced County, and -5 to 88 feet above msl in Fresno County (Figure CC-47~~Figure CC-47~~), where no measurements are available for this time period in Madera County. Available Fall 2013 measurements range from -138 to 156 feet above msl in Stanislaus County, -94 to 19 feet above msl in Merced County, and -72 to -4 feet above msl in Fresno County (Figure CC-48~~Figure CC-48~~), where no measurements are available for this time period in Madera County. The Lower Aquifer exhibits less seasonal difference in groundwater elevations than the Upper Aquifer. Throughout most of the Subbasin, the Lower Aquifer shows lower piezometric heads than the Upper Aquifer suggesting that potential exists for downward vertical gradient.

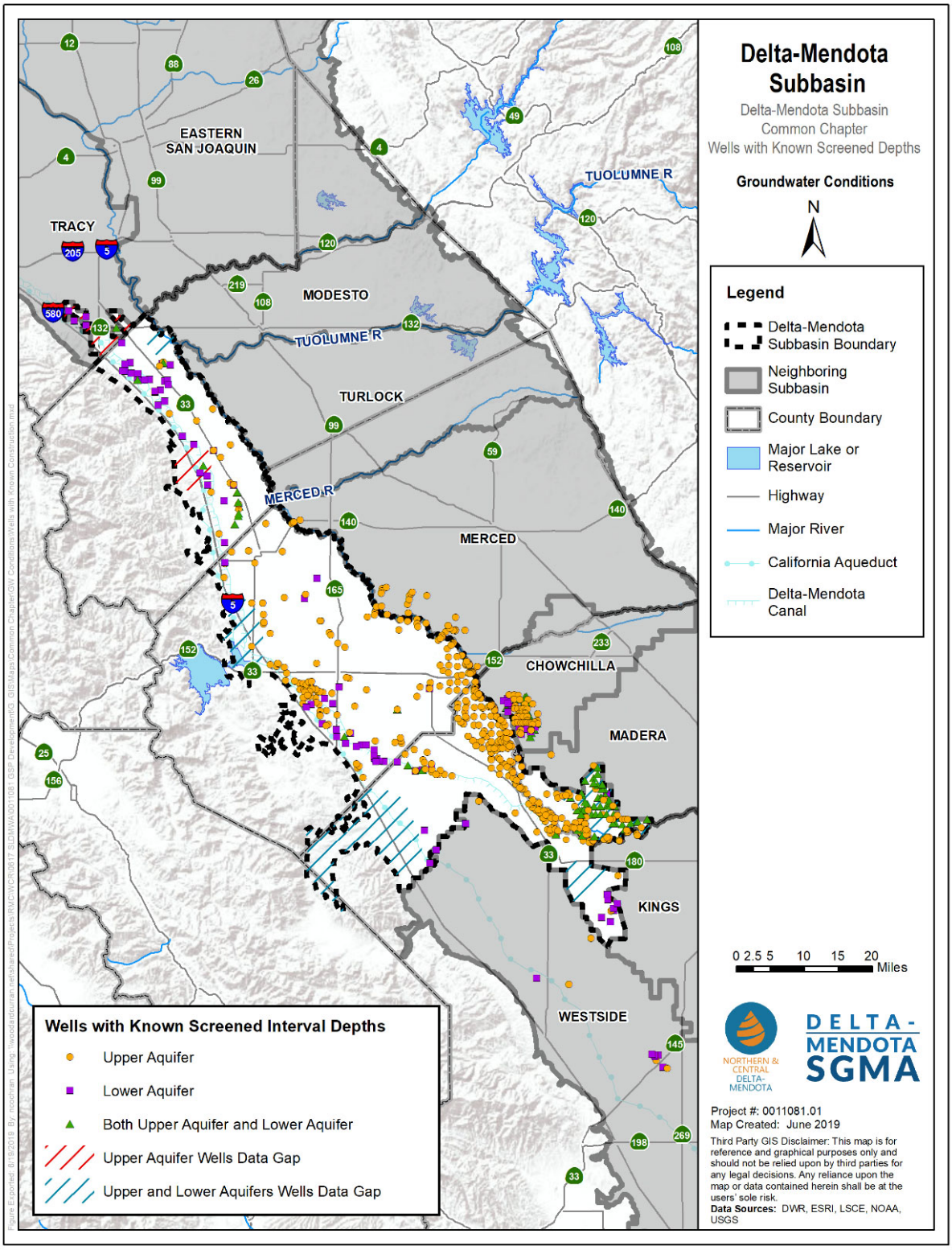
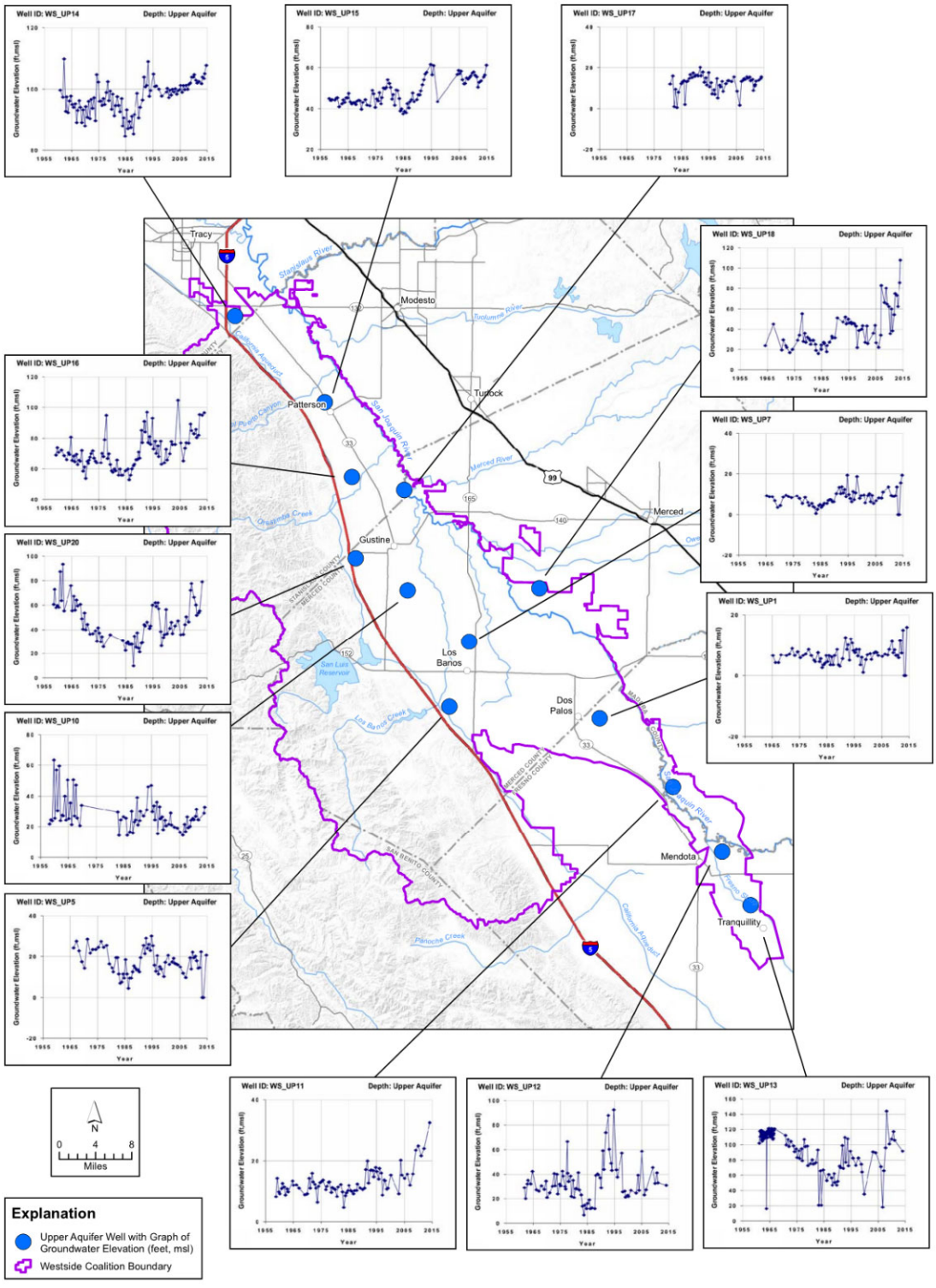
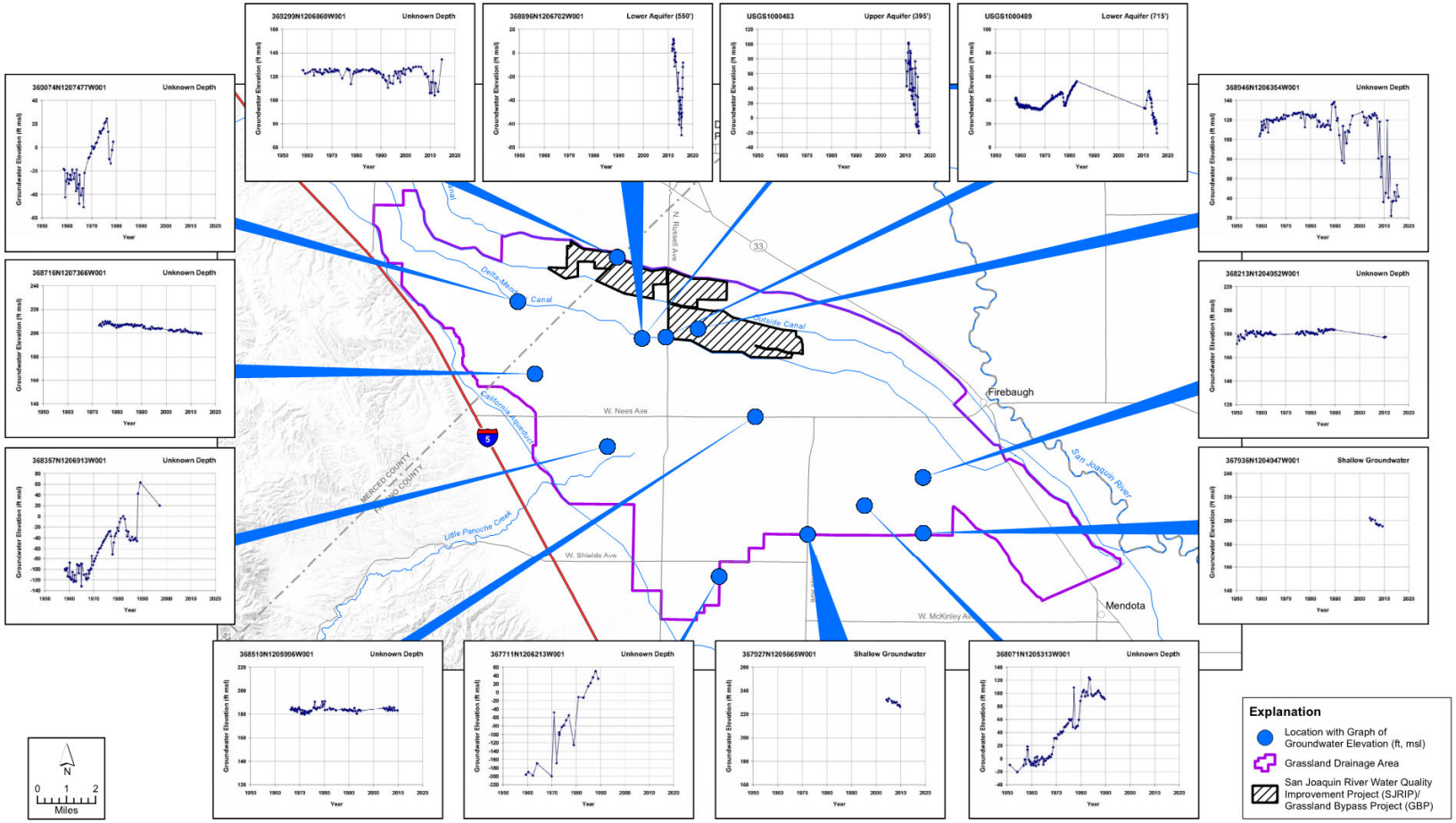


Figure CC-41: Wells with Known Screened Interval Depths



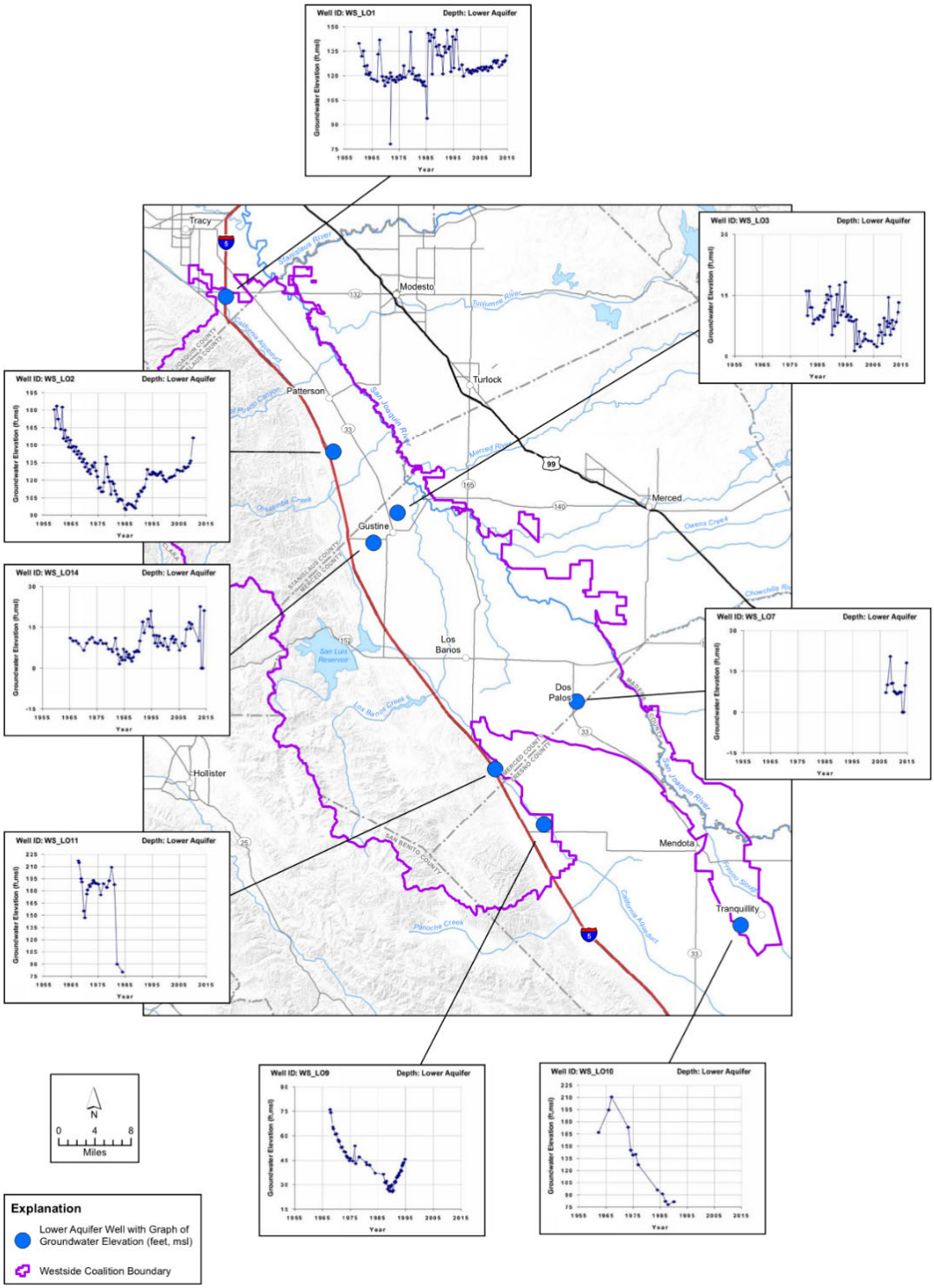
Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016

Figure CC-42: Select Graphs of Groundwater Elevations, Upper Aquifer



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-43: Select Graphs of Groundwater Elevations, Various Depths



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-44: Select Graphs of Groundwater Elevations, Lower Aquifer

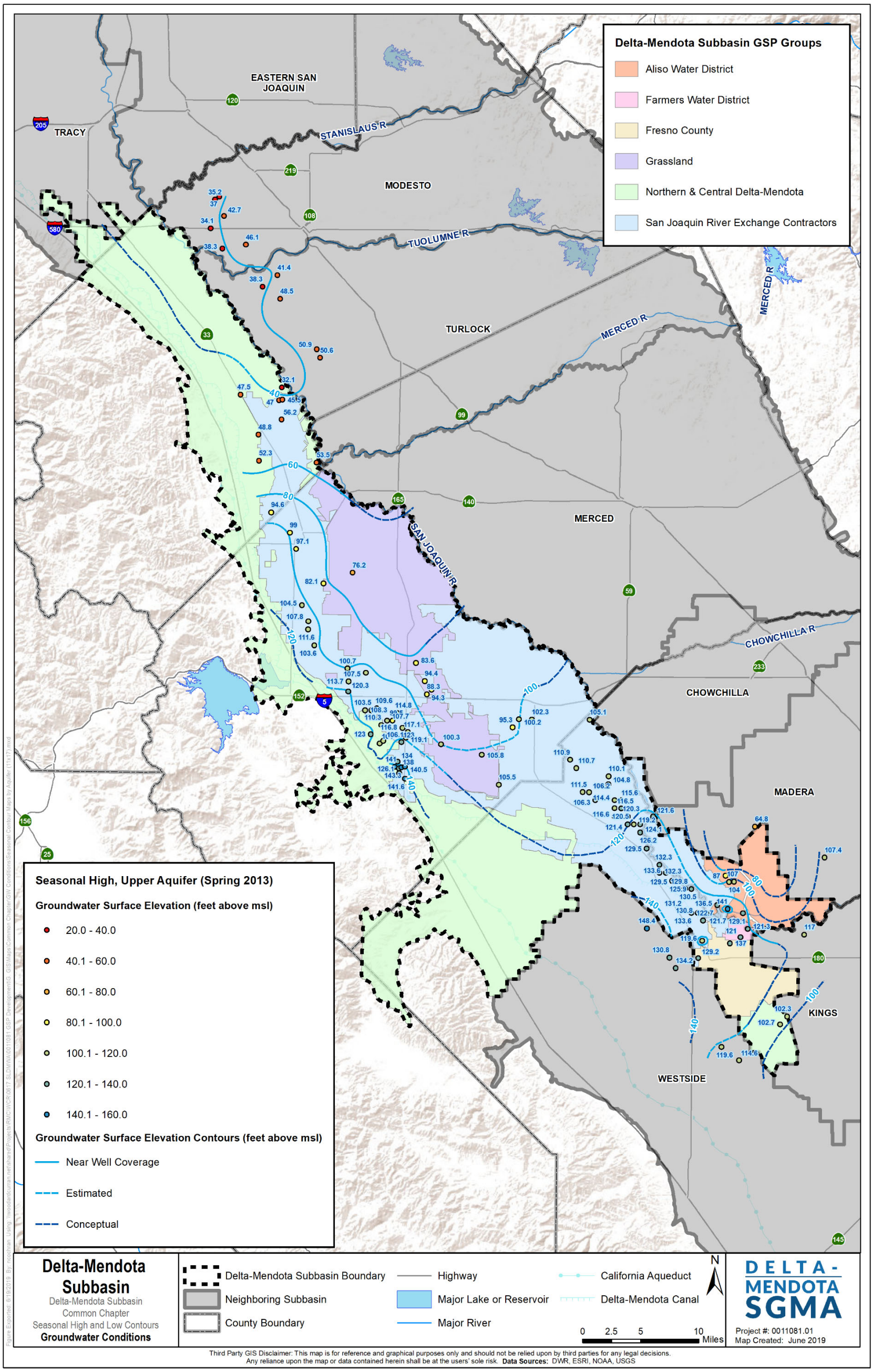


Figure CC-45: Spring 2013 Upper Aquifer Groundwater Contour Map

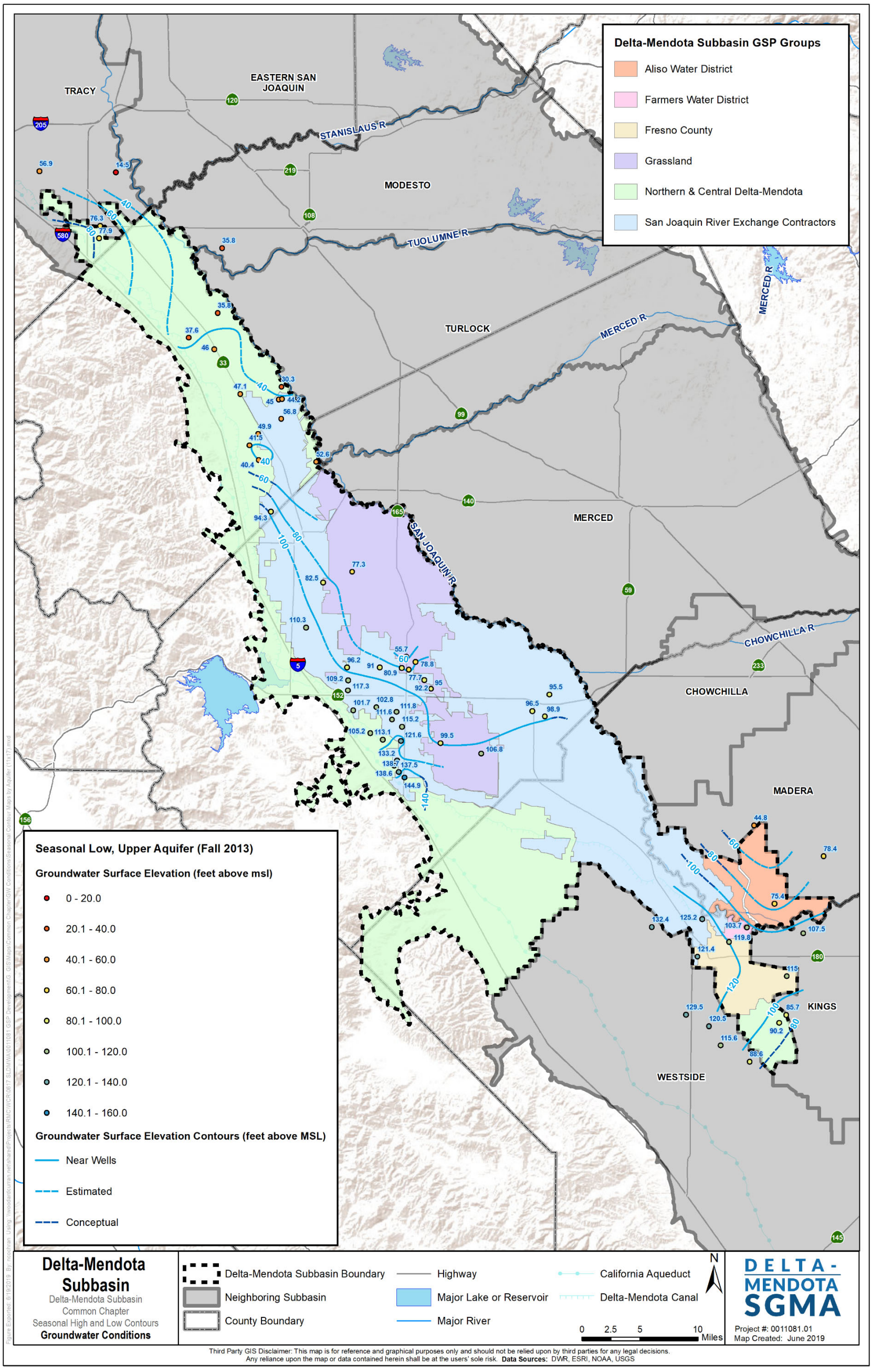


Figure CC-46: Fall 2013 Upper Aquifer Groundwater Contour Map

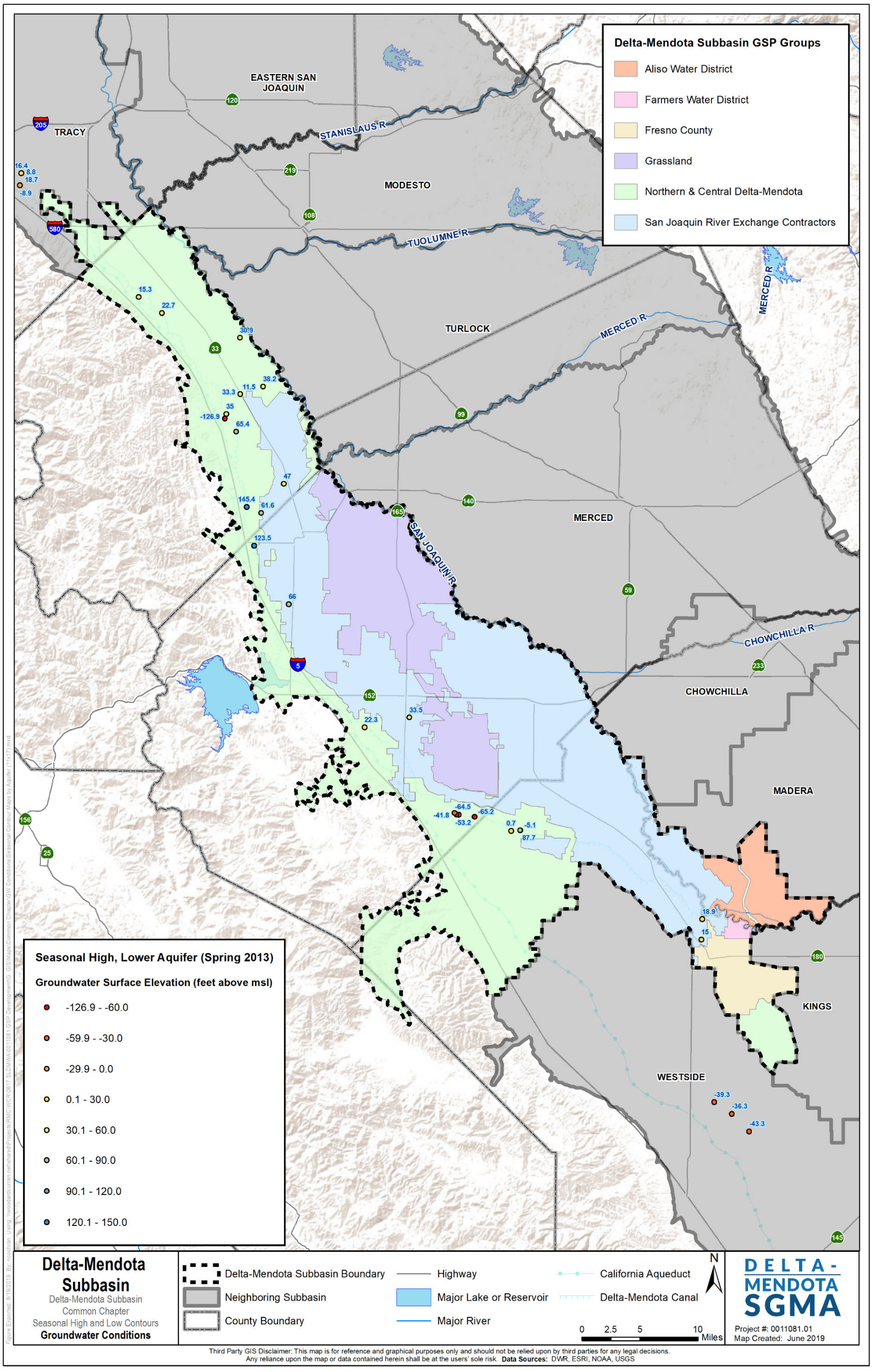


Figure CC-47: Spring 2013 Lower Aquifer Groundwater Elevation Measurements

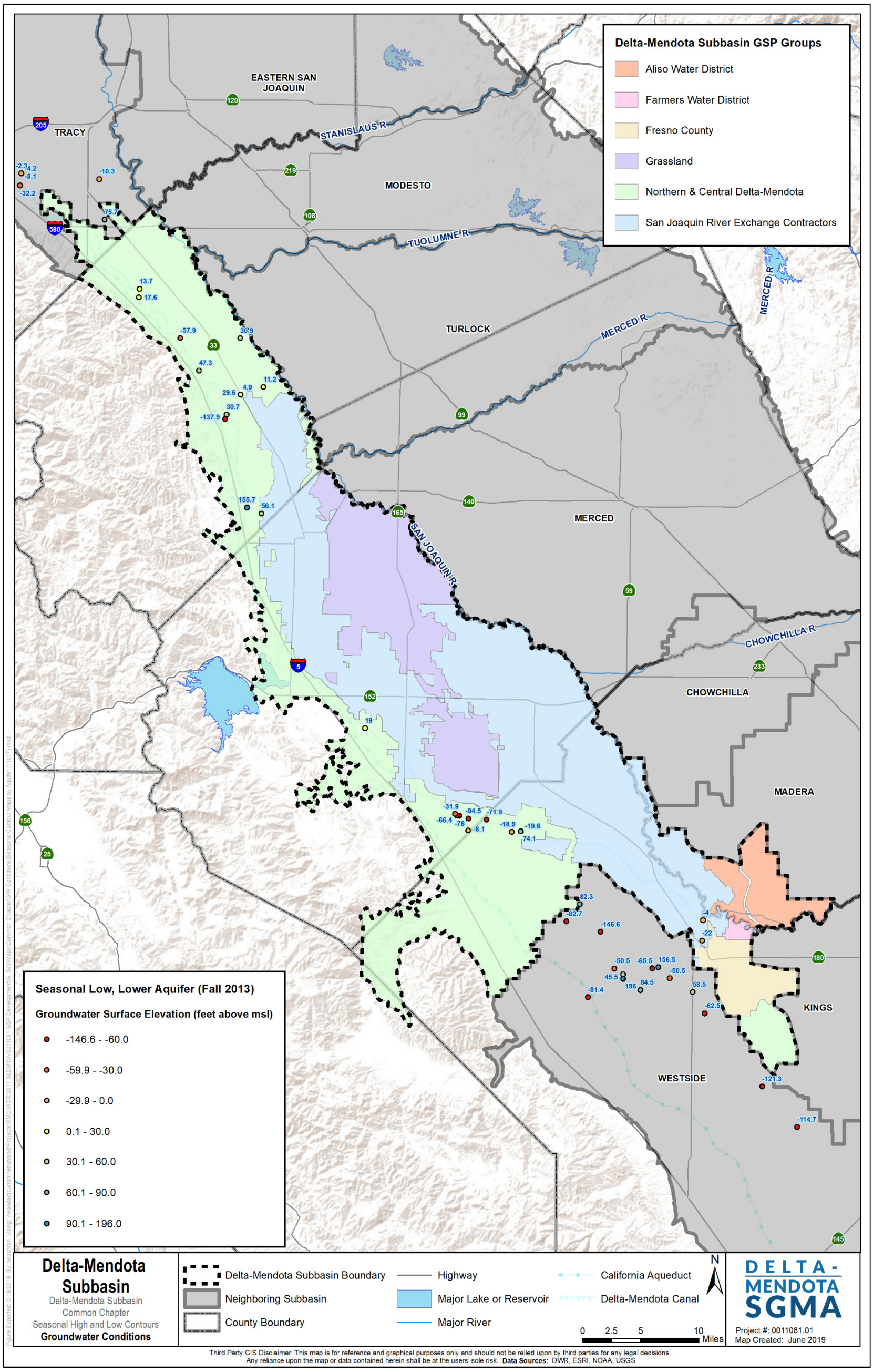


Figure CC-48: Fall 2013 Lower Aquifer Groundwater Elevation Measurements

4.2.3 Groundwater Storage

Annual changes in groundwater storage for both the Upper and Lower Aquifers in the Delta-Mendota Subbasin were estimated as part of the development of the Historic (WY2003-2012), Current (WY2013) and Projected Water Budgets (WY2014-2070). For information on how change in storage was calculated, refer to Section 4.3.2 – Water Budgets of this Common Chapter. Figure CC-49~~Figure CC-49~~ and Figure CC-50~~Figure CC-50~~ show annual change in storage, cumulative change in storage, and water year type for the Upper Aquifer and Lower Aquifer, respectively, from WY 2003 through 2013 for the Delta-Mendota Subbasin. For the purposes of the water budget four water year types were utilized, wet, average (corresponding to above and below normal water years), dry (corresponding to dry and critical water years) and Shasta critical.

Change in storage is negative for 6 out of the 11-year historic and current water budget period for the Upper Aquifer, and 9 out of 11 years for the Lower Aquifer. Despite periods of wet conditions with recharge outpacing extractions, an overall declining trend in groundwater storage can be observed in both the Upper Aquifer and Lower Aquifer. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about ~~1,300~~624,0000 AF in the Upper Aquifer and ~~678~~375,000 AF in the Lower Aquifer between WY2003 to 2013.

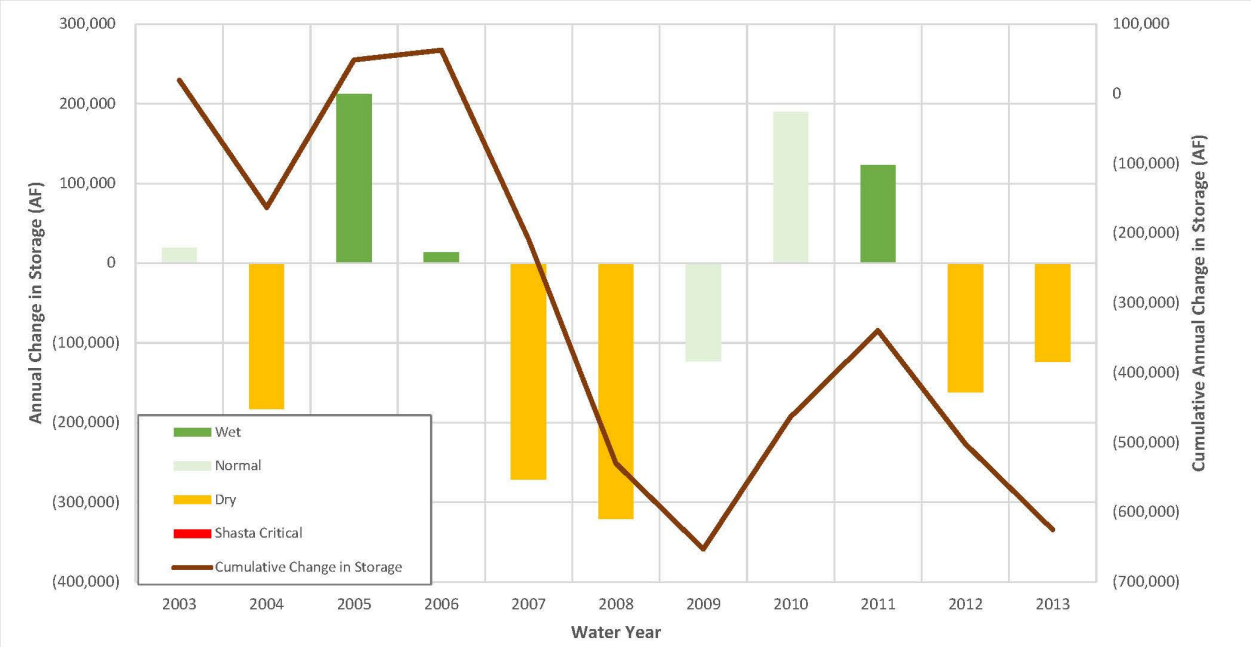


Figure CC-49: Calculated Upper Aquifer Change in Storage, Annual and Cumulative

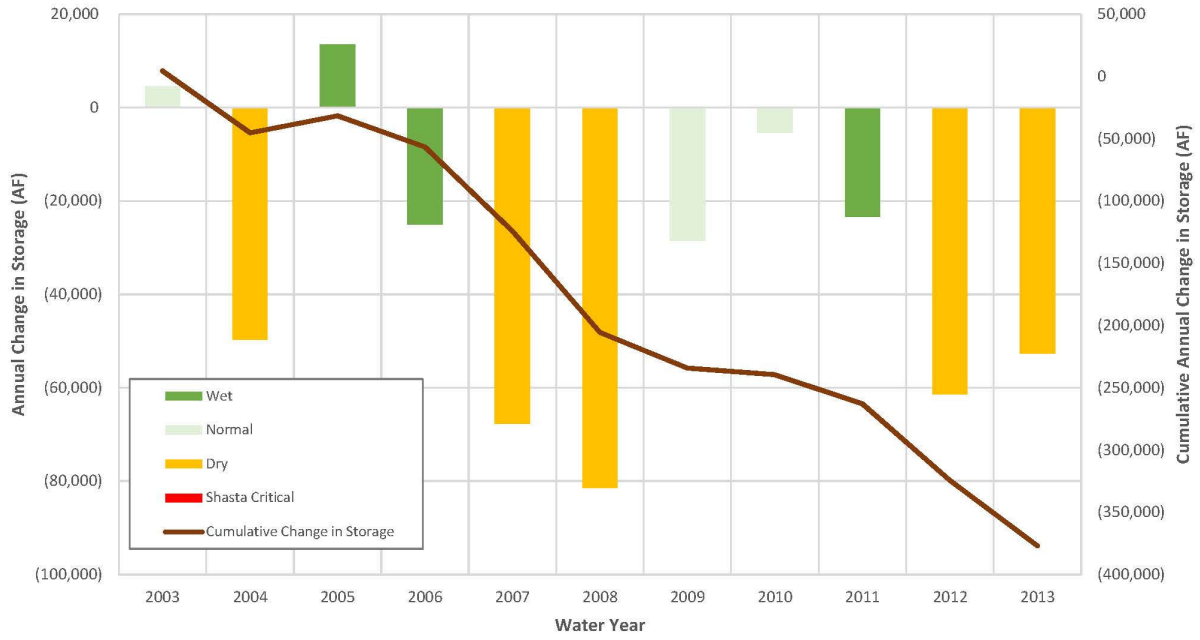


Figure CC-50: Calculated Lower Aquifer Change in Storage, Annual and Cumulative

4.2.4 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Delta-Mendota Subbasin. The Subbasin is located inland from the Pacific Ocean; thus, groundwater conditions related to seawater intrusion are not applicable to the Delta-Mendota Subbasin.

4.2.5 Groundwater Quality

Groundwater quality varies considerably from west to east and north to south throughout the Delta-Mendota Subbasin. In general, Upper Aquifer water quality has historically been impacted by overlying land uses with some areas showing increasing concentrations of nitrate and TDS. Areas of elevated salt concentrations can be found in the Subbasin, generally along the southern portion of the San Joaquin River and in the southern portion of the Subbasin. Lower Aquifer groundwater has, and remains in most cases, to be of generally good quality. For more information about historic and current conditions relative to groundwater quality in each GSP Group area, refer to the individual GSPs.

4.2.6 Land Subsidence

Long-term groundwater level declines can result in a one-time release of "water of compaction" from compacting silt and clay layers (aquitards) resulting in inelastic land subsidence (Galloway et al., 1999). There are several other types of subsidence in the San Joaquin Valley, including subsidence related to hydrocompaction of moisture-deficient deposits above the water table, subsidence related to fluid withdrawal from oil and gas fields, subsidence caused by deep-seated tectonic movements, and subsidence caused by oxidation of peat soils that is a major factor in the Sacramento-San Joaquin Delta (Sneed et al., 2013). However, aquifer-system compaction caused by groundwater pumping causes the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Poland et al., 1975; Ireland et al., 1984; Farrar and Bertoldi, 1988; Bertoldi et al., 1991; Galloway and Riley, 1999).

Land subsidence is a prevalent issue in the Delta-Mendota Subbasin as it has impacted prominent infrastructure of statewide importance, namely the DMC and the California Aqueduct, as well as local canals, causing serious operational, maintenance, and construction-design issues (Sneed et al., 2013). Reduced freeboard and flow capacity for the DMC and California Aqueduct have rippling effects on imported water availability throughout the State. Even small amounts of subsidence in critical locations, especially where canal gradients are small, can impact canal operations (Sneed and Brandt, 2015). While some subsidence is reversible (referred to as elastic subsidence), inelastic or irreversible subsidence is caused mainly by pumping groundwater from below the Corcoran Clay, thus causing compaction and reducing storage in the fine-grained materials in the lower confined aquifer as well as damaging well infrastructure. As a result, important and extensive damages and repairs have resulted in the loss of conveyance capacity in canals that deliver water or remove floodwaters, the realignment of canals as their constant gradient becomes variable, the raising of infrastructure such as canal check stations, and the releveling of furrowed fields.

Available Data

There are six UNAVCO Continuous GPS (CGPS) locations that monitor subsidence within the Delta-Mendota Subbasin (Figure CC-51~~Figure CC-51~~). Changes in land surface elevation have also been measured at DMC Check Structures. Figure CC-52~~Figure CC-52~~ through Figure CC-57~~Figure CC-57~~ show the vertical change in land surface elevation from a given time point (specified on charts) for the UNAVCO CGPS stations within the Delta-Mendota Subbasin, along with annual CVP allocations. Table CC-5~~Table CC-5~~ summarizes the greatest monthly land subsidence rate and corresponding year(s) of that change at each UNAVCO CGPS station. Overall, the greatest monthly subsidence rates occurring after January 1, 2015 occurred during the Spring of 2016 to the Spring of 2017. Land subsidence rates (in feet per year), as measured by USBR from December 2011 to December 2014, are shown in Figure CC-58~~Figure CC-58~~. Based on these data, within the majority of the Delta-Mendota Subbasin, annual subsidence rates were between -0.15 and -0.3 feet/year during this period (or between -0.45 and -0.9 feet of total subsidence over this three-year period).

Table CC-5: Subsidence Monitoring Trends
UNAVCO CGPS Stations

Station ID	Greatest Monthly Land Subsidence Rate as of January 1, 2015 (feet)	Year(s) of Greatest Monthly Subsidence Rate
P255	-0.0292	Spring 2016 to 2017
P259	-0.0183	Spring 2016 to 2017
P252	-0.033	Spring 2016 to 2017
P303	-0.2190	Spring 2016 to 2017
P301	-0.0029	Spring 2016 to 2017
P304	-0.0003	Spring 2013 to 2017

Historic Conditions

Along the DMC, in the northern portion of the San Joaquin Valley, extensive groundwater extraction from unconsolidated deposits caused subsidence exceeding 8.5 meters (or about 28 feet) between 1926 and 1970 (Poland et al., 1975), reaching 9 meters (or about 30 feet) in 1980 (Ireland, 1986). Land subsidence from groundwater pumping began in the San Joaquin Valley in the mid-1920s (Poland et al., 1975; Bertoldi et al., 1991; Galloway and Riley, 1999), and by 1970, about half of the San Joaquin Valley had land subsidence of more than 0.3 meters (or about 1 foot) (Poland et al., 1975). When groundwater pumping decreased in the Delta-Mendota Subbasin following imported water deliveries from the CVP via the ~~dMC~~ DMC in the early 1950s, compaction rates were reduced in certain areas and water levels recovered. Notable droughts of 1976-1977 and 1987-1992 saw renewed compaction during these periods, with increased groundwater pumping as imported supplies were reduced or unavailable. However, following these droughts, compaction virtually ceased and groundwater levels rose to near pre-drought levels quite rapidly (Swanson, 1998; Galloway et al., 1999).

Subsidence contours for 1926-1970 (Poland et al., 1975) show the area of maximum active subsidence was southwest of the community of Mendota. Historical subsidence rates in the Mendota area exceeded 500 millimeters/year (or about 20 inches/year) during the mid-1950s and early 1960s (Ireland et al., 1984). The area southwest of Mendota has experienced some of the highest levels of subsidence in California, where from 1925 to 1977, this area sustained over 29 feet of subsidence (USGS, 2017). Historical subsidence rates along Highway 152 calculated from leveling-survey data from 1972, 1988, and 2004 show that for the two 16-year periods (1972-1988 and 1988-2004), maximum subsidence rates of about 50 millimeters/year (or about 2 inches/year) were found just south of El Nido (Sneed et al., 2013). Geodetic surveys completed along the DMC in 1935, 1953, 1957, 1984, and annually from 1996-2001 indicated that subsidence rates were greatest between 1953 and 1957 surveys, and that the maximum subsidence along the DMC (about 3 meters, or about 10 feet) was just east of DMC Check Structure Number 18.

After 1974, land subsidence was demonstrated to have slowed or largely stopped (DWR, June 2017); however, land subsidence remained poised to resume under certain conditions. Such an example includes the severe droughts that occurred between 1976 and 1977 and between 1987 and 1991. Those droughts, along with other corroborating factors, led to diminished deliveries of imported water which prompted some water agencies and farmers (especially in the western Valley) to refurbish old pumps, drill new water wells, and begin pumping groundwater to make up for cutbacks in the imported water supply. The decisions to renew groundwater pumping were encouraged by the fact that groundwater levels had recovered to near-predevelopment levels. CGPS data collected between 2007 to 2014 show seasonally variable subsidence and compaction rates, including uplift as elastic rebound occurs during the fall and winter (Sneed and Brandt, 2015). Vertical displacement at P303, near Los Banos, indicates subsidence at fairly consistent rates during and between drought periods (Sneed and Brandt, 2015). Vertical displacement at P304, near Mendota, indicates that most subsidence occurred during drought periods with very little occurring between drought periods. Finally, data from extensometers 12S/12E-16H2, located on the DMC west of Los Banos, and 14S/13E-11D6, located between the DMC and California Aqueduct west of Mendota, showed subsidence rate increases during 2014, the third year of the most recent drought (Sneed and Brandt, 2015).

Subsidence impacts to the California Aqueduct, which runs parallel and in close proximity to the Delta-Mendota Canal across the Subbasin, is of statewide importance. During the construction of the California Aqueduct, it was thought that subsidence within the San Joaquin Valley would cease with the delivery of water from the Central Valley Project, though additional freeboard was incorporated into the design and construction of the Aqueduct in an attempt to mitigate for future subsidence (DWR, June 2017). After

water deliveries from the Aqueduct began, subsidence rates decreased to an average of less than 0.1 inches/year during normal to wet hydrologic years. During dry to critical hydrologic years, subsidence increased to an average of 1.1 inches per year. The 2012-2015 drought produced subsidence similar to those seen before the Aqueduct began delivering water, with some areas experiencing nearly 1.25 inches of sinking per month (based on NASA UAVSAR flight measurements). Dry and critically dry water years since Aqueduct deliveries began have resulted in extensive groundwater withdrawals, causing some areas near the Aqueduct to subside nearly 6 feet.

Current Conditions

Based on subsidence rates observed over the last decade, it is anticipated that without mitigation, subsidence will continue to impact operations of the DMC and California Aqueduct. For example, recently, Reach 4A of the San Joaquin River near Dos Palos experienced between 0.38 and 0.42 feet/year in subsidence between 2008 and 2016. As a result of subsidence, freeboard in Reach 4A is projected to be reduced by 0.5 foot by 2026 as compared to 2016, resulting in a 50 percent reduction in designed flow capacity (DWR, May 2018). Reduced flow capacities in the California Aqueduct will impact deliveries and transfers throughout the State and result in the need to pump more groundwater, thus contributing to further subsidence.

More recent subsidence measuring indicates subsidence hot spots within the Subbasin include the area east of Los Banos and the Tranquillity Irrigation District (TRID) area. USGS began periodic measurements of the land surface in parts of the San Joaquin Valley over the last decade. Between December 2011 and December 2014, total subsidence in the area east of Los Banos, located within the Merced Subbasin (also referred to as the El Nido-Red Top area), over the three-year period ranged from 0.15 to 0.75 feet, or 1.8 to 9 inches respectively (KDSA, 2015). The Jet Propulsion Laboratory (JPL) at the California Institute of Technology has also been monitoring subsidence in California using interferometric synthetic aperture radar (or InSAR), and a recent progress report documenting data for the period from May of 2015 to September of 2016 indicates that the two previously-identified primary subsidence areas near the community of Corcoran and centered on El Nido was joined by a third area of significant subsidence near TRID. For the study period (as shown in **Figure CC-59**~~**Figure CC-59**~~), maximum total subsidence of 22 inches was measured near Corcoran, while the El Nido area subsided 15 inches and the TRID area subsided around 20 inches. Analyses at two particular stations near El Nido show interesting trends. At Station P303, between 2007 and 2014, 50 mm (or nearly 2 inches) of subsidence occurred at this location. Vertical displacement at P303 (**Figure CC-55**~~**Figure CC-55**~~) show subsidence at fairly consistent rates during and between drought periods, indicating that these areas continued to pump groundwater despite climatic variations (possibly due to a lack of surface water availability) (Sneed and Brandt, 2015). Residual compaction may also be a factor. Vertical displacement at Station P304 indicated that most subsidence in this particular area occurred during drought periods and very little occurred between drought periods (**Figure CC-57**~~**Figure CC-57**~~). This suggests that this area received other sources of water (most likely surface water available between drought periods) and that residual compaction was not very important in this area. These two areas demonstrate a close link between the availability of surface water, groundwater pumping, and inelastic land subsidence.

Total land subsidence from April 2015 to April 2016 in the San Joaquin Valley is shown in

Figure CC-60: Vertical Displacement, April 2015 to April 2016

~~**Figure CC-60: Vertical Displacement, April 2015 to April 2016**~~. Subsidence monitoring in the Delta-Mendota Subbasin, and in the San Joaquin Valley as a whole, demonstrated significant inelastic land subsidence as a result of the last drought, with effects continuing to the present time (as evidenced by

continued subsidence between 2016 and 2018 through surveys of the DMC). While the impacts appeared to have slowed, the temporal and spatial impacts of continued subsidence have not yet been evaluated.

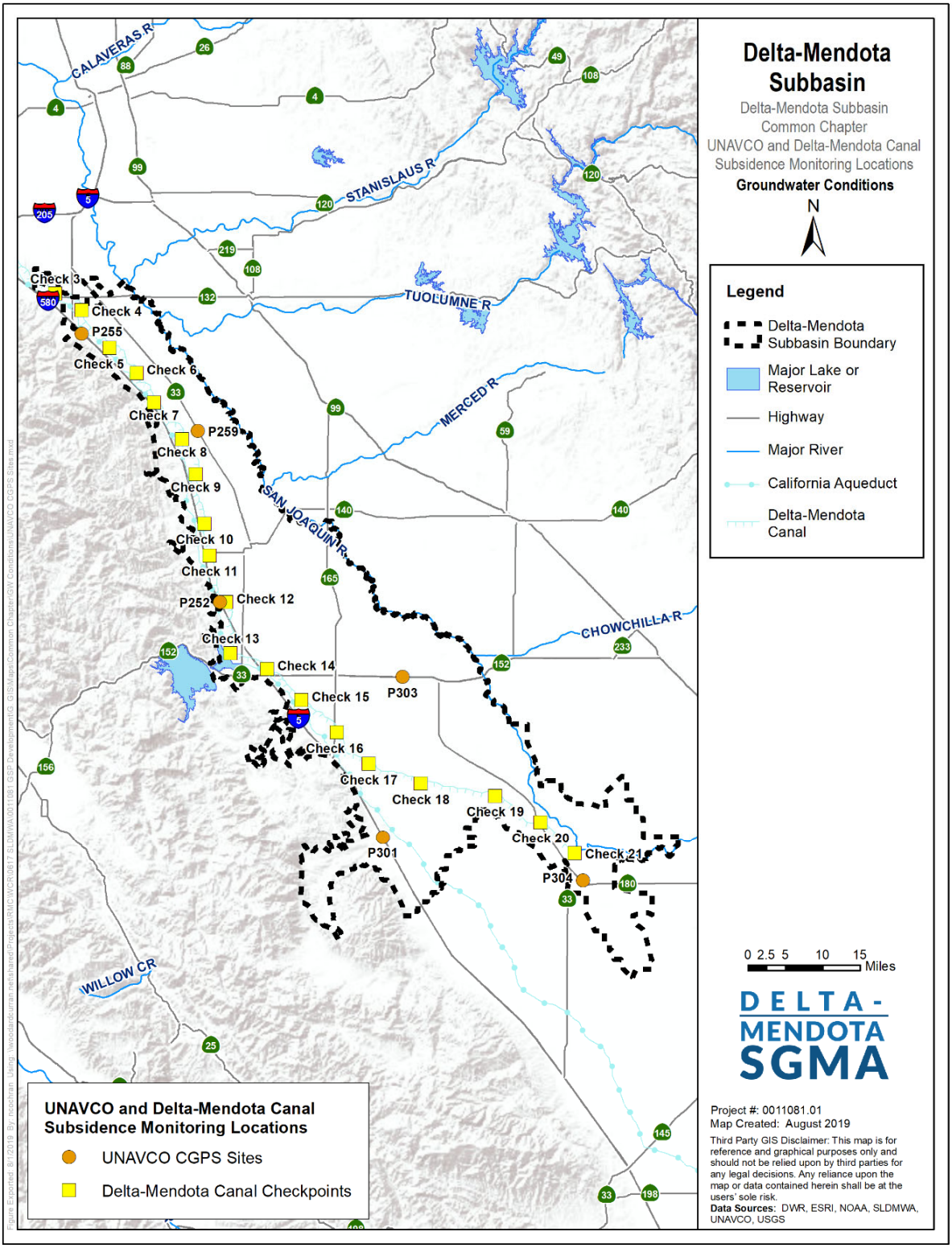


Figure CC-51: UNAVCO and Delta-Mendota Canal Subsidence Monitoring Locations

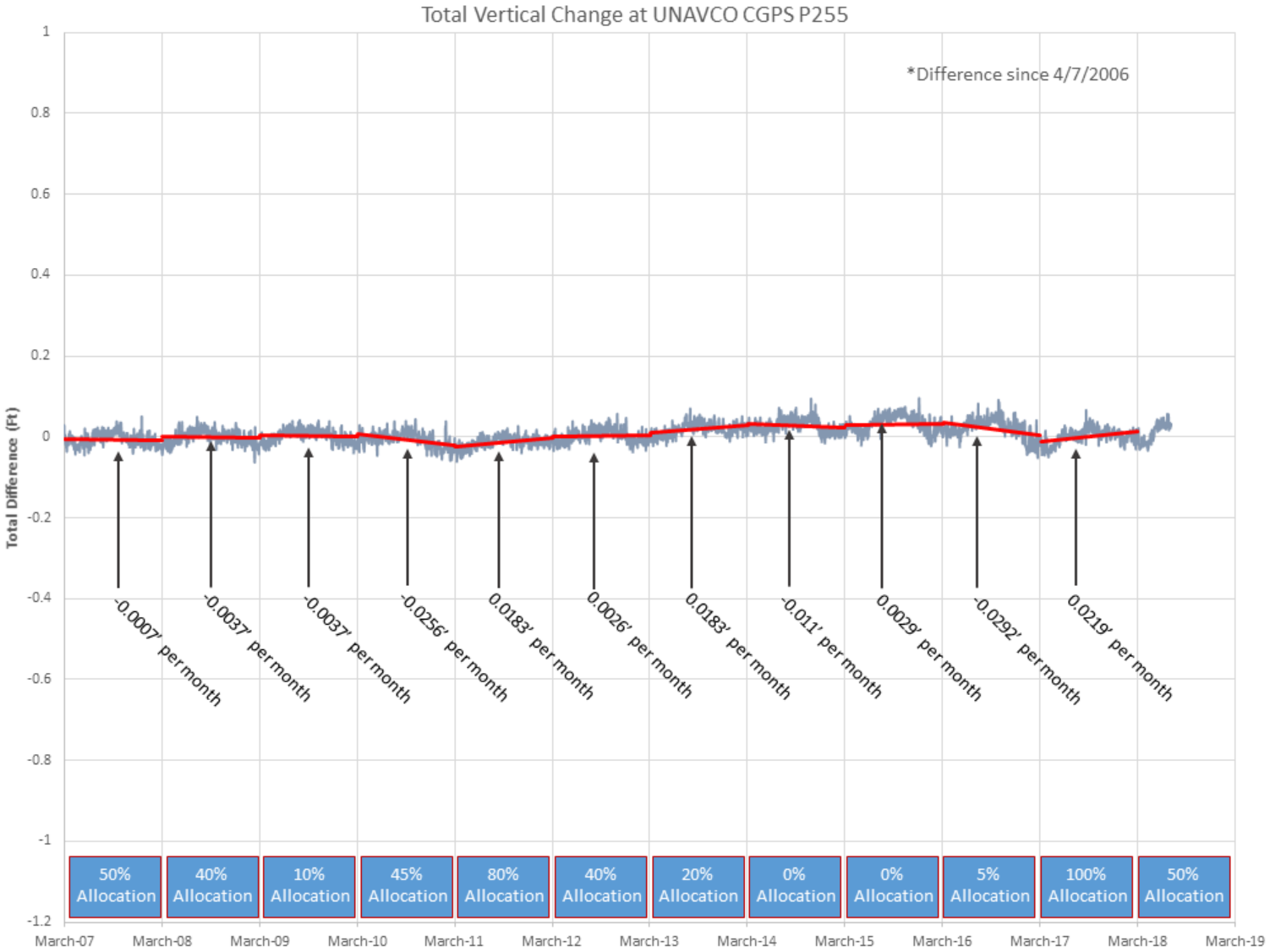


Figure CC-52: Vertical Elevation Change at UNAVCO CGPS P255, Spring 2007 to 2018

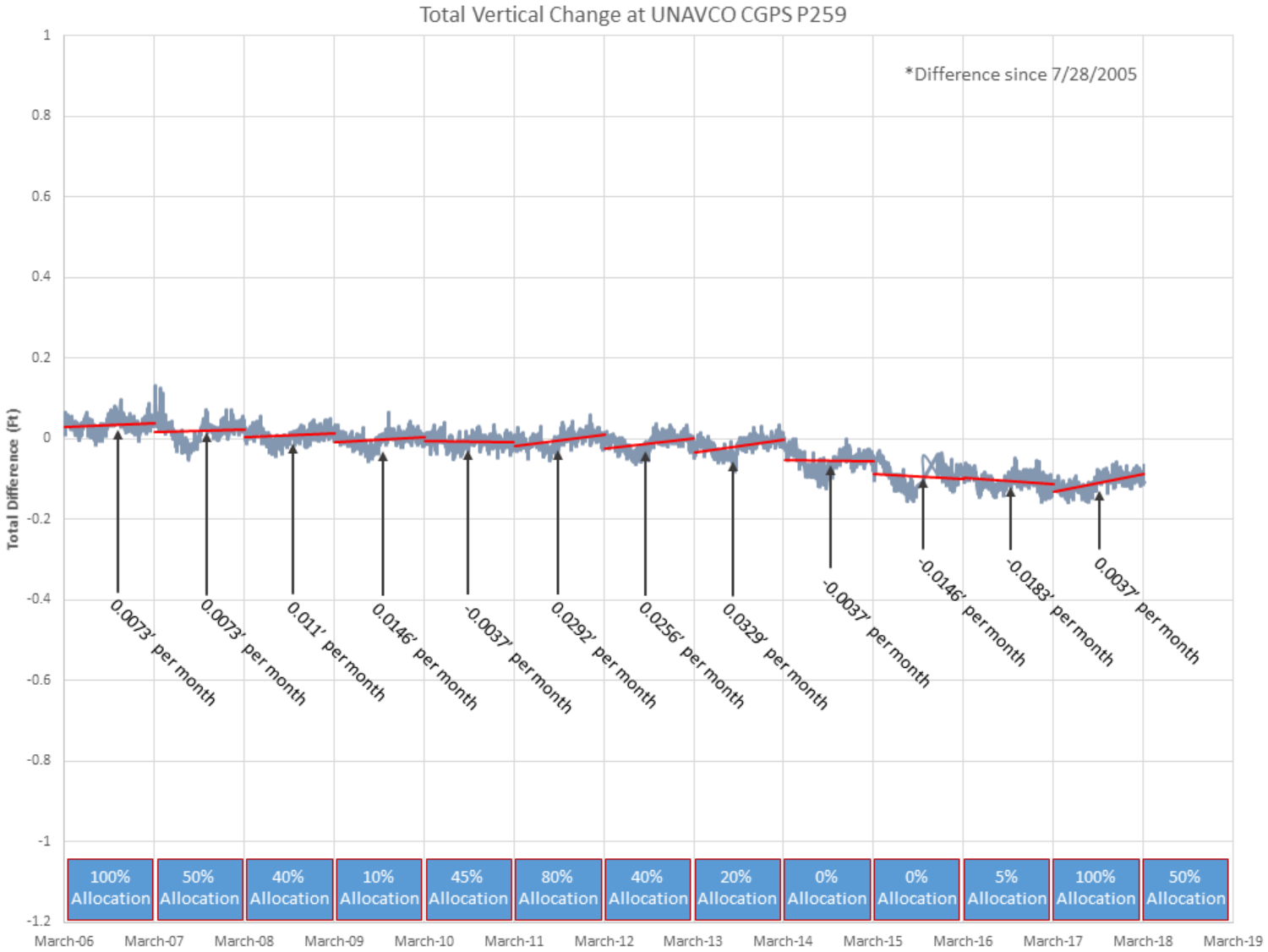


Figure CC-53: Vertical Elevation Change at UNAVCO CGPS P259, Spring 2006 to 2018

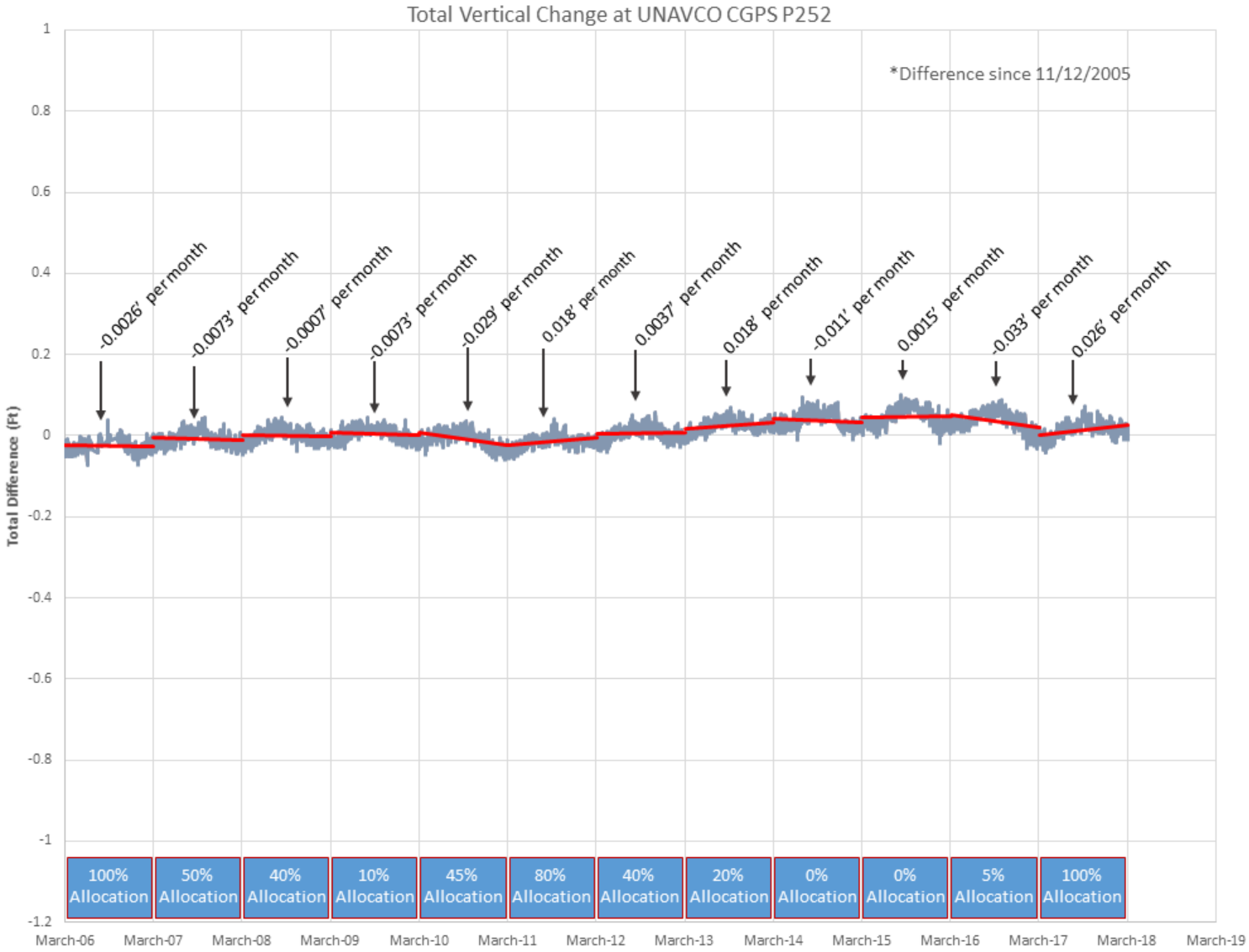


Figure CC-54: Vertical Elevation Change at UNAVCO CGPS P252, Spring 2006 to 2018

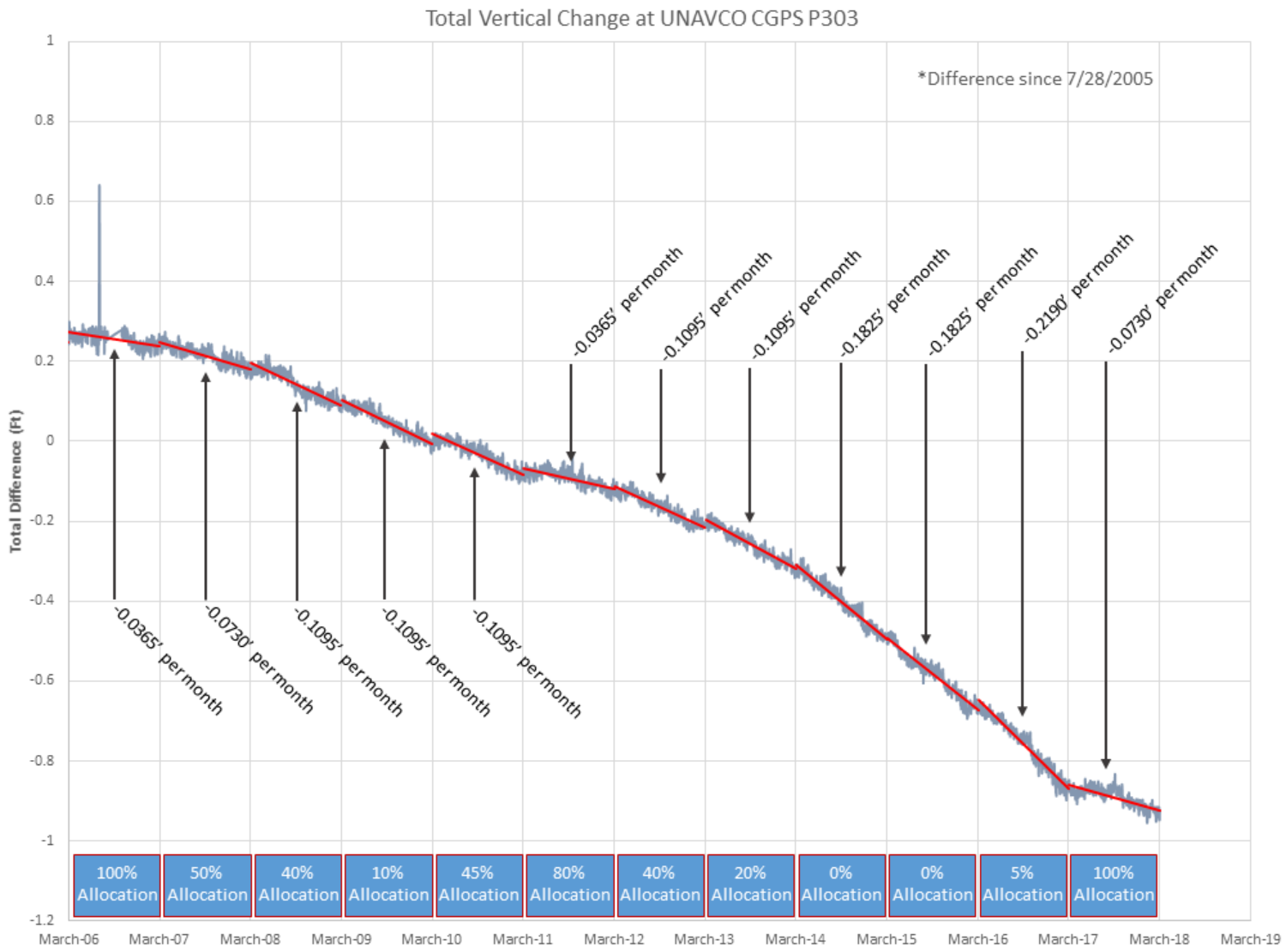


Figure CC-55: Vertical Elevation Change at UNAVCO CGPS P303, Spring 2006 to 2018

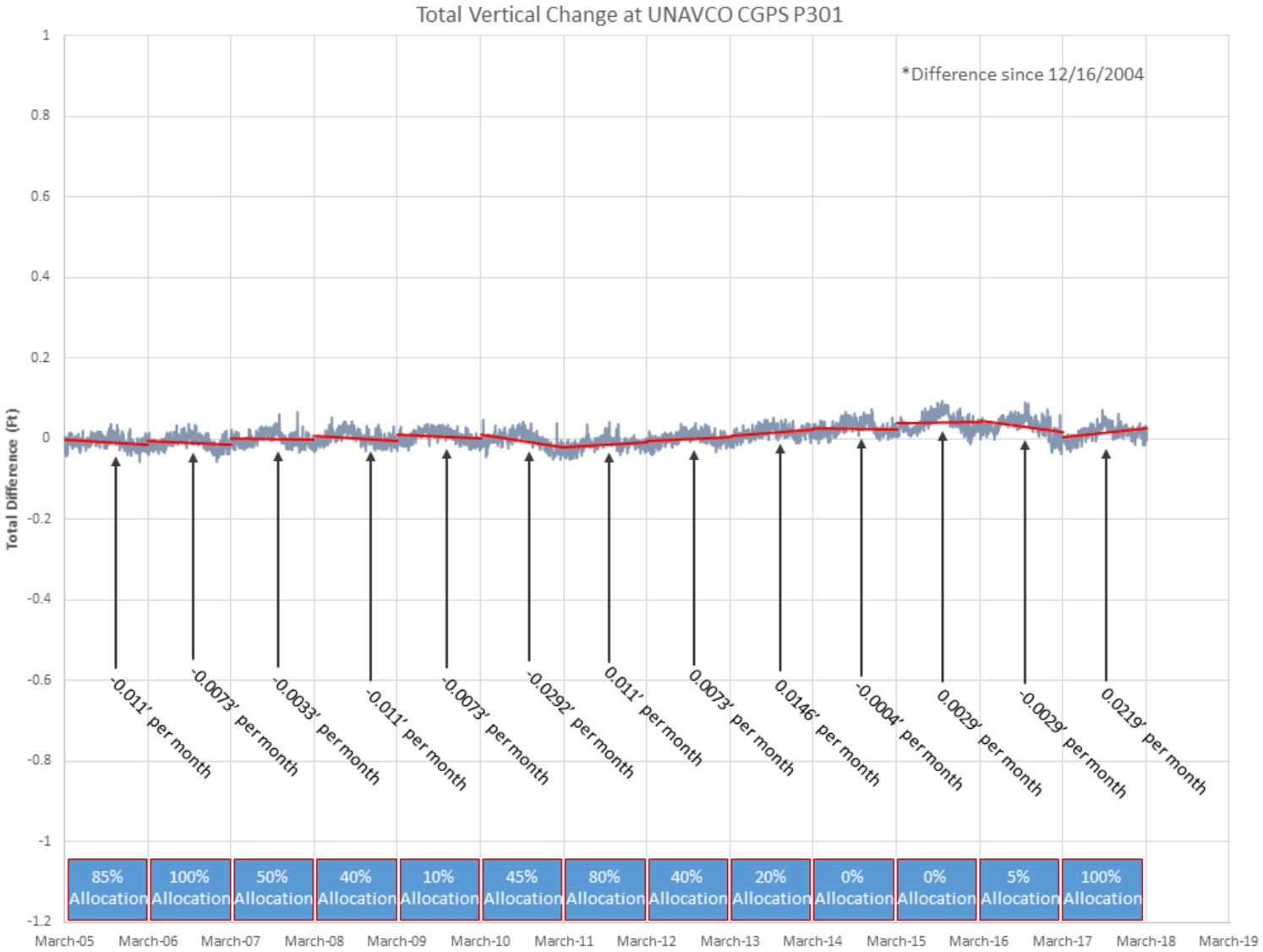


Figure CC-56: Vertical Elevation Change at UNAVCO CGPS P301, Spring 2005 to 2018

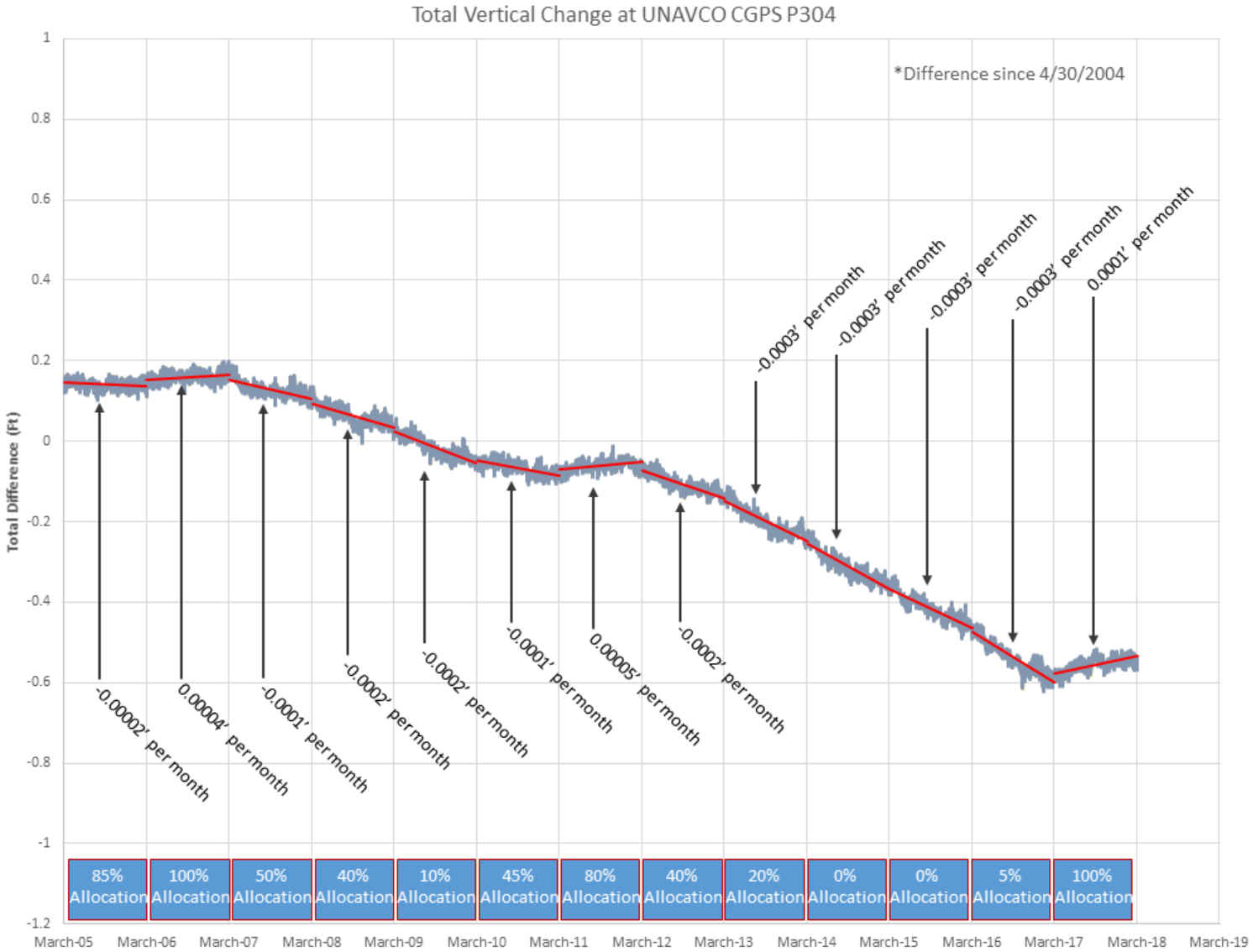


Figure CC-57: Vertical Elevation Change at UNAVCO CGPS P304, Spring 2005 to 2018

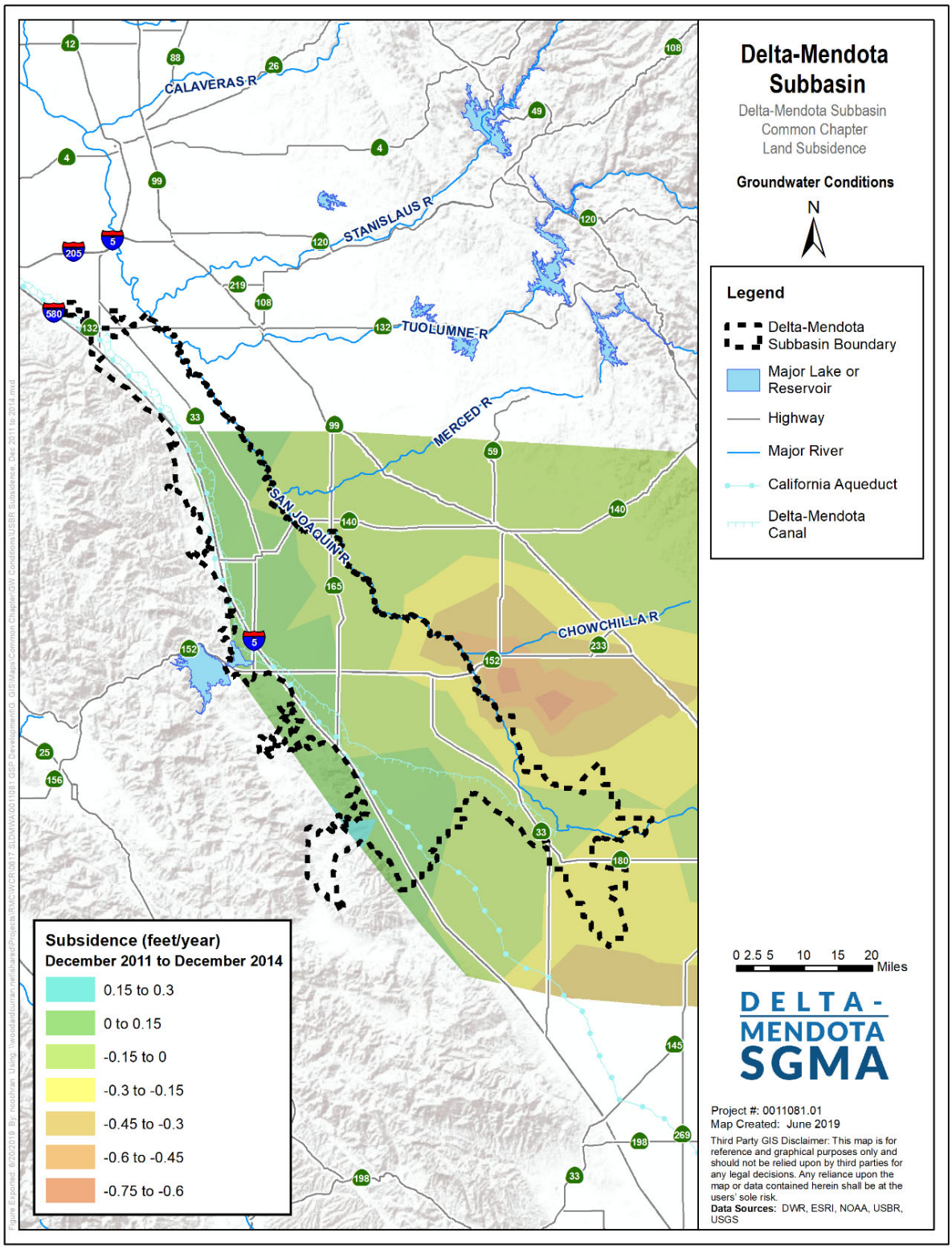


Figure CC-58: Land Subsidence, December 2011 to December 2014

Source: Progress Report: Subsidence in California, March 2015 – September 2016, Farr et. Al. JPL, 2017

Figure CC-59: Recent Land Subsidence at Key San Joaquin Valley Locations

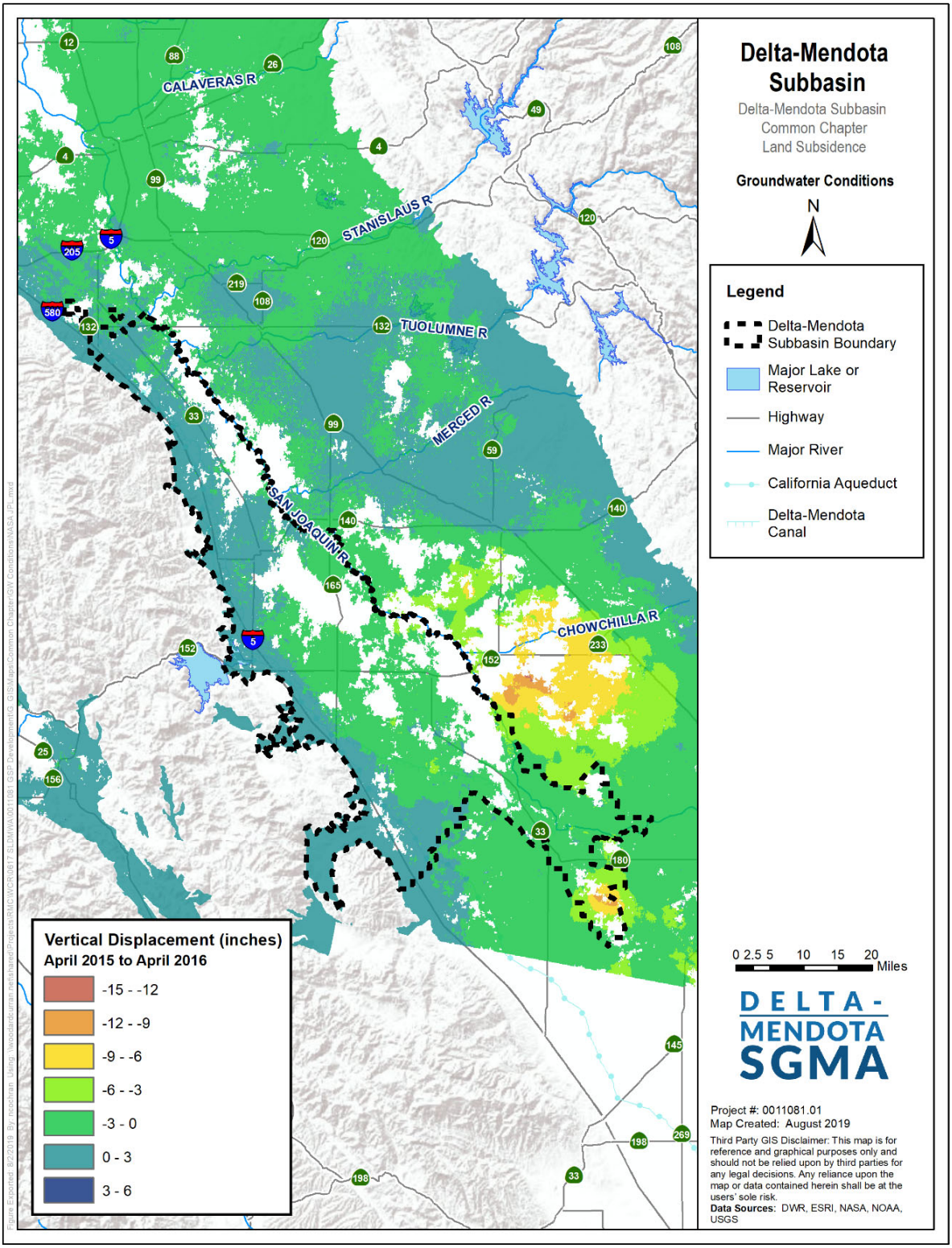


Figure CC-60: Vertical Displacement, April 2015 to April 2016

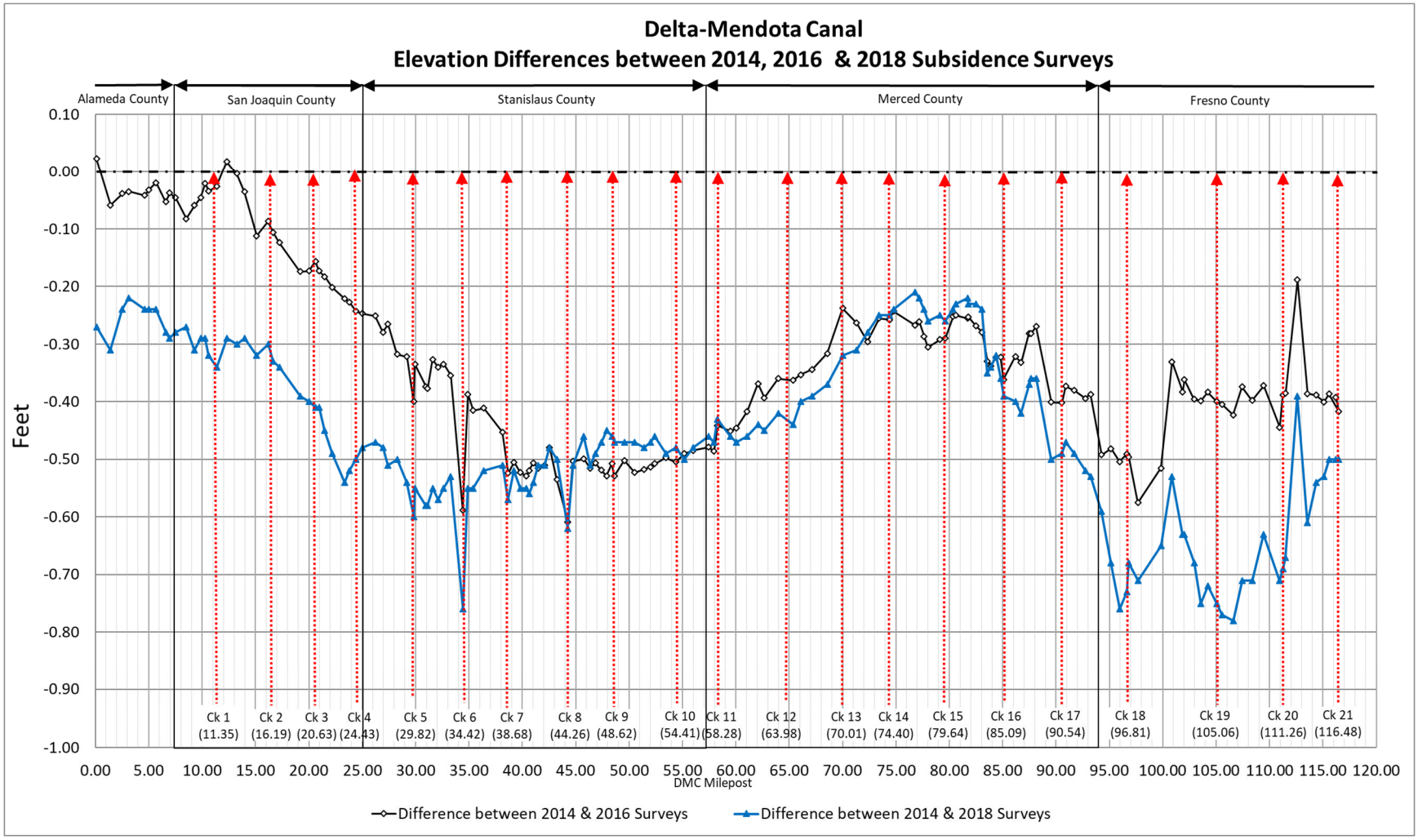


Figure CC-61: Elevation Change along the Delta-Mendota Canal, 2014 through 2018

4.2.7 Interconnected Surface Water Systems

Understanding the location, timing and magnitude of groundwater pumping impacts on interconnected surface water systems is important for the proper management of groundwater resources in order to minimize impacts on interconnected surface waters and the biological communities and permitted surface water diverters that rely on those resources. Historically, throughout the San Joaquin Valley, many interconnected stream reaches have transitioned from net-gaining to net-losing streams (TNC, 2014). Gaining streams occur when streamflows increase as a result of groundwater contribution and losing streams occur when streamflows decrease due to infiltration into the bed of the stream (McBain & Trush, Inc., 2002). Increased groundwater pumping has the ability to contribute to the depletion of interconnected waters with the nature, rate, and location of increased pumping being a function of distance to the river, as well as depth, timing, and rate of groundwater pumping.

Available Data

Two communities in the Delta-Mendota Subbasin are likely most vulnerable to the loss of interconnected surface water as a result of groundwater pumping: San Joaquin River surface water diverters and groundwater dependent ecosystems (GDEs). These communities represent the primary beneficial users of interconnected surface water and groundwater. Streams stemming from the west side of the Delta-Mendota Subbasin are ephemeral in nature, and only two of these creeks reach the San Joaquin River (Del Puerto Creek and Orestimba Creek). These creeks lose their flows to the underlying vadose zone (net-losing streams) and therefore do not represent areas of potential GDEs.

Groundwater dependent ecosystems are defined under Article 2 Definitions, § 351 Definitions of the GSP Emergency Regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018) provided by DWR in conjunction with The Nature Conservancy (TNC) was initially used to identify GDEs within the Delta-Mendota Subbasin, following the associated guidance document provided by TNC (Rohde et al., 2018). Local verification efforts were conducted in the Delta-Mendota Subbasin by different GSA representatives to ground-truth GDEs based on local knowledge. Specifically, areas where natural communities have been urbanized or otherwise modified prior to 2015 were eliminated from the data set used to identify GDEs.

Identification of Interconnected Surface Water Systems

The San Joaquin River and Fresno Slough are the primary surface water bodies interconnected with Delta-Mendota Subbasin groundwater. For information about the sources used to determine the interconnected segments of the San Joaquin River and Fresno Slough within the Delta-Mendota Subbasin, refer to the individual GSPs.

Historic Conditions

The San Joaquin River and its tributaries drain approximately 13,500 mi^2 (measured at the USGS gaging station at Vernalis) along the western flank of the Sierra Nevada and eastern flank of the Coast Range, and flows northward into the Sacramento-San Joaquin Delta where it is joined by the Calaveras and Mokelumne Rivers before combining with the Sacramento River. Typical of Mediterranean climate catchments, river flows vary widely seasonally and from year to year. Three major tributaries join the San Joaquin from the east: the Merced, Tuolumne, and Stanislaus Rivers. Smaller tributaries include the Fresno River, Chowchilla River, Bear Creek, and Fresno Slough (from the Kings River). Precipitation is

predominantly snow above about 5,500 to 6,000 feet in the Sierra Nevada, with rain in the middle and lower elevations of the Sierra foothills and in the Coast Range. As a result, the natural hydrology historically reflected a mixed runoff regime dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff. Most flow is derived from snowmelt from the Sierra Nevada, with relatively little runoff contributed from the western side of the drainage basin in the rain shadow of the Coast Range. The unimpaired average annual water yield (WY1906-2002) of the San Joaquin River, as measured immediately above Millerton Reservoir, is 1,801,000 acre-feet (USBR, 2002); the post-Friant Dam average annual water yield (WY 1950-2000) to the lower San Joaquin River is 695,500 acre-feet (USGS, 2000). As average precipitation decreases from north to south, the San Joaquin River basin (including the Stanislaus, Tuolumne, and Merced Rivers) contributes about 22% of the total runoff to the Delta (DWR, 1998).

Current Conditions

Historically, most of the San Joaquin River, which forms the great majority of the Delta-Mendota Subbasin's eastern border, was a gaining reach. Snowmelt runoff during the spring and early summer resulted in these conditions through a good portion of the year. However, significant decreases in groundwater elevations due to a myriad of factors, including pumping, tile drains, the channelizing of flood flows, and upstream diversions on the river, have reversed this condition so most reaches are now losing reaches. Some localized gaining reaches still remain on the lower river, such as between the Stanislaus and Merced Rivers; however, many reaches along these rivers (and along localized streams) may transition from gaining to losing depending on hydrology.

Estimates of Timing and Quantity of Depletions

Using available data and where feasible, each Delta-Mendota Subbasin GSP Group quantified the gains and/or losses from the groundwater at each interconnected reach of the San Joaquin River adjoining the Delta-Mendota Subbasin. **Table CC-6~~Table CC-6~~** summarizes these estimates. For more information about the sources or methods used to estimate the timing and quantity of depletions, refer to the individual GSPs.

Table CC-6: Estimated Quantity of Gains/Depletions for Interconnected Stream Reaches, San Joaquin River

Landmark		River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 1		*267.5 to 229.0*	Located outside the Delta-Mendota Subbasin				
A	Friant Dam	267.5					
	North Fork Road Bridge	266.8					
	Cobb Island Bridge	259.0					
	State Route 41 (Lanes Bridge)	255.2					
	Scout Island Bend	250.0					
	ATSF Railroad Bridge	245.0					
B	State Route 99	243.2					
	Southern Pacific Railroad	243.2					
	State Route 145 Bridge (Skaggs Bridge)	234.1					
	Gravelly Ford	229.0					
REACH 2		*229.0 to 204.8*					
A	Gravelly Ford	229.0		Yes	Losing when flowing		
	Upstream Limit of Right Bank Levee	227.0					
	Upstream Limit of Left Bank Levee	225.0					
B	Chowchilla Bypass Control Structure	216.1	Farmers Water District	Yes	Losing when flowing	-4	2003 to 2013 average. High in 2010 (-8 cfs), low in 2004 and 2009 (-1 cfs)
	Mendota Dam	204.8					
	Mendota Pool			Yes	Losing	-40	-29,000 AFY
REACH 3		*204.8 to 182.0*		Yes	Losing	-25	-18.000 AFY
	Mendota Dam	204.8					
	Avenue 7.5 Bridge (Firebaugh)	195.2					
	Sack Dam	182.0					
REACH 4		*182.0 to 135.8*				~~-5~~0 - 0	Losses when wet; gaining in some areas (but unquantifiable)
A	Sack Dam	182.0		Y~~e~~s - first 2 miles ~~N~~o - next 1.5 miles Y~~e~~s - remaining miles	Losing		
	State Route 152 Bridge	173.9		Yes	Gaining		
B	Sand Slough Control Structure	168.5					
	Mariposa Slough Control Structure	168.4					
	Turner Island Road Bridge	157.2					

Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
Mariposa Bypass confluence	147.2					
Bear Creek/Eastside Bypass confluence	135.8					
REACH 5	*135.8 to 118.0*		Yes	Gaining	unquantifiable	Likely gaining from ag/refuge draining but unquantifiable
Bear Creek/Eastside Bypass confluence	135.8					
State Route 165 Bridge (Lander Avenue)	132.9					
Salt Slough con fluence	127.7					
State Route 140 Bridge (Fremont Ford)	125.1					
Mud Slough confluence	121.2					
Merced River confluence (Hills Ferry Bridge)	118.0					
Newman to Crows Landing		Northern & Central Delta-Mendota	Yes	Gaining	50	50
Crows Landing to Patterson		Northern & Central Delta-Mendota Region	Yes	Gaining	-50 to 200	-50 to 200
Patterson to Vernalis		Northern & Central Delta-Mendota Region	Yes	Gaining	190	6.1 cfs/mi for 30.8 miles. Based on Cooley, W. 2001. *Groundwater flow net analysis for lower San Joaquin River Basin.* Memo to CRWQCB, August 8, 2001

Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined under the GSP Emergency Regulations as referring "to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (§351(m)). Under §354.16(g) of the GSP Emergency Regulations, each Plan is required to identify GDEs within the subbasin utilizing data provided by DWR or the best available information. The following section describes the process for verifying GDEs within the Delta-Mendota Subbasin and the location of verified and potential GDEs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018c) provided by DWR was used in conjunction with information provided by The Nature Conservancy (TNC) to identify GDEs within the Delta-Mendota Subbasin. To further screen available information regarding GDEs, each GSP Group developed individualized criteria. Additional details regarding the screening process implemented by each GSP can be found in the individual GSPs.

Based on the screening process implemented by each individual GSP Group, GDE polygons determined not to be GDEs were removed from the mapping. **Figure CC-62~~Figure CC-62~~** and **Figure CC-63~~Figure CC-63~~** summarize the results of the GDE analysis for the Subbasin. Results are compiled into two habitat classes: wetlands (**Figure CC-62~~Figure CC-62~~**) and vegetation (**Figure CC-63~~Figure CC-63~~**). Wetland features are commonly associated with surface expression of groundwater under natural, unmodified conditions. Vegetation feature types are commonly associated with the sub-surface presence of groundwater (phreatophytes – deep rooted plants). Confirmed GDEs have been grouped into larger polygons based on proximity and aquifer connection.

In general, identified Possible GDEs are primarily located along the San Joaquin River corridor, within the northern portion of the Northern & Central Delta-Mendota Region GSP, the SJREC GSP, the Grassland GSP, and the Fresno GSP Plan Areas, where some possible GDEs have been identified along ephemeral streams that originate from the Coast Range. Table CC-7~~Table CC-7~~ includes all freshwater species within the Delta-Mendota Subbasin as identified by TNC (2018). Per TNC data, these species (listed in Table CC-7~~Table CC-7~~) have either been observed or have the potential to exist within the Delta-Mendota Subbasin; however, the actual presence of these species have not been verified. As a result of the identification of Possible GDEs for the purpose of SGMA, no land use protections for GDEs are conveyed unless otherwise required. Additionally, the Delta Mendota Subbasin recognizes the opportunity to present further-refined GDE delineations in the subsequent GSP Updates.

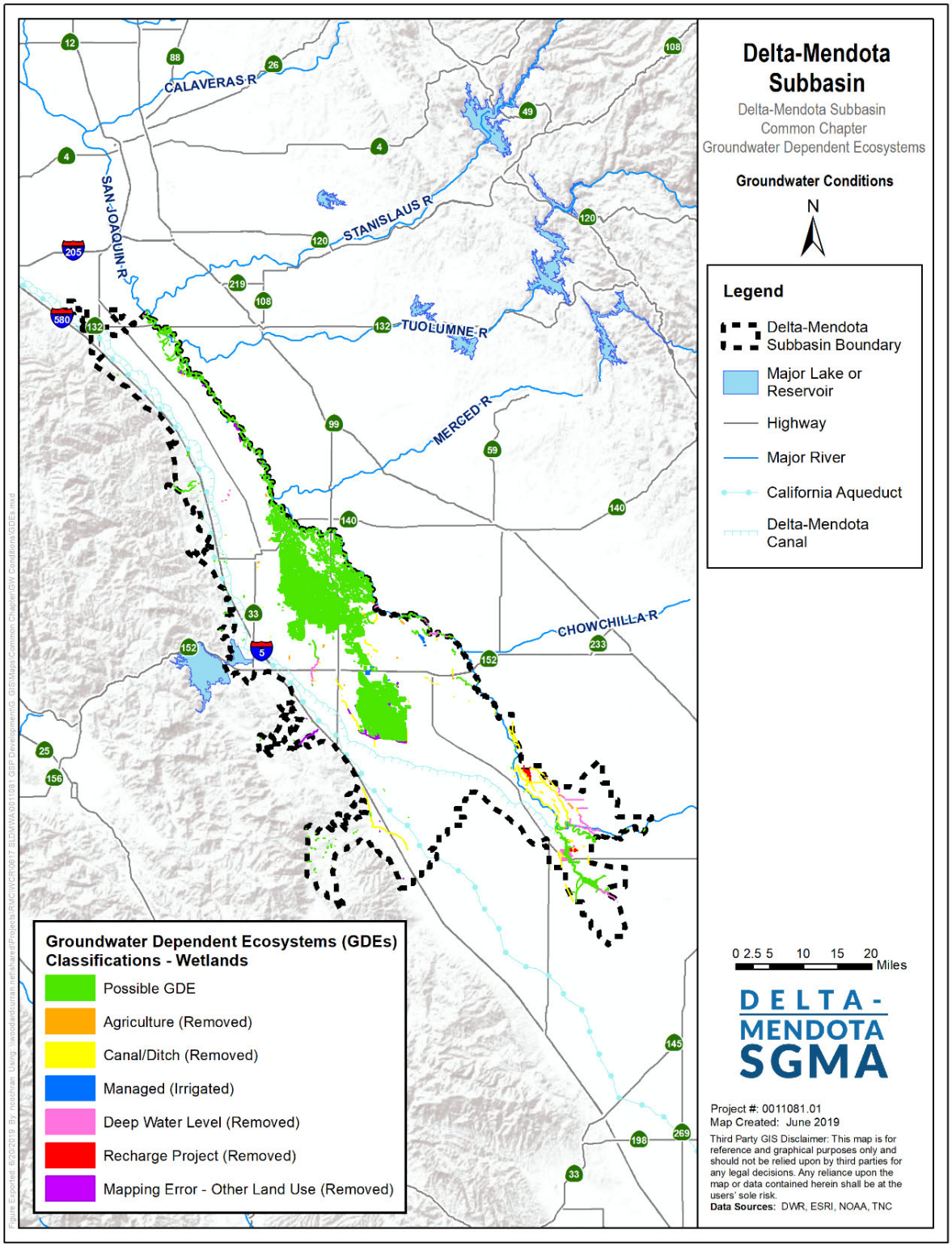


Figure CC-62: Groundwater Dependent Ecosystems, Wetlands

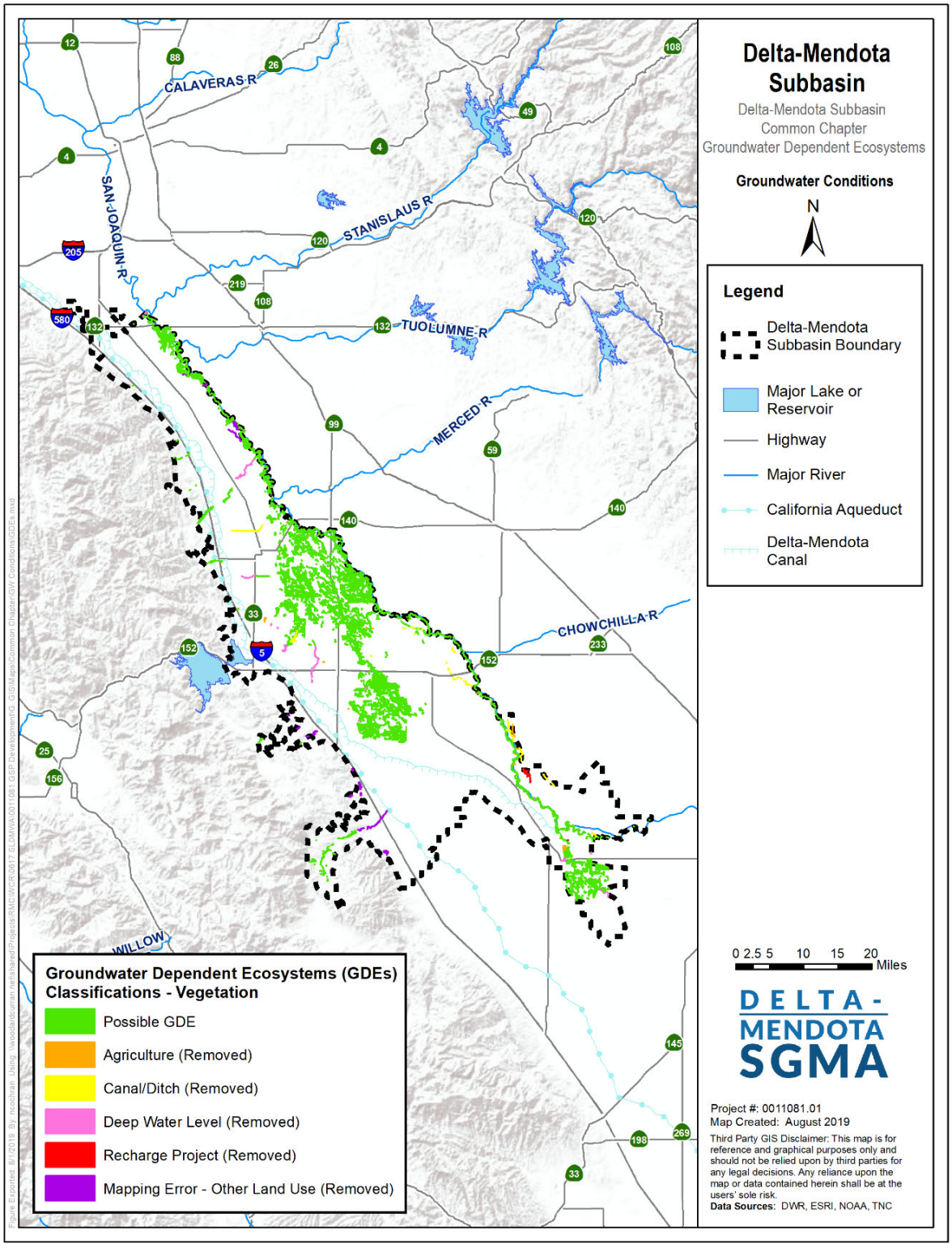


Figure CC-63: Groundwater Dependent Ecosystems, Vegetation

Table CC-7: List of Potential Freshwater Species

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Actitis macularius	Spotted Sandpiper	Birds		
Aechmophorus clarkii	~~Clark's~~Clark's Grebe	Birds		
Aechmophorus occidentalis	Western Grebe	Birds		
Agelaius tricolor	Tricolored Blackbird	Birds	Bird of Conservation Concern	Special Concern
Aix sponsa	Wood Duck	Birds		
Anas acuta	Northern Pintail	Birds		
Anas americana	American Wigeon	Birds		
Anas clypeata	Northern Shoveler	Birds		
Anas crecca	Green-winged Teal	Birds		
Anas cyanoptera	Cinnamon Teal	Birds		
Anas discors	Blue-winged Teal	Birds		
Anas platyrhynchos	Mallard	Birds		
Anas strepera	Gadwall	Birds		-
Anser albifrons	Greater White-fronted Goose	Birds		
Ardea alba	Great Egret	Birds		
Ardea herodias	Great Blue Heron	Birds		
Aythya affinis	Lesser Scaup	Birds		
Aythya americana	Redhead	Birds		Special Concern
Aythya collaris	Ring-necked Duck	Birds		
Aythya marila	Greater Scaup	Birds		
Aythya valisineria	Canvasback	Birds		Special
Botaurus lentiginosus	American Bittern	Birds		
Bucephala albeola	Bufflehead	Birds		
Bucephala clangula	Common Goldeneye	Birds		
Butorides virescens	Green Heron	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Calidris alpina	Dunlin	Birds		
Calidris mauri	Western Sandpiper	Birds		
Calidris minutilla	Least Sandpiper	Birds		
Chen caerulescens	Snow Goose	Birds		
Chen rossii	Ross's Goose	Birds		
Chlidonias niger	Black Tern	Birds		Special Concern
Chroicocephalus philadelphia	Bonaparte's Gull	Birds		
Cistothorus palustris	Marsh Wren	Birds		
Cygnus columbianus	Tundra Swan	Birds		
Cypseloides niger	Black Swift	Birds	Bird of Conservation Concern	Special Concern
Dendrocygna bicolor	Fulvous Whistling-Duck	Birds		Special Concern
Egretta thula	Snowy Egret	Birds		
Empidonax traillii	Willow Flycatcher	Birds	Bird of Conservation Concern	Endangered
Fulica americana	American Coot	Birds		
Gallinago delicata	Wilson's Snipe	Birds		
Gallinula chloropus	Common Moorhen	Birds		
Geothlypis trichas	Common Yellowthroat	Birds		
Grus canadensis	Sandhill Crane	Birds		
Haliaeetus leucocephalus	Bald Eagle	Birds	Bird of Conservation Concern	Endangered
Himantopus mexicanus	Black-necked Stilt	Birds		
Icteria virens	Yellow-breasted Chat	Birds		Special Concern
Limnodromus scolopaceus	Long-billed Dowitcher	Birds		
Lophodytes cucullatus	Hooded Merganser	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Megaceryle alcyon	Belted Kingfisher	Birds		
Mergus merganser	Common Merganser	Birds		
Mergus serrator	Red-breasted Merganser	Birds		
Numenius americanus	Long-billed Curlew	Birds		
Numenius phaeopus	Whimbrel	Birds		
Nycticorax ~~nycticorax~~	Black-crowned Night-Heron	Birds		
Oxyura jamaicensis	Ruddy Duck	Birds		
Pandion haliaetus	Osprey	Birds		Watch list
Pelecanus erythrorhynchos	American White Pelican	Birds		Special Concern
Phalacrocorax auritus	Double-crested Cormorant	Birds		
Phalaropus tricolor	Wilson's Phalarope	Birds		
Plegadis chihi	White-faced Ibis	Birds		Watch list
Pluvialis squatarola	Black-bellied Plover	Birds		
Podiceps nigricollis	Eared Grebe	Birds		
Podilymbus podiceps	Pied-billed Grebe	Birds		
Porzana carolina	Sora	Birds		
Rallus limicola	Virginia Rail	Birds		
Recurvirostra americana	American Avocet	Birds		
Riparia ~~riparia~~	Bank Swallow	Birds		Threatened
Setophaga petechia	Yellow Warbler	Birds		
Tachycineta bicolor	Tree Swallow	Birds		
Tringa melanoleuca	Greater Yellowlegs	Birds		
Tringa semipalmata	Willet	Birds		
Tringa solitaria	Solitary Sandpiper	Birds		
Vireo bellii	Bell's Vireo	Birds		
Vireo bellii pusillus	Least Bell's Vireo	Birds	Endangered	Endangered

	Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
	Xanthocephalus ~~xanthocephalus~~	Yellow-headed Blackbird	Birds		Special Concern
	Artemia franciscana	San Francisco Brine Shrimp	Crustaceans		
	Branchinecta conservatio	Conservancy Fairy Shrimp	Crustaceans	Endangered	Special
	Branchinecta lindahli	Versatile Fairy Shrimp	Crustaceans		
	Branchinecta longiantenna	Longhorn Fairy Shrimp	Crustaceans	Endangered	Special
	Branchinecta lynchi	Vernal Pool Fairy Shrimp	Crustaceans	Threatened	Special
	Lepidurus packardi	Vernal Pool Tadpole Shrimp	Crustaceans	Endangered	Special
	Linderiella occidentalis	California Fairy Shrimp	Crustaceans		Special
Oncorhynchus mykis~~s~~ - s - CV	Central Valley steelhead	Fishes	Threatened	Special	
	Oncorhynchus mykiss irideus	Coastal rainbow trout	Fishes		
	Pogonichthys macrolepidotus	Sacramento splittail	Fishes		Special Concern
	Actinemys marmorata	Western Pond Turtle	Herps		Special Concern
	Ambystoma californiense	California Tiger Salamander	Herps	Threatened	Threatened
	Anaxyrus boreas	Boreal Toad	Herps		
	Pseudacris regilla	Northern Pacific Chorus Frog	Herps		
	Rana boylii	Foothill Yellow-legged Frog	Herps	Under Review in the Candidate or Petition Process	Special Concern
	Rana draytonii	California Red-legged Frog	Herps	Threatened	Special Concern

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Spea hammondii	Western Spadefoot	Herps	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis atratus	Santa Cruz Gartersnake	Herps		
Thamnophis elegans	Mountain Gartersnake	Herps		
Thamnophis gigas	Giant Gartersnake	Herps	Threatened	Threatened
Thamnophis hammondii	Two-striped Gartersnake	Herps		Special Concern
Thamnophis sirtalis	Common Gartersnake	Herps		
Aeshnidae fam.	Aeshnidae fam.	Insects & other inverts		
Anax junius	Common Green Darner	Insects & other inverts		
Brillia spp.	Brillia spp.	Insects & other inverts		
Callicorixa spp.	Callicorixa spp.	Insects & other inverts		
Capnia hitchcocki	Arroyo Snowfly	Insects & other inverts		
Chironomus spp.	Chironomus spp.	Insects & other inverts		
Coenagrionidae fam.	Coenagrionidae fam.	Insects & other inverts		
Corisella spp.	Corisella spp.	Insects & other inverts		
Cricotopus spp.	Cricotopus spp.	Insects & other inverts		
Ischnura cervula	Pacific Forktail	Insects & other inverts		
Ischnura denticollis	Black-fronted Forktail	Insects & other inverts		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Mesocapnia bulbosa	Bulbous Snowfly	Insects & other inverts		
Paraleptophlebia associata	A Mayfly	Insects & other inverts		
Paratanytarsus spp.	Paratanytarsus spp.	Insects & other inverts		
Phaenopsectra spp.	Phaenopsectra spp.	Insects & other inverts		
Procladius spp.	Procladius spp.	Insects & other inverts		
Psectrocladius spp.	Psectrocladius spp.	Insects & other inverts		
Tanypus spp.	Tanypus spp.	Insects & other inverts		
Tipulidae fam.	Tipulidae fam.	Insects & other inverts		
Trichocorixa spp.	Trichocorixa spp.	Insects & other inverts		
Castor canadensis	American Beaver	Mammals		
Lontra canadensis	North American River Otter	Mammals		
Neovison vison	American Mink	Mammals		
Ondatra zibethicus	Common Muskrat	Mammals		
Anodonta californiensis	California Floater	Mollusks		Special
Margaritifera falcata	Western Pearlshell	Mollusks		Special
Pyrgulopsis diablensis	Diablo Range Pyrg	Mollusks		Special
Alopecurus saccatus	Pacific Foxtail	Plants		
Ammannia coccinea	Scarlet Ammannia	Plants		
Anemopsis californica	Yerba Mansa	Plants		
Arundo donax	NA	Plants		
Azolla filiculoides	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Azolla microphylla	Mexican mosquito fern	Plants		Special
Baccharis salicina		Plants		
Bacopa eisenii	Gila River Water-hyssop	Plants		
Bidens laevis	Smooth Bur-marigold	Plants		
Bolboschoenus glaucus	NA	Plants		
Bolboschoenus maritimus paludosus	NA	Plants		
Callitriche marginata	Winged Water-starwort	Plants		
Ceratophyllum demersum	Common Hornwort	Plants		
Chloropyresclle hispidum		Plants		Special
Chloropyron palmatum	NA	Plants	Endangered	Special
Cotula coronopifolia	NA	Plants		
Crassula aquatica	Water Pygmyweed	Plants		
Crypsis vaginiflora	NA	Plants		
Cyperus erythrorhizos	Red-root Flatsedge	Plants		
Cyperus squarrosus	Awned Cyperus	Plants		
Downingia bella	Hoover's Downingia	Plants		
Downingia pulchella	Flat-face Downingia	Plants		
Echinodorus berteroi	Upright Burhead	Plants		
Elatine brachysperma	Shortseed Waterwort	Plants		
Elatine californica	California Waterwort	Plants		
Eleocharis acicularis	Least Spikerush	Plants		
Eleocharis atropurpurea	Purple Spikerush	Plants		
Eleocharis coloradoensis		Plants		
Eleocharis macrostachya	Creeping Spikerush	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Eleocharis montevidensis	Sand Spikerush	Plants		
Eleocharis quadrangulata	NA	Plants		
Elodea canadensis	Broad Waterweed	Plants		
Epilobium cleistogamum	Cleistogamous Spike-primrose	Plants		
Eragrostis hypnoides	Teal Lovegrass	Plants		
Eryngium castrense	Great Valley Eryngo	Plants		
Eryngium racemosum	Delta Coyote-thistle	Plants		Endangered
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle	Plants		Special
Eryngium vaseyi vallicola		Plants		
Eryngium vaseyi	Vasey's Coyote-thistle	Plants		
Euthamia occidentalis	Western Fragrant Goldenrod	Plants		
Hydrocotyle verticillata	Whorled Marsh-pennywort	Plants		
Juncus acuminatus	Sharp-fruit Rush	Plants		
Juncus xiphioides	Iris-leaf Rush	Plants		
Lasthenia ferrisiae	Ferris'' Goldfields	Plants		Special
Lasthenia fremontii	Fremont's Goldfields	Plants		
Lemna aequinoctialis	Lesser Duckweed	Plants		
Lemna gibba	Inflated Duckweed	Plants		
Lemna minor	Lesser Duckweed	Plants		
Lepidium jaredii	Jared's Pepper-grass	Plants		Special
Lepidium oxycarpum	Sharp-pod Pepper-grass	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Limnanthes douglasii	Douglas'' Meadowfoam	Plants		
Limosella acaulis	Southern Mudwort	Plants		
Lipocarpha micrantha	Dwarf Bulrush	Plants		
Ludwigia peploides	NA	Plants		
Ludwigia repens	Creeping Seedbox	Plants		
Lythrum californicum	California Loosestrife	Plants		
Marsilea vestita	NA	Plants		
Mimulus cardinalis	Scarlet Monkeyflower	Plants		
Mimulus guttatus	Common Large Monkeyflower	Plants		
Montia fontana	Fountain Miner's-lettuce	Plants		
Myosurus minimus	NA	Plants		
Myosurus sessilis	Sessile Mousetail	Plants		
Myriophyllum aquaticum	NA	Plants		
Najas guadalupensis	Southern Naiad	Plants		
Navarretia heterandra	Tehama Navarretia	Plants		
Navarretia leucocephala	White-flower Navarretia	Plants		
Navarretia prostrata	Prostrate Navarretia	Plants		Special
Neostapfia colusana	Colusa Grass	Plants	Threatened	Endangered
Panicum dichotomiflorum	NA	Plants		
Paspalum distichum	Joint Paspalum	Plants		
Persicaria hydropiperoides		Plants		
Persicaria lapathifolia		Plants		
Persicaria maculosa	NA	Plants		
Persicaria pensylvanica	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phacelia distans	NA	Plants		
Phyla lanceolata	Fog-fruit	Plants		
Phyla nodiflora	Common Frog-fruit	Plants		
Pilularia americana	NA	Plants		
Plagiobothrys acanthocarpus	Adobe Popcorn-flower	Plants		
Plagiobothrys greenei	Greene's Popcorn-flower	Plants		
Plagiobothrys humistratus	Dwarf Popcorn-flower	Plants		
Plagiobothrys leptocladus	Alkali Popcorn-flower	Plants		
Plantago elongata	Slender Plantain	Plants		
Pluchea odorata	Scented Conyza	Plants		
Pogogyne douglasii	NA	Plants		
Pogogyne zizyphoroides		Plants		
Potamogeton diversifolius	Water-thread Pondweed	Plants		
Potamogeton foliosus	Leafy Pondweed	Plants		
Potamogeton nodosus	Longleaf Pondweed	Plants		
Potamogeton pusillus	Slender Pondweed	Plants		
Psilocarphus brevissimus	Dwarf Woolly-heads	Plants		
Psilocarphus oregonus	Oregon Woolly-heads	Plants		
Psilocarphus tenellus	NA	Plants		
Puccinellia simplex	Little Alkali Grass	Plants		
Ranunculus sceleratus	NA	Plants		
Rorippa curvisiliqua	Curve-pod Yellowcress	Plants		
Rorippa palustris	Bog Yellowcress	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Rotala ramosior	Toothcup	Plants		
Ruppia cirrhosa	Widgeon-grass	Plants		
Ruppia maritima	Ditch-grass	Plants		
Sagittaria longiloba	Longbarb Arrowhead	Plants		
Sagittaria montevidensis calycina		Plants		
Salix exigua	Narrowleaf Willow	Plants		
Salix gooddingii	Goodding's Willow	Plants		
Schoenoplectus acutus occidentalis	Hardstem Bulrush	Plants		
Schoenoplectus americanus	Three-square Bulrush	Plants		
Sinapis alba	NA	Plants		
Sparganium eurycarpum		Plants		
Stuckenia pectinata		Plants		
Typha domingensis	Southern Cattail	Plants		
Typha latifolia	Broadleaf Cattail	Plants		
Veronica americana	American Speedwell	Plants		
Wolffiella lingulata	Tongue Bogmat	Plants		
Zannichellia palustris	Horned Pondweed	Plants		

Source: The Nature Conservancy (TNC). 2018. Identifying Environmental Surface Water Use~~r~~s - Freshwater Species List for Each Groundwater Basin dataset. https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

4.2.8 Data Gaps

The Delta-Mendota Subbasin is an extensive subbasin covering a large area extending along the northwestern end of the San Joaquin Valley. While there is a significant amount of data available regarding various groundwater-related aspects of the Subbasin, much is still not known in multiple locations around the Subbasin. To this end, the following data gaps have been identified and will be addressed as part of the interim period between adoption of this GSP and its first 5-year update.

- Information regarding subsidence varies in extent around the region. While there is a large amount of land elevation survey data available in association with the DMC and the San Joaquin River Restoration Program, other areas in the Delta-Mendota Subbasin require additional data collection to both further establish and monitor future land subsidence rates.

- Only three shallow groundwater wells exist proximate to the northern end of the San Joaquin River (outside of the area being addressed by the San Joaquin River Restoration Program). Additional nested or clustered monitoring wells are required adjacent to the river on the northern end of the Subbasin to evaluate horizontal and vertical groundwater gradients, and in connection with river stage monitoring, to assess the interconnection between the San Joaquin River and the northeastern end of the Delta-Mendota Subbasin.

- There are a large number of wells in the Delta-Mendota Subbasin where no well construction information exists or is readily available. Video surveys and other surveys should be conducted on selected wells that may potentially be added to the Subbasin monitoring network to (1) identify where the wells are screened, and (2) determine if the well(s) are appropriate as additions to the GSP Groups' groundwater monitoring programs.

- Mapping of GDEs in the Delta-Mendota Subbasin, as contained in this Common Chapter, is an initial assessment of their location. This mapping may be refined using most recent groundwater elevation/depth to water contour mapping.

- Monitoring networks contained herein are preliminary and were formulated based on existing well information. As additional wells are installed in the Subbasin and additional well construction information is obtained for existing wells, these networks may need to be refined to improve on the spatial (areal and vertical) distribution of monitoring points and the data collected for evaluation of conditions of the groundwater basin.

- The sustainable yield estimates and water budgets contained in this Common Chapter for both the Upper and Lower Aquifers were developed using limited data. As additional data are collected over the first five years, improved sustainable yield estimates and estimates of water in storage in both principle aquifers should be prepared utilizing the new data.

In addition to these Subbasin-level data gaps, additional data gaps have been identified for each GSP Plan Area. Please see the individual GSPs for additional identified data gaps.

4.3 Delta-Mendota Subbasin Water Budgets

This section describes the common coordinated assumptions agreed upon and utilized by each GSP Group in the Delta-Mendota Subbasin in developing the historical, current, and projected water budgets for their respective GSP Plan Areas. These coordinated historical, current, and projected water budgets

were then compiled to prepare the subbasin-level water budgets required under the GSP Regulations § 357.4(b)(3)(B), presented below. The sustainable yield for the Upper Aquifer and Lower Aquifer developed at the Subbasin-level and agreed upon by all GSP Groups in the Delta-Mendota Subbasin is also presented along with a description as to how the sustainable yield for each primary aquifer was calculated.

4.3.1 Coordinated Assumptions

All common coordinated assumptions agreed upon and utilized by each GSP Group in preparing their respective historical, current, and projected water budgets are presented in Technical Memoranda 3 (*Assumptions for the Historical, Current, and Projected Water Budgets of the Delta-Mendota Subbasin*), which is included in **Appendix B** of this Common Chapter.

The data and methodologies used to develop the water budgets in the six individual GSPs (and compiled herein as the Subbasin Water Budgets) were coordinated with the express objective to "rely on the best available information and best available science to quantify the water budget for the basin" (Title 23 of the California Code of Regulations [23 CCR] § 354.18(e)). Given the complex nature of the Subbasin, different data sets and methodologies were appropriate for and/or available in different portions of the Subbasin. As such, a significant effort was made by the Subbasin GSAs to: (1) identify the different sources and accuracy of the available data; (2) consolidate these data and associated methodologies into a general hierarchy for use by the GSAs to honor the local conditions, while maintaining consistency with the intent of 23 CCR § 354.18(e); and (3) standardize the terminology for purposes of the Common Chapter presentation of the Subbasin Water Budget. These standardized water budget components and data sources are presented in **Table CC-8** and **Table CC-9** for the historic and current, and projected water budgets, respectively, and are further described below, while acknowledging that significant additional detail is presented in the six underlying GSPs. In some cases, data were not available or applicable, as acknowledged below and in the tables. Additionally, in some cases the specific terminology and/or the details of the calculations included in each underlying GSP remains unique relative to the standardized terminology and descriptions presented below; a full reconciliation of water budget nomenclature will be conducted as part of the 2025 GSP updates, as well as updates to the datasets and methodologies employed. Water use in the Subbasin is largely for agricultural purposes, with local municipal and industrial (M&I) uses. As appropriate, these M&I uses were quantified and incorporated in the individual GSP water budgets.

LAND SURFACE WATER BUDGET

The data sources/methodologies used to estimate the six major components of the Historical and Current Land Surface Water Budgets are summarized in **Table CC-8** and for the Projected Land Surface Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. For purposes of the Subbasin GSPs, the Historical and Current Water Budgets represent Water Year (WY) 2003-2013, where the historical period is WY 2003-2012 and the current year is WY 2013. The Projected Water Budgets reflect projected conditions through 2070[1] and consider the impacts

[1] The Subbasin GSAs agreed to use actual data from WYs 2014-2017 and assume a repeat of the historical hydrology for the years WY 2018-2070. The selected period for the projected water budgets meets SGMA

of climate change and projects and management actions (PMAs). To the extent possible the data sources and methodology used were consistent with those identified by the California Department of Water Resources (DWR) in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the Best Management Practices (BMP) –4 - Water Budget.[1] As applicable and available, models and tools (e.g., the Central Valley Hydrologic Model 2 [CVHM2]) were used to support the local sources and assumptions incorporated into the development of the Subbasin Groundwater Water Budget.

(1) **Precipitation (Inflow).** For the Historical and Current Land Surface Water Budgets, total precipitation across the Subbasin was estimated using either: (1) PRISM: the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM); (2) CIMIS: area-weighted data from the California Irrigation Management Information System (CIMIS) stations located in the Subbasin; California Data Exchange Center (CDEC) and/or (3) data from the National Water Service Station located in Los Banos, CA. Total precipitation was further parsed into effective and non-effective precipitation, as applicable to each GSP area, based on assumptions regarding deep percolation percentages and other losses.

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors and guidance provided by DWR were applied to the historical precipitation record to project the impact of climate change on precipitation across the Subbasin. For example, either (1) the Gridded Statewide Precipitation and Change Factors developed for the Water Storage Investment Program (WSIP) using the Variable Infiltration Capacity (VIC) Macroscale Hydrology Model (DWR, 2018) were applied to the available precipitation data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR Climate Change Technical Advisory Group (CCTAG) were incorporated (DWR CCTAG, 2015).

(2) **Applied Water – Groundwater (Inflow).** To estimate the volume of applied groundwater for the Historical and Current Land Surface Water Budgets (including both agricultural and M&I pumping, as applicable to each GSP area), the total pumping within the Subbasin was estimated using the following hierarchy of sources, depending upon existing records: (1) Flow meters: volumetric flow meter records from pumping wells; (2) Power bills: electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency); and/or (3) Consumptive use: reported crop acreages and consumptive use data based on either Irrigation

requirements by establishing a 50-year period, where the timeframe is continuous between the historic, current, and projected water budgets. The historic hydrologic period for simulating the projected water budget hydrologic schema was chosen as WY 1979-2017, then wrapping around to include WY 1965-1978 hydrology. Actual data and hydrology were used for WY 2014- 2017 with the representative water years simulating WY 2018 and beyond (e.g., WY2018 is represented by the hydrology from WY1979; WY2019 is represented by the hydrology from WY1980, and so forth, with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historical water year 1965 would represent the forty-fourth year of the projection).

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

Training and Research Center (ITRC)[1] Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure or crop coefficient methodologies (e.g., those provided in the Food and Agricultural Organization of the United States (FAO) Irrigation and Drainage Paper No. 56 (FAO-56) (Snyder *et. al*., 2000, Snyder and Bali, 2008) or the ITRC Crop Coefficient data for Zone 14), corrected as applicable, for applied local and imported surface water. This volume of applied groundwater is consistent with the volume estimated under Water Budget Component (9) Extraction of the Groundwater Water Budget (see below).

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of applied groundwater was estimated using various, complementary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production rates would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effects of the planned projects and management actions (PMAs) are implicitly, rather than explicitly, accounted for (i.e., to the extent that climate change and PMAs increase or decrease the amount of water otherwise available to meet applied water demands, the volume of applied groundwater will be adjusted accordingly). Total inflow to Shasta Lake dictates the amount of imported surface water available for use in the Subbasin. The WSIP model was used to analyze the impacts of climate change on the Subbasin and anticipate projected inflow to Shasta Lake, and as to whether or not the water year would be classified as Shasta Critical under the Exchange Contract, the Refuge Contract, and by municipal users.

(3) **Surface Water Inflow (Inflow).** Surface water serves as an inflow to Subbasin water budget as both applied surface water and as seepage from streams and rivers. To estimate the volume of applied surface water for the Historical and Current Land Surface Water Budgets, the total diversions within the Subbasin over the historical and current water budget time periods were reported using the best available data for each source. Deliveries from the Central Valley Project (CVP), State Water Project (SWP), the San Joaquin River, and other local streams and rivers were compiled from records from the following sources, including, but not limited to: State Water Resources Control Board (SWRCB) diversion reports; United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records; CVP refuge water supply delivery data; and GSA member agency records.

To account for seepage of surface water into the Subbasin from streams and rivers for the Historical and Current Water Budgets, California Data Exchange Center (CDEC) data were used (i.e., by comparing the reductions in measured flow at successive gauging stations after accounting for other diversions) and/or from estimates of seepage losses from certain water bodies from prior water infiltration studies or modeling efforts, as described in the individual GSPs. Seepage from streams and rivers is counted either towards the Groundwater Water Budget directly or towards the Land Surface Water Budget and then, because of the lack of storage capacity in the land surface system and by way of mass balance principles, some or all of this

[1] California Polytechnic State University, San Luis Obispo

water adds to the Groundwater Water Budget through Water Budget Component (6) Deep Percolation (see below).

For the Projected Land Surface Water Budgets, the volume of applied surface water was estimated as (1) the records of actual delivery data as available for the respective service areas for WY 2014-2017; and (2) estimates of anticipated future deliveries by WY type for WY 2018-2070, inclusive of climate change considerations to the extent they could be reasonably estimated (i.e., directly modeled based on data provided by DWR and the USBR), or using water year types as a proxy (i.e., future dry year deliveries would reflect historical average dry year deliveries over the historical record). The impacts of planned PMAs on the availability of applied surface water volumes were also incorporated, as applicable.

For the Projected Land Surface Water Budgets, the volume of surface water seepage was adjusted, as applicable and available, based on climate change factors provided by DWR. Changes to surface water seepage were directly estimated as a result of PMAs or other program implementation (e.g., the impact on seepage resulting from the San Joaquin River Restoration Program [SJRRP] implemented by the USBR).

(4) **Surface Water Outflow (Outflow).** As described above, total precipitation was parsed into effective and non-effective precipitation (i.e., the latter being that portion of the total precipitation that cannot be used by the plants because it either runs off or percolates beyond the root zone). Similarly, a portion of the applied water can run off or deep percolate (typically termed "irrigation inefficiency"). Other surface water outflows (losses) from the Subbasin Land Surface Water Budget include agency-measured or estimated "spills" (i.e., outflow from tile drained fields, canal spills, field runoff, and precipitation runoff) and stream gauge readings, flow meter readings, and transfer pumping data. These collective data sets, sources, and methodologies were used to estimate the historical and current outflows from this component of the Subbasin Land Surface Water Budget.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of surface water outflows were estimated based on estimates provided by the GSA member agencies (using water year types as a proxy), while those components that may be impacted by climate change (e.g., runoff) were adjusted to reflect changes to precipitation and reference evapotranspiration (ETo). Changes to surface water outflows were directly estimated as a result of PMAs or other program implementation (e.g., water conservation programs to reduce spills) as information was available.

(5) **Evapotranspiration (Outflow).** The largest outflow for the Historical and Current Land Surface Water Budget is evapotranspiration (consumptive use) by crops. As such, a combination of CIMIs ETo data, crop acreage, and crop coefficient data and methodologies (e.g., ITRC data and methodologies) were utilized to estimate the consumptive use, including municipal uses, of water in the Subbasin. In addition, direct evaporation from surface water bodies and phreatophytes (i.e., groundwater dependent ecosystems [GDEs]) was estimated based on the surface area and time period it was wetted.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the 2030 Central Tendency and 2070 Central Tendency climate change factors or guidance provided by DWR were applied to the historical ETo record to

project the impact of climate change on ETo across the Subbasin. For example, either the Gridded Statewide Precipitation and Change Factors developed for the WSIP using the VIC Macroscale Hydrology Model (DWR, 2018) were applied to the available ETo data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR CCTAG (2015) were incorporated.

(6) **Deep Percolation (Outflow).** For the Historical, Current, and Projected Land Surface Water Budgets, this water budget component is estimated as the sum of the other Outflow components (Water Budget Components 4 and 5) of the Land Surface Water Budget subtracted from the sum of the Inflow components (Water Budget Components 1 through 3) and represents the total volume of water that seeps past the root zone and into the Subbasin aquifer(s). This includes applied water seepage, as well as stream seepage (from the San Joaquin River, Delta-Mendota Canal, and California Aqueduct, and other canals), and delivery losses. To the extent that climate change and PMA implementation affects the volumes of Water Budget Components 1 through 5, these impacts are reflected in the resultant Outflow component, Water Budget Component (6) Deep Percolation, which serves as the inflow component, and Water Budget Component (7) Deep Percolation to the Groundwater Water Budget (see below).

GROUNDWATER WATER BUDGET

The data sources/methodologies used to estimate the Historical and Current Groundwater Water Budgets are summarized in **Table CC-8** and for the Projected Groundwater Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. The time periods for the Groundwater Water Budgets are consistent with those used for the Land Surface Water Budgets, and likewise, to the extent possible, the data sources and methodology used were consistent with those identified by DWR in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the BMP –4 - Water Budget.[1] As identified in **Table CC-8** and **Table CC-9**, significant data gaps were identified in several of the GSPs on key aspects of the Groundwater Water Budget; additional efforts are on-going to address those data gaps and refine the water budgets as part of the 2025 GSP update. As applicable and available, models and tools (e.g., CVHM2, Westside Subbasin Groundwater Model, and a numerical flow model for the Farmers Water District and Fresno County areas) were used to validate the local sources and support assumptions used to develop the Subbasin Groundwater Water Budget.

(7) **Deep Percolation (Inflow).** In all instances, this component of the Groundwater Water Budget is directly linked to the Water Budget Component (6) Deep Percolation of the Land Surface Water Budget. To the extent that climate change is factored into the Historical, Current, and Projected Land Surface Water Budgets, those impacts are reflected in the varying volumes of deep percolation that are assumed to recharge the aquifer system(s) via infiltration.

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

(8) **Lateral Subsurface Flow (Inflow).** For the Historical and Current Groundwater Water Budgets, this component is estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

8A. Upper Aquifer. For the Upper Aquifer, lateral inflows were generally estimated using Darcy's equation[1] and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries. Mountain front recharge from the Coastal Range was also assumed to provide an additional source of inflow to the Upper Aquifer.

8B. Lower Aquifer. To the extent possible, lateral inflows to the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and coarse assumptions regarding contributions of other sources of inflow, or via a groundwater flow model, as available. However, this portion of the Groundwater Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

In instances where there was significant downward flow between the Upper and Lower Aquifers, vertical flow was estimated using Darcy's equation, estimated aquifer characteristics, and groundwater gradients. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while water level maps for wet, normal, and dry water year types were prepared to determine the elevation and groundwater gradient. Furthermore, flow to the Lower Aquifer from the Upper Aquifer is acknowledged as a data gap.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical inflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in inflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs. As additional data are obtained during implementation of the GSPs, the inputs will be updated and improved to revise the Projected Groundwater Water Budget.

(9) **Extraction (Outflow).** Consistent with the methodology used to estimate Water Budget Component (2), Applied Groundwater, of the Historical and Current Land Surface Water Budgets, the total pumping from the Subbasin aquifers was estimated using the following hierarchy of sources depending upon available records: (1) Flow meters: Volumetric flow meter records from pumping wells; (2) Power bills: Electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency and duration of operation); and/or (3)

[1] Darcy's equation in which groundwater flow velocity is identified as a function of the aquifer hydraulic conductivity and hydraulic gradient based upon measured water levels and aquifer properties. Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice Hall, Inc. Englewood Cliffs, NJ. p 16.

Consumptive use: crop acreages and consumptive use data based on either ITRC-METRIC or crop coefficient methodologies. While the exact distribution of pumping from the Upper and Lower Aquifers is acknowledged as a data gap, total extractions were assumed to be partitioned between the aquifers, with the majority of extractions (80-90%) occurring in the Upper Aquifer. Information regarding well construction obtained and compiled from the local and Subbasin Well Census and Inventory projects completed by the GSAs in 2022 will be used to further improve the estimated allocation of groundwater extraction between the aquifers in the 2025 GSP update.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of pumped groundwater was estimated using various, complimentary methods, including (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record, with the exception of M&I pumping which was projected based on information provided in various source documents such as Urban Water Management Plans). Climate change impacts and the effect of the planned PMAs are implicitly, rather than explicitly, accounted for.

(10) **Lateral Subsurface Flow (Outflow).** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin, but similarly to Water Budget Component (8) of the Groundwater Water Budget.

10A. Upper Aquifer. Lateral outflows were generally estimated using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries.

10B. Lower Aquifer. To the extent possible, lateral outflows from the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. However, this portion of the Groundwater Water Budget was acknowledged as a significant data gap which the GSAs are working to address through the collection and evaluation of additional data, etc.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical outflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in outflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs.

(11) **Change in Storage.** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

11A. Upper Aquifer. A sum of the Outflow components (Water Budget Components 9 through 10) of the Groundwater Water Budget was subtracted from the Inflow components (Water Budget Components 7 and 8) to assess the change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

11B. Lower Aquifer. Approaches varied among the GSPs given the limited available data, which the GSAs are working to address through the collection of additional data, etc. Change in storage was estimated using measured subsidence as a proxy (i.e., due to compaction caused by inelastic land subsidence), as the difference between inflows and outflows based on modeled results, or as an assumed proportion of overall groundwater change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

Projected Groundwater Water Budgets. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the change in storage volumes used in the Historical and Current Water Budgets were averaged by water year type and used throughout the projected water budget period, or were calculated as the difference between inflows and outflows.

Table CC-8: Historical and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS and National Weather Service (NWS)
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports; landowner records	San Joaquin River inflows	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CVO; California Data Exchange Center (CDEC) where available, water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Transfer pumping and San Joaquin River outflows	Transfer pumping that exceeds applied groundwater	Non-effective precipitation and agency measured spills	Evapotranspiration and non-effective precipitation)	Non-effective precipitation and flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS					
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow- Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)			Data G–p - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Flow meters
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Assumed 10% of total pumping
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)				
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Land subsidence as proxy	Inflow - Outflow		Land subsidence as proxy		

Table CC-9: Projected Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)			PRISM and California Irrigation Management Information System (CIMIS), applying CCF		CIMIS and National Weather Service (NWS), applying CCF
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use			Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	San Joaquin River inflows (CDEC and United States Geological Survey [USGS])	Mendota Pool Inflow~~w~~ - USBR CVO	USBR CVO and SWRCB diversion reports, using WY types as a proxy		USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	San Joaquin River outflows (CDEC and USGS)	Mendota Pool outflows (USBR CVO)	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS (calculated with CCFs and WY types as a proxy)					
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy
Groundwater	Outflow	Extraction~~e~~ - Upper Aquifer	Consumptive use and irrigation efficiency using WY type as a proxy with CCFs and PMAs	Adjusted historic metered data using WY type as a proxy with CCFs and PMAs		Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs		
Groundwater	Outflow	Extraction~~e~~ - Lower Aquifer	Unused - Data Gap	Not Applicable	Unused - Data Gap		Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs	
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused – Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) with CCFs
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Unused – Data Gap	Inflow - Outflow	Projected land subsidence and WY types used as a proxy with CCFs and PMAs		Inflow - Outflow	Projected land subsidence and WY types used as proxy with CCFs and PMAs

4.3.2 GSP-Level Water Budgets

Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.

All historical, current, and projected water budgets developed within the Delta-Mendota Subbasin are consistent with GSP Regulations §-354.18 Water Budget, and DWR's *Best Management Practices for the Sustainable Management of Groundwater Water Budget BMP* (2016c) document was used when and where applicable at the discretion of each GSP Group.

4.3.3 Coordinated Water Budgets

The land surface budget, groundwater budget, and annual change in storage for the historical water budget, current water budget, and projected water budget with climate change factors (CCFs) and projects and management actions for the Delta-Mendota Subbasin were developed by compiling the water budgets prepared by each of GSP Group. The land surface budget is an accounting of water flows into and out of the land surface above an aquifer within with Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins, the atmosphere, and the groundwater aquifer below. The groundwater budget is an accounting of groundwater flows into and out of the two principal groundwater aquifers (Upper Aquifer and Lower Aquifer) within the Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins as well as the above land surface.

Subsequent to the submittal of the Delta-Mendota GSP in January 2022, and in response to the Consultation Initiation Letter (CIL) received from DWR on January 21, 2022 in which DWR stated that, while the same data may have been used in developing the water budgets, the terminology used to describe those data sets were not consistent across the basin, the Delta-Mendota Subbasin GSAs acknowledge additional detail was needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets through a reduction in the number of water budget components. The mapping of the original GSP water budget components into the revised simplified coordinated water budget component terminology is discussed in the prior section (Section 4.3.1 of this revised Common Chapter).

After agreeing to the set of common simplified definitions for water budget components, the six Delta-Mendota GSP groups mapped their prior water budget components to the new common definitions.

The revised land surface budget and groundwater budget are presented respectively for the historical water budget in **Table CC-10~~Table CC-8~~** and **Table CC-11~~Table CC-9~~,** for the current water budget in **Table CC-12~~Table CC-10~~** and **Table CC-13~~Table CC-11~~**, and for the projected water budget with climate change factors and projects and management actions in **Table CC-14~~Table CC-12~~** and **Table CC-15~~Table CC-13~~**. All categories presented in the land surface budget and groundwater budget tables were agreed upon by all Delta-Mendota GSP Groups, with representatives from each GSP group tasked with filling out these budget tables as appropriate to account for the unique hydrology, land use, and water use within their respective GSP regions. The tables below are simply compilations of the individual

GSP water budget data as provided by their respective plan preparers, and no water budget data were modified during the mapping process.

Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current, and projected water budgets were completed using best available science and data, and efforts were made to use the same data sources throughout the Subbasin where available, though due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines, or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

~~.~~ **Figure CC-64**~~**Figure CC-64**~~ shows the revised average annual and cumulative change in storage in both principal aquifers under the Subbasin projected water budget (including application of climate change factors and the addition of projects and management actions).

~~Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current and projected water budgets were completed using best available science and data. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.~~

Table CC-108: Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	Total Inflows	Surface Water Outflows	Evapotranspiration	Deep Percolation	Total Outflows
2003	N	450,000	395,000	2,501,000	**3,346,000**	1,306,000	1,772,000	293,000	**3,371,000**
2004	D	412,000	417,000	2,433,000	**3,262,000**	1,206,000	1,760,000	315,000	**3,281,000**
2005	W	739,000	303,000	2,764,000	**3,806,000**	1,614,000	1,810,000	352,000	**3,776,000**
2006	W	571,000	293,000	3,311,000	**4,175,000**	2,111,000	1,804,000	296,000	**4,211,000**
2007	D	258,000	474,000	2,485,000	**3,217,000**	1,230,000	1,701,000	310,000	**3,241,000**
2008	D	328,000	527,000	2,295,000	**3,150,000**	1,140,000	1,769,000	331,000	**3,240,000**
2009	N	304,000	511,000	2,191,000	**3,006,000**	1,017,000	1,813,000	327,000	**3,157,000**
2010	N	539,000	380,000	2,637,000	**3,556,000**	1,515,000	1,655,000	406,000	**3,576,000**
2011	W	626,000	279,000	3,283,000	**4,188,000**	2,013,000	1,799,000	414,000	**4,226,000**
2012	D	275,000	470,000	2,582,000	**3,327,000**	1,301,000	1,679,000	355,000	**3,335,000**

~~Water Year~~	~~Water Year Type~~	~~Precipitation~~	~~Applied Wate_r Groundwater~~	~~Applied Wate_r Imported Surface Water~~	~~Total Inflows~~	~~Runoff~~	~~Evapotranspiration~~	~~Surface Water Outflows~~	~~Deep Percolation~~	~~Total Outflows~~
~~2003~~	~~Normal~~	~~451,000~~	~~382,000~~	~~1,485,000~~	~~2,364,000~~	~~310,000~~	~~1,771,000~~	~~31,000~~	~~291,000~~	~~2,403,000~~
~~2004~~	~~Dry~~	~~412,000~~	~~398,000~~	~~1,486,000~~	~~2,341,000~~	~~263,000~~	~~1,764,000~~	~~31,000~~	~~304,000~~	~~2,362,000~~
~~2005~~	~~Wet~~	~~739,000~~	~~285,000~~	~~1,483,000~~	~~2,567,000~~	~~357,000~~	~~1,811,000~~	~~35,000~~	~~338,000~~	~~2,541,000~~
~~2006~~	~~Wet~~	~~572,000~~	~~270,000~~	~~1,499,000~~	~~2,399,000~~	~~318,000~~	~~1,795,000~~	~~34,000~~	~~289,000~~	~~2,436,000~~
~~2007~~	~~Dry~~	~~259,000~~	~~471,000~~	~~1,499,000~~	~~2,275,000~~	~~240,000~~	~~1,724,000~~	~~31,000~~	~~307,000~~	~~2,302,000~~
~~2008~~	~~Dry~~	~~329,000~~	~~529,000~~	~~1,382,000~~	~~2,288,000~~	~~224,000~~	~~1,797,000~~	~~30,000~~	~~327,000~~	~~2,378,000~~
~~2009~~	~~Normal~~	~~304,000~~	~~517,000~~	~~1,360,000~~	~~2,227,000~~	~~191,000~~	~~1,843,000~~	~~30,000~~	~~321,000~~	~~2,385,000~~
~~2010~~	~~Normal~~	~~538,000~~	~~371,000~~	~~1,392,000~~	~~2,354,000~~	~~283,000~~	~~1,669,000~~	~~30,000~~	~~394,000~~	~~2,376,000~~
~~2011~~	~~Wet~~	~~626,000~~	~~259,000~~	~~1,556,000~~	~~2,518,000~~	~~321,000~~	~~1,794,000~~	~~34,000~~	~~402,000~~	~~2,551,000~~
~~2012~~	~~Dry~~	~~276,000~~	~~471,000~~	~~1,505,000~~	~~2,303,000~~	~~223,000~~	~~1,709,000~~	~~30,000~~	~~353,000~~	~~2,315,000~~

Table CC-119: Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget

Groundwater Budget												
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2003	N	324,000	196,000	117,000	**637,000**	357,000	39,000	260,000	106,000	**762,000**	17,000	5,000	22,000
2004	D	345,000	180,000	114,000	**639,000**	376,000	42,000	286,000	132,000	**836,000**	(180,000)	(48,000)	(228,000)

2005	W	424,000	223,000	128,000	**775,000**	268,000	36,000	269,000	78,000	**651,000**	223,000	14,000	237,000
2006	W	394,000	203,000	120,000	**717,000**	260,000	34,000	264,000	75,000	**633,000**	18,000	(23,000)	(5,000)
2007	D	358,000	161,000	99,000	**618,000**	431,000	48,000	280,000	130,000	**889,000**	(282,000)	(67,000)	(349,000)
2008	D	371,000	169,000	106,000	**646,000**	481,000	55,000	293,000	141,000	**970,000**	(341,000)	(80,000)	(421,000)
2009	N	361,000	195,000	112,000	**668,000**	466,000	53,000	273,000	117,000	**909,000**	(134,000)	(28,000)	(162,000)
2010	N	470,000	211,000	124,000	**805,000**	350,000	39,000	264,000	116,000	**769,000**	180,000	(4,000)	176,000
2011	W	515,000	205,000	124,000	**844,000**	248,000	32,000	277,000	83,000	**640,000**	125,000	(23,000)	102,000
2012	D	417,000	168,000	107,000	**692,000**	432,000	45,000	288,000	141,000	**906,000**	(171,000)	(62,000)	(233,000)

~~**Groundwater Budget**~~

~~Water Year~~	~~Water Year Type~~	~~Inflows~~								~~Outflows~~					~~Change in Storage~~				
		~~Deep Percolation~~			~~Subsurface Groundwater Inflows~~		~~Seepage through Corcoran Clay~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Groundwater Extraction from Upper Aquifer~~	~~Groundwater Extraction from Lower Aquifer~~	~~Subsurface Groundwater Outflows~~		~~Total Outflows~~	~~Estimated Annual Change in Groundwater Storage~~				
		~~*Precipitation Infiltration*~~	~~*Surface Water Infiltration*~~	~~*Applied Water Infiltration*~~	~~*Upper Aquifer*~~	~~*Lower Aquifer*~~						~~*Upper Aquifer*~~	~~*Lower Aquifer*~~		~~Inflows~~	~~Outflows~~	~~Change in Storag_e—Upper Aquifer~~	~~Change in Storag_e—Lower Aquifer~~	~~Change in Storag_e - Total~~
~~2003~~	~~Normal~~	~~51,000~~	~~66,000~~	~~174,000~~	~~206,000~~	~~68,000~~	~~45,000~~	~~32,000~~	~~**642,000**~~	~~350,000~~	~~49,000~~	~~210,000~~	~~105,000~~	~~**759,000**~~	~~641,000~~	~~759,000~~	~~20,000~~	~~5,000~~	~~24,000~~
~~2004~~	~~Dry~~	~~36,000~~	~~65,000~~	~~204,000~~	~~184,000~~	~~64,000~~	~~45,000~~	~~30,000~~	~~**628,000**~~	~~365,000~~	~~49,000~~	~~233,000~~	~~131,000~~	~~**823,000**~~	~~628,000~~	~~822,000~~	~~(183,000)~~	~~(50,000)~~	~~(232,000)~~
~~2005~~	~~Wet~~	~~78,000~~	~~79,000~~	~~181,000~~	~~229,000~~	~~78,000~~	~~45,000~~	~~72,000~~	~~**762,000**~~	~~252,000~~	~~47,000~~	~~223,000~~	~~78,000~~	~~**645,000**~~	~~762,000~~	~~645,000~~	~~212,000~~	~~14,000~~	~~225,000~~
~~2006~~	~~Wet~~	~~59,000~~	~~78,000~~	~~152,000~~	~~208,000~~	~~70,000~~	~~45,000~~	~~98,000~~	~~**710,000**~~	~~238,000~~	~~46,000~~	~~221,000~~	~~78,000~~	~~**628,000**~~	~~710,000~~	~~628,000~~	~~14,000~~	~~(25,000)~~	~~(11,000)~~
~~2007~~	~~Dry~~	~~23,000~~	~~66,000~~	~~218,000~~	~~171,000~~	~~50,000~~	~~45,000~~	~~48,000~~	~~**621,000**~~	~~431,000~~	~~57,000~~	~~217,000~~	~~127,000~~	~~**877,000**~~	~~621,000~~	~~876,000~~	~~(272,000)~~	~~(68,000)~~	~~(339,000)~~
~~2008~~	~~Dry~~	~~26,000~~	~~69,000~~	~~233,000~~	~~186,000~~	~~57,000~~	~~45,000~~	~~40,000~~	~~**656,000**~~	~~475,000~~	~~70,000~~	~~234,000~~	~~131,000~~	~~**955,000**~~	~~655,000~~	~~954,000~~	~~(321,000)~~	~~(81,000)~~	~~(403,000)~~
~~2009~~	~~Normal~~	~~21,000~~	~~66,000~~	~~235,000~~	~~207,000~~	~~62,000~~	~~45,000~~	~~33,000~~	~~**669,000**~~	~~469,000~~	~~66,000~~	~~210,000~~	~~104,000~~	~~**894,000**~~	~~669,000~~	~~893,000~~	~~(123,000)~~	~~(28,000)~~	~~(151,000)~~
~~2010~~	~~Normal~~	~~53,000~~	~~73,000~~	~~267,000~~	~~230,000~~	~~74,000~~	~~45,000~~	~~65,000~~	~~**807,000**~~	~~335,000~~	~~52,000~~	~~215,000~~	~~112,000~~	~~**759,000**~~	~~808,000~~	~~759,000~~	~~190,000~~	~~(5,000)~~	~~184,000~~
~~2011~~	~~Wet~~	~~67,000~~	~~96,000~~	~~239,000~~	~~217,000~~	~~74,000~~	~~45,000~~	~~101,000~~	~~**839,000**~~	~~234,000~~	~~40,000~~	~~229,000~~	~~86,000~~	~~**634,000**~~	~~840,000~~	~~633,000~~	~~124,000~~	~~(23,000)~~	~~100,000~~
~~2012~~	~~Dry~~	~~26,000~~	~~71,000~~	~~257,000~~	~~180,000~~	~~57,000~~	~~45,000~~	~~62,000~~	~~**698,000**~~	~~432,000~~	~~56,000~~	~~230,000~~	~~136,000~~	~~**899,000**~~	~~698,000~~	~~898,000~~	~~(162,000)~~	~~(61,000)~~	~~(224,000)~~

Table CC-12~~10~~: Delta-Mendota Subbasin Current Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	Total Inflows	Surface Water Outflows	Evapotranspiration	Deep Percolation	Total Outflows
2013	D	318,000	521,000	2,597,000	3,436,000	1,386,000	1,671,000	402,000	3,459,000

~~Land Surface Budget~~											
~~Water Year~~	~~Water Year Type~~	~~Inflows~~						~~Outflows~~				
		~~Precipitation~~	~~Surface Water Inflows~~	~~Applied Wate_r - Groundwater~~	~~Applied Wate_r - Imported Surface Water~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Runoff~~	~~Evapotranspiration~~	~~Surface Water Outflows~~	~~Deep Percolation~~	~~Total Outflows~~
~~2013~~	~~Dry~~	~~318,000~~	~~31,000~~	~~514,000~~	~~1,428,000~~	~~17,000~~	~~2,308,000~~	~~228,000~~	~~1,685,000~~	~~30,000~~	~~385,000~~	~~2,328,000~~

Table CC-13~~11~~: Delta-Mendota Subbasin Current Water Budget, Groundwater System

Groundwater Budget												
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2013	D	467,000	173,000	112,000	752,000	477,000	51,000	278,000	136,000	942,000	(128,000)	(55,000)	(183,000)

~~Groundwater Budget~~																
~~Water Year~~	~~Water Year Type~~	~~Inflows~~							~~Outflows~~					~~Change in Storage~~				
		~~Deep Percolation~~			~~Subsurface Groundwater Inflows~~		~~Seepage through Corcoran Clay~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Groundwater Extraction from Upper Aquifer~~	~~Groundwater Extraction from Lower Aquifer~~	~~Subsurface Groundwater Outflows~~		~~Total Outflows~~	~~Estimated Annual Change in Groundwater Storage~~				
		~~*Precipitation Infiltration*~~	~~*Surface Water Infiltration*~~	~~*Applied Water Infiltration*~~	~~*Upper Aquifer*~~	~~*Lower Aquifer*~~						~~*Upper Aquifer*~~	~~*Lower Aquifer*~~		~~Inflows~~	~~Outflows~~	~~Change in Storag_e – Upper Aquifer~~	~~Change in Storag_e – Lower Aquifer~~	~~Change in Storag_e – Total~~
~~2013~~	~~Dry~~	~~28,000~~	~~68,000~~	~~289,000~~	~~177,000~~	~~67,000~~	~~45,000~~	~~65,000~~	~~739,000~~	~~447,000~~	~~65,000~~	~~220,000~~	~~140,000~~	~~917,000~~	~~738,000~~	~~917,000~~	~~(123,000)~~	~~(53,000)~~	~~(176,000)~~

Table CC-1412: Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget (containing climate change factors and projects and management actions)

		Land Surface Budget														
		Inflows							Outflows							
		Precipitation	Applied Water - Groundwater	Surface Water Inflow	Applied Waer - Groundwater (Project Effect–) - NCDM Only	Applied Water - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	Total Inflows	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	Total Outflows
2014	SC	283,000	601,000	1,725,000	0	0	1,000	**2,610,000**	852,000	1,616,000	0	0	230,000	0	0	**2,698,000**
2015	SC	363,000	650,000	1,247,000	0	0	0	**2,260,000**	479,000	1,528,000	0	0	287,000	0	0	**2,294,000**
2016	D	712,000	392,000	1,605,000	0	0	0	**2,709,000**	631,000	1,618,000	0	0	403,000	0	0	**2,652,000**
2017	W	686,000	303,000	3,651,000	0	0	6,000	**4,646,000**	2,423,000	1,773,000	0	0	445,000	0	0	**4,641,000**
2018	N	527,000	389,000	2,628,000	(6,000)	0	7,000	**3,545,000**	1,506,000	1,660,000	0	0	403,000	0	0	**3,569,000**
2019	W	712,000	266,000	3,162,000	(7,000)	2,000	6,000	**4,141,000**	1,975,000	1,810,000	0	0	368,000	0	0	**4,153,000**
2020	D	434,000	394,000	2,187,000	(6,000)	9,000	7,000	**3,025,000**	939,000	1,726,000	0	0	343,000	0	0	**3,008,000**
2021	W	808,000	261,000	3,261,000	(7,000)	7,000	6,000	**4,336,000**	2,025,000	1,821,000	0	0	403,000	0	0	**4,249,000**
2022	W	1,021,000	249,000	3,266,000	(7,000)	7,000	6,000	**4,542,000**	2,190,000	1,834,000	0	0	449,000	0	0	**4,473,000**
2023	N	580,000	389,000	2,658,000	(8,000)	6,000	7,000	**3,632,000**	1,470,000	1,711,000	0	0	403,000	0	0	**3,584,000**
2024	D	573,000	387,000	2,176,000	(3,000)	6,000	6,000	**3,145,000**	963,000	1,726,000	0	0	374,000	0	0	**3,063,000**
2025	W	884,000	261,000	3,256,000	(7,000)	7,000	6,000	**4,407,000**	1,993,000	1,847,000	0	0	424,000	0	0	**4,264,000**
2026	D	575,000	483,000	2,098,000	(43,000)	52,000	9,000	**3,174,000**	914,000	1,785,000	0	0	412,000	0	0	**3,111,000**
2027	D	653,000	481,000	2,078,000	(41,000)	49,000	9,000	**3,229,000**	914,000	1,766,000	0	0	419,000	0	0	**3,099,000**
2028	D	534,000	484,000	2,115,000	(42,000)	50,000	9,000	**3,150,000**	934,000	1,789,000	0	0	353,000	0	0	**3,076,000**
2029	D	462,000	484,000	2,099,000	(46,000)	55,000	9,000	**3,063,000**	910,000	1,744,000	0	0	356,000	0	0	**3,010,000**
2030	SC	417,000	575,000	1,800,000	(47,000)	49,000	3,000	**2,797,000**	833,000	1,624,000	0	0	363,000	0	0	**2,820,000**
2031	SC	492,000	573,000	1,780,000	(48,000)	51,000	2,000	**2,850,000**	815,000	1,633,000	0	0	406,000	0	0	**2,854,000**
2032	W	832,000	269,000	3,250,000	(31,000)	46,000	6,000	**4,372,000**	1,963,000	1,830,000	0	0	490,000	1,000	0	**4,284,000**
2033	D	466,000	490,000	2,001,000	(46,000)	60,000	10,000	**2,981,000**	869,000	1,741,000	0	0	364,000	1,000	0	**2,975,000**
2034	W	851,000	252,000	3,258,000	(29,000)	47,000	7,000	**4,386,000**	2,003,000	1,791,000	0	0	465,000	1,000	0	**4,260,000**
2035	W	731,000	280,000	3,163,000	(32,000)	48,000	7,000	**4,197,000**	1,969,000	1,849,000	0	0	422,000	1,000	0	**4,241,000**
2036	W	774,000	316,000	3,268,000	(31,000)	50,000	7,000	**4,384,000**	2,052,000	1,867,000	0	0	494,000	1,000	0	**4,414,000**
2037	W	1,194,000	252,000	3,274,000	(28,000)	49,000	7,000	**4,748,000**	2,254,000	1,780,000	0	0	607,000	1,000	0	**4,642,000**
2038	N	448,000	431,000	2,689,000	(47,000)	53,000	10,000	**3,584,000**	1,529,000	1,660,000	0	0	381,000	0	0	**3,570,000**
2039	N	488,000	446,000	2,655,000	(46,000)	52,000	10,000	**3,605,000**	1,487,000	1,698,000	0	0	411,000	0	0	**3,596,000**
2040	D	534,000	423,000	2,200,000	(46,000)	66,000	9,000	**3,186,000**	1,001,000	1,712,000	0	0	411,000	1,000	0	**3,125,000**
2041	D	384,000	437,000	2,139,000	(52,000)	62,000	9,000	**2,979,000**	879,000	1,704,000	0	0	374,000	1,000	0	**2,958,000**

Land Surface Budget																
		Inflows							Outflows							
		Precipitation	Applied Water - Groundwater	Surface Water Inflow	Applied Waer - Groundwater (Project Effect–) - NCDM Only	Applied Water - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2042	N	530,000	469,000	2,730,000	(46,000)	51,000	10,000	**3,744,000**	1,532,000	1,795,000	0	0	400,000	0	0	**3,727,000**
2043	D	488,000	437,000	2,101,000	(48,000)	68,000	11,000	**3,057,000**	884,000	1,797,000	0	0	331,000	1,000	0	**3,013,000**
2044	W	875,000	286,000	3,231,000	(37,000)	53,000	11,000	**4,419,000**	2,141,000	1,831,000	0	0	419,000	1,000	0	**4,392,000**
2045	W	622,000	313,000	3,263,000	(45,000)	53,000	12,000	**4,218,000**	1,971,000	1,847,000	0	0	355,000	1,000	0	**4,174,000**
2046	D	268,000	571,000	2,149,000	(57,000)	68,000	12,000	**3,011,000**	893,000	1,794,000	0	0	346,000	1,000	0	**3,034,000**
2047	D	402,000	575,000	2,067,000	(55,000)	64,000	12,000	**3,065,000**	834,000	1,820,000	0	0	383,000	0	0	**3,037,000**
2048	N	331,000	593,000	2,696,000	(49,000)	49,000	12,000	**3,632,000**	1,457,000	1,893,000	0	0	358,000	0	0	**3,708,000**
2049	N	658,000	407,000	2,683,000	(29,000)	62,000	12,000	**3,793,000**	1,525,000	1,706,000	0	0	474,000	2,000	0	**3,707,000**
2050	W	708,000	316,000	3,145,000	(40,000)	54,000	13,000	**4,196,000**	1,974,000	1,878,000	0	0	376,000	1,000	0	**4,229,000**
2051	D	350,000	447,000	2,110,000	(51,000)	69,000	13,000	**2,938,000**	858,000	1,738,000	0	0	302,000	1,000	0	**2,899,000**
2052	D	390,000	553,000	2,103,000	(46,000)	67,000	14,000	**3,081,000**	873,000	1,727,000	0	0	416,000	1,000	0	**3,017,000**
2053	SC	306,000	634,000	1,765,000	(44,000)	47,000	8,000	**2,716,000**	801,000	1,699,000	0	0	304,000	0	0	**2,804,000**
2054	SC	340,000	632,000	1,678,000	(29,000)	34,000	7,000	**2,662,000**	750,000	1,657,000	0	0	354,000	0	0	**2,761,000**
2055	D	630,000	453,000	1,831,000	(39,000)	49,000	14,000	**2,938,000**	855,000	1,742,000	0	0	385,000	1,000	0	**2,983,000**
2056	W	745,000	351,000	3,073,000	(44,000)	46,000	12,000	**4,183,000**	1,935,000	1,894,000	0	0	450,000	0	0	**4,279,000**
2057	W	693,000	313,000	3,150,000	(34,000)	55,000	12,000	**4,189,000**	1,932,000	1,893,000	0	0	401,000	1,000	0	**4,227,000**
2058	N	478,000	547,000	2,688,000	(49,000)	54,000	15,000	**3,733,000**	1,417,000	1,871,000	0	0	446,000	0	0	**3,734,000**
2059	W	739,000	309,000	3,154,000	(33,000)	55,000	13,000	**4,237,000**	1,941,000	1,888,000	0	0	425,000	1,000	0	**4,255,000**
2060	D	405,000	441,000	2,111,000	(52,000)	69,000	15,000	**2,989,000**	847,000	1,786,000	0	0	360,000	1,000	0	**2,994,000**
2061	W	910,000	300,000	3,276,000	(33,000)	55,000	13,000	**4,521,000**	2,106,000	1,896,000	0	0	512,000	1,000	0	**4,515,000**
2062	N	466,000	459,000	2,687,000	(50,000)	58,000	16,000	**3,636,000**	1,482,000	1,757,000	0	0	420,000	0	0	**3,659,000**
2063	N	477,000	544,000	2,674,000	(49,000)	54,000	16,000	**3,716,000**	1,454,000	1,861,000	0	0	397,000	0	0	**3,712,000**
2064	D	338,000	447,000	2,123,000	(49,000)	70,000	16,000	**2,945,000**	818,000	1,780,000	0	0	341,000	1,000	0	**2,940,000**
2065	N	725,000	443,000	2,688,000	(47,000)	58,000	17,000	**3,884,000**	1,502,000	1,739,000	0	0	573,000	1,000	0	**3,815,000**
2066	W	668,000	323,000	3,153,000	(34,000)	55,000	15,000	**4,180,000**	1,929,000	1,897,000	0	0	383,000	1,000	0	**4,210,000**
2067	W	690,000	321,000	3,262,000	(33,000)	55,000	15,000	**4,310,000**	1,942,000	1,898,000	0	0	394,000	1,000	0	**4,235,000**
2068	D	448,000	558,000	1,859,000	(52,000)	69,000	12,000	**2,894,000**	872,000	1,695,000	0	0	327,000	1,000	0	**2,895,000**
2069	D	382,000	561,000	1,824,000	(50,000)	66,000	12,000	**2,795,000**	788,000	1,688,000	0	0	328,000	1,000	0	**2,805,000**
2070	W	962,000	302,000	3,388,000	(34,000)	55,000	16,000	**4,689,000**	2,130,000	1,887,000	0	0	557,000	1,000	0	**4,575,000**

Land Surface Budget														
Water Year	Water Year Type	Inflows							Outflows					
		Precipitation	Surface Water Inflows	Applied Wate_r – Groundwater	Applied Wate_r – Imported Surface Water	Project Effects	Other Direct Recharge	Total Inflows	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	Total Outflows
2014	Shasta Critical	283,000	26,000	556,000	1,025,000	0	7,000	1,897,000	189,000	1,605,000	5,000	200,000	0	1,999,000
2015	Shasta Critical	363,000	26,000	607,000	907,000	0	8,000	1,911,000	169,000	1,519,000	4,000	261,000	0	1,953,000
2016	Dry	712,000	39,000	355,000	1,219,000	0	9,000	2,334,000	280,000	1,598,000	32,000	367,000	0	2,277,000
2017	Wet	686,000	53,000	282,000	1,442,000	16,000	8,000	2,487,000	330,000	1,755,000	39,000	405,000	0	2,529,000
2018	Normal	527,000	39,000	356,000	1,376,000	0	6,000	2,304,000	279,000	1,625,000	33,000	363,000	(1,000)	2,300,000
2019	Wet	712,000	53,000	234,000	1,501,000	11,000	8,000	2,519,000	331,000	1,780,000	39,000	338,000	(1,000)	2,488,000
2020	Dry	434,000	39,000	353,000	1,463,000	9,000	7,000	2,305,000	236,000	1,693,000	32,000	314,000	3,000	2,275,000
2021	Wet	808,000	53,000	227,000	1,499,000	6,000	8,000	2,601,000	383,000	1,787,000	39,000	352,000	10,000	2,561,000
2022	Wet	1,021,000	53,000	216,000	1,502,000	16,000	8,000	2,816,000	440,000	1,803,000	39,000	412,000	10,000	2,694,000
2023	Normal	580,000	39,000	355,000	1,443,000	4,000	6,000	2,427,000	257,000	1,683,000	33,000	371,000	2,000	2,344,000
2024	Dry	573,000	39,000	344,000	1,466,000	8,000	7,000	2,437,000	260,000	1,695,000	32,000	347,000	3,000	2,334,000
2025	Wet	884,000	53,000	227,000	1,501,000	16,000	8,000	2,689,000	355,000	1,815,000	39,000	384,000	10,000	2,593,000
2026	Dry	575,000	39,000	440,000	1,423,000	15,000	8,000	2,500,000	248,000	1,751,000	32,000	377,000	7,000	2,408,000
2027	Dry	653,000	39,000	438,000	1,423,000	14,000	8,000	2,575,000	280,000	1,732,000	32,000	380,000	9,000	2,424,000
2028	Dry	534,000	39,000	442,000	1,424,000	14,000	8,000	2,461,000	275,000	1,758,000	32,000	312,000	9,000	2,377,000
2029	Dry	462,000	39,000	441,000	1,422,000	15,000	8,000	2,387,000	257,000	1,709,000	32,000	312,000	10,000	2,310,000
2030	Shasta Critical	417,000	26,000	531,000	1,136,000	3,000	8,000	2,121,000	209,000	1,591,000	5,000	318,000	9,000	2,123,000
2031	Shasta Critical	492,000	26,000	531,000	1,136,000	3,000	8,000	2,196,000	211,000	1,606,000	5,000	360,000	9,000	2,182,000
2032	Wet	832,000	53,000	234,000	1,503,000	21,000	8,000	2,651,000	335,000	1,802,000	39,000	420,000	23,000	2,596,000
2033	Dry	466,000	26,000	445,000	1,350,000	20,000	8,000	2,315,000	245,000	1,706,000	5,000	316,000	11,000	2,272,000
2034	Wet	851,000	53,000	215,000	1,500,000	34,000	8,000	2,661,000	365,000	1,756,000	39,000	405,000	23,000	2,565,000
2035	Wet	731,000	53,000	243,000	1,502,000	22,000	8,000	2,559,000	324,000	1,815,000	39,000	356,000	23,000	2,534,000
2036	Wet	774,000	53,000	278,000	1,508,000	35,000	8,000	2,656,000	301,000	1,842,000	39,000	441,000	23,000	2,623,000
2037	Wet	1,194,000	53,000	211,000	1,497,000	37,000	8,000	3,000,000	494,000	1,741,000	39,000	554,000	24,000	2,828,000
2038	Normal	448,000	39,000	390,000	1,440,000	12,000	6,000	2,335,000	273,000	1,626,000	33,000	335,000	15,000	2,267,000
2039	Normal	488,000	39,000	404,000	1,439,000	11,000	6,000	2,387,000	265,000	1,664,000	33,000	362,000	15,000	2,324,000
2040	Dry	534,000	39,000	373,000	1,466,000	26,000	7,000	2,445,000	263,000	1,675,000	32,000	376,000	11,000	2,346,000
2041	Dry	384,000	39,000	388,000	1,468,000	16,000	7,000	2,302,000	214,000	1,671,000	32,000	335,000	10,000	2,252,000
2042	Normal	530,000	39,000	427,000	1,484,000	12,000	6,000	2,498,000	282,000	1,759,000	34,000	344,000	15,000	2,419,000
2043	Dry	488,000	39,000	386,000	1,449,000	26,000	7,000	2,395,000	238,000	1,766,000	33,000	285,000	11,000	2,322,000
2044	Wet	875,000	53,000	244,000	1,483,000	50,000	7,000	2,712,000	400,000	1,799,000	40,000	380,000	24,000	2,619,000
2045	Wet	622,000	53,000	270,000	1,512,000	42,000	6,000	2,505,000	328,000	1,809,000	39,000	318,000	23,000	2,494,000
2046	Dry	268,000	39,000	516,000	1,477,000	17,000	7,000	2,324,000	225,000	1,765,000	33,000	301,000	11,000	2,324,000
2047	Dry	402,000	39,000	522,000	1,427,000	15,000	8,000	2,413,000	202,000	1,795,000	32,000	333,000	10,000	2,362,000

Land Surface Budget														
Water Year	Water Year Type	Inflows							Outflows					
		Precipitation	Surface Water Inflows	Applied Water – Groundwater	Applied Water – Imported Surface Water	Project Effects	Other Direct Recharge	Total Inflows	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	Total Outflows
2048	Normal	331,000	39,000	548,000	1,455,000	6,000	5,000	**2,384,000**	212,000	1,858,000	33,000	298,000	14,000	**2,401,000**
2049	Normal	658,000	39,000	359,000	1,438,000	39,000	6,000	**2,539,000**	280,000	1,667,000	33,000	409,000	18,000	**2,389,000**
2050	Wet	708,000	53,000	267,000	1,505,000	48,000	7,000	**2,588,000**	343,000	1,840,000	39,000	336,000	23,000	**2,558,000**
2051	Dry	350,000	39,000	390,000	1,465,000	24,000	7,000	**2,275,000**	222,000	1,704,000	32,000	254,000	11,000	**2,212,000**
2052	Dry	390,000	39,000	496,000	1,421,000	28,000	8,000	**2,382,000**	210,000	1,693,000	32,000	363,000	11,000	**2,298,000**
2053	Shasta Critical	306,000	26,000	576,000	1,109,000	3,000	7,000	**2,027,000**	180,000	1,661,000	5,000	250,000	9,000	**2,096,000**
2054	Shasta Critical	340,000	26,000	575,000	1,045,000	5,000	8,000	**1,999,000**	154,000	1,627,000	4,000	300,000	8,000	**2,085,000**
2055	Dry	630,000	39,000	394,000	1,205,000	16,000	9,000	**2,293,000**	253,000	1,701,000	32,000	317,000	10,000	**2,303,000**
2056	Wet	745,000	53,000	300,000	1,432,000	35,000	8,000	**2,573,000**	311,000	1,857,000	39,000	395,000	22,000	**2,602,000**
2057	Wet	693,000	53,000	261,000	1,505,000	28,000	8,000	**2,548,000**	302,000	1,855,000	39,000	322,000	24,000	**2,518,000**
2058	Normal	478,000	39,000	494,000	1,459,000	11,000	5,000	**2,486,000**	208,000	1,836,000	33,000	380,000	15,000	**2,457,000**
2059	Wet	739,000	53,000	252,000	1,501,000	55,000	8,000	**2,608,000**	306,000	1,844,000	39,000	372,000	24,000	**2,561,000**
2060	Dry	405,000	39,000	377,000	1,466,000	23,000	7,000	**2,317,000**	200,000	1,743,000	32,000	305,000	11,000	**2,280,000**
2061	Wet	910,000	53,000	244,000	1,502,000	56,000	8,000	**2,773,000**	348,000	1,851,000	39,000	459,000	24,000	**2,697,000**
2062	Normal	466,000	39,000	400,000	1,441,000	14,000	6,000	**2,366,000**	230,000	1,716,000	33,000	352,000	15,000	**2,331,000**
2063	Normal	477,000	39,000	483,000	1,453,000	11,000	5,000	**2,468,000**	236,000	1,816,000	33,000	332,000	15,000	**2,417,000**
2064	Dry	338,000	39,000	379,000	1,469,000	26,000	7,000	**2,258,000**	168,000	1,739,000	32,000	287,000	11,000	**2,226,000**
2065	Normal	725,000	39,000	382,000	1,438,000	17,000	6,000	**2,607,000**	249,000	1,693,000	33,000	499,000	16,000	**2,474,000**
2066	Wet	668,000	53,000	261,000	1,503,000	28,000	8,000	**2,521,000**	293,000	1,853,000	39,000	300,000	24,000	**2,485,000**
2067	Wet	690,000	53,000	257,000	1,502,000	28,000	8,000	**2,538,000**	296,000	1,851,000	39,000	313,000	24,000	**2,499,000**
2068	Dry	448,000	26,000	484,000	1,188,000	17,000	8,000	**2,171,000**	222,000	1,650,000	5,000	267,000	11,000	**2,144,000**
2069	Dry	382,000	26,000	490,000	1,191,000	15,000	8,000	**2,112,000**	186,000	1,652,000	5,000	262,000	11,000	**2,105,000**
2070	Wet	962,000	53,000	236,000	1,498,000	55,000	8,000	**2,812,000**	360,000	1,838,000	39,000	490,000	24,000	**2,727,000**

Table CC-1513: Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget
(containing climate change factors and projects and management actions)

Groundwater Budget																		
		Inflows							Outflows							Change in Storage		
			Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effect–) - NCDM Only	Deep Percolation (Project Effect–) - NCDM Only	Project Effects		Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer-Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only		Estimated Annual Change in Groundwater Storage		
		Infiltration	*Upper Aquifer*	*Lower Aquifer*					**Total Inflows**	*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*			**Total Outflows**	*Upper Aquifer*	*Lower Aquifer*	*Total*
2014	SC	275,000	162,000	115,000	0	0	0	0	**552,000**	513,000	101,000	321,000	191,000	0	0	**1,126,000**	(428,000)	(234,000)	(662,000)
2015	SC	333,000	154,000	113,000	0	0	0	0	**600,000**	558,000	101,000	325,000	202,000	0	0	**1,186,000**	(408,000)	(234,000)	(642,000)
2016	D	487,000	152,000	112,000	0	0	0	0	**751,000**	354,000	60,000	313,000	156,000	0	0	**883,000**	(89,000)	(130,000)	(219,000)
2017	W	525,000	198,000	128,000	0	0	0	10,000	**861,000**	254,000	50,000	307,000	91,000	0	0	**702,000**	148,000	(28,000)	120,000
2018	N	465,000	190,000	115,000	0	0	0	0	**770,000**	347,000	59,000	264,000	101,000	0	0	**771,000**	105,000	44,000	149,000
2019	W	461,000	216,000	124,000	0	0	0	10,000	**811,000**	231,000	38,000	279,000	74,000	0	0	**622,000**	122,000	11,000	133,000
2020	D	385,000	153,000	106,000	0	0	3,000	0	**647,000**	354,000	57,000	298,000	136,000	0	0	**845,000**	(185,000)	(142,000)	(327,000)
2021	W	464,000	218,000	125,000	0	0	10,000	0	**817,000**	224,000	39,000	280,000	72,000	0	0	**615,000**	135,000	27,000	162,000
2022	W	553,000	218,000	125,000	0	0	10,000	10,000	**916,000**	214,000	37,000	276,000	77,000	0	0	**604,000**	254,000	40,000	294,000
2023	N	449,000	186,000	117,000	0	0	3,000	0	**755,000**	348,000	55,000	264,000	111,000	0	0	**778,000**	89,000	74,000	163,000
2024	D	417,000	151,000	108,000	0	0	3,000	0	**679,000**	349,000	58,000	301,000	134,000	0	0	**842,000**	(153,000)	(94,000)	(247,000)
2025	W	493,000	214,000	125,000	0	0	10,000	10,000	**852,000**	227,000	38,000	278,000	73,000	0	0	**616,000**	176,000	44,000	220,000
2026	D	451,000	152,000	107,000	0	0	6,000	0	**716,000**	413,000	51,000	302,000	137,000	0	0	**903,000**	(169,000)	(56,000)	(225,000)
2027	D	470,000	152,000	106,000	0	0	9,000	0	**737,000**	411,000	52,000	303,000	131,000	0	0	**897,000**	(148,000)	(47,000)	(195,000)
2028	D	390,000	153,000	104,000	0	0	9,000	0	**656,000**	414,000	51,000	304,000	130,000	0	0	**899,000**	(225,000)	(55,000)	(280,000)
2029	D	395,000	154,000	103,000	0	0	10,000	0	**662,000**	410,000	51,000	303,000	129,000	0	0	**893,000**	(213,000)	(67,000)	(280,000)
2030	SC	400,000	159,000	97,000	0	0	9,000	0	**665,000**	454,000	84,000	312,000	127,000	0	0	**977,000**	(230,000)	(104,000)	(334,000)
2031	SC	442,000	158,000	97,000	0	0	9,000	0	**706,000**	453,000	82,000	313,000	118,000	0	0	**966,000**	(188,000)	(89,000)	(277,000)
2032	W	545,000	220,000	115,000	0	0	22,000	0	**902,000**	213,000	35,000	279,000	68,000	0	0	**595,000**	258,000	61,000	319,000
2033	D	400,000	157,000	98,000	0	0	10,000	0	**665,000**	402,000	50,000	308,000	133,000	0	0	**893,000**	(201,000)	(70,000)	(271,000)
2034	W	547,000	220,000	118,000	0	0	22,000	10,000	**917,000**	203,000	29,000	273,000	70,000	0	0	**575,000**	275,000	57,000	332,000
2035	W	459,000	220,000	119,000	0	0	22,000	0	**820,000**	225,000	34,000	276,000	76,000	0	0	**611,000**	162,000	55,000	217,000
2036	W	552,000	221,000	119,000	0	0	22,000	10,000	**924,000**	243,000	51,000	275,000	76,000	0	0	**645,000**	275,000	65,000	340,000
2037	W	719,000	217,000	122,000	0	0	23,000	10,000	**1,091,000**	202,000	31,000	269,000	80,000	0	0	**582,000**	442,000	53,000	495,000
2038	N	415,000	185,000	114,000	0	0	15,000	0	**729,000**	350,000	58,000	258,000	111,000	0	0	**777,000**	90,000	87,000	177,000
2039	N	455,000	197,000	117,000	0	0	15,000	0	**784,000**	360,000	63,000	262,000	108,000	0	0	**793,000**	142,000	82,000	224,000
2040	D	457,000	151,000	104,000	0	0	10,000	0	**722,000**	348,000	53,000	299,000	136,000	0	0	**836,000**	(82,000)	(65,000)	(147,000)
2041	D	410,000	150,000	101,000	0	0	10,000	0	**671,000**	352,000	56,000	299,000	130,000	0	0	**837,000**	(123,000)	(68,000)	(191,000)
2042	N	448,000	197,000	111,000	0	0	15,000	0	**771,000**	385,000	62,000	264,000	100,000	0	0	**811,000**	98,000	98,000	196,000

Groundwater Budget																			
-	-	Inflows							Outflows							Change in Storage			
-	-	Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effect–) - NCDM Only	Deep Percolation (Project Effect–) - NCDM Only	Project Effects	Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer-Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	Total Outflows	Estimated Annual Change in Groundwater Storage		
-	-		*Upper Aquifer*	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2043	D	368,000	151,000	100,000	0	0	10,000	0	**629,000**	357,000	55,000	298,000	109,000	0	0	**819,000**	(173,000)	(58,000)	(231,000)
2044	W	502,000	209,000	119,000	0	0	23,000	28,000	**881,000**	220,000	38,000	282,000	71,000	0	0	**611,000**	227,000	59,000	286,000
2045	W	413,000	215,000	121,000	0	0	22,000	28,000	**799,000**	235,000	43,000	271,000	77,000	0	0	**626,000**	141,000	32,000	173,000
2046	D	382,000	151,000	101,000	0	0	10,000	0	**644,000**	469,000	68,000	296,000	112,000	0	0	**945,000**	(264,000)	(85,000)	(349,000)
2047	D	422,000	150,000	99,000	0	0	10,000	0	**681,000**	471,000	71,000	298,000	105,000	0	0	**945,000**	(214,000)	(64,000)	(278,000)
2048	N	393,000	187,000	109,000	0	0	14,000	0	**703,000**	475,000	92,000	263,000	100,000	0	0	**930,000**	(27,000)	69,000	42,000
2049	N	545,000	188,000	110,000	0	0	16,000	0	**859,000**	345,000	56,000	262,000	103,000	0	0	**766,000**	209,000	90,000	299,000
2050	W	436,000	217,000	120,000	0	0	23,000	28,000	**824,000**	239,000	46,000	274,000	73,000	0	0	**632,000**	173,000	41,000	214,000
2051	D	343,000	152,000	101,000	0	0	10,000	0	**606,000**	361,000	58,000	296,000	136,000	0	0	**851,000**	(195,000)	(88,000)	(283,000)
2052	D	466,000	150,000	98,000	0	0	10,000	0	**724,000**	463,000	66,000	296,000	105,000	0	0	**930,000**	(183,000)	(82,000)	(265,000)
2053	SC	341,000	156,000	97,000	0	0	9,000	0	**603,000**	499,000	99,000	312,000	104,000	0	0	**1,014,000**	(322,000)	(95,000)	(417,000)
2054	SC	392,000	156,000	96,000	0	0	8,000	0	**652,000**	514,000	98,000	312,000	102,000	0	0	**1,026,000**	(270,000)	(98,000)	(368,000)
2055	D	422,000	152,000	96,000	0	0	9,000	0	**679,000**	376,000	62,000	296,000	101,000	0	0	**835,000**	(138,000)	(69,000)	(207,000)
2056	W	511,000	222,000	115,000	0	0	22,000	28,000	**898,000**	258,000	58,000	278,000	67,000	0	0	**661,000**	244,000	48,000	292,000
2057	W	437,000	222,000	116,000	0	0	23,000	0	**798,000**	249,000	41,000	279,000	73,000	0	0	**642,000**	110,000	46,000	156,000
2058	N	479,000	205,000	108,000	0	0	15,000	0	**807,000**	453,000	69,000	266,000	105,000	0	0	**893,000**	63,000	83,000	146,000
2059	W	482,000	221,000	120,000	0	0	23,000	28,000	**874,000**	245,000	40,000	275,000	74,000	0	0	**634,000**	192,000	55,000	247,000
2060	D	395,000	150,000	101,000	0	0	10,000	0	**656,000**	361,000	51,000	293,000	136,000	0	0	**841,000**	(157,000)	(76,000)	(233,000)
2061	W	581,000	218,000	120,000	0	0	23,000	28,000	**970,000**	238,000	40,000	274,000	72,000	0	0	**624,000**	297,000	56,000	353,000
2062	N	454,000	198,000	113,000	0	0	15,000	0	**780,000**	372,000	60,000	262,000	109,000	0	0	**803,000**	115,000	83,000	198,000
2063	N	431,000	200,000	113,000	0	0	15,000	0	**759,000**	448,000	71,000	264,000	107,000	0	0	**890,000**	17,000	90,000	107,000
2064	D	376,000	152,000	101,000	0	0	11,000	0	**640,000**	368,000	52,000	299,000	134,000	0	0	**853,000**	(183,000)	(68,000)	(251,000)
2065	N	657,000	186,000	111,000	0	0	15,000	0	**969,000**	360,000	60,000	263,000	103,000	0	0	**786,000**	321,000	95,000	416,000
2066	W	419,000	218,000	120,000	0	0	23,000	0	**780,000**	258,000	42,000	280,000	74,000	0	0	**654,000**	78,000	50,000	128,000
2067	W	430,000	217,000	121,000	0	0	23,000	0	**791,000**	257,000	42,000	277,000	77,000	0	0	**653,000**	96,000	54,000	150,000
2068	D	362,000	155,000	102,000	0	0	10,000	0	**629,000**	451,000	64,000	311,000	113,000	0	0	**939,000**	(291,000)	(72,000)	(363,000)
2069	D	364,000	154,000	98,000	0	0	10,000	0	**626,000**	457,000	62,000	312,000	105,000	0	0	**936,000**	(297,000)	(64,000)	(361,000)
2070	W	638,000	211,000	118,000	0	0	23,000	28,000	**1,018,000**	237,000	42,000	270,000	70,000	0	0	**619,000**	350,000	55,000	405,000

Groundwater Budget																					
Water Year	Water Year Type	Inflows								Outflows					Change in Storage						
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	Project Effects	Total Inflows	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		Total Outflows	Estimated Annual Change in Groundwater Storage					
		Precipitation Infiltration	Surface Water Infiltration	Applied Water Infiltration	Upper Aquifer	Lower Aquifer							Upper Aquifer	Lower Aquifer		Inflows	Outflows	Change in Storag_e – Upper Aquifer	Change in Storag_e – Lower Aquifer	Change in Storag_e – Total
2014	Shasta Critical	51,000	58,000	96,000	162,000	70,000	45,000	58,000	0	**540,000**	500,000	97,000	281,000	186,000	**1,109,000**	540,000	1,110,000	(433,000)	(123,000)	(556,000)
2015	Shasta Critical	39,000	57,000	167,000	157,000	68,000	45,000	60,000	0	**593,000**	546,000	98,000	282,000	197,000	**1,168,000**	593,000	1,168,000	(405,000)	(132,000)	(537,000)
2016	Dry	98,000	75,000	235,000	154,000	67,000	45,000	70,000	0	**744,000**	338,000	57,000	280,000	151,000	**871,000**	743,000	871,000	(92,000)	(49,000)	(141,000)
2017	Wet	93,000	93,000	212,000	198,000	82,000	45,000	109,000	16,000	**848,000**	245,000	50,000	260,000	87,000	**687,000**	843,000	688,000	142,000	(14,000)	128,000
2018	Normal	70,000	84,000	228,000	190,000	70,000	45,000	77,000	5,000	**769,000**	328,000	57,000	233,000	100,000	**763,000**	763,000	762,000	105,000	18,000	122,000
2019	Wet	106,000	92,000	145,000	215,000	79,000	45,000	105,000	15,000	**802,000**	226,000	37,000	233,000	73,000	**614,000**	798,000	614,000	116,000	13,000	128,000
2020	Dry	58,000	78,000	179,000	152,000	62,000	45,000	68,000	9,000	**651,000**	336,000	52,000	266,000	134,000	**833,000**	645,000	833,000	(184,000)	(43,000)	(227,000)
2021	Wet	108,000	93,000	166,000	218,000	80,000	45,000	85,000	16,000	**811,000**	219,000	37,000	235,000	71,000	**607,000**	805,000	608,000	128,000	15,000	144,000
2022	Wet	126,000	88,000	221,000	216,000	80,000	45,000	107,000	26,000	**909,000**	209,000	35,000	231,000	75,000	**595,000**	904,000	596,000	246,000	21,000	267,000
2023	Normal	81,000	78,000	212,000	188,000	72,000	45,000	75,000	9,000	**760,000**	329,000	52,000	234,000	108,000	**768,000**	753,000	768,000	91,000	28,000	119,000
2024	Dry	75,000	74,000	194,000	153,000	62,000	45,000	70,000	9,000	**682,000**	331,000	51,000	270,000	132,000	**829,000**	676,000	829,000	(152,000)	(13,000)	(164,000)
2025	Wet	111,000	91,000	173,000	214,000	81,000	45,000	107,000	26,000	**848,000**	220,000	36,000	234,000	71,000	**606,000**	841,000	606,000	170,000	27,000	197,000
2026	Dry	75,000	76,000	223,000	153,000	62,000	45,000	70,000	13,000	**717,000**	391,000	46,000	269,000	135,000	**886,000**	711,000	885,000	(165,000)	(7,000)	(172,000)
2027	Dry	82,000	80,000	233,000	153,000	60,000	45,000	68,000	15,000	**736,000**	390,000	47,000	270,000	128,000	**880,000**	731,000	879,000	(144,000)	0	(144,000)
2028	Dry	72,000	81,000	161,000	156,000	59,000	45,000	68,000	15,000	**657,000**	391,000	47,000	269,000	127,000	**879,000**	651,000	879,000	(216,000)	(5,000)	(222,000)
2029	Dry	60,000	84,000	175,000	155,000	58,000	45,000	68,000	16,000	**661,000**	387,000	46,000	269,000	127,000	**874,000**	654,000	875,000	(208,000)	(13,000)	(221,000)
2030	Shasta Critical	59,000	65,000	204,000	162,000	57,000	40,000	65,000	9,000	**661,000**	440,000	78,000	277,000	125,000	**960,000**	660,000	960,000	(225,000)	(33,000)	(257,000)
2031	Shasta Critical	66,000	66,000	240,000	162,000	57,000	40,000	65,000	9,000	**705,000**	439,000	77,000	276,000	116,000	**948,000**	703,000	947,000	(180,000)	(22,000)	(201,000)
2032	Wet	112,000	97,000	236,000	222,000	75,000	40,000	86,000	29,000	**897,000**	205,000	32,000	240,000	68,000	**585,000**	891,000	584,000	253,000	17,000	271,000
2033	Dry	61,000	69,000	195,000	161,000	57,000	40,000	65,000	17,000	**665,000**	386,000	45,000	273,000	130,000	**874,000**	659,000	874,000	(195,000)	(18,000)	(213,000)
2034	Wet	114,000	96,000	214,000	219,000	77,000	40,000	107,000	39,000	**906,000**	194,000	26,000	233,000	69,000	**562,000**	901,000	562,000	269,000	15,000	285,000
2035	Wet	100,000	93,000	165,000	220,000	78,000	40,000	86,000	29,000	**811,000**	215,000	30,000	237,000	74,000	**596,000**	806,000	596,000	157,000	14,000	171,000
2036	Wet	105,000	89,000	236,000	219,000	78,000	40,000	105,000	39,000	**911,000**	234,000	48,000	236,000	74,000	**632,000**	905,000	633,000	266,000	19,000	285,000
2037	Wet	149,000	86,000	359,000	214,000	83,000	40,000	107,000	40,000	**1,078,000**	192,000	27,000	230,000	77,000	**566,000**	1,072,000	566,000	431,000	14,000	445,000
2038	Normal	80,000	75,000	175,000	187,000	74,000	40,000	75,000	21,000	**727,000**	323,000	54,000	232,000	107,000	**756,000**	722,000	756,000	95,000	20,000	115,000
2039	Normal	72,000	75,000	219,000	195,000	76,000	40,000	77,000	21,000	**775,000**	332,000	60,000	236,000	105,000	**773,000**	769,000	773,000	143,000	20,000	163,000
2040	Dry	76,000	70,000	232,000	154,000	63,000	40,000	70,000	18,000	**723,000**	324,000	46,000	271,000	133,000	**814,000**	717,000	814,000	(75,000)	(11,000)	(87,000)
2041	Dry	61,000	75,000	197,000	153,000	60,000	40,000	68,000	16,000	**670,000**	328,000	49,000	269,000	128,000	**814,000**	665,000	814,000	(115,000)	(12,000)	(127,000)
2042	Normal	80,000	82,000	198,000	197,000	72,000	40,000	75,000	21,000	**765,000**	357,000	58,000	238,000	99,000	**792,000**	758,000	791,000	98,000	27,000	125,000
2043	Dry	72,000	77,000	136,000	152,000	60,000	40,000	70,000	18,000	**625,000**	329,000	49,000	271,000	106,000	**795,000**	617,000	796,000	(171,000)	(10,000)	(180,000)
2044	Wet	117,000	91,000	172,000	209,000	80,000	40,000	107,000	57,000	**873,000**	203,000	35,000	242,000	70,000	**590,000**	867,000	590,000	230,000	17,000	247,000

Groundwater Budget																					
Water Year	Water Year Type	Inflows									Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	Project Effects	Total Inflows	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		Total Outflows	Estimated Annual Change in Groundwater Storage				
		Precipitation Infiltration	Surface Water Infiltration	Applied Water Infiltration	Upper Aquifer	Lower Aquifer							Upper Aquifer	Lower Aquifer		Inflows	Outflows	Change in Storag_e – Upper Aquifer	Change in Storag_e – Lower Aquifer	Change in Storag_e – Total
2045	Wet	89,000	87,000	113,000	215,000	81,000	40,000	107,000	56,000	**788,000**	217,000	40,000	230,000	75,000	**602,000**	782,000	603,000	143,000	9,000	151,000
2046	Dry	44,000	75,000	179,000	154,000	61,000	40,000	68,000	17,000	**638,000**	439,000	62,000	268,000	109,000	**918,000**	632,000	919,000	(259,000)	(19,000)	(278,000)
2047	Dry	52,000	80,000	206,000	152,000	59,000	40,000	68,000	16,000	**673,000**	440,000	65,000	270,000	103,000	**918,000**	667,000	919,000	(210,000)	(10,000)	(220,000)
2048	Normal	52,000	84,000	168,000	188,000	68,000	40,000	75,000	20,000	**695,000**	446,000	85,000	237,000	98,000	**906,000**	690,000	907,000	(26,000)	19,000	(7,000)
2049	Normal	94,000	84,000	271,000	188,000	70,000	40,000	77,000	24,000	**848,000**	312,000	51,000	238,000	101,000	**742,000**	842,000	742,000	210,000	24,000	234,000
2050	Wet	87,000	90,000	133,000	216,000	80,000	40,000	107,000	57,000	**810,000**	219,000	41,000	235,000	72,000	**607,000**	803,000	608,000	172,000	11,000	183,000
2051	Dry	48,000	76,000	134,000	152,000	61,000	40,000	68,000	17,000	**596,000**	329,000	51,000	269,000	133,000	**822,000**	591,000	822,000	(192,000)	(20,000)	(212,000)
2052	Dry	49,000	81,000	249,000	154,000	58,000	40,000	68,000	17,000	**716,000**	430,000	60,000	268,000	103,000	**901,000**	711,000	901,000	(175,000)	(14,000)	(189,000)
2053	Shasta Critical	49,000	63,000	148,000	160,000	57,000	40,000	63,000	9,000	**589,000**	474,000	91,000	276,000	101,000	**982,000**	588,000	982,000	(316,000)	(14,000)	(330,000)
2054	Shasta Critical	37,000	65,000	208,000	161,000	55,000	40,000	63,000	8,000	**637,000**	488,000	91,000	277,000	101,000	**997,000**	638,000	996,000	(262,000)	(18,000)	(280,000)
2055	Dry	85,000	86,000	152,000	156,000	55,000	40,000	70,000	16,000	**660,000**	340,000	54,000	268,000	100,000	**802,000**	654,000	801,000	(139,000)	(6,000)	(145,000)
2056	Wet	95,000	97,000	185,000	220,000	75,000	40,000	107,000	55,000	**874,000**	237,000	52,000	238,000	66,000	**633,000**	869,000	633,000	236,000	17,000	253,000
2057	Wet	97,000	95,000	133,000	223,000	76,000	40,000	85,000	30,000	**779,000**	228,000	34,000	240,000	72,000	**614,000**	772,000	613,000	105,000	14,000	119,000
2058	Normal	66,000	82,000	236,000	205,000	68,000	40,000	75,000	21,000	**793,000**	416,000	61,000	239,000	103,000	**859,000**	786,000	860,000	65,000	20,000	85,000
2059	Wet	101,000	92,000	152,000	222,000	79,000	40,000	107,000	58,000	**851,000**	222,000	33,000	235,000	72,000	**602,000**	845,000	602,000	187,000	18,000	205,000
2060	Dry	59,000	76,000	168,000	151,000	61,000	40,000	70,000	17,000	**642,000**	325,000	42,000	265,000	133,000	**805,000**	635,000	805,000	(155,000)	(13,000)	(167,000)
2061	Wet	108,000	91,000	243,000	217,000	80,000	40,000	107,000	58,000	**944,000**	214,000	33,000	235,000	70,000	**592,000**	938,000	592,000	289,000	20,000	309,000
2062	Normal	73,000	79,000	199,000	199,000	73,000	40,000	77,000	22,000	**762,000**	330,000	53,000	236,000	106,000	**765,000**	756,000	765,000	119,000	21,000	140,000
2063	Normal	71,000	77,000	183,000	201,000	73,000	40,000	75,000	21,000	**741,000**	408,000	61,000	237,000	104,000	**850,000**	735,000	850,000	20,000	25,000	45,000
2064	Dry	50,000	74,000	159,000	153,000	61,000	40,000	68,000	18,000	**623,000**	328,000	42,000	271,000	131,000	**812,000**	616,000	813,000	(180,000)	(9,000)	(190,000)
2065	Normal	81,000	82,000	388,000	187,000	71,000	40,000	77,000	22,000	**948,000**	315,000	53,000	238,000	100,000	**746,000**	941,000	745,000	323,000	26,000	349,000
2066	Wet	94,000	90,000	114,000	219,000	80,000	40,000	85,000	30,000	**752,000**	229,000	34,000	240,000	72,000	**615,000**	745,000	615,000	74,000	17,000	91,000
2067	Wet	97,000	89,000	126,000	216,000	80,000	40,000	85,000	30,000	**763,000**	227,000	33,000	236,000	75,000	**611,000**	756,000	611,000	92,000	16,000	108,000
2068	Dry	65,000	58,000	146,000	157,000	62,000	40,000	63,000	11,000	**602,000**	415,000	53,000	274,000	110,000	**892,000**	603,000	892,000	(284,000)	(12,000)	(296,000)
2069	Dry	57,000	64,000	150,000	156,000	58,000	40,000	63,000	11,000	**599,000**	421,000	53,000	274,000	103,000	**891,000**	598,000	890,000	(290,000)	(8,000)	(298,000)
2070	Wet	119,000	100,000	274,000	211,000	77,000	40,000	107,000	57,000	**985,000**	204,000	33,000	227,000	69,000	**573,000**	980,000	573,000	350,000	19,000	369,000

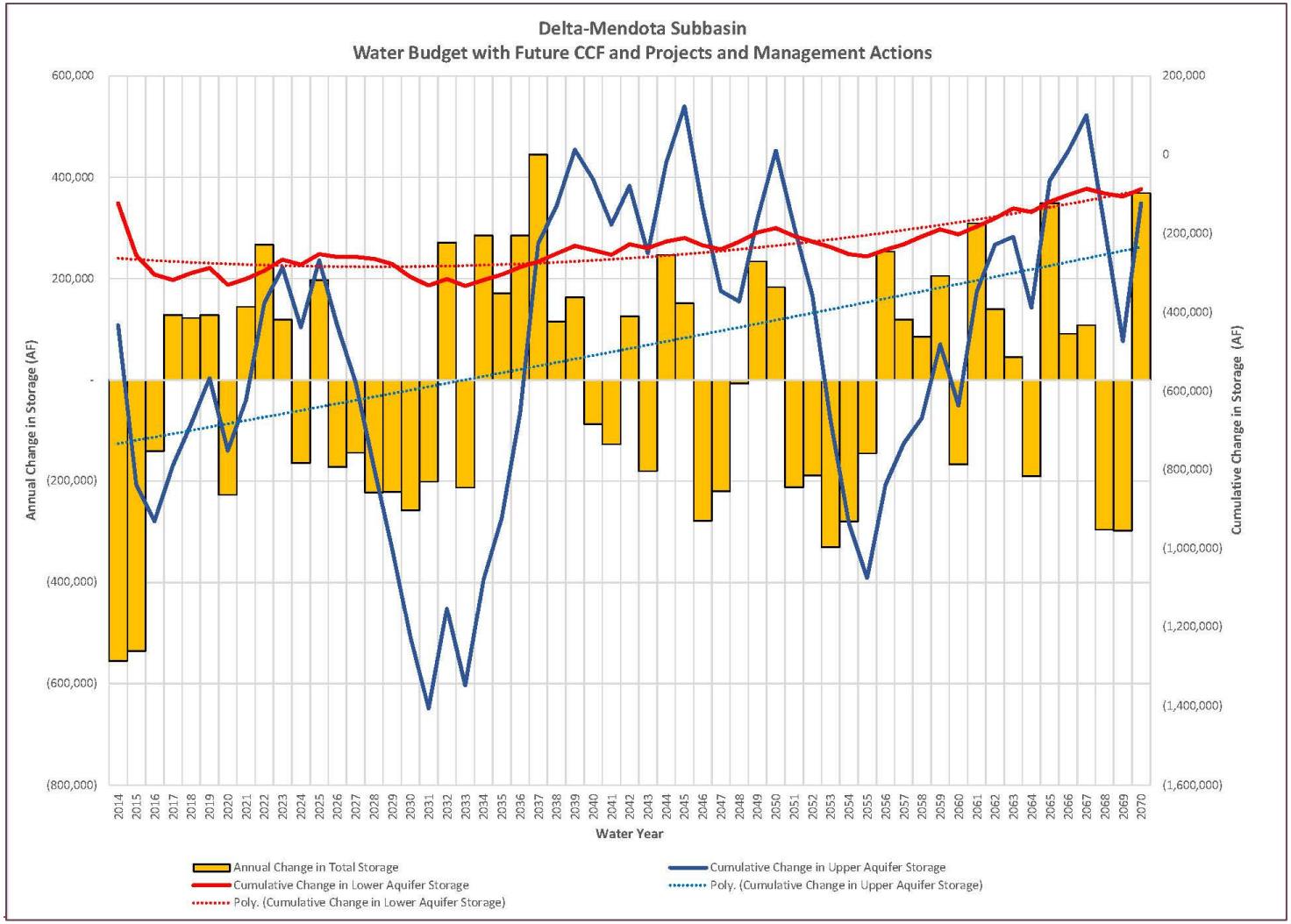
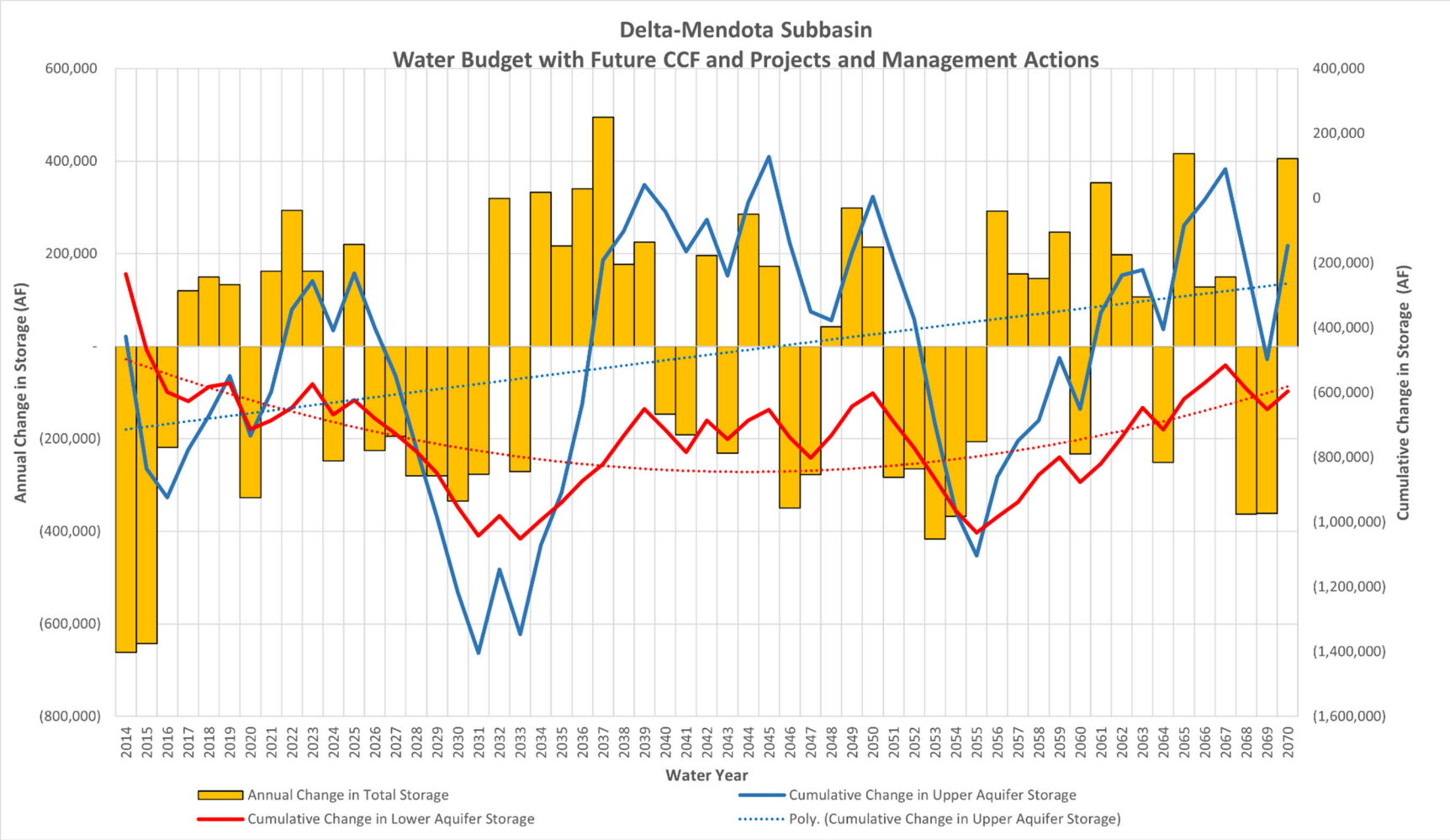

Delta-Mendota Subbasin
Water Budget with Future CCF and Projects and Management Actions
Annual Change in Storage (AF)
Cumulative Change in Storage (AF)
Water Year
600,000
400,000
200,000
-
(200,000)
(400,000)
(600,000)
(800,000)
200,000
0
(200,000)
(400,000)
(600,000)
(800,000)
(1,000,000)
(1,200,000)
(1,400,000)
(1,600,000)
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070
Annual Change in Total Storage
Cumulative Change in Upper Aquifer Storage
Cumulative Change in Lower Aquifer Storage
Poly. (Cumulative Change in Upper Aquifer Storage)
Poly. (Cumulative Change in Lower Aquifer Storage)

Figure CC-64: Change in Storage, Delta-Mendota Subbasin Projected Water Budget



4.3.4 Sustainable Yield

Under SGMA, sustainable yield is defined as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (CWC 10721(w)). Sustainable yield estimates for the Upper Aquifer and Lower Aquifer have been developed in a coordinated fashion for the Delta-Mendota Subbasin by the Delta-Mendota Technical Working Group and approved by the Delta-Mendota Coordination Committee.

Upper Aquifer Sustainable Yield Estimate

Methodologies for calculating Upper Aquifer sustainable yield were discussed by both the Delta-Mendota Coordination Committee and an ad-hoc Technical Working Group of the Coordination Committee. During a workshop dedicated to this effort, several basic concepts and principles were discussed to calculate the Upper Aquifer sustainable yield estimate. Consideration was given to several potential options with increasing detail, including a combination of the following: total Subbasin Upper Aquifer pumping volumes, total Subbasin Upper Aquifer change in storage, and Subbasin Upper Aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota Region GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics.

An overarching goal of this Subbasin is to maintain a balanced water budget by managing groundwater extractions (pumping). Therefore, the Upper Aquifer sustainable yield was estimated using the change in storage from the historic water budget (WY2003-2012). Based on these considerations, the following formula was selected for estimating Upper Aquifer sustainable yield utilizing the consolidated historic water budget components:

> Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Subsurface Outflow – Subsurface Inflow)

~~Given existing Subbasin data gaps and uncertainties associated with the data used to develop the water budgets and this estimate, it was also decided that a +/- 10% factor should be applied to determine a range for the Upper Aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage Subbasin contour mapping for the historic water budget period and the reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the Upper Aquifer.~~

The formula for determining Upper Aquifer sustainable yield was applied to the following compiled Delta-Mendota Subbasin projected water budgets (WY2014-2070):

- ~~—~~Projected Baseline values with Climate Change Factors
- ~~—~~Projected Baseline values with Climate Change Factors and Projects and Management Actions

This analysis resulted in an Upper Aquifer Sustainable Yield estimate ~~ranging from 325,000 acre-feet to of~~ 480,000403,000 acre-feet~~, demonstrating the Subbasin's Upper Aquifer sustainable yield estimated without implementing any projects and management actions (low end of range) and how the Subbasin's~~

~~Upper Aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range)~~.

The Upper Aquifer sustainable yield values, derived from calculations using the best available but limited data, are is considered to be a preliminary estimations only and will be updated to an anticipated higher level of accuracy in future GSP updates. The intention of the Delta-Mendota Subbasin GSAs, following GSP submission in 2020, is to increase subbasin-wide data collection efforts. Improved data, modeling results, and understanding of subsurface flows will allow the GSAs and each GSP Group to improve estimated sustainable yield values for future GSP updates. The GSP Groups are in the process of developing GSP implementation guidelines that will address future data collection efforts and other GSP implementation activities.

The Upper Aquifer sustainable yield calculated range reflects the principle that the GSAs within the Delta-Mendota Subbasin reserve the right to claim or retain some portion of subbasin outflow generated by the lowering of groundwater levels from neighboring subbasins and the equitable portion of sources of recharge shared between two subbasins, by physical or non-physical means, in the future if the Delta-Mendota Subbasin GSAs determine that doing so will improve Subbasin sustainability or will prevent undesirable results due to the chronic lowering of groundwater levels. Furthermore, intra-basin coordination during GSP development, followed by continuing inter-basin coordination discussions and data collection after GSP adoption, will allow the GSAs to further refine these determinations.

Lower Aquifer Sustainable Yield Estimate

Currently, within the Delta-Mendota Subbasin, the distribution of known Lower Aquifer water level data and extraction volume data are not sufficient to allow for an accurate calculation of Lower Aquifer sustainable yield utilizing the same methodology as for the Upper Aquifer. Following discussions by both the Coordination Committee and the ad hoc Technical Working Group of the Coordination Committee, a consensus was reached to establish a Lower Aquifer sustainable yield estimate for the Subbasin by evaluating studies previously conducted in adjoining subbasinsbased on a projection of existing subsidence rates as measured along the DMC with the minimum threshold established for inelastic land subsidence.

In the original 2020 submittal, the calculation for the Lower Aquifer sustainable yield was based on the following. The Westlands Water District GSA recently conducted a study using groundwater modeling, in conjunction with the Westside GSP development, to estimate sustainable yield for the Westside Subbasin. Based on an analysis of available data and an initial assumption of Lower Aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018), the GSA estimates a sustainable yield of 230,000 to 250,000 acre-feet, with historic conditions suggesting a range from 250,000 to 300,000 acre-feet (Westlands Water District GSA, Westside Subbasin's Groundwater Model Forecast and Augmentation Strategies presentation to the WWD Board on April 3, 2019). Using Westlands Water District GSA's analysis, the Delta-Mendota Coordination Committee recommended a slightly more conservative sustainable yield value of one-third (0.33) an acre-foot per acre for the Delta-Mendota Subbasin. Using this more conservative value, the estimated Lower Aquifer sustainable yield is approximately 250,000 acre-feet per year over the approximately 750,000-acre subbasin. It should be noted that sustainable management of the Lower Aquifer is governed by significant and unreasonable subsidence rather than sustainable yield. The distribution of sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of each GSA in the Subbasin to manage Lower Aquifer pumping to prevent significant and unreasonable subsidence.

Acknowledging that land subsidence is occurring at localized areas in the Subbasin, the DMCC refined the Lower Aquifer sustainable yield calculation, adjusting the value from 250,000 AF to 101,000 AF, based on observed extractions from the Lower Aquifer during WY2015. This refinement is consistent

with the common definitions established across the Subbasin for all SMCs. It is important to note that subsidence will be the primary factor influencing the allowable volume of groundwater that can be extracted from the Lower Aquifer without incurring significant and unreasonable impacts on beneficial uses and users. As such, this number will be updated as data gaps are filled, particularly using the Proposition (Prop) 68 grant-funded well inventory and subsidence study and the results of the Airborne Electromagnetic (AEM) survey recently completed by DWR. Furthermore, the Subbasin will investigate the feasibility to recharge the Lower Aquifer as a means of reducing subsidence and managing future Lower Aquifer sustainable yield.

~~Since DWR classified the Delta-Mendota Subbasin as a critically overdraft subbasin due to subsidence issues, the more conservative acre-foot per acre value for a Lower Aquifer sustainable yield estimation is considered valid as a starting point for the Subbasin. Lower Aquifer groundwater extractions may be managed to a stricter criterion in some areas in order to reduce or eliminate the potential for future inelastic land subsidence on critical infrastructure.~~

The Lower Aquifer sustainable yield estimate will be refined in the future based on data collected and compiled for the Subbasin. This current sustainable yield approximation highlights the importance of an accepted Subbasin-level subsidence monitoring program concurrent with improved estimates of sub-Corcoran Clay groundwater extractions.

5. SUSTAINABLE MANAGEMENT CRITERIA

As required by Subarticle 3. Sustainable Management Criteria of the GSP regulations, the GSPs must include a sustainability goal and definitions of undesirable results, in addition to defining what is considered to be significant and unreasonable and establishing minimum thresholds, measurable objectives and 5-year interim goals. Given the variability of conditions within the Delta-Mendota Subbasin, a subbasin-wide sustainability goal and definitions of undesirable results were developed at the subbasin-level, while the definitions of significant and unreasonable, minimum thresholds, measurable objectives and 5-year interim goals were established at the GSP Plan area-level.

This section describes the coordinated sustainability goal and definition of undesirable results at a subbasin-level and the sustainable management criteria at a GSP-level. Sustainable management criteria developed by each GSP Group were further compared and coordinated between neighboring GSP Groups to avoid conflicts, particularly in setting numeric minimum thresholds, measurable objectives, and interim milestones at boundary locations. The sustainable management criteria for each GSP Group for each applicable sustainability indicator are presented herein.

5.1 Coordinated Assumptions and Data

All common coordinated assumptions and data agreed upon and implemented by each GSP Group in developing their respective sustainable management criteria for each applicable sustainability indicator are presented in Technical Memoranda 4 (*Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Indicators, and GSP Documentation*), which is included in **Appendix B** of this Common Chapter.

During preparation of the January 2020 GSP, ~~Once~~ each GSP Group drafted their respective sustainable management criteria for each applicable sustainability indicator and then met ~~, the Delta-Mendota Subbasin Technical Working Group requested that all GSP Groups meet~~ with their neighboring GSP Groups to coordinate minimum thresholds and measurable objectives to avoid conflicts and ensure each GSP Group would not negatively impact their neighboring GSP Groups from achieving sustainability. ~~These coordination meetings took place between April and August of 2019.~~In the CIL received on January 21, 2022, DWR stated that "The GSPs have not established common definitions of undesirable results in the Subbasin." nor did they comply with the Emergency GSP Regulations in establishing common definitions and methodologies for SMC. In response, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to develop, at a subbasin level, singular coordinated definitions and methods for establishing SMC for each applicable sustainability indicator.

5.2 Coordinated Sustainability Goal and Undesirable Results

The sustainability goal for the Delta-Mendota Subbasin was established to succinctly state the objectives and desired conditions of the Subbasin that culminates 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:

> *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 during the 20222 revision of this Common Chapter for the following applicable sustainability indicators:

- **Chronic lowering of groundwater ~~levels~~levels** - Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater~~Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions~~.

- **Reduction in groundwater ~~storage~~storage** - A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater~~Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions~~.

- **Degraded water ~~quality~~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~~Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities~~.

- **Land ~~subsidence~~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~~Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety~~.

- **Depletions of interconnected surface ~~water~~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~~Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water~~.

5.3 GSP-Level Sustainable Management Criteria

In the original 2020 GSP submittals for the Delta-Mendota Subbasin, each ~~For more information on the development of the sustainable management criteria and information used to support the established sustainable management criteria for the individual GSP Groups, refer to the individual GSPs. Each~~ GSP Group defined what ~~is~~ was considered significant and unreasonable in their Plan Area for each applicable sustainability indicator~~s~~, in addition to establishing minimum thresholds, measurable objectives and 5-year interim goals for their Plan Area, ~~.~~

~~Each GSP Group developed their sustainable management criteria~~ consistent with GSP Regulations Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria (§ 354.2 through 354.30). DWR's *Draft Best Management Practices for the Sustainable Management of Groundwater Sustainable Management Criteria BMP* (2017) document was also used when and where applicable at the discretion of each GSP Group.

Subsequent to this submittal, the Technical Working Group and Coordination Committee met to develop consistent definitions and methodologies for establishing numeric metrics for each applicable sustainability indicator. These revised SMC are discussed in the next section.

5.4 Delta-Mendota Subbasin Sustainable Management Criteria

The sustainable management criteria for each sustainability indicator contains the following components: the subbasin-wide definitions of an undesirable result~~, GSP level definition~~ and of significant and unreasonable, sustainability goals, ~~5-year interim goals,~~ minimum thresholds (MTs), ~~and~~ measurable objectives (MOs), and five-year interim milestones (IMs). Separate tables show the sustainable management criteria for chronic lowering of groundwater levels ~~(**Table CC-14**)~~, reduction in groundwater storage ~~(**Table CC-15**)~~, degraded water quality, ~~(**Table CC-16**),~~ land subsidence, ~~(**Table CC-17**),~~ and depletions of interconnected surface water ~~(**Table CC-18**) w~~with ~~details corresponding to the individual GSP Groups~~maps showing representative monitoring sites with corresponding numeric MTs and MOs, and a table summarizing the MTs and MOs by representative monitoring location. ~~The established sustainable management criteria were developed through detailed analysis and consideration of conditions unique to each GSP Group, where more detail may be necessary to support the decisions made by each GSP Group. For greater detail regarding the development of the sustainable management criteria for each GSP Group, refer to the sustainable management criteria section or chapter contained in each individual GSP.~~

5.4.1 Chronic Lowering of Groundwater Levels

Chronic Lowering of Groundwater Levels is arguably the most fundamental Sustainability Indicator, as it directly and indirectly influences several other Sustainability Indicators, such as Reduction of Groundwater Storage, Land Subsidence, and Degraded Water Quality. The Subbasin GSAs are committed to maintaining groundwater levels above historic low conditions in order to avoid undesirable results to beneficial uses and users of groundwater and to prevent further decrease of groundwater levels due to groundwater management actions performed within the Subbasin.

The GSAs developed SMCs for Chronic Lowering of Groundwater Levels using readily available historic records of groundwater level data for 61 of the 75 Representative Monitoring Sites (RMS). The MTs and MOs were developed for each RMS using common data and coordinated assumptions, as detailed in **Table CC-16**, and are consistent with the requirement of Title 23 of the California Code of Regulations (23 CCR) § 354.28(c) to consider trends in historic groundwater levels, water year type, projected water use in the Basin, and relationship with other sustainability indicators. The equivalent process was used in both the Upper Aquifer and Lower Aquifer within the Subbasin.

The MT is currently established as a fixed elevation at each RMS, equivalent to the historic seasonal low prior to the end of WY2016, based on available groundwater level data. The MO is to maintain water levels at or above the Water Year 2015 seasonal high at more than 50% of RMS in a GSP area. The GSAs will conduct a minimum of bi-annual groundwater level monitoring to track progress towards sustainability at the 75 RMS.

Per the definition of Undesirable Results for Chronic Lowering of Groundwater Levels, the exceedance of a MT at a single RMS is not indicative of an Undesirable Result; rather, the exceedance of MTs at 50% or more RMS within a GSP area is considered to cause significant and unreasonable impacts to locally-specific beneficial uses and users of groundwater, namely the increased costs associated with modifying wells to access groundwater, securing alternative sources, or required mitigation of groundwater dependent ecosystems. To account for future year-to-year variations in hydrology, compliance will be assessed by comparing a four-year rolling average of groundwater level measurements to the fixed MT at each RMS within a GSP area.

In addition to the SMCs developed as part of this GSP, the GSAs will continue to coordinate to develop shorter-term ("acute") groundwater level thresholds in the five-year GSP update that will be submitted in 2025. These thresholds will be set at levels that avoid short-term undesirable results, particularly for domestic water users, groundwater dependent ecosystems, and interconnected surface waters and subsidence when present. Each year, both the historic seasonal low MT value and the acute groundwater elevation thresholds will apply, whichever is more protective.

~~Table CC-14: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					

Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur If 30% of the wells in the Mmonitoring Zzone exceed the min174escripimum threshold value on a 4-year consecutive average under normal or average year conditions.	Groundwater elevations dropping below historic lows (2015-2016)	Groundwater elevations dropping below historic lows (2015-2016)	Lowering of groundwater levels would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	Groundwater elevations dropping below the Minimum Threshold criteria at 40% of representative monitoring locations concurren	The San Joaquin River Exchange Contractors (SJREC) GSP Groupha

					~~tly over a given water year resulting in shallow domestic wells going dry in the same subregion zone as the representative~~	~~sapositive impact to the aquifer and is unlikely to cause Significant~~

					monitoring points in violation, higher pumping costs, and/or the need to modify wells to obtain groundwater.	ieant and/or Unreasonable lowering of groundwater level s. Tri

						~~groundwater level shall not be allowed to recover to a level below the interim milestone for groundwater level~~

						~~ofreneariningan Undesirable Result. Currently, an approximatio~~

						~~n o f 2 5 % b e l o w h i s t o r i c l o w f o r e a e l h m a n a g e m e n t a r e a i s u s e d t o i n d~~

						~~ieateanUndesirableResultwhichwillbereflectedbasedonannua~~

						~~Update and integration with other GSP Groups.~~

Sustainability Goal for Sustainability Criterion	To maintain the historic hydrological cycle and expand access to surface water during flood years for replenishment of the Upper Aquifer.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain water levels and storage sufficient to meet operational storage in each the Upper Aquifer and Lower Aquifer.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water levels to meet demand of the beneficial

5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: WSE > Measurable Objective Year 10: WSE > Measurable Objective Year 15: WSE > Measurable Objective	Year 5: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: Maintain groundwater levels; SJREC GSP Group is sustai

					~~nd water elevations compare to 2012 through 2017 hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows~~	~~nable: Year 10: Maintain current water levels; SJREC GSP Group~~

					rable to 2012 through 2017 hydrologic highs and lows	sustainable. Year 15: Maintain neutral water level s; SJREGGS

Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table	Upper Aquifer Season Low >- 126 feet below ground surface (ft bgs) Season High >- 57 ft bgs Lower Aquifer Season Low >213 ft bgs Season High >- 185 ft bgs	Upper Aquifer Season Low >- 63 feet below ground surface (ft bgs) Season High >- 55 ft bgs Lower Aquifer Season Low >213 ft bgs Season High >- 185 ft bgs	Upper Aquifer: 20% lowered water elevation from recent historic low (set at each monitoring site). Lower Aquifer: Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds	Upper Aquifer: Hydrologic low Lower Aquifer: 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlike

				~~in future GSP Updates.~~		~~lytoeausegroundwaterovederdraft. Asaresultofthisandhistor~~

						~~ideal groundwater management; trigger levels have been established~~

						~~shed for area presently in need of management area. If water~~

						~~levels drop below the established trigger level, not transfers or~~

						~~from underwater outs: det hear area all low ed. Thi: sma nage ment has~~

						~~been in place for parts of the Subbasin for years and has proven ef~~

						~~feet above healthy aquifer.~~

Measurable Objective	The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.	Maintain seasonal highs and lows above minimum thresho 196escript196lds.	Maintain seasonal highs and lows above minimum thresho 196escript196lds.	Upper Aquifer: Recent historic low (set at each monitoring site Lower Aquifer: Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	Both Aquifers: Seasonal historic high average, Spring 2012 or Spring 2017, which ever elevation is lowest or where data exists.	Operate groundwater levels between effective zone and

						~~the Minimum Threshold.~~

Table CC-16: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels

Definition of Undesirable Results	Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	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.
Sustainability Goal	Maintain groundwater levels that are comparable to existing conditions (historic low conditions as of Water Year 2016) in order to continue meeting the demand of beneficial uses and users of groundwater and prevent a trend of decreasing groundwater levels. The Delta-Mendota Subbasin will continue successful and ongoing coordination with neighboring Subbasins to address chronic lowering of groundwater levels caused by pumping outside of the Subbasin.
Minimum Threshold	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 water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. See **Table 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.
Measurable Objective	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 Year 2016 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.
5-Year Interim Milestones	**Year 5:** Gather data and complete the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer for the Grassland GSP area. Develop a coordinated methodology and complete the establishment of acute groundwater elevation thresholds. Identify chronic lowering of groundwater levels caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-65** for the Upper Aquifer and **Figure CC-66** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-17**.

Table CC-17: Numeric SMC for the Chronic Lowering of Groundwater Levels

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
09-001	Aliso Water District	Upper	40.5	114.3
09-002	Aliso Water District	Upper (Composite)	-4.0	17.1
09-003	Aliso Water District	Upper	37.4	52.9
09-004	Aliso Water District	Upper	37.7	51.9
10-001	Farmers Water District	Upper	34.0	102.7
12-001	Fresno County	Upper	98.2	103.2
13-001	Fresno County	Upper	109.4	120.5
13-003	Fresno County	Upper	48.6	116.1
13-004	Fresno County	Lower	-59.0	-27.0
11-001	Grassland	Lower	TBD	TBD
11-002	Grassland	Lower	TBD	TBD
11-003	Grassland	Lower	TBD	TBD
11-004	Grassland	Lower	TBD	TBD
11-005	Grassland	Lower	TBD	TBD
11-006	Grassland	Lower	TBD	TBD
11-007	Grassland	Upper	79.9	91.1
11-008	Grassland	Upper	82.3	93.2
11-009	Grassland	Upper	63.4	77.3
11-013	Grassland	Upper	76.8	80.4
11-014	Grassland	Upper	68.1	80.7
11-015	Grassland	Upper	72.8	75.7
11-016	Grassland	Upper	83.1	92.8
11-017	Grassland	Upper	90.2	116.6
11-019	Grassland	Upper	27.0	27.0
19-003	Grassland	Upper	90.5	91.8
01-001	NCDM	Lower	-44.9	-13.4
01-002	NCDM	Lower	-36.1	-18.9
01-003	NCDM	Lower	-21.8	62.3
01-004	NCDM	Upper	158.9	161.8
01-005	NCDM	Upper	110.6	179.6
01-006	NCDM	Lower	77.1	94.0
01-007	NCDM	Lower	12.3	56.7
01-008	NCDM	Lower	-44.9	2.4

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
02-002	NCDM	Lower	-18.3	33.7
02-009	NCDM	Upper	-6.2	29.8
03-001	NCDM	Upper	30.7	46.7
03-002	NCDM	Upper	7.7	67.2
03-003	NCDM	Upper	TBD	TBD
04-001	NCDM	Lower	-17.6	-3.6
06-001	NCDM	Lower	-52.3	16.1
06-002	NCDM	Upper	31.5	44.6
06-003	NCDM	Lower	-9.1	18.5
06-004	NCDM	Upper	14.8	30.5
07-002	NCDM	Lower	1.6	10.8
07-003	NCDM	Upper	62.5	89.9
07-005	NCDM	Lower	-84.7	-41.8
07-007	NCDM	Lower	-53.4	-26.6
07-008	NCDM	Lower	-63.0	-47.0
07-009	NCDM	Upper	49.3	73.9
07-010	NCDM	Upper	64.0	96.2
07-012	NCDM	Upper	TBD	TBD
07-014	NCDM	Lower	-133.5	-47.2
07-015	NCDM	Lower	-147.0	-65.0
07-016	NCDM	Lower	-2.4	74.6
07-017	NCDM	Upper	TBD	TBD
07-018	NCDM	Upper	TBD	TBD
07-028	NCDM	Lower	-88.2	-64.8
07-029	NCDM	Upper	TBD	TBD
07-030	NCDM	Lower	TBD	TBD
07-031	NCDM	Lower	TBD	TBD
07-032	NCDM	Lower	TBD	TBD
07-035	NCDM	Upper	-99.8	95.2
08-002	NCDM	Upper	50.7	83.7
14-001	SJREC	Upper	24.0	48.5
14-002	SJREC	Upper	96.5	125.7
14-003	SJREC	Upper	81.3	92.2
14-004	SJREC	Upper	78.7	92.6
14-005	SJREC	Upper	92.2	106.2
14-006	SJREC	Upper	76.7	98.2
14-007	SJREC	Upper	73.5	98.5
14-008	SJREC	Upper	70.5	98.5

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
14-019	SJREC	Lower	-48.8	35.0
14-020	SJREC	Lower	38.1	57.4
14-021	SJREC	Lower	-33.0	14.8
23-001	SJREC	Upper	102.3	120.2

T–D - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

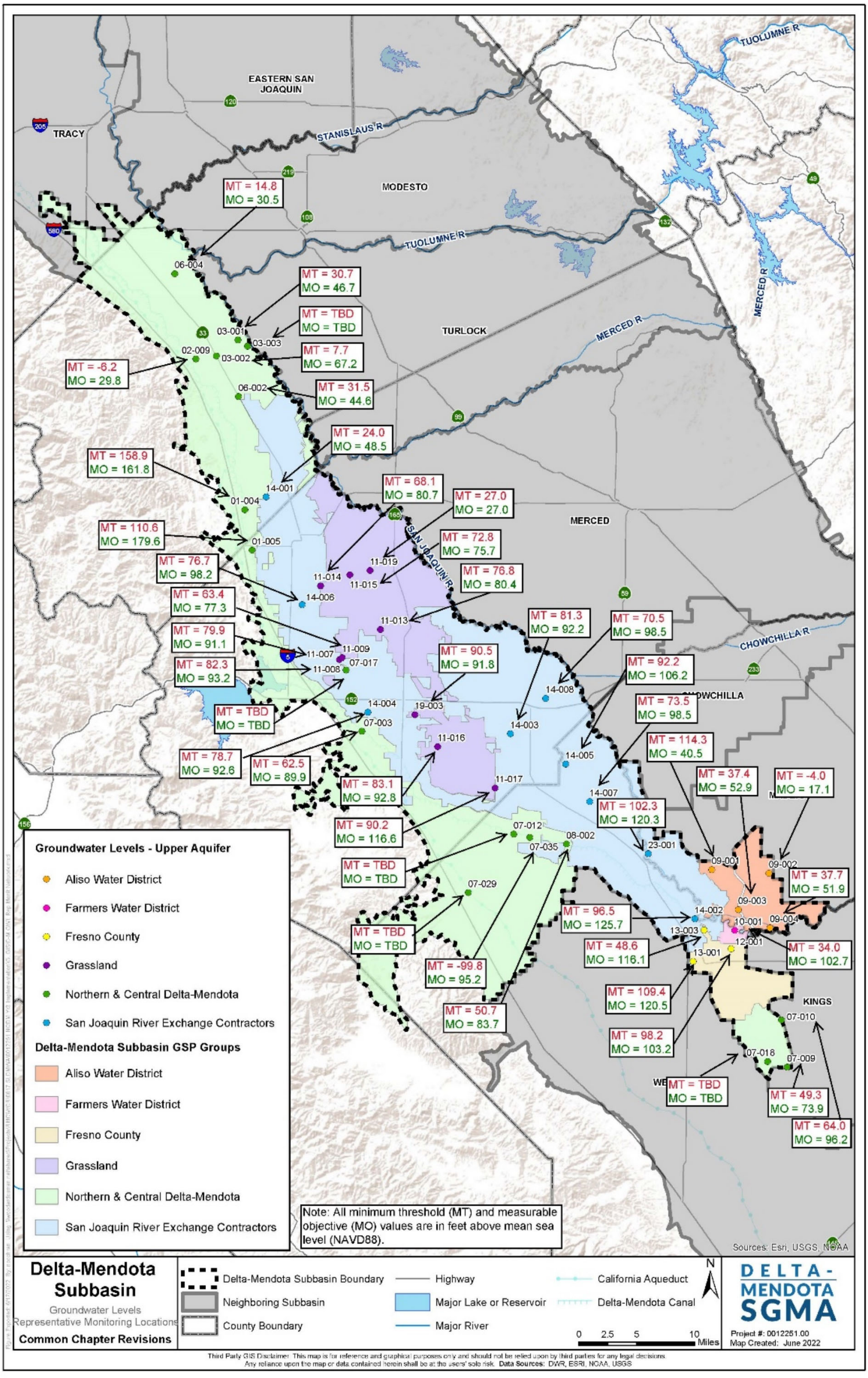


Figure CC-65: Groundwater Level Representative Monitoring Locations with SMC – Upper Aquifer

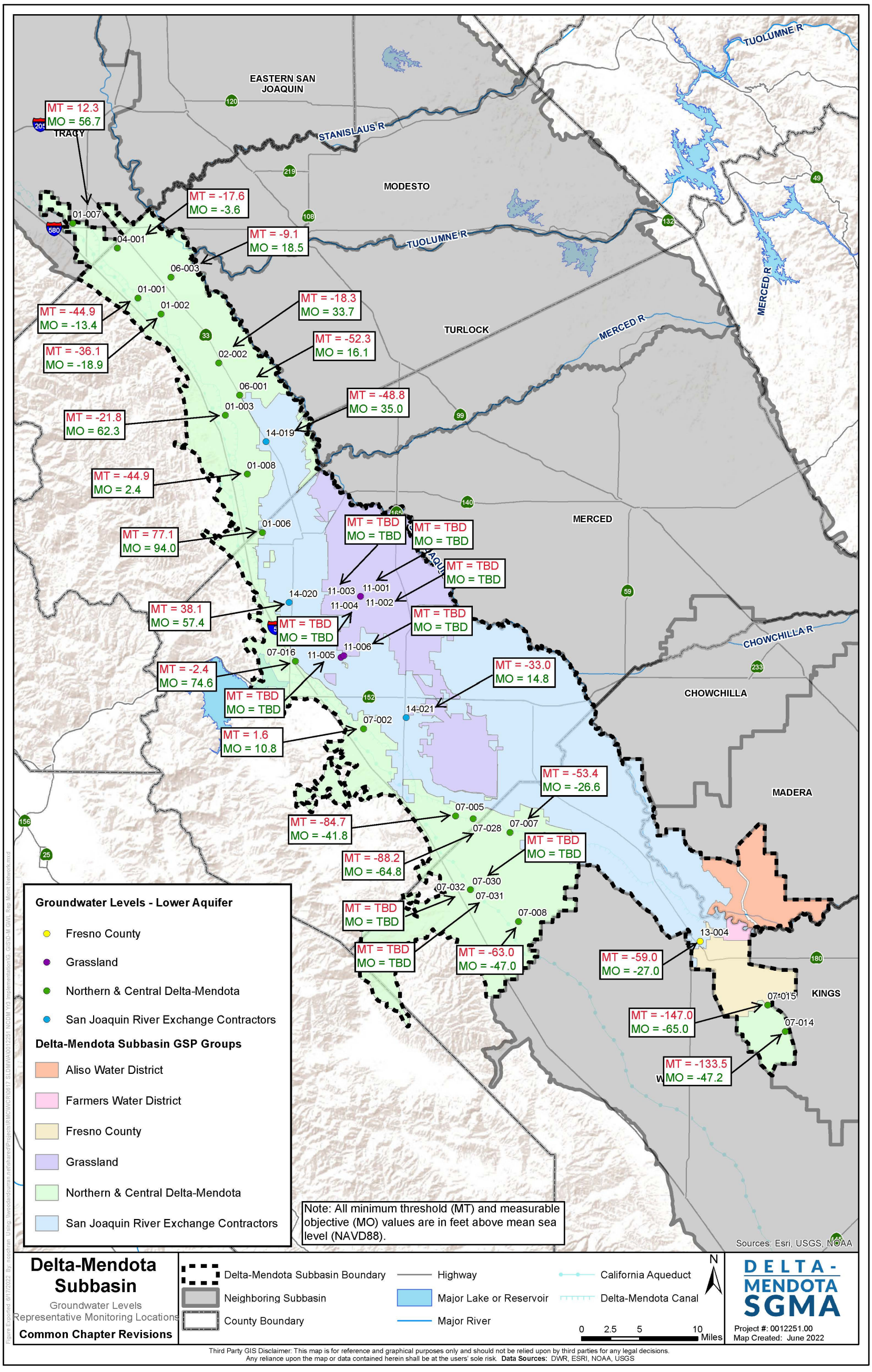


Figure CC-66: Groundwater Level Representative Monitoring Locations with SMC – Lower Aquifer

5.4.2 Reduction in Groundwater Storage

The GSAs intend to maintain groundwater storage at volumes that will continue to meet the demands of beneficial uses and users of groundwater, provide a three-year drought buffer, and minimize reductions in groundwater storage during extended dry periods. Further, the GSAs will coordinate with neighboring subbasins to address reductions in groundwater storage caused by pumping outside of the Subbasin. The SMCs were developed using common data and coordinated assumptions, as detailed in **Table CC-18** and will be monitored a minimum of bi-annually as detailed for Chronic Lowering of Groundwater Levels in Section 5.4.1 (**Table CC-16**) and consistent Land Subsidence monitoring as detailed in Section 5.4.4 (**Table CC-21**).

Pursuant to 23 CCR § 354.28(d), the MTs for Reduction of Groundwater Storage may be set by using groundwater levels as a proxy if it is demonstrated that a correlation exists between the two metrics. It is logical to link these two Sustainability Indicators for the Upper Aquifer, as the amount of groundwater in storage is directly, if not linearly, related to groundwater levels. As such, in the Upper Aquifer, it is not necessary to set a unique MT for Reduction of Groundwater Storage, and the MTs for Chronic Lowering of Groundwater Levels are used as a proxy for the Reduction of Groundwater Storage Sustainability Indicator. Similarly, the MOs for Chronic Lowering of Groundwater Levels serves as a proxy for Reduction of Groundwater Storage. Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are protective of the Reduction of Groundwater Storage Sustainability indicator and local beneficial uses and users of the Upper Aquifer, as the SMCs maintain sufficient water storage to maintain beneficial uses, including the conjunctive use of groundwater.

In the Lower Aquifer, the physical reduction in groundwater storage is caused by inelastic land subsidence, as detailed in Section 5.4.4 (**Table CC-21**). As such, the SMCs set for Land Subsidence (which are designed to reduce subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040) are reasonably protective and used as a tool to calculate the Reduction of Groundwater Storage Sustainability Indicator SMCs in the Lower Aquifer[1].

[1] The most significant subsidence in the Subbasin observed between from 2014-2018 was a 0.6 foot decline at Check 18 of the Delta-Mendota Canal. During those same years, the water budget calculation estimated what the change in storage was in the Lower Aquifer. Given the apparent relationship between the loss in groundwater storage and the observed subsidence, the projected allowable additional subsidence (i.e., two feet by 2040) was converted to a groundwater storage volume in the Lower Aquifer and used as the SMC.

Table CC-18: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage	
Definition of Undesirable Results	A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	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.
Sustainability Goal	Maintain historic groundwater storage volumes in order to continue meeting the demand of beneficial uses and users of groundwater and to provide a 3-year drought buffer. Minimize reductions in groundwater storage during extended dry periods. Work with neighboring Subbasins to address reduction in groundwater storage caused by pumping outside of the Subbasin.
Minimum Threshold	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.
Measurable Objective	For the Upper Aquifer, maintain groundwater levels in accordance with the measurable objectives set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, minimize loss of groundwater storage caused by inelastic land subsidence.
5-Year Interim Milestones	**Year 5:** Maintain groundwater levels in accordance with the measurable objectives. Identify reduction in groundwater storage caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

5.4.3 Degraded Groundwater Quality

The GSP groups within the Delta-Mendota Subbasin are committed to preventing the migration or elevated concentrations of constituents of concern due to groundwater management activities. The primary constituent of concern in the Subbasin is salinity, frequently reported as total dissolved solids (TDS).

For drinking water, California has three secondary maximum contaminant level (SMCL) standards for TDS, all based on aesthetic considerations such as taste and odor, not public health concerns. These are 500 mg/L (recommended limit), 1,000 mg/L (upper limit), and 1,500 mg/L (short-term limit). To reflect the Subbasin's designation as a Municipal (MUN) beneficial use, as established in the Central Valley Water Control Plans (often referred to as Basin Plans), the Subbasin has selected the upper limit of 1,000 mg/L as the Minimum Threshold.

The Delta-Mendota GSAs also recognize that a Salt Control Program for the San Joaquin Valley was recently developed through the collaborative CV-SALTS Program and was adopted into the Central Valley Basin Plans to address the long-term problem of salt accumulation in the Valley. The program recognizes that salt accumulation and water uses vary widely across the Valley. The program approach is intended to protect beneficial uses by maintaining water quality that meets applicable objectives, allow some salt accumulation in areas where salt can be stored without impairing beneficial uses of water, and, through long-term management, restore water quality where reasonable, feasible, and practicable.

A Prioritization and Optimization (P&O) Study planning process is now underway to identify potential requirements that will protect beneficial uses, improve salt management, and restore water quality where possible. During the next ten years (Phase 1), the P&O Study will: characterize the salt conditions and trends in the Valley; identify salt management needs and mechanisms; evaluate the feasibility of potential solutions; prepare an implementation plan; and review and recommend revising salinity regulations as necessary. [1]

The minimum thresholds and measurable objectives for groundwater quality incorporate these standards and objectives for salinity. The minimum threshold is therefore set as 1,000 mg/L TDS, and the measurable objective is a concentration less than 1,000 mg/L TDS with acknowledgement that salinity standards are still being developed by water quality experts and regulatory agencies in the Central Valley, and thus may need to be revised in the future. Additionally, groundwater is frequently blended with other water supplies to reduce TDS concentrations to meet the salinity sensitivity of a particular beneficial use.

For any representative monitoring site that currently exceeds the TDS thresholds set forth above, the existing regulatory water quality compliance and remediation programs will apply. These include, but are not limited to, the CV-SALTS Salt Control Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), the Safe and Affordable Funding for Equity and Resilience (SAFER) program, and the Bureau of Reclamation's Refuge Water Supply Program. For any future exceedance of the TDS thresholds at representative monitoring sites that do not currently exceed the objectives, the applicable GSP group is required to coordinate and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently in order to avoid exacerbating the exceedance.

The sustainable management criteria also incorporate by reference the specific requirements for preventing the migration of contaminants adopted by the Central Valley Regional Water Quality Control Board in Cleanup and Abatement Orders for individual contaminated sites.[2]

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[1] *See* https://www.cvsalinity.org/salt-program/; https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

[2] *E.g.* the Cleanup and Abatement Order R5-2018-0033 for the Spreckels facility: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/fresno/r5-2018-0033.pdf

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
Definition of Undesirable Results	Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	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.
Sustainability Goal	Minimize further impairment of water supplies resulting from groundwater management activities that cause the migration or concentration of contaminant plumes or the increased rate of movement or concentrations of constituents of concern. Coordinate with and support compliance with existing regulatory groundwater quality orders and objectives for drinking water, agricultural irrigation, and managed wetlands. Work with neighboring Subbasins to address existing or potential impairments of groundwater quality in the Subbasin caused by groundwater management activities outside the Subbasin.
Minimum Threshold	The minimum threshold for salinity is 1,000 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.

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
Measurable Objective	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.
5-Year Interim Milestones	**Year 5:** Maintain salinity consistent with measurable objectives. Participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State Water Resources and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative. Develop correlation between groundwater quality and groundwater levels in order to establish methodology for the use of groundwater levels as a proxy for groundwater quality. **Year 10:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Utilizing the methodology developed by the Year 5 Interim Milestone, develop minimum thresholds and measurable objectives for groundwater quality that utilize groundwater elevations as a proxy for monitoring. **Year 15:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-67** for the Upper Aquifer and **Figure CC-68** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-20**.

Table CC-20: Numeric SMC for Degraded Groundwater Quality

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
09-002	Aliso Water District	Upper	1,000	< 1,000
09-003	Aliso Water District	Upper	1,000	< 1,000
09-005	Aliso Water District	Upper	1,000	< 1,000
09-196	Aliso Water District	Upper	1,000	< 1,000
10-001	Farmers Water District	Upper	1,000	< 1,000
10-005	Farmers Water District	Upper	1,000	< 1,000
12-002	Fresno County	Upper	N/A	N/A
12-003	Fresno County	Upper	N/A	N/A

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
12-004	Fresno County	Upper	N/A	N/A
12-005	Fresno County	Upper	N/A	N/A
12-006	Fresno County	Upper	1,000	< 1,000
12-007	Fresno County	Upper	N/A	N/A
13-006	Fresno County	Upper	N/A	N/A
13-007	Fresno County	Upper	N/A	N/A
13-008	Fresno County	Upper	N/A	N/A
11-010	Grassland	Lower	TBD	TBD
11-011	Grassland	Lower	1,000	< 1,000
11-012	Grassland	Lower	1,000	< 1,000
11-021	Grassland	Upper	N/A	N/A
19-002	Grassland	Upper	1,000	< 1,000
19-004	Grassland	Upper	N/A	N/A
01-001	NCDM	Lower	1,000	< 1,000
01-002	NCDM	Lower	1,000	< 1,000
01-003	NCDM	Lower	N/A	N/A
01-004	NCDM	Upper	1,000	< 1,000
01-006	NCDM	Lower	1,000	< 1,000
01-007	NCDM	Lower	1,000	< 1,000
01-008	NCDM	Lower	1,000	< 1,000
01-018	NCDM	Upper (assumed)	1,000	< 1,000
02-002	NCDM	Lower	1,000	< 1,000
02-009	NCDM	Upper	1,000	< 1,000
03-001	NCDM	Upper	N/A	N/A
03-003	NCDM	Upper	N/A	N/A
03-007	NCDM	Upper	1,000	< 1,000
04-001	NCDM	Lower	1,000	< 1,000
06-001	NCDM	Lower	1,000	< 1,000
06-002	NCDM	Upper	1,000	< 1,000
06-003	NCDM	Lower	1,000	< 1,000
06-004	NCDM	Upper	N/A	N/A
07-002	NCDM	Lower	1,000	< 1,000
07-003	NCDM	Upper	1,000	< 1,000
07-007	NCDM	Lower	1,000	< 1,000
07-008	NCDM	Lower	N/A	N/A
07-012	NCDM	Upper	N/A	N/A
07-014	NCDM	Lower	1,000	< 1,000
07-015	NCDM	Lower	1,000	< 1,000
07-016	NCDM	Lower	1,000	< 1,000

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
07-017	NCDM	Upper	1,000	< 1,000
07-018	NCDM	Upper	N/A	N/A
07-028	NCDM	Lower	N/A	N/A
07-029	NCDM	Upper	N/A	N/A
07-030	NCDM	Lower	N/A	N/A
07-031	NCDM	Lower	N/A	N/A
07-032	NCDM	Lower	N/A	N/A
07-033	NCDM	Upper	1,000	< 1,000
07-034	NCDM	Lower (assumed)	N/A	N/A
07-035	NCDM	Upper	N/A	N/A
08-002	NCDM	Upper	N/A	N/A
14-001	SJREC	Upper	1,000	< 1,000
14-002	SJREC	Upper	1,000	< 1,000
14-003	SJREC	Upper	N/A	N/A
14-004	SJREC	Upper	1,000	< 1,000
14-005	SJREC	Upper	N/A	N/A
14-006	SJREC	Upper	1,000	< 1,000
14-007	SJREC	Upper	N/A	N/A
14-008	SJREC	Upper	1,000	< 1,000
14-019	SJREC	Lower	1,000	< 1,000
14-020	SJREC	Lower	1,000	< 1,000
14-021	SJREC	Lower	N/A	N/A
23-001	SJREC	Upper	1,000	< 1,000

Notes:

1. Current TDS concentration is defined as prior to the end of WY 2016.
2. N/A - Current groundwater quality exceeds 1,000 mg/L TDS.
3. TBD - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

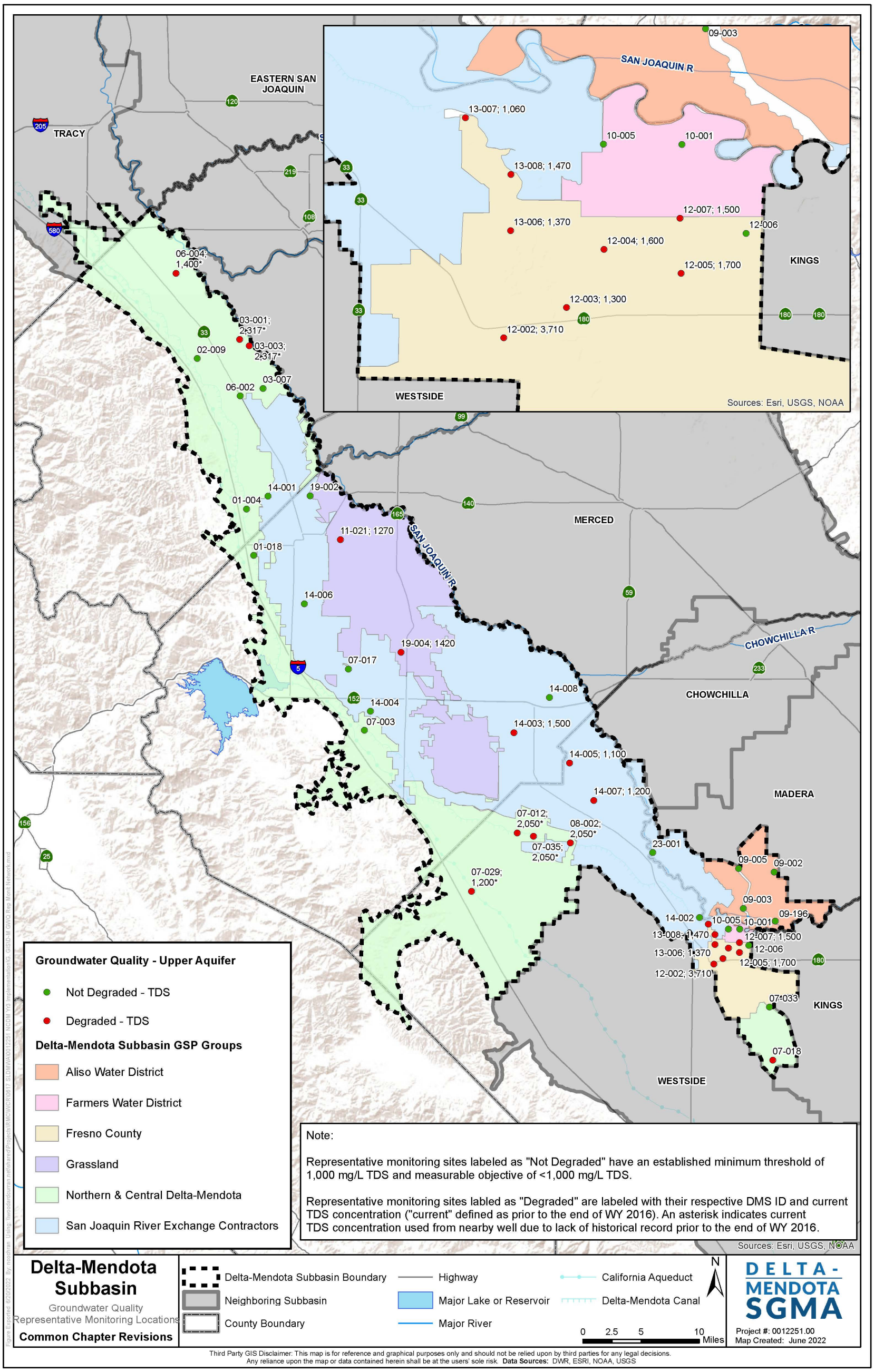

Figure CC-67: Groundwater Quality Representative Monitoring Locations with SMC – Upper Aquifer

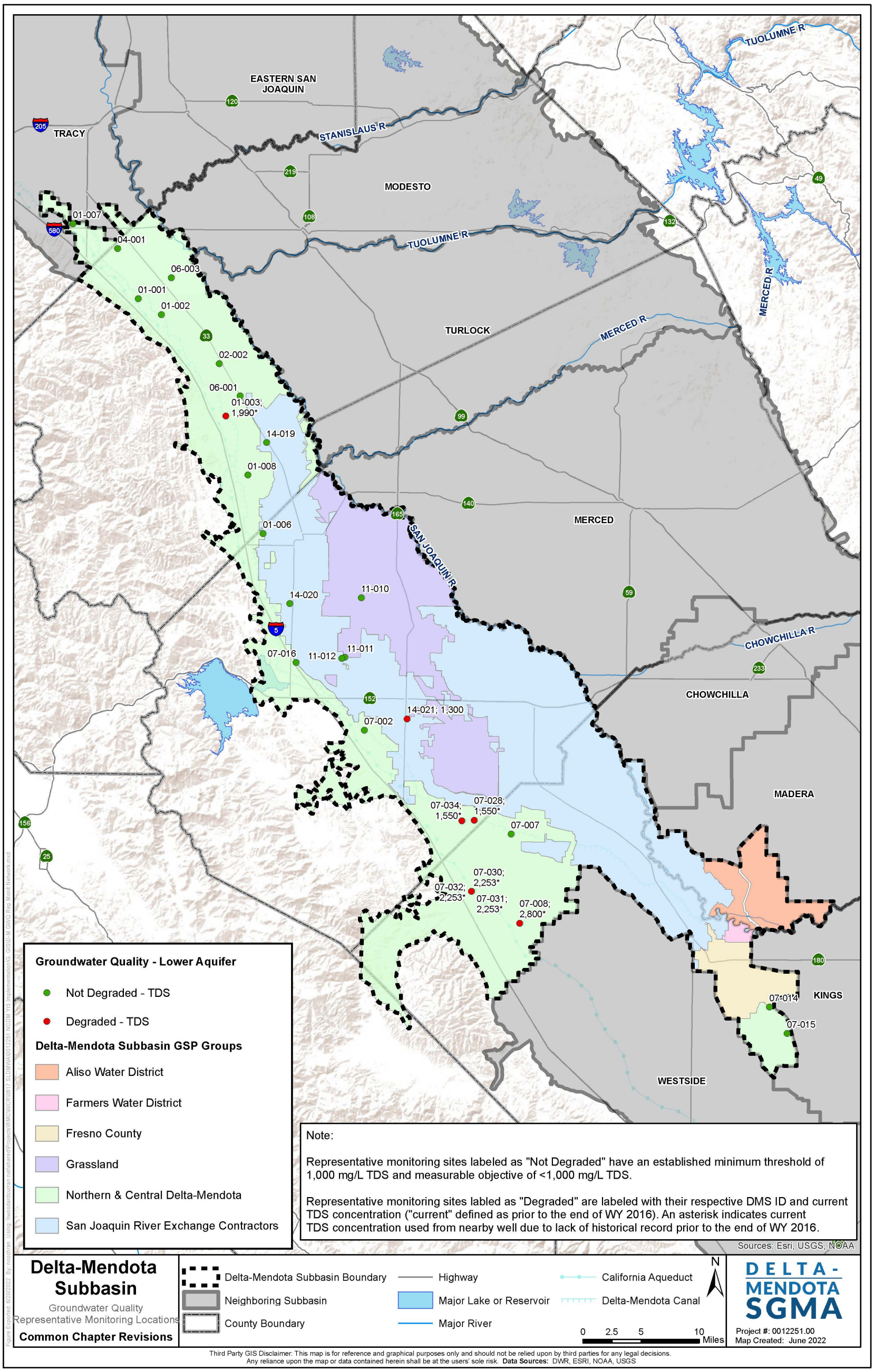

Figure CC-68: Groundwater Quality Representative Monitoring Locations with SMC – Lower Aquifer

5.4.4 Inelastic Land Subsidence

The Subbasin GSAs are committed to ramping down the amount of allowable subsidence caused by groundwater extraction in the Subbasin and eliminating additional subsidence within the Subbasin by 2040. Further, the GSAs will coordinate with neighboring subbasins to address inelastic land subsidence caused by groundwater management activities that occur outside of the Subbasin.

The SMCs for Land Subsidence were coordinated at the Subbasin level and are designed to be protective of critical infrastructure, including significant and unreasonable reductions of conveyance capacity (i.e., structural damage that creates an unmanageable reduction of design capacity), impacts to natural resource areas (i.e., unmitigated decreases in the ability to irrigate or drain these areas by gravity), or conditions that threaten public health and safety (i.e., unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges). The Subbasin-wide MT is set to prevent subsidence that exceeds the corrective design standards or established triggers for critical infrastructure, including the Delta-Mendota Canal and California Aqueduct. At the RMS, the MT is defined as two feet of additional inelastic subsidence by 2040 attributable to groundwater extraction within the Subbasin. The MO is set at no additional subsidence after 2040 based on groundwater extractions within the Delta-Mendota Subbasin.

The GSAs further developed Interim Milestones (IMs) to periodically reduce the amount of allowable subsidence and meet the MO by 2040. The IMs allow for no more than 1.0 foot of additional subsidence by 2025, 0.5 feet of additional subsidence by 2030 (1.5 feet of cumulative subsidence), 0.25 feet of additional subsidence by 2035 (1.75 feet of cumulative subsidence), and 0.25 feet of additional subsidence by 2040 (2.0 feet of cumulative subsidence). The SMCs were defined at 45 RMS in the Subbasin, and the GSAs will conduct monitoring to track progress towards sustainability. Additionally, as part of the 5-year update to the GSPs, the Subbasin Hydrogeologic Conceptual Model (HCM) will be reviewed and revised to incorporate new data, including Airborne Electromagnetic (AEM) survey data provided by DWR and data/results from the Subsidence Study prepared using Prop 68 grant funding. Additionally, the GSAs will continue work with USBR on revisions to the CVHM2 model for simulating groundwater extraction-subsidence interactions, to re-evaluate inelastic land subsidence SMC to consider new data and studies, and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis.

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence

Definition of Undesirable Results	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.
Definition of Significant and Unreasonable	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 inelastic 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

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence	
	land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.
Sustainability Goal	Minimize inelastic land subsidence by ramping down allowable subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040. Work with neighboring Subbasins to address inelastic land subsidence caused by groundwater extraction outside of the Subbasin.
Minimum Threshold	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.
Measurable Objective	Minimize inelastic land subsidence attributable to groundwater extraction within the Subbasin, with no additional subsidence after 2040.
5-Year Interim Milestones	**Year 5:** Interim goal of no more than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation. Review and revise Hydrogeologic Conceptual Model (HCM) to incorporate new data. Re-evaluate inelastic land subsidence SMC to consider new data and studies and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis. Gather data and complete the selection or establishment of representative monitoring sites (RMS) for land subsidence, with particular attention to the locations of critical infrastructure in the Subbasin, and in coordination with the Bureau of Reclamation and Department of Water Resources. Determine the relative proportion of subsidence caused by groundwater extraction within and outside the Subbasin for each RMS. Where subsidence is caused by pumping outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 10:** Interim goal of no more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis. **Year 15:** Interim goal of no more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis.

The numeric MTs and MOs by RMS are shown below in **Figure CC-69**, with the numeric SMC tabulated in **Table CC-22**.

Table CC-22: Numeric SMC for Inelastic Land Subsidence

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
09-006	Aliso Water District	2	0
09-007	Aliso Water District	2	0
09-008	Aliso Water District	2	0
10-008	Farmers Water District	2	0
12-010	Fresno County	2	0
13-010	Fresno County	2	0
11-018	Grassland	2	0
11-019	Grassland	2	0
11-020	Grassland	2	0
01-009	NCDM	2	0
01-010	NCDM	2	0
01-011	NCDM	2	0
01-012	NCDM	2	0
01-013	NCDM	2	0
01-014	NCDM	2	0
01-015	NCDM	2	0
01-016	NCDM	2	0
01-017	NCDM	2	0
02-003	NCDM	2	0
02-004	NCDM	2	0
02-005	NCDM	2	0
02-006	NCDM	2	0
02-007	NCDM	2	0
02-008	NCDM	2	0
03-004	NCDM	2	0
03-005	NCDM	2	0
03-006	NCDM	2	0
04-003	NCDM	2	0
04-004	NCDM	2	0
04-005	NCDM	2	0
06-006	NCDM	2	0
07-019	NCDM	2	0
07-020	NCDM	2	0

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
07-021	NCDM	2	0
07-022	NCDM	2	0
07-023	NCDM	2	0
07-024	NCDM	2	0
07-025	NCDM	2	0
07-026	NCDM	2	0
07-027	NCDM	2	0
14-014	SJREC	2	0
14-015	SJREC	2	0
14-016	SJREC	2	0
14-017	SJREC	2	0
14-018	SJREC	2	0

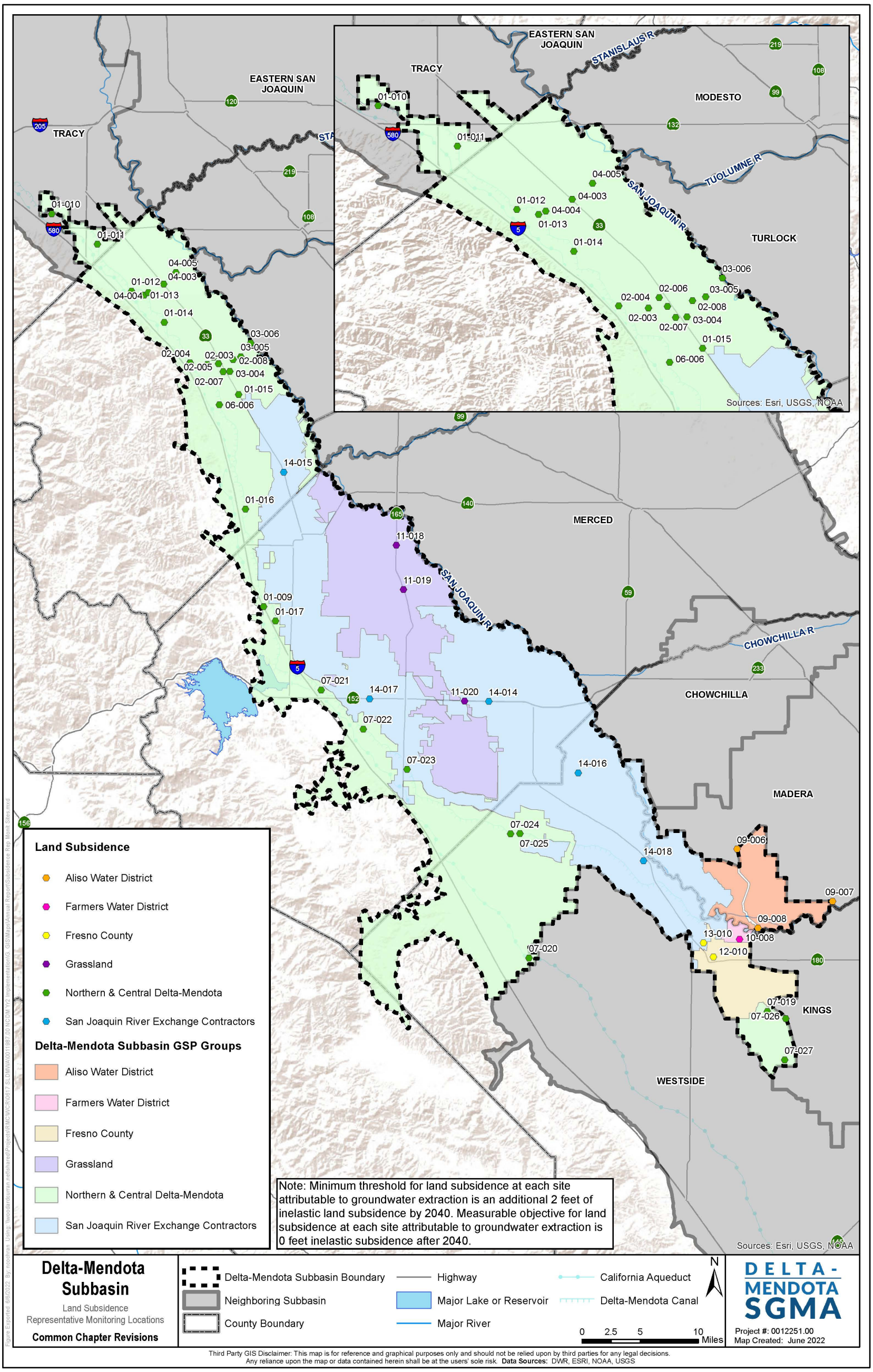

Figure CC-69: Land Subsidence Representative Monitoring Locations with SMC

5.4.5 Depletion of Interconnected Surface Water

The GSAs are committed to managing groundwater within the Subbasin to maintain interconnected surface waters comparable to existing conditions and prevent a trend of increasing interconnected surface water losses from the San Joaquin River. The GSAs will coordinate with neighboring subbasins to address interconnected surface water losses caused by groundwater management activities that occur outside of the Subbasin.

Presently, the Depletion of Interconnected Surface Water Sustainability Indicator is identified as a data gap within the Subbasin. Until the GSAs are able to collect the additional data necessary to set quantitative SMCs for this Sustainability Indicator, the SMCs for Chronic Lowering of Groundwater Levels serve as a proxy in the Upper Aquifer, pursuant to 23 CCR §354.28(d). Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are understood to be protective of the Depletion of Interconnected Surface Water Sustainability indicator and local natural resources and downstream beneficial uses and users. The RMS locations and frequency are consistent with that detailed in Section 6.

The GSAs plan to establish an Interconnected Surface Water monitoring network and develop SMCs as detailed in Table CC-18. By 2025, the GSAs anticipate completing an Interconnected Surface Water monitoring network that includes nine existing sites in the San Joaquin River Restoration Program and additional sites funded by the SGMA Implementation Grant award. The additional RMS will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. By 2030, the GSAs anticipate being able to gather and analyze data from these new RMS to estimate the influence of groundwater levels on gains and losses observed on the San Joaquin River. At this point, the Subbasin GSAs will establish Interconnected Surface Water SMCs as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results.

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water

Definition of Undesirable Results	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.
Definition of Significant and Unreasonable	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.
Sustainability Goal	Maintain interconnected surface waters comparable to existing conditions (historic low conditions as of Water Year 2016) in order to prevent a trend of increasing interconnected surface water losses from the San Joaquin River. Work with neighboring Subbasins to address increased interconnected surface water losses caused by pumping outside of the Subbasin.
Minimum Threshold	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 (see below). The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	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. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. For any RMS without data prior to Water Year 2016, Minimum Thresholds 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.
Measurable Objective	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 (see below). Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at 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 Year 2016 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. 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.
5-Year Interim Milestones	**Year 5:** Fill data gaps, establish, and manage groundwater use to avoid the rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. The Subbasin will complete a monitoring network of Interconnected Surface Water sites that will include six existing sites and datasets. GSP groups will complete the monitoring network with additional sites installed with SGMA Implementation Grant funding awarded to the Subbasin. The existing nine sites are part of the San Joaquin River Restoration Program and are located along the San Joaquin River at the southern end of the Subbasin. These nine sites, and the associated datasets, will continue to be utilized by the Subbasin as part of its monitoring network. Additional representative monitoring network sites for Interconnected Surface Water will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. **Year 10:** Gather and analyze data from Subbasin's established representative monitoring network sites. Also gather and analyze available data in cooperation with neighboring subbasins, the U.S. Bureau of Reclamation's San Joaquin River Restoration Program, the U.S. Geological Survey, and DWR's California

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	Data Exchange Center (CDEC), to estimate the influence of groundwater on gains and losses in the San Joaquin River. Establish minimum thresholds and measurable objectives as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. **Year 15:** Monitor and maintain interconnected surface waters in accordance with revised minimum thresholds and measurable objectives. Where increased interconnected surface water losses are caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The RMN for this sustainability indicator is shown below in **Figure CC-70**. Please see **Table CC-17** for the numeric SMC associated with the Chronic Lowering of Groundwater Levels.

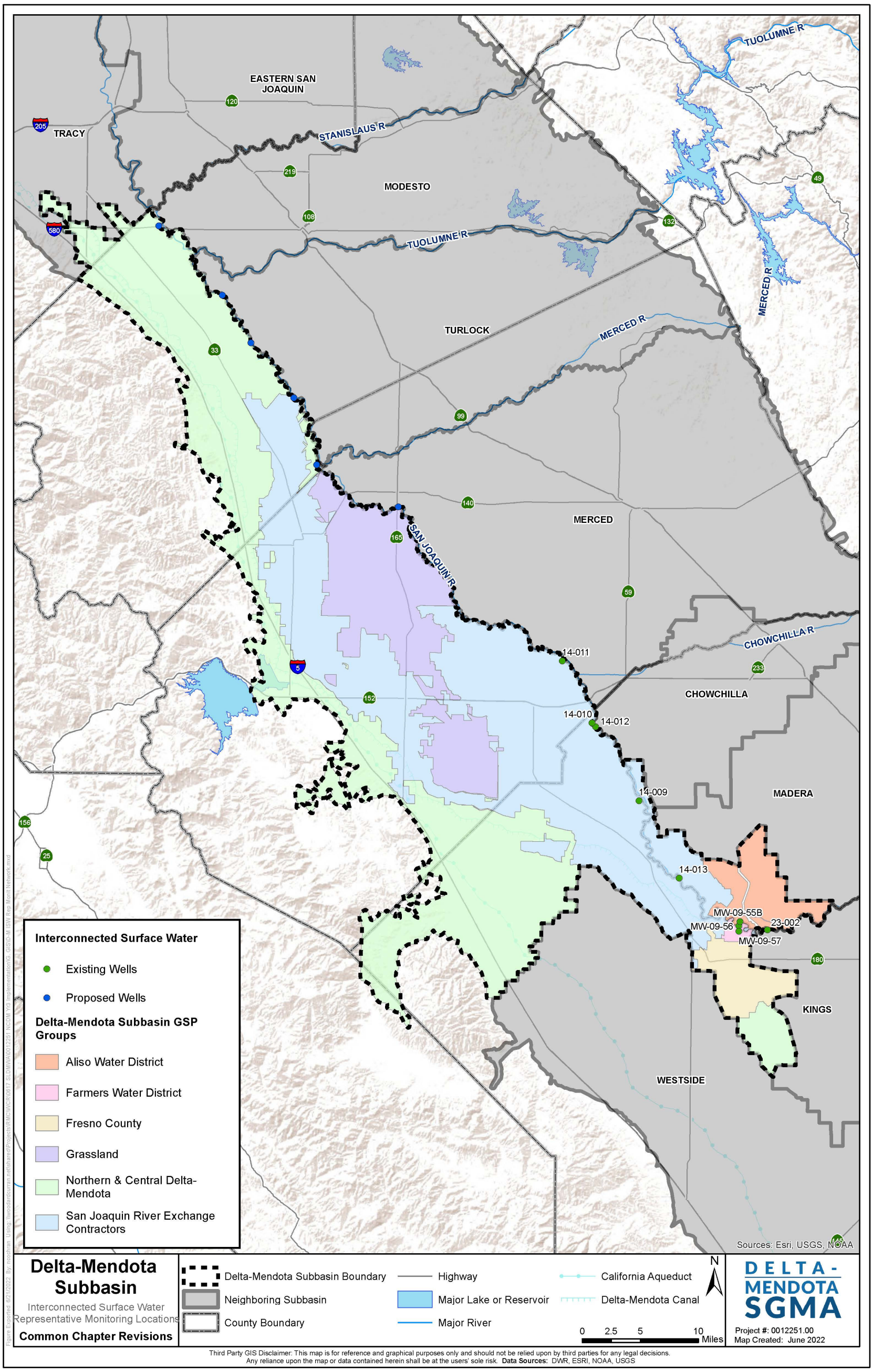

Figure CC-70: Interconnected Surface Water Representative Monitoring Locations with SMC

~~Table CC-15: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					
Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur if 30% of the wells in the Mmonitoring Zzone exceed the min225escripimum threshold value on a 4-year consecutive average under normal or average year conditions.	Depletion of storage greater than the 2012-2016 period.	Depletion of storage greater than the 2012-2016.	Insufficient water storage to develop necessary water to maintain critical habitat. Reduction in storage would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	If water levels are managed to meet the Minimum Thresholds, the Northern & Central Delta-Mendota Region GSP Group does not anticipate long-term reductions in storage. And, through coordination with other GSP Groups in the Subbasin, additional projects and/or management actions will be implemented to prevent the long-term decline in storage.	The San Joaquin River Exchange Contractors (SJREC) GSP Group has a positive impact on the aquifer and is unlikely to cause Significant and/or Unreasonable reduction of groundwater storage. Triggers have been established to recover aquifer water levels before nearing an Undesirable Result. Currently, an approximation of 25% below historic low water levels for each management area coupled with a determined storage coefficient, is used to indicate an Undesirable Result which will be refined based on annual updates and integration with other GSP Groups.
Sustainability Goal for Sustainability Criterion	To expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both Delta-Mendota and Madera subbasins where overdraft is occurring.	Minimize storage change during extended dry periods.	Minimize storage change during extended dry periods.	Maintain water levels and storage sufficient to meet operational demand.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water storage to meet demand of the beneficial users.
5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: WSE > Measurable Objective Year 10: WSE > Measurable Objective Year 15: WSE > Measurable Objective	Year 5: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows	Year 5: Maintain current water levels, SJREC GSP Group is sustainable Year 10: Maintain current water levels, SJREC GSP Group is sustainable Year 15: Maintain current water levels, SJREC GSP Group is sustainable

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table.	Upper Aquifer – Storage Loss of >12,000 acre-feet (AF) from over extended dry period Lower Aquifer – Storage Loss of >4600 AF over extended dry period	Upper Aquifer – Storage Loss of >90,000 acre-feet (AF) over extended dry period – Lower Aquifer – Storage Loss of >55,000 AF over extended dry period	Upper Aquifer: 20% lowered water elevation from recent historic low (set at each monitoring site). Lower Aquifer: Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	Upper Aquifer: Hydrologic low Lower Aquifer: 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlikely to cause groundwater overdraft. As a result of this and historical groundwater management, trigger levels have been established for a representative site in each management area. If water levels drop below the established trigger level, no transfers of groundwater outside the area are allowed. This management has been in place for parts of the Subbasin for years and has proven effective to preserve a healthy aquifer.
Measurable Objective	The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.	Long term average change of 0 AF/year	Long term average change of 0 AF/year	Upper Aquifer: Recent historic low (set at each monitoring site). Lower Aquifer: Four lower aquifer representative monitoring sites have been identified at a multi-completion well. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	Both Aquifers: Seasonal historic high average, Spring 2012 or Spring 2017, whichever elevation is lowest or where data exists.	Operate groundwater levels between the effective root zone and the Minimum Threshold which will maintain groundwater storage.

~~Table CC-16: Delta-Mendota Subbasin SMC for Degraded Water Quality~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities					
Definition of Significant and Unreasonable	Aliso is not experiencing any significant and unreasonable impacts of water quality. Significant and unreasonable is defined as a reduction in crop production due to water quality issues and if 30% of the wells exceed the minimum threshold value on a 4-year consecutive average without treatment.	(1) Continued migration of the Steffens plume (elevated Total dissolved solids [TDS]) in Upper Aquifer both within Management Area A and towards Farmers Water District. (2) Unreasonable rates of migration of groundwater in the Upper Aquifer with naturally-occurring elevated concentrations of total dissolved solids in Management Area B. (3) Potential effects on the beneficial uses of groundwater include agricultural and domestic uses. (4) Degraded water quality in the Fresno Slough effect beneficial users of surface water	(1) Impairment of groundwater quality from the migration of the Steffens Plume from Fresno Coun'ty's Management Area A. Impacts from the Steffens plume impacts Farmers Water District's ability to utilize groundwater for adjacent use and discharge into the Mendota Pool. (2) Potential effects on the beneficial users of groundwater include water quality levels that impact crops and drinking water standards for domestic uses. (3) Degraded water quality in the Fresno Slough effecting beneficial users of surface water.	Degradation of groundwater quality resulting in reduced ability to develop and manage groundwater for habitat productivity.	(1) Exceedance of maximum contaminant levels (MCLs) or water quality objectives (WQOs) for irrigation in public water systems for three (3) consecutive sampling events in non-drought years or the additional degradation of current groundwater quality where current groundwater quality exceeds the MCLs or WQOs for irrigation. (2) Water quality degradation due to recharge projects that exceeds 20% of the aquifer's assimilative capacity for one or more constituents without justification of a greater public benefit achieved	Migration of contamination plume that makes the water unusable for beneficial use
Sustainability Goal for Sustainability Criterion	Maintain Current Water Quality	Contain the Spreckels Plume and maintain historical rates of saline front migration	Prevent further degradation of groundwater quality from the Steffens Plume migrating from Fresno County Management Area A	Maintain groundwater quality suitable for habitat	Maintain existing water quality in all aquifers	Monitor existing groundwater contamination sites and engage to ensure cleanup and abatement orders are consistent with the San Joaquin River Exchange Contractors (SJREC) GSP Group. Work with upslope drainage area to reduce the migration of saline water into the SJREC GSP Group
5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: Average annual rate of degradation of 30 milligrams per liter (mg/L) TDS for saline front Year 10: Average annual rate of degradation of 30 mg/L TDS for saline front Year 15: Average annual rate of degradation of 30 mg/L TDS for saline front Spreckels Steffens plume dependent on Central Valley Regional Water Quality Control Board (CV-RWQCB) Cleanup and Abatement Order (CAO) actions.	Year 5: 1000 milligrams per liter (mg/L) total dissolved solids (TDS) Year 10: 800 mg/L TDS Year 15: 700 mg/L TDS	Year 5: < Measurable Objective Year 10: < Measurable Objective Year 15: < Measurable Objective	Year 5: Maintain 2003-2017 groundwater quality range Year 10: Maintain 2003-2017 groundwater quality range Year 15: Maintain 2003-2017 groundwater quality range	Continue mitigation efforts on the migration of saline water from upslope drainage.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	Electrical Conductivity (EC_) - 4.5 deciSiemens per meter (dS/m)* Chlorine (Cl^-) - 13.3 milliequivalents per liter (meq/L)* NO_3-N - 30 milligrams per liter (mg/L)**	Average annual rate of degradation of 60 mg/L TDS for saline front. Threshold for Steffens plume determined by CV-RWQCB.	TDS concentration of 1100 mg/L	Production Wellhead thresholds: Total dissolved solids (TDS) 2,500 milligrams per liter (mg/L) in both aquifers	NO3 – 10 mg/L as N (Primary MCL) TDS – 1,000 mg/L (Secondary MCL) Boron – 0.7 mg/L (WQO for irrigation) or current groundwater quality where it exceeds MCLs or WQOs for irrigation as of December 2018	The minimum threshold is defined as the amount of poor-quality groundwater that is greater than what can be successfully managed through the management actions
Measurable Objective	E_C - 0.75-1.0 dS/m, based on JM Lord and FAO 100% yield for grapes and almonds. C_l - 3.0 meq/L, based on JM Lord minimum recommendations NO_3-N - >5 mg/L, based on FAO Section 5.1, sensitive crop tolerance	Average annual rate of degradation of 20 mg/L TDS for saline front. Measurable objective for Steffens plume will be determined by CV-RWQCB as part of a CAO.	TDS concentration equivalent to background concentrations (approximately 500 mg/L, depending on Cleanup and Abatement Order [CAO] from Central Valley Regional Water Quality Control Board [CV-RWQCB] for Steffens Plume).	Upper Aquifer: Production Wellhead thresholds: 20% increase from max historic electrical conductivity (EC) concentration Lower Aquifer: Lower aquifer representative water quality monitoring sites have been identified; however, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals and measurable objectives in future GSP Updates.	2003-2017 groundwater quality range conditions by GSP sub-region	Mitigate impacts of the migration of saline groundwater from lands upslope of the SJREC GSP

* Based on Food and Agriculture Organization (FAO) 50% yield for grapes

** Based on FAO Section 5.1 typical crop tolerance

Table CC-17: Delta-Mendota Subbasin SMC for Land Subsidence

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland
Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conve conditions that threaten public health and safety			
Definition of Significant and Unreasonable	Aliso is not currently experiencing any significant and unreasonable effects of subsidence. Significant and unreasonable impacts are assumed to occur when the levees within the District have subsided to an elevation causing impacts to the water carrying capacity of the San Joaquin River and Chowchilla Bypass beyond their design flow rates, causing significant and unreasonable flooding or crop damage.	Damage to infrastructure and loss of conveyance capacity in neighboring Groundwater Sustainability Agencies (GSAs).	Damage to infrastructure, loss of conveyance capacity, and potential inability to flood or drain by gravity and associated habitat impacts.	Damage to infrastruct permanent loss of conveyance capacity be mitigation, and poten inability to flood or dra gravity and associat habitat impacts.
Sustainability Goal for Sustainability Criterion	Expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both the Delta-Mendota and Madera subbasins where subsidence is occurring.	No contribution to lower aquifer compaction.	No contribution to lower aquifer compaction.	No permanent reducti conveyance and abili manage habitat.
5-Year Interim Goals	Interim goals established at 0.5-feet of additional subsidence per 5-year interim goal period.	Year 5: -0.0088 ft Year 10: -0.0065 ft Year 15: -0.0043 ft	Year 5: at Fordel-Ext: -0.015 ft P304-PBO: -0.084 ft Year 10: at Fordel-Ext: -0.013 ft P304-PBO: -0.068 ft Year 15: at Fordel-Ext: -0.011 ft P304-PBO: -0.0065 ft	The Grassland Plan ar not causing subsidenc will work with neighbo achieve Subbasin-wi sustainability. Year 5: > Measurab Objective Year 10: > Measurab Objective Year 15: > Measurab Objective
Minimum Threshold	The minimum threshold is set to not exceed the current rate of subsidence of 0.2 feet/year or 4.0 feet total by 2040	-0.011 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.017 ft - P304-PBO: -0.1 ft	The minimum thresho not to exceed, on aver the historic annual ave rate of subsidence fr December 2011 to Dece 2015 as defined at ea representative subsid monitoring site: Point 108: -0.1 Point 152: -0.1 Point 137: -0.1
Measurable Objective	The Measurable Objective is set to be the more restrictive of the two Significant and Unreasonable scenarios. It is assumed that significant impacts will cause flooding and crop damage will be ½1/2 of the current design minimum freeboard of 4 feet (therefore 2 feet).	-0.002 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.0086 ft - P304-PBO: -0.036 ft	The measurable object not to exceed, on aver the historic annual ave rate of subsidence fr December 2011 to Dece 2018, defined at eac respective site: - Point 108: -0.08 ft/ - Point 152: -0.1 ft/y - Point 137: -0.11 ft/

~~Table CC-18: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water					
Definition of Significant and Unreasonable	Aliso Water District groundwater pumping does not influence surface water depletion. Landowners within the District are limited by the Herminghaus Agreement and similar pumping restrictions along the San Joaquin River that prevent pumping from above the A-Clay. Additionally, the primary aquifer, where groundwater pumping occurs, is disconnected from surface water source. A significant and unreasonable result would be a reduction in water availability to downstream beneficial users beyond what was experienced in similar water years in recent history as a result of groundwater extractions.	(1) San Joaquin River Restoration Project (SJRRP) operations and groundwater extractions from the Upper Aquifer that will influence stream depletion along San Joaquin River (2) Water level measurements along the San Joaquin River in the shallow zone of the Upper Aquifer to determine degree of vertical gradient (3) Potential degradation to groundwater dependent ecosystems (GDEs) along San Joaquin River primarily dependent on SJRRP operations of San Joaquin River flows since groundwater pumping expected to remain stable and consistent with historical (pre-SJRRP) levels	Decrease in surface water stage in Mendota Pool from Bureau of Reclamation and Central California Irrigation District (CCID) operations that impact groundwater dependent ecosystems (GDEs) and operations in Mendota Wildlife Area.	The Grassland Plan Area groundwater pumping does not influence surface water depletion. Reduction of interconnected surface water bodies and associated groundwater dependent ecosystems (GDEs), requiring reduction in groundwater pumping (no management activities have depleted interconnected surface water in the Grassland Plan Area within the Historic Period). A significant and unreasonable undesirable result would regard impaired habitat directly associated with interconnected surface waters.	Where interconnected stretches of surface water are identified, an X%* increase in depletions of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	When groundwater extraction directly decreases streamflow in losing stretch of the San Joaquin River.
Sustainability Goal for Sustainability Criterion	Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Minimize downward gradient in the San Joaquin River	Maintain stage in Mendota Pool between 12.75 and 13 feet.	No reduction in interconnected surface water bodies or associated GDEs due to GGSA pumping.	No loss of productive agriculture due to an inability to pump groundwater.	Mitigate observed reductions of interconnected surface and groundwater due to pumping in the San Joaquin River Exchange Contractors (SJREC) GSP Group area.
5-Year Interim Goals	Not Applicable	Year 5: gradient of -1.1 Year 10: gradient of -0.99 Year 15: gradient of -0.83 All gradients measured at monitoring site SJRRP-09-55, 55b	Year 5: Mendota Pool staff gage reading of 7.4 ft Year 10: Mendota Pool staff gage reading of 9.1 ft Year 15: Mendota Pool staff gage reading of 11.3 ft	Year 5: WSE > Measurable Objective (Upper Aquifer) Year 10: WSE > Measurable Objective (Upper Aquifer) Year 15: WSE > Measurable Objective (Upper Aquifer)	Year 5: Establish Minimum Threshold and Measurable Objective for this parameter Year 10: To be determined (TBD) in 2025 GSP update based on additional data analysis Year 15: TBD in 2025 GSP update based on additional data analysis	Year 5: Mitigate depleted interconnected surface water in the San Joaquin River Year 10: Mitigate depleted interconnected surface water in the San Joaquin River Year 15: Mitigate depleted interconnected surface water in the San Joaquin River

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	Not Applicable Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -1.3 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 5.4 ft	20% lowered water elevation from recent historic low (set at each monitoring site).	An X%* increasle in surface water depletions along interconnected stretches of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	Observed increase in seepage from the San Joaquin River due to groundwater extractions in the SJREC GSP Group area. The SJREC plan to work with the counties to restrict perforating wells above the first encountered restrictive clay layer (near the San Joaquin River) to prevent induced seepage similar to the established operations defined in the Herminghaus Agreement on Reach 2 of the San Joaquin River.
Measurable Objective	Not Applicable. Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -0.67 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 13.5 ft	Recent historic low (set at each monitoring site).	No increased depletions of surface water as a result of groundwater pumping.	Same as Minimum Threshold

6. SUBBASIN MONITORING PROGRAM

As required by Subarticle 4. Monitoring Networks of the GSP regulations, the GSPs must include a monitoring network for each sustainability indicator, in addition to describing the monitoring protocols and data management to be followed in implementing the GSP monitoring program. Given the variability of conditions within the Delta-Mendota Subbasin, each GSP Group initially developed their individual monitoring networks, in coordination with their neighboring GSP Groups, such that the subbasin-wide monitoring program is simply a compilation of those coordinated individual monitoring networks. These representative monitoring networks were then re-evaluated as part of the update to the Subbasin GSP in 2022. Please see the individual GSPs for further discussion as to how the monitoring networks were developed.

The subbasin-wide monitoring networks presented herein are the representative monitoring networks for each of the applicable sustainability indicators, as defined according to the GSP Regulations § 354.36, *Representative Monitoring*. It is at the representative monitoring sites where each GSP Group has defined minimum thresholds, measurable objectives, and interim milestones to evaluate progress in achieving the Subbasin's sustainability goal by 2040. Data collected at the representative monitoring locations may be augmented with additional data, as available and appropriate, from other locations and/or publicly-available datasets, in evaluating Subbasin conditions on an annual basis.

6.1.1 Coordinated Assumptions and Data

As previously noted, the required monitoring networks were initially developed at the GSP-level in order to appropriately capture the variability of hydrogeologic and water quality conditions in the Delta-Mendota Subbasin, and then re-evaluated at the Subbasin level to confirm that the monitoring networks meet the necessary requirements. All common coordinated assumptions agreed upon and implemented by each GSP Group in developing their respective monitoring networks are presented in Technical Memorandum 5 (*Assumptions for Delta-Mendota Subbasin Monitoring Network*) which is included in **Appendix B** of this Common Chapter.

6.1.2 Coordinated Monitoring Activities

All Delta-Mendota Subbasin GSP Groups have agreed to utilize the following monitoring protocols, data management, and roles and responsibilities for implementing and reporting from their respective monitoring plans under SGMA to ensure consistency in data collection, analysis and management allowing for subbasin-wide evaluation of groundwater conditions relative to the Subbasin sustainability goal, as defined and agreed upon by all GSP Groups.

Monitoring Protocols

Each GSP Group will utilize agreed-upon protocols, which may be the same as, or equal to, data collection protocols (i.e., industry standards and best management practices) to ensure the collection of comparable data using comparable methods. Additionally, the following minimum monitoring frequency for each applicable sustainability indicator was agreed upon by each GSP Group during the joint Delta-Mendota Subbasin Coordination Committee and Technical Working Group meeting on June 18, 2019:

- **Chronic lowering of groundwater levels/reduction in groundwater ~~storage~~storage** - Twice per year, with seasonal high groundwater elevation data collected between February and April, and seasonal low groundwater elevation data collected between September and October. All measurements will be collected to a tenth of a foot.

- **Degraded water quality** – Once per year during irrigation season, typically between May and July.
- **Depletions of interconnected surface water** – Twice per year in conjunction with groundwater level monitoring.
- **Subsidence** – Publicly available subsidence data will be used along with locally-collected data. At a minimum, three data points will be collected within the first five years of GSP implementation, with a baseline value from 2019 or a date prior to that.

For non-monitored data to be reported as part of the annual reports (e.g., groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g., electrical usage, crop demand, ET) and/or other industry best practices. Additionally, where available and applicable, public datasets will be used to augment monitoring data collected by the Subbasin and analyzed on an annual basis.

Data Management

Each GSP Group will be responsible for conducting quality control reviews of data collected from the monitoring networks. As described in the Coordination Agreement, each GSP Group will exchange and share collected data in order to facilitate analysis and reporting at the Subbasin level. The Coordinated Data Management System (DMS) will be the primary vehicle by which data are shared amongst the GSP Groups, and it will be the responsibility of each GSP Group to conduct a quality control review of data entered into the DMS.

Roles and Responsibilities

It will be the responsibility of each GSP Group, and the GSAs included in that group, to conduct the monitoring program as agreed upon at the Subbasin level, for reviewing the data collected, and for ensuring that these data are available at the Subbasin level. **Figure CC-71**~~**Figure CC-65**~~ shows the general flow of data collected from the Delta-Mendota monitoring programs.

Figure CC-72~~**Figure CC-66**~~ shows the roles and responsibilities of each GSA and GSP Group in the collecting, processing and reporting of data from the GSP monitoring networks. Additionally, it is the responsibility of each GSP Group, including their respective GSAs, to maintain the monitoring network and, as appropriate, revise and/or expand the monitoring networks to fill identified data gaps. Please see the individual GSPs for further information regarding data gaps and the GSAs plans for addressing those gaps.

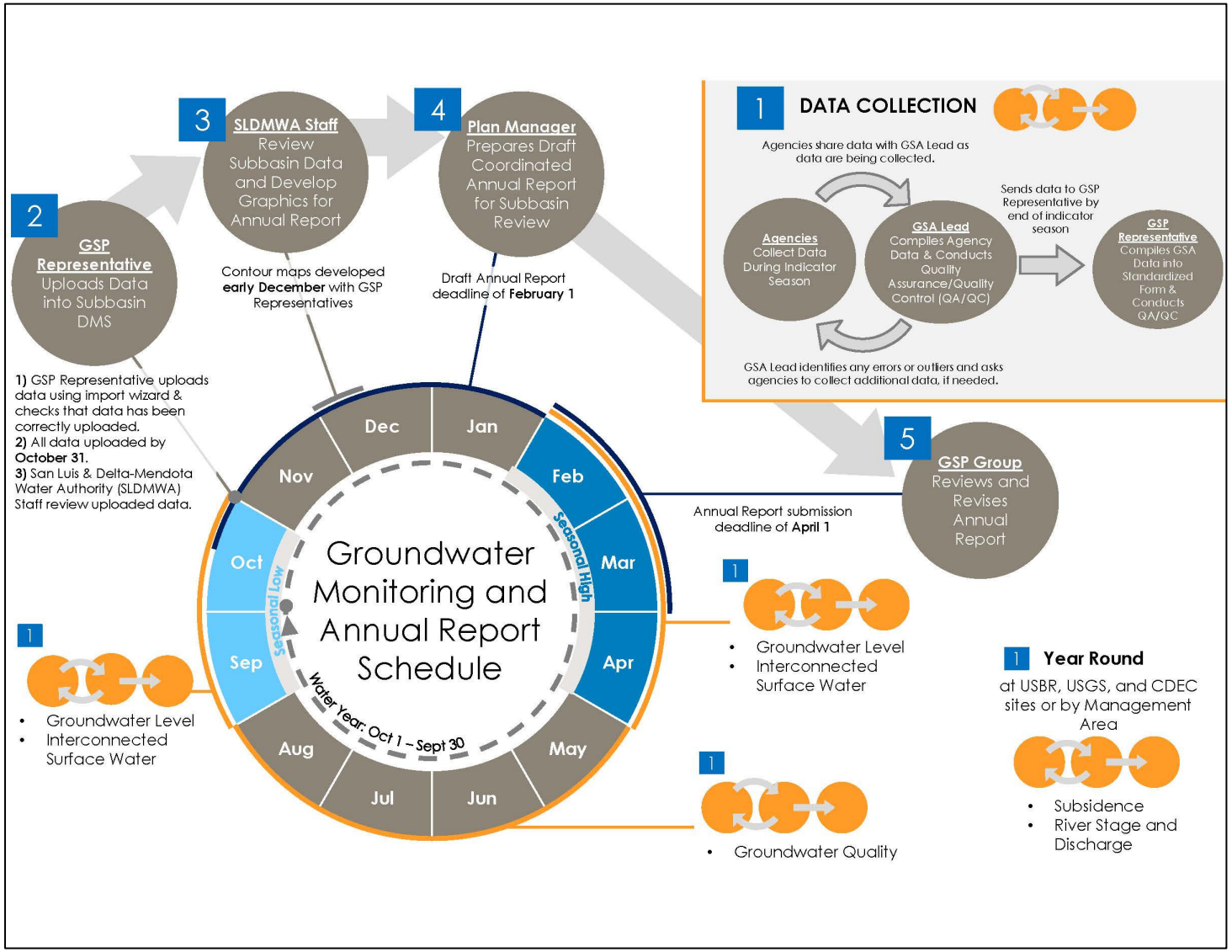

Figure CC-~~71~~65: Data Flow in Delta-Mendota Subbasin

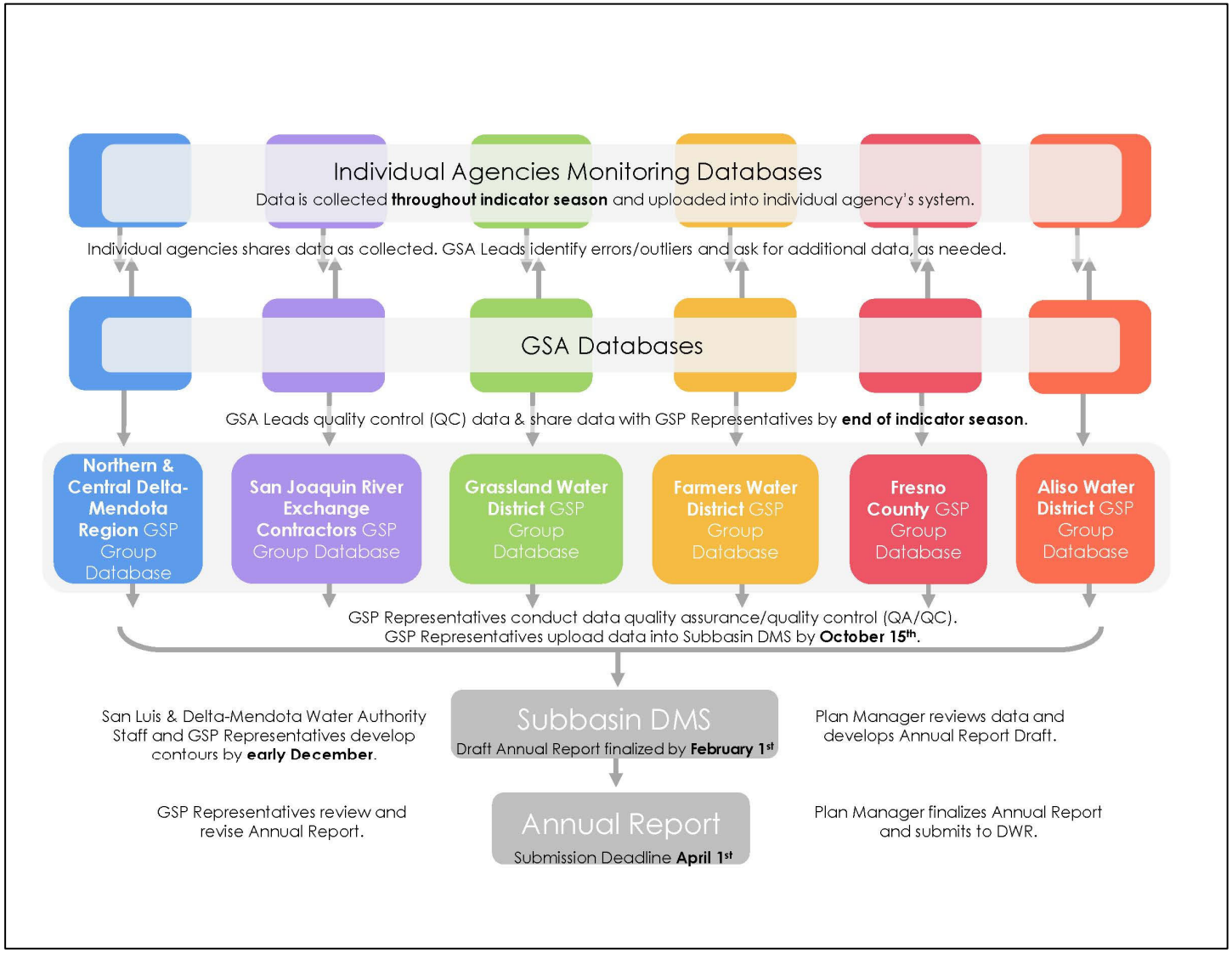

Figure CC-~~72~~66: Delta-Mendota Monitoring and Data Management Roles and Responsibilities

6.1.3 GSP-Level Monitoring Networks

For more information on the individual GSP monitoring networks for each applicable sustainability indicator, including how the networks were developed, please refer to the individual GSPs. The monitoring networks for each applicable sustainability indicator for each GSP Group were developed in accordance with the GSP Regulations Article 5. Plan Contents, Subarticle 4. Monitoring Networks (§ 354.21 – 354.40). DWR's Best Management Practices for the *Sustainable Management of Groundwater Monitoring Protocols, Standards, and Sites BMP* (2016b) and *Monitoring Networks and Identification of Data Gaps BMP* (2016a) documents were used when and where applicable at the discretion of each GSP group in developing monitoring networks and monitoring protocols.

6.1.4 Delta-Mendota Subbasin Monitoring Networks

The subbasin-level monitoring networks are a compilation of the representative monitoring networks developed by each individual GSP Group and reviewed and modified at the Subbasin level for consistency and appropriate coverage. The monitoring network for the chronic lowering of groundwater sustainability indicator is comprised of two parts, the Upper Aquifer (**Figure CC-73~~Figure CC-67~~**) and Lower Aquifer (**Figure CC-74~~Figure CC-68~~**). The monitoring networks for the reduction in groundwater storage for the Upper Aquifer and Lower Aquifer are the same as those utilized for the chronic lowering of groundwater levels. The monitoring network for the degraded water quality sustainability indicator is also comprised of two parts, the Upper Aquifer (**Figure CC-75~~Figure CC-69~~**) and Lower Aquifer (**Figure CC-76~~Figure CC-70~~**). Data gaps (areas without wells of known construction) are shown for the Upper Aquifer and Lower Aquifer for the chronic lowering of groundwater and degraded water quality sustainability indicator. The interconnected surface water monitoring network for the Delta-Mendota Subbasin is shown in **Figure CC-77~~Figure CC-71~~**, and the monitoring network for land subsidence for the Delta-Mendota Subbasin is shown in **Figure CC-78~~Figure CC-72~~**.

The Delta-Mendota Subbasin representative monitoring networks will be periodically reviewed and revised, as appropriate, by the GSP Groups responsible for maintaining them and coordinated at the Subbasin level. Revised monitoring networks will be included in the five-year updates to the GSPs.

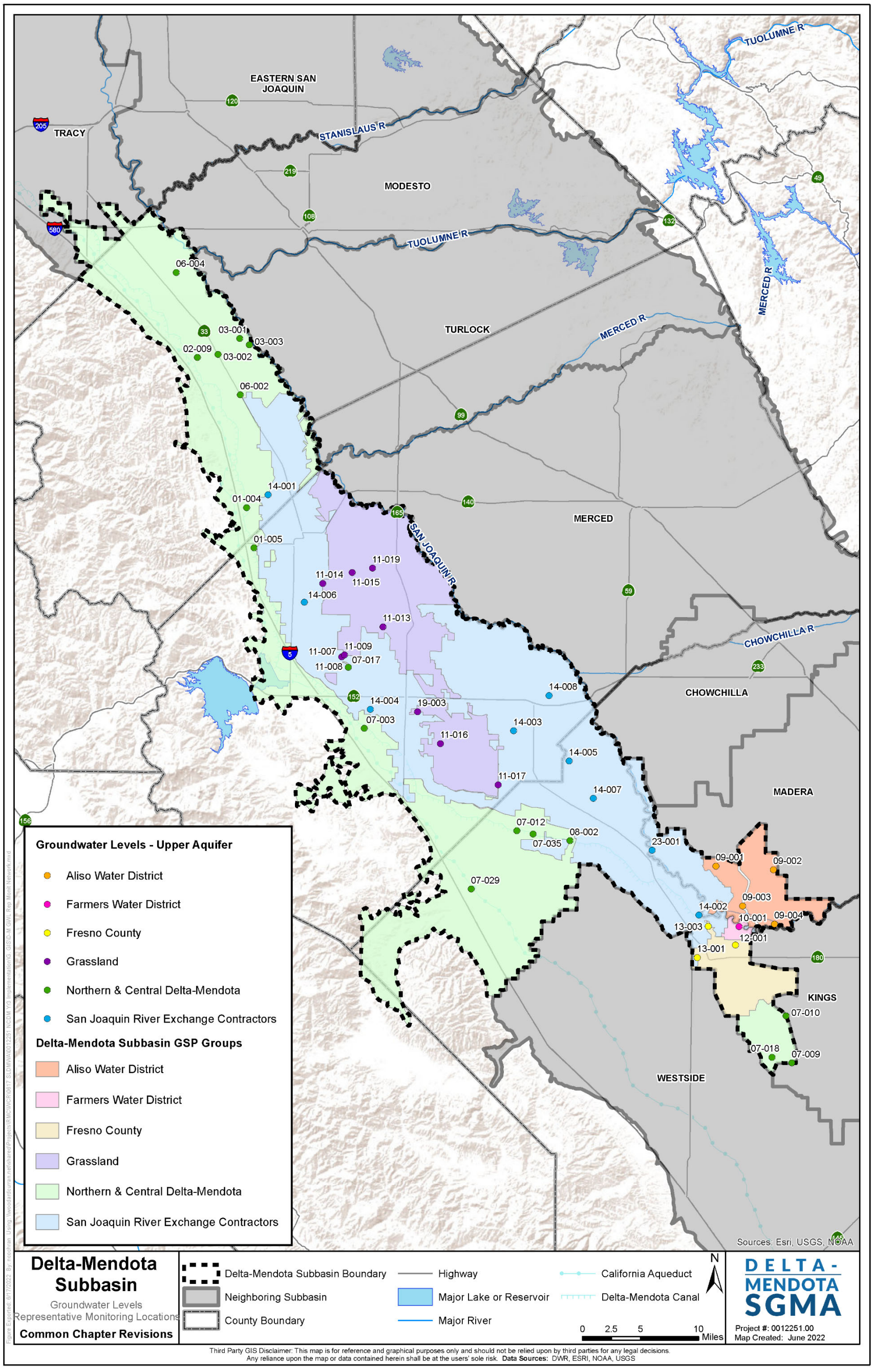

Figure CC-~~73~~67: Upper Aquifer Groundwater Level Monitoring Network

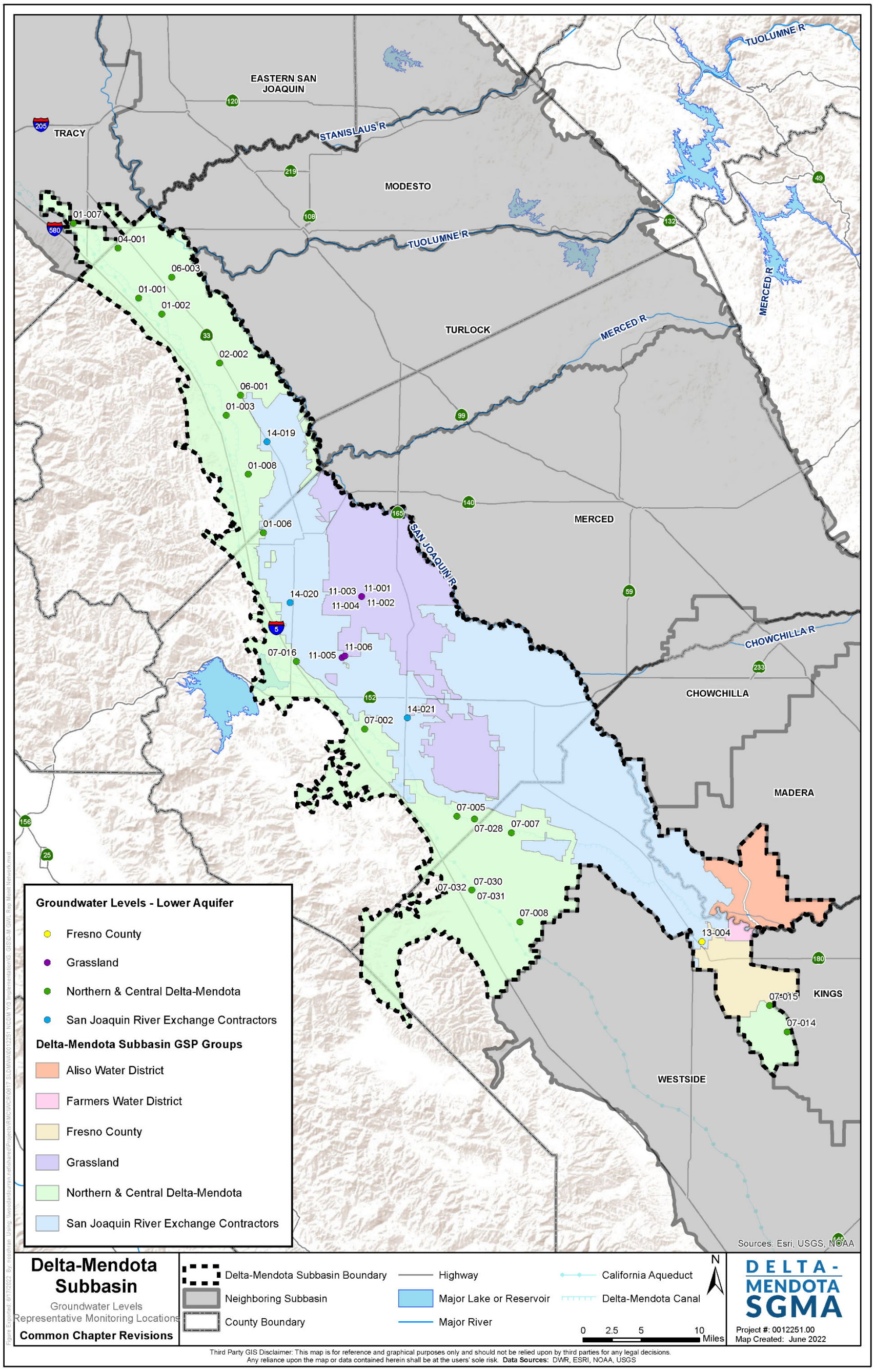

Figure CC-~~74~~68: Lower Aquifer Groundwater Level Monitoring Network

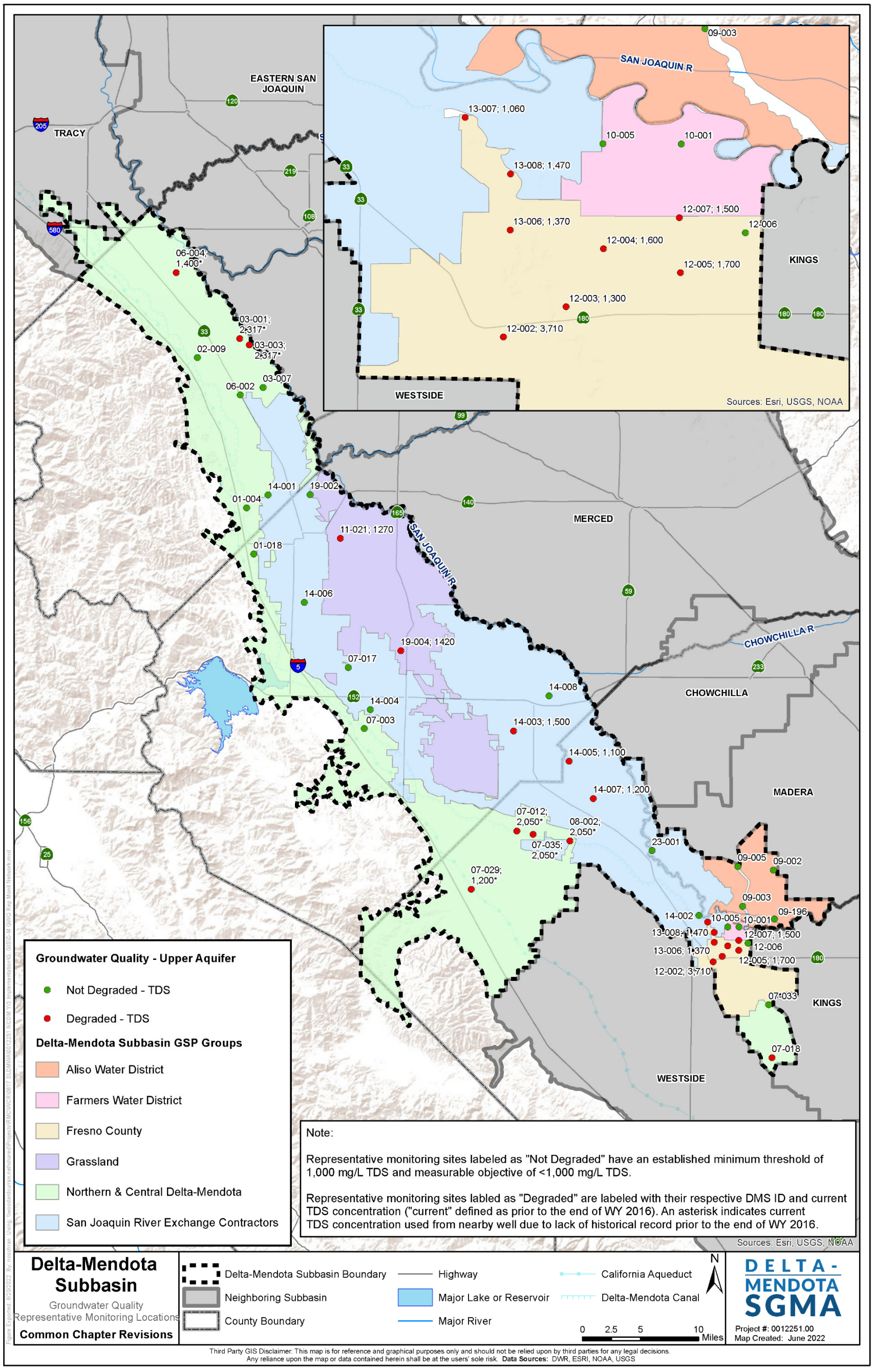

Figure CC-~~75~~69: Upper Aquifer Groundwater Quality Monitoring Network

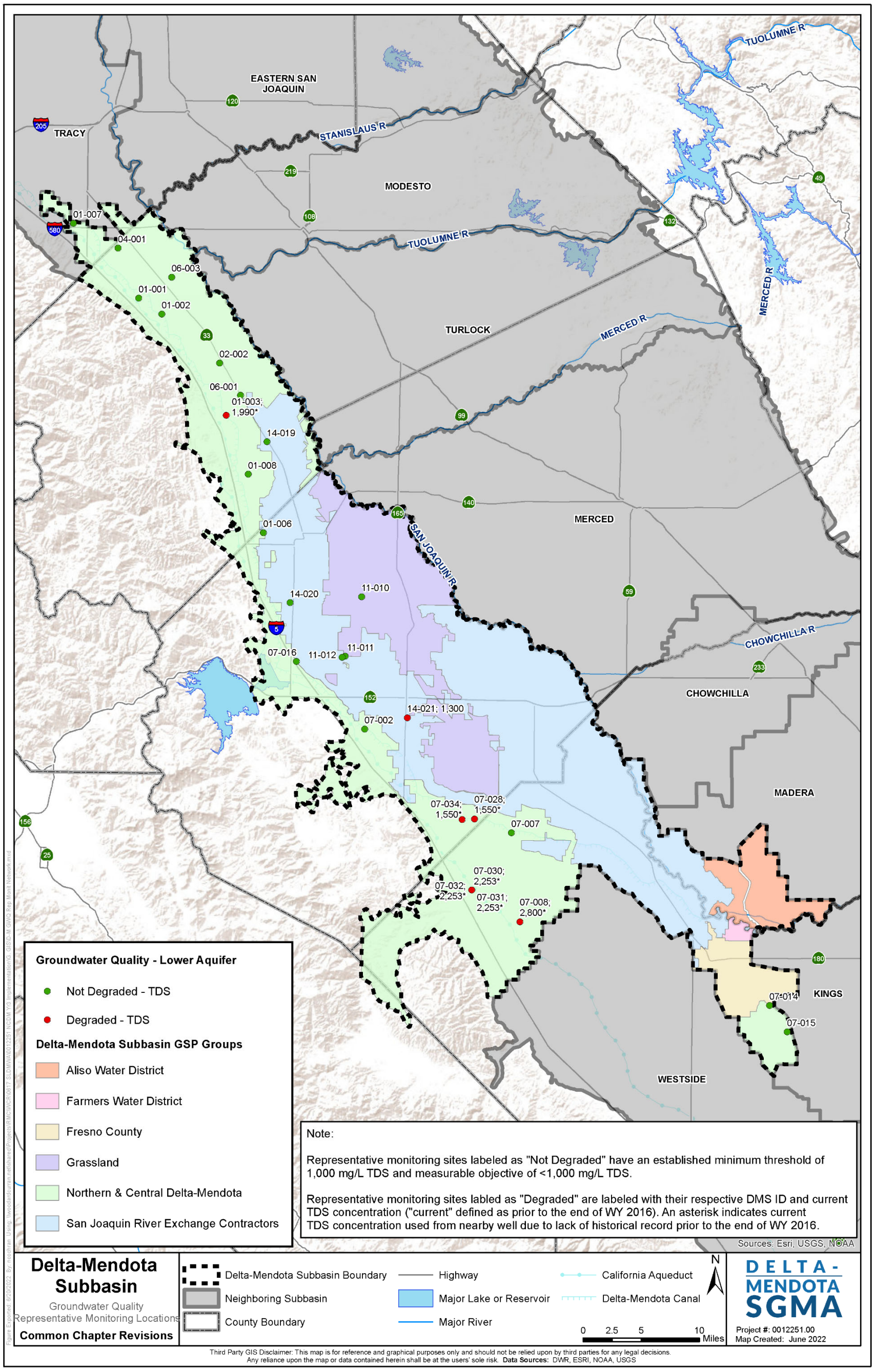

Figure CC-~~76~~70: Lower Aquifer Groundwater Quality Monitoring Network

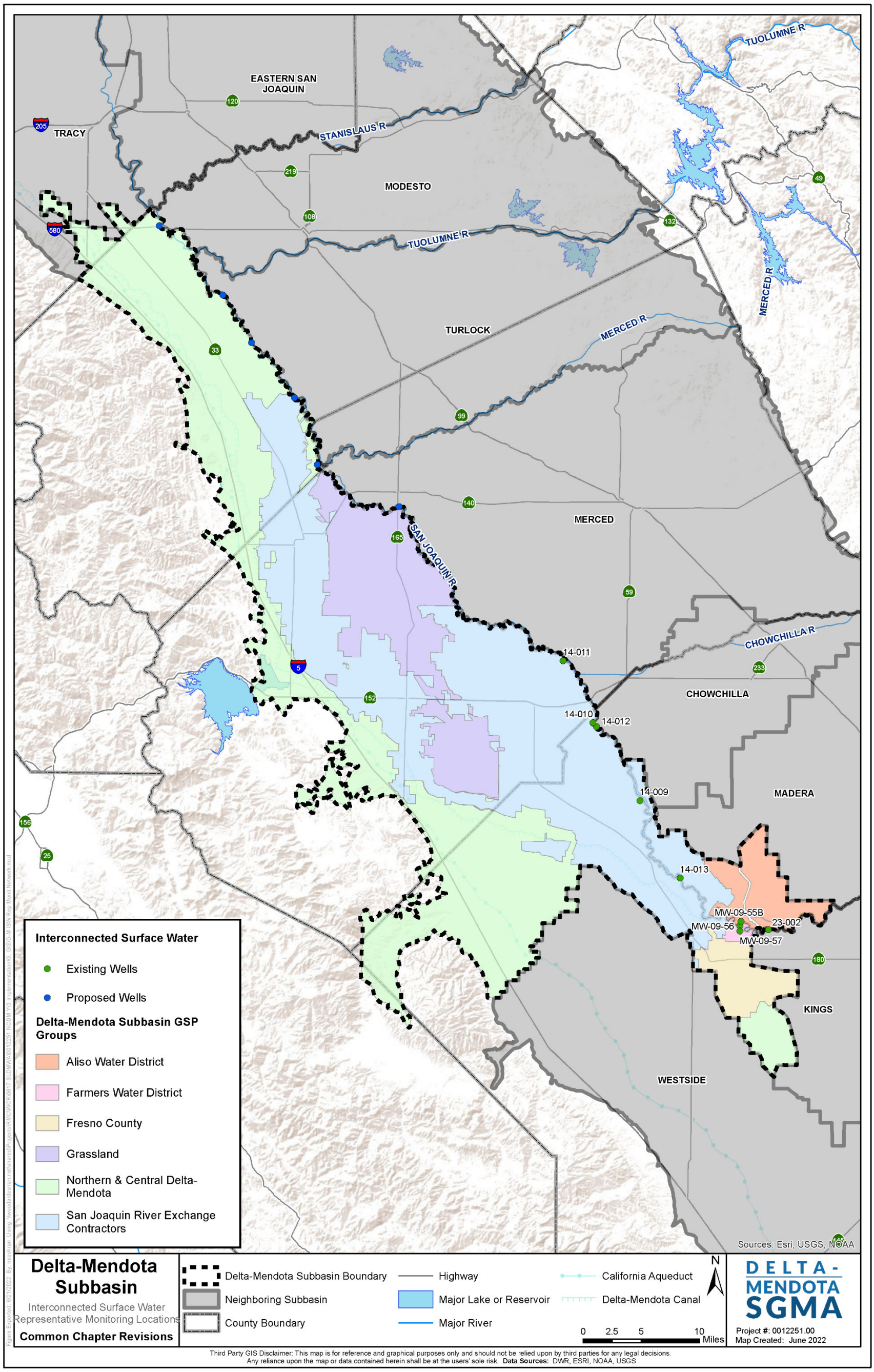

Figure CC-~~77~~71: Interconnected Surface Water Monitoring Network

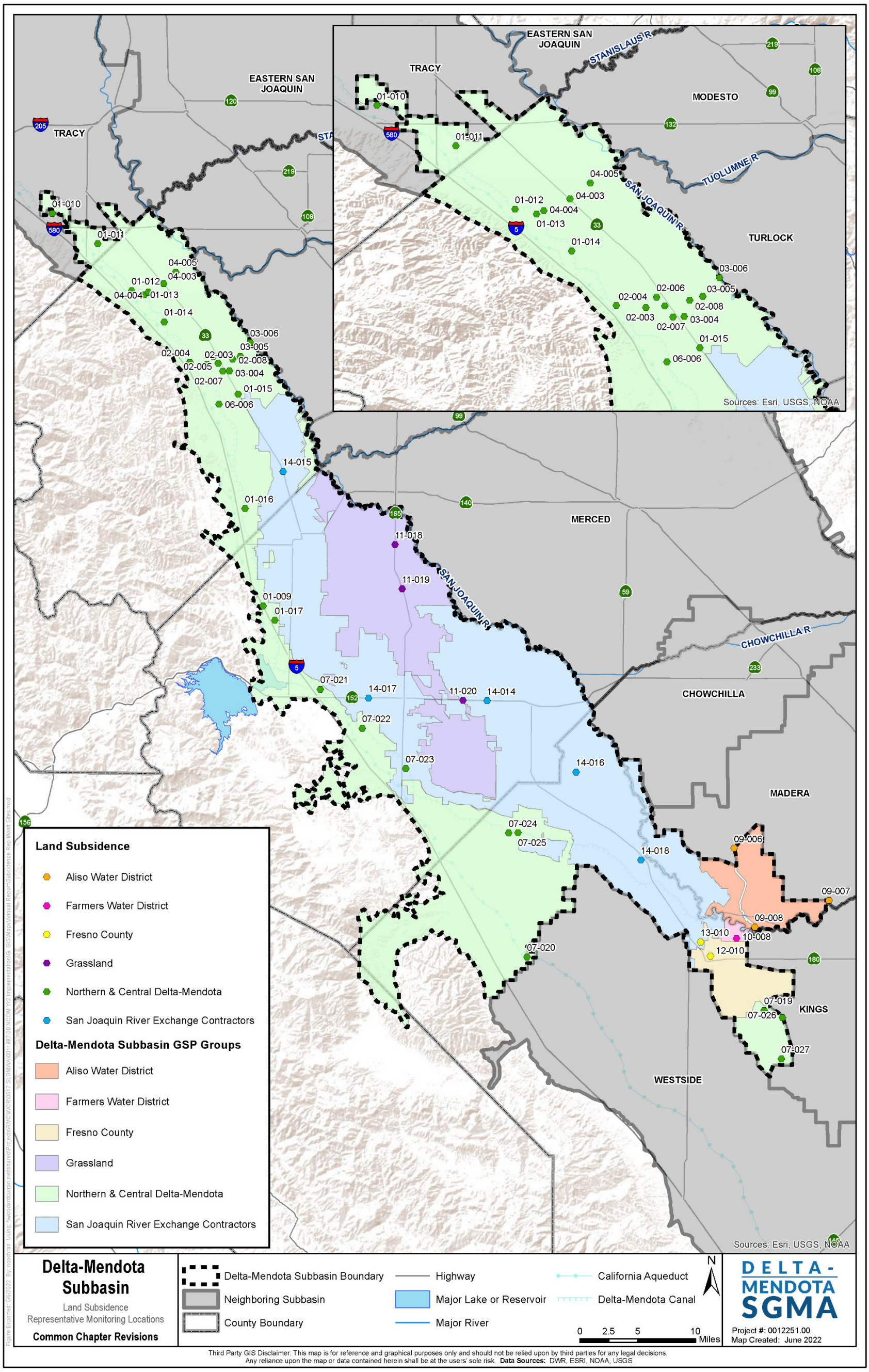

Figure CC-~~78~~72: Land Surface Elevation Monitoring Network

7. SUBBASIN DATA COLLECTION AND MANAGEMENT

As required in §352.6, Data Management System of the GSP regulations, each GSA is required to develop and maintain a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP(s). Additionally, per §354.4, Reporting Monitoring Data to the Department, all monitoring data is to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data but which will allow for the required compendium of data sets for preparation of Subbasin annual reports. The coordinated DMS will also provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The individual GSP Groups have also developed and will maintain separate data storage processes or DMSs. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

Section 6.1.2 describes the process by which monitoring data are collected by each GSP Group and processed for inclusion in the Coordinated DMS. In order to be able to track data by location in the Subbasin, each monitoring locations in the Delta-Mendota Subbasin is assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, the subsequent four digits indicate which specific monitoring

location in that GSA area. As shown in Figure CC-72~~Figure CC-66~~, the general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon monitoring protocols and transmits it to the GSA Representative.
- Each GSA Representative then compiles the data and conducts a quality control check.
- The GSA Representative then transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative then uploads the data set into the DMS using import wizards designed specifically for this process.
- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS are then augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS are subsequently imported into the DMS as GIS files to ensure all data are kept in one place and to allow for access by GSAs and other Subbasin stakeholders.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future maintenance. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Coordinated DMS as described herein may be supplemented by additional DMS developed and maintained by each GSP Group in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

8. STAKEHOLDER OUTREACH

California Code of Regulations, Title 23, §354.10 identifies the requirements for notice and communication information presented in a GSP, which includes:

- A summary of information relating to notification and communication by the GSAs with other agencies and interested parties;
- 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;
- A list of public meetings at which the GSP was discussed or considered by the GSAs;
- Comments regarding the GSP received by the GSAs and a summary of any responses by the GSAs;
- A communication section of the GSP that includes an explanation of the GSAs' decision-making process, identification of opportunities for public engagement, a discussion of how public input and response was used, a description of how the GSAs encouraged the active involvement of diverse social, cultural and economic elements of the population within the basin, and the methods used by the GSAs to inform the public about progress implementing the GSP, including the status of projects and actions.

In meeting these requirements, outreach and educational activities were conducted at the Subbasin, GSP and GSA level throughout the GSP development process. This section describes the noticing and outreach conducted at the Delta-Mendota Subbasin level for GSP development. Please refer to each individual Subbasin GSP for specific details regarding noticing and communication, and descriptions of the beneficial uses and users of groundwater at the GSP and GSA level. Information regarding Subbasin coordination and committees can be found in Section 2, Delta-Mendota Subbasin Governance, of this document.

8.1 Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Delta-Mendota Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs.

~~The facilitation~~The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Appendix E**. The Communications Plan identifies near- and long-term outreach and

engagement strategies, tactics, and tools for stakeholder engagement in GSP development and implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

The Delta-Mendota Subbasin is home to a large Hispanic or Latino population with many using Spanish as their primary language. As such, public noticing, educational materials and other outreach efforts were developed and presented in both English and Spanish throughout the GSP development process.

8.2 Public Noticing and Information

The Delta-Mendota Subbasin GSAs developed and used several coordinated tools, in addition to their own resources to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- **Website:** The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below), and provides links to the individual GSP websites maintained by each GSP Group.

- **Delta-Mendota Subbasin Newsletter:** The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.

- **Informational Materials**: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials before and during meetings, workshops, and other outreach activities.

8.3 List of Public Meetings Where the GSPs were Discussed

Each GSP Group for the Delta-Mendota Subbasin has conducted individual outreach efforts relative to their own GSP Plan area in addition to those same efforts at the subbasin-level. Please refer to each of the individual GSPs for this information. Below is a list of the coordinated public workshops and meetings where the GSPs were discussed. These include meetings of the Delta-Mendota Subbasin Coordination Committee, the two Subbasin Working Groups and coordinated public workshops. All meetings were publicly noticed and held from June 2017 through July 2019. Meeting agenda, minutes and handouts are available on the Delta-Mendota Subbasin website at www.deltamendota.org.

Delta-Mendota Coordination Committee Meetings

The Delta-Mendota Subbasin Coordination Committee meets on the second Monday of each month at 9:30 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, a special meeting of the Coordination Committee was held on March 8, 2019 to discuss sustainable yield estimation methodologies.

Delta-Mendota Technical Working Group Meetings

The Delta-Mendota Technical Working Group meets on the third Tuesday of each month at 10:00 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, several special meetings of the Technical Working Group were held to discuss specific topics. These additional meetings were as follows:

- August 24, 2018 and September 19, 2018 meetings to discuss Groundwater Dependent Ecosystems
- August 8, 2018, October 30, 2018 and December 19, 2018 meetings to discuss water budgets

Delta-Mendota Communication Working Group Meetings

The Delta-Mendota Communications Working Group meets on the fourth Tuesday of each month at 1:00 pm. These meetings typically conducted via conference call. Meeting information for this working group is available on the Delta-Mendota Subbasin website.

Coordinated Public Workshops

Coordinated public workshops were held for the Delta-Mendota Subbasin shown in the table below. All workshops were advertised and conducted in both English and Spanish.

Table CC-2419: Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshops		
May 14, 2018	Los Banos, San Luis & Delta Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical and analytical models • Water budgets
October 24, 2018	Los Banos, College Greens Building	
October 25, 2018	Patterson, Hammon Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Banos, College Greens Building	

Date	Location, Venue	Topic
February 20, 2019	Patterson, Patterson City Hall	• Historic and current water budgets • Sustainability criteria • Undesirable results • Projects and management actions
March 4, 2019	Santa Nella, Romero Elementary School	
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Banos, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Please see **Appendix F** for summaries of the coordinated public workshops, and **Appendix G** for example promotional materials for the public workshops.

8.4 Comments Regarding the GSPs

Key components of the six Subbasin GSPs were presented at the public workshops conducted throughout the GSP development process. **Appendix F** contains summaries of the coordinated public workshops, including comments received from and feedback provided to workshop participants. Additionally, each of the GSP Groups in the Delta-Mendota Subbasin are individually responsible for the public review of their plans and for addressing any public comments received. Please see the individual GSPs for additional information regarding plan review.

8.5 Subbasin Decision Making Process

The Delta-Mendota Subbasin Coordination Agreement outlines the responsibilities of all Subbasin parties, including decision making protocols and voting structure. These are further discussed in Chapter 2 of this document.

During the GSP development process, the Technical Working Group was charged with coordinating implementation of the required technical elements of the GSP (e.g., water budgets, monitoring networks), and to provide recommendations to the Delta-Mendota Subbasin Coordination Committee. Similarly, the Communications Working Group was charged with implementing the Subbasin Communications Plan and with providing recommendations for workshops and other outreach activities to the Coordination Committee. The Coordination Committee took actions and approved recommendations and work products and provided direction to both working groups and other ad hoc committees.

In general, the coordinated decision-making process included developing agendas for each meeting of the Delta-Mendota Subbasin Coordination Committee and for each Working Group meeting. The agendas were developed in concert with the Technical and Communications Working Groups, and the respective representatives of each GSP Group. Agenda items were either educational, informational, or required direction or decision. Meeting agendas, meetings minutes and handouts have been posted on the Delta-Mendota Subbasin website for public access.

8.6 Opportunities for Public Engagement and How Public Input was Used

Community input was encouraged and received at all meetings of the Coordination Committee, Technical Working Group, Communications Working Group meetings and at the public workshops. The Subbasin

GSPs (and therefore, this Common Chapter) was shaped by community input, Working Group input, and Coordination Committee direction and decisions.

8.6.1 Opportunities for Public Engagement

Regular opportunities for public engagement were available throughout GSP development. The Coordination Committee, Technical and Communications Working Groups, and individual GSA staff encouraged public input throughout the development of the GSPs as described below. A list of stakeholder and community organizations contacted as part of the Subbasin coordinated outreach efforts is included in **Appendix H**.

Meetings and Direct Engagement

Open meetings and public workshops were held as described in Section 8.1. In addition, GSA staff made direct contact with community representatives to encourage their participation in the GSP development process. GSA representatives provided their contact information by phone, email, or mail both online (on the Subbasin website) and at workshops for stakeholder questions and comments.

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- **Agricultural Interests:** Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.
- **School Districts:** Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.
- **Industrial Interests:** There are many industrial interested in the Subbasin, including packaging and processing plants, mining industries, and other similar facilities that use groundwater in some fashion. The GSP Groups have identified these interests within their respective Plan areas and have disseminated information related to GSP development during individual outreach efforts.
- **Environmental/Conservation Interests:** Environmental and conservation interests in the Subbasin have been contacted and communicated with during GSP development. Specific related interest groups contacted during GSP development include The Nature Conservancy, the California Department of Fish and Wildlife, Audubon, and various sportsman clubs and wetland managers.

- **Disadvantaged Communities:** The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.
- **Other Interests:** Other potential groundwater users in the Subbasin (or those with groundwater-related interests) contacted during GSP development included the various counties in which the Delta-Mendota Subbasin lie and/or are adjoining (including San Joaquin County and San Benito County), Caltrans, the DWR State Water Project Division of Operations and Maintenance, the U.S. Bureau of Reclamation, the U.S. Geological Survey and the San Joaquin River Restoration Program.

The Reader should refer to each individual GSP for a more ~~complete description~~complete description of GSP-specific meetings and direct engagement.

GSP Section Review and Comment Periods

Each GSP Group was responsible for coordinating the individual review of their GSP. Please see each GSP for additional information as to their specific public review process. This Common Chapter to the six Delta-Mendota Subbasin GSPs was posted on the Subbasin's website (www.deltamendota.org) following submittal of the Subbasin GSPs.

8.6.2 How Public Input and Response was Used in the Development of the GSP

Each GSP Group was responsible for coordinating the individual review of their GSP and for determining how to incorporate public input and responses into their respective plans. Public input to the GSPs was solicited through the GSP development process through a number of means, including coordinated public workshops, Board of Directors presentations, City Council presentations, and growers' meetings. Please see the individual GSPs for more information regarding GSP-specific outreach efforts and how stakeholder and public input was received and factored into the GSPs.

8.7 Revisions to Common Chapter and Subbasin GSPs

As previously noted in this document, the Delta-Mendota Subbasin received a Consultation Initiation Letter on January 21, 2022 from DWR. The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Basin Manager, Plan Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings were held on March 7, March 30, April 19, May 24, and June 20 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies.

The four deficiencies identified in DWR's CIL are summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Potential Deficiency 2: The GSPs have not established common definitions of undesirable results in the Subbasin.

Potential Deficiency 3: The GSPs in the Subbasin have not set sustainable management criteria in accordance with GSP regulations.

Potential Deficiency 4: The management areas established in the Plan have not sufficiently addressed the requirements specified in 23 CCR §354.20.

This revised Common Chapter, and associated revisions to the six Subbasin GSPs, have been prepared in response to the deficiencies identified in the CIL based on direction provided by the Delta-Mendota Subbasin Coordination Committee, the Delta-Mendota Technical Working Group, the Subbasin GSAs and DWR. It is intended to document how the deficiencies identified in the CIL were addressed in the revised GSPs and associated Common Chapter, and where those revisions are addressed in the Common Chapter.

A Notice of Intent to Adopt the revised Common Chapter and six Subbasin GSPs (known as the Amended Groundwater Sustainability Plan) was distributed on March 15, 2022. Public meetings for the adoption of the Common Chapter and Subbasin GSPs were held in June and July of 2022; please see the Subbasin's website (www.deltamendota.org) for the respective dates for each GSAs meeting and adoption.

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Appendix H - Response to Comments Received

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General Counsel

July 12, 2022

To: Boards of Directors for the
Grassland Water District and
Grassland Resource Conservation District
(acting as legislative body for the Grassland Groundwater Sustainability Agency)

From: Ricardo Ortega, General Manager and
Ellen Wehr, General Counsel

Re: Response to Comments Received on Revised Grassland Groundwater Sustainability Plan

On July 12, 2022, prior to the scheduled joint board meeting of the Grassland Water District, Grassland Resource Conservation District, and Grassland Groundwater Sustainability Agency ("GGSA"), comments were submitted by the California Sportfishing Protection Alliance ("CSPA") regarding the proposed Revised Grassland Groundwater Sustainability Plan ("GGSP"). The Revised GSP addresses inadequacies in the GGSP that were identified by the California Department of Water Resources ("DWR") in late January.

Adequacy of Public Participation Opportunities

The first comment is that the GGSA failed to provide meaningful opportunity for public participation in the development of the revised GGSP. The deficiencies identified by DWR were focused on the need for more coordination with other GSP groups in the Delta-Mendota Subbasin. Accordingly, the Grassland GSA participated in deliberations about revisions to the GSP at meetings of the Subbasin Coordination Committee, which has representatives from all six GSP groups in the Subbasin. The Coordination Committee held more than 10 public meetings during the six month review period. Attorneys for CSPA attended many of those meetings. While some discussions were held in closed session if necessary, many hours of deliberations took place in the public forum, and public comments were regularly requested. The GGSA is not aware of any requests for materials by CSPA that were denied.

CSPA will continue to have an opportunity to review and comment on the GGSP. After the GGSA adopts and submits a revised GSP, DWR will provide CSPA and other members of the public with a formal opportunity to submit comments.

The GGSA has endeavored to assist the public in reviewing and commenting on the Revised GSP by providing a version that highlights all changes made, which is attached as Exhibit G to the Revised GSP. Public participation opportunities for the Revised GSP are adequate and in compliance with the Sustainable Groundwater Management Act ("SGMA").

Public Trust Resources and Groundwater Dependent Ecosystems

The second area of comments improperly criticizes the Grassland GSP for failing to address public trust resources or adequately identify groundwater dependent ecosystems (GDEs). The Grassland GSP (in both its original form and as revised) defines the vast majority of lands and waters within its boundaries as GDEs, and endeavors to protect those significant public trust resources throughout the GSP. (*See* Section 2.5.12 of the Revised GGSP.) A GDE mapping tool was developed by The Nature Conservancy and approved by DWR, and this tool was used for purposes of the Grassland GSP. In fact, The Nature Conservancy gave the Grassland GSP a very high "score" when reviewing GSPs across the state, noting that "[w]etland and vegetative GDEs were identified and mapped using The Nature Conservancy's data."[1] None of the comments previously submitted by CSPA and attached to the recently received comment letter pertain specifically to the Grassland GSP, but appear to be focused on other areas in the Subbasin.

It should be emphasized, as discussed in the Grassland GSP, that fish and wildlife species are not being harmed by the minimal use of groundwater to support wetland ecosystems within the Grassland GSP area, nor is groundwater use in the area unsustainable. While CSPA's comments continue to focus on groundwater use in other areas in the Subbasin, the Grassland GSA has not been made aware of any evidence of harm to the environment from its careful management of groundwater within the Grassland Ecological Area.

Interconnected Surface Water

The final area of comments focuses on interconnected surface water. The Grassland GSP area is a "gaining reach" of the San Joaquin River, likely due to the continuing contributions of the wetland complex to the health of the aquifer and surrounding aquatic systems. As described on pages 3-55 and 4-8 of the Revised GSP: "The portion of the San Joaquin River that runs along the eastern edge of the Plan Area is a gaining stream; therefore, there is no contribution from the river to the groundwater system."

[1] The Nature Conservancy, *SGMA Signals: Managing Groundwater for Nature*, p. 25 (2021), *available at*: https://groundwaterresourcehub.org/public/uploads/pdfs/110421_SGMA_Report_K.pdf?fbclid=IwAR0LgAGVFW_zzsOzCtpURFjmjOnJiCDF7M-JAPKAjRZHih9__ZJ0u03GgW4

SGMA, on the other hand, focuses on *depletions* of interconnected surface water, which do not appear to be present in the Grassland GSP area. CSPA's generalized comments about surface water depletions do not appear to apply to the Grassland GSP.

For purposes of basinwide coordination, and due to a lack of sufficient groundwater and stream gauge data in some areas along the river, the GSP groups in the subbasin have proposed an interim set of criteria based on groundwater levels, to monitor interconnected surface water and prevent further depletions. A more accurate set of thresholds based on the rate or volume of interconnected surface water depletions will be developed once the data is collected, an effort currently being funded through a grant approved this year by DWR.

On multiple occasions, DWR has indicated that this approach should be acceptable. The Grassland GSA and other GSAs in the Subbasin diligently sought grant funding and are now developing a plan with funding received to fill the data gaps related to our understanding of interconnected surface water. CSPA has provided no specific data that would allow for the development of a rate- or volume-based criteria for interconnected surface water depletions.

In summary, the Grassland GSA has done its best to allow for public participation while working on a tight six-month timeline for revisions, using the meeting structure adopted by the Subbasin Coordination Committee. The Revised GSP complies with the requirements of SGMA and other laws, and is protective of public trust resources and GDEs.