Report

Engineering Report on 2022 Groundwater Conditions of the Central San Joaquin Water Conservation District

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SECTION 1

Introduction

The Central San Joaquin Water Conservation District (District) was formed in 1959 under the California Water Conservation District Act of 1931, with the purpose of conserving sources of water within the District, securing supplemental sources of water, and ensuring that sufficient amounts of water would be available to all users in the District at a reasonable rate.

The authorizing California Water Code section grants the District authority to levy and collect both groundwater assessments and charges for surface water. An annual engineer's report on groundwater conditions, a public hearing on that report, and a Board of Directors' decision on the rate are required prior to levying a groundwater charge.

1.1 Water Code Definitions and Requirements

According to the California Water Code Section 75560, the District is obligated to produce an annual engineering investigation and report describing the groundwater conditions within the District. The investigation spans the current, preceding, and ensuing water years. A water year is defined in the Water Code as the period extending from July 1 within one calendar year to June 30 of the following calendar year. The water year is identified by the year in which the period ends. This report is prepared for water year 2022.

Accumulated and annual groundwater overdraft estimations are to be described in the annual report. The Water Code defines the annual overdraft as the "amount by which the production of water from groundwater supplies within the District during the water year exceeds the natural replenishment of such groundwater supplies in such water year." Although the Water Code specifically refers to the term "overdraft," groundwater conditions are reported in terms of changes in groundwater storage, both negative and positive. This approach is adopted because assessing whether or not a groundwater system is in overdraft requires an assessment of long-term conditions rather than year-to-year variations.

While the District is located within the Eastern San Joaquin County Subbasin, it overlies only part of the groundwater basin. Consequently, groundwater conditions within the District are linked intimately with water use within the groundwater-basin areas outside the District. Trends in groundwater levels within the District depend on not only the recharge and pumping within the District but also the recharge and pumping outside the District.

This report describes groundwater conditions within the District and is the "Engineer's Report" as required by Section 75560 of the California Water Code. This report gives a general overview of groundwater levels and changes in groundwater storage for the groundwater system underlying the District to establish the overall health of the groundwater system and describes past trends in groundwater levels and storage.

1.2 Data Sources

The report was developed based on an analysis of current and past groundwater levels in the basin underlying the District and a review of reports that resulted from previous investigations. No independent field investigations were conducted for this report. The following primary sources of data and information were used for this report:

- Camp Dresser & McKee (CDM), *Water Management Plan Phase 1 – Planning Analysis and Strategy*, prepared for San Joaquin County Flood Control and Water Conservation District, September 2001.
- Camp Dresser & McKee (CDM), *Integrated Conjunctive Use Project*, prepared for Northeastern San Joaquin County Groundwater Banking Authority, 2008.
- Brown and Caldwell Consulting Engineers, *Eastern San Joaquin County Groundwater Study*, prepared for the San Joaquin County Flood Control and Water Conservation District, October 1985.
- Engineering Science, *Redraft Loan Application Report* (New Melones Supply), prepared for the Central San Joaquin Water Conservation District, August 1987.
- San Joaquin County Department of Public Works, *Eastern San Joaquin Groundwater Basin Groundwater Management Plan* prepared for the Northeastern San Joaquin County Groundwater Banking Authority, September 2004.
- San Joaquin County Flood Control and Water Conservation District, *Semi-Annual Groundwater Reports* (years 1972 to 2012).
- U.S. Geological Survey (USGS) 1908 report titled *Preliminary Report on the Ground Waters of San Joaquin Valley, California*, Water Supply Paper 222.
- California Department of Water Resources (DWR) web page (http://www.water.ca.gov/waterdatalibrary/groundwater/hydrographs/basin_wells.cfm) for additional data not provided by the County and historical data for District and near-District wells identified in the electronic transfer of County well and water level data.
- A georeferenced April 1999 District boundary from the U.S. Bureau of Reclamation (Reclamation) website (http://www.usbr.gov/).
- Precipitation data from the California Data Exchange Center for the Stockton Fire Station 4, located in downtown Stockton (http://cdec.water.ca.gov/).

Data assimilated from these sources have an unknown level of accuracy; it is assumed that estimates of annual change in groundwater storage in this report have an accuracy of about ± 25 percent.

1.3 District Groundwater Basin Characteristics

Currently, the District encompasses approximately 73,000 acres (not including roads, buildings, and other non-pervious areas), of which nearly 67,000 acres are irrigated (Central San Joaquin Water Conservation District, 2018 written communication). Brown and Caldwell's 1985 *Eastern San Joaquin County Groundwater Study* indicates groundwater levels within the District had been dropping at an average annual rate of 1.8 feet during the previous 50 years. As discussed later, this rate of decline has decreased during the past 30 years. Furthermore, the present groundwater-level trend appears to be nearly static.

The District overlies a portion of the San Joaquin River Groundwater Basin, specifically the Eastern San Joaquin County Subbasin, as defined by DWR. Brown and Caldwell (1985) investigations defined aquifer parameters such as hydraulic conductivity, thickness, and specific yield within the study area. These values were compared previously to those used in the more recent numerical model developed for San Joaquin County (CDM, 2001) and were determined to be generally consistent. Groundwater basin properties are generally defined as: specific yield[1] = 9.5 percent, aquifer thickness = 650 feet (ft), hydraulic conductivity = 400 gallons per day per square foot or 53.6 ft per day (ft/day).

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[1] CDM (2001) does not provide values for specific storage or storativity. Value indicated is an assumption based on the Brown and Caldwell 1985 report.

SECTION 2

Groundwater Conditions

The majority of irrigation water within the District is drawn from privately owned agricultural wells. However, an increasing percentage of lands are irrigated using local and imported surface water. The primary source of the surface water is water purchased by the District from the U. S. Bureau of Reclamation ("USBR"), and nearby water districts when feasible, for delivery during the irrigation season. Precipitation runoff from uplands to the east of the District and irrigation tailwater from upstream croplands also contribute to the surface-water supply.

2.1 Groundwater Elevation Trends

Early groundwater conditions in the Central Valley were described by the U.S. Geological Survey ("USGS") in a 1908 report titled *Preliminary Report on the Ground Waters of San Joaquin Valley, California,* Water Supply Paper 222. Groundwater elevation contours for the District, reproduced from the USGS report on Figure 2.1, show the water table as high as 85 ft above sea level in the area west of the Farmington Flood Control Basin. Groundwater flow in 1908 was primarily westerly across the District. This map was used as the pre-development condition from which to estimate the accumulated change in groundwater storage, as required by Sections 75561(b) and 75574(d) of the California Water Code (discussed in Section 2.3.1).

The San Joaquin County Flood Control and Water Conservation District (County) and DWR have collected groundwater level data from approximately 80 wells[2] within and adjacent to the District on a semi-annual basis since the early 1980s. Spring levels are usually measured in early March; fall levels are measured between late September and early November. Groundwater elevation data collected over the past 10 years for wells used to develop current District groundwater elevation maps are listed in Table 2.1.

The locations of wells monitored by DWR and the County are shown on Figure 2.2. Well construction information is not available for all of these monitoring wells, so the depth intervals of the well screens are not known in some cases. Further, existing well construction data, where available, indicate variable depth intervals of screens. To simplify the analysis of groundwater conditions, it is assumed that groundwater flow beneath the District is primarily horizontal; thus, effects associated with vertical groundwater flow are not considered in this report. Measurements of spring 2022 groundwater levels were used to develop a map showing water elevation within the wells (Figure 2.3).

Spring groundwater elevation values were used to assess District groundwater conditions because groundwater levels are measured in early March, before most early-season

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[2] The set of wells used to evaluate groundwater conditions is variable over the period of record (1980 to 2022). Some wells have been destroyed and others added. Wells may also have gaps in their records because they were either not accessible or operating at the time of the groundwater-level survey.

groundwater pumping begins. For purposes of this report, the spring groundwater levels are assumed to represent groundwater conditions prior to the irrigation season.

The general regional direction of groundwater flow within the District is northwesterly toward Stockton (see Figure 2.3), which is consistent with observations made over the past 25 years, as well as with regional modeling results presented by CDM (2001).

Historic trends of groundwater elevations at five wells in the District for 1960 through 2022 are shown on Figure 2.4. The locations of each of these wells are highlighted by a black circle around the well location on Figure 2.2. Figure 2.4 shows that the general rate of groundwater decline observed during 1960-1980 has decreased since 1980. With the exception of short-term variations in groundwater levels (such as the wet period during the mid-1980s and the 1987-1994 drought), groundwater levels have generally stabilized or increased since 1980 until about 2013. Since then, groundwater levels have returned approximately to 1980 levels.

Annual precipitation is shown on Figure 2.4. Annual precipitation is a significant index to groundwater conditions, because precipitation is correlated with irrigation demands, surface-water availability, groundwater pumping, and other elements of the groundwater budget for the District and the overall Eastern San Joaquin County Subbasin. The precipitation influence can be seen by comparing groundwater level responses in 2006 (a wet year, precipitation of 22.3 inches) and 2007 (a dry year, precipitation of 9.8 inches). Groundwater levels rose in 2006, and they declined in 2007. While this is the general relation, frequent exceptions occur. For example, water year 2017 was an above normal year, with 21.8 inches of total precipitation. However, groundwater levels for 2017 are lower than for 2016.

2.2 Groundwater Balance Components

Developing a conceptual regional groundwater balance for the District involves identifying components of groundwater recharge within the District. The primary groundwater-inflow components include groundwater recharge from precipitation (R_P), groundwater recharge from applied water (R_A), groundwater recharge from streams and canals (R_S), and subsurface inflow from areas adjacent to the District (R_U). The primary groundwater-outflow components include shallow groundwater evapotranspiration (D_E), groundwater pumping from agricultural wells in the District (D_P), and subsurface outflow to areas adjacent to the District (D_U). These components of recharge and discharge can be expressed as a water-budget equation in the form

$$R_P + R_A + R_S + R_U - D_E - D_P - D_U = \Delta S$$

where ΔS is the change in groundwater storage.

2.2.1 Groundwater Inflows

Following is a brief description of each of the primary components of groundwater inflow to the District.

Groundwater Recharge from Precipitation

Annual precipitation at the Stockton Fire Station 4 (STK), (and now the Stockton Airport, SOC), between 1960 and 2022 averages approximately 15 inches. A portion of the precipitation recharges the aquifer; the remainder is lost through evapotranspiration and surface runoff. Recharge from precipitation occurs within both irrigated and non-irrigated areas. The recharge from precipitation was not estimated, but the combined recharge from precipitation, applied water, and streams can be deduced from the water-budget equation rearranged in the form

$$R_P + R_A + R_S = -R_U + D_E + D_P + D_U + \Delta S$$

given the estimates that are derived below for the quantities on the right hand side of the equation. The quantities on the left hand side of the equation sum to 120,000 acre-ft for 2022.

Groundwater Recharge from Applied Water

CDM (2001) estimated that 160,000 acre-ft of water is applied for irrigation annually; this includes both groundwater and surface-water sources. With the extending of the boundaries of the district in 2016, the applied water is assumed to increase by approximately 15 percent to 184,000 acre-ft. A portion of the applied water recharges the aquifer; the remainder of the applied water is lost through evapotranspiration and surface-water runoff. The recharge from applied water was not estimated, except that the undifferentiated sum of recharge from precipitation, applied water, and streams was estimated from the water-budget equation above.

Groundwater Recharge from Streams

The channels provide groundwater recharge from storm runoff during winter and spring months (generally from December through April). However, with delivery of additional surface water through existing streams, more sustained streamflows occur during the irrigation season, which correspondingly produces sustained recharge. Surface-water deliveries occur from approximately mid-April through mid-October. The recharge from streams was not estimated, except that the undifferentiated sum of recharge from precipitation, applied water, and streams was estimated.

Subsurface Inflow from Areas Adjacent to the District

Subsurface inflow occurs along the eastern, southern, and western District boundaries, according to the groundwater elevations shown on Figure 2.3. Historically, groundwater flows were westerly across the District, as shown on Figure 2.1. Due to groundwater pumping within the District and adjacent areas over the past 70 years, groundwater levels and the general direction of groundwater flow have changed. Groundwater now generally flows northwesterly across the District.

The subsurface inflow was about 73,000 acre-ft during 2022. That estimate was derived from the aquifer properties and the groundwater-level gradients along the boundary. The relevant aquifer properties are the aquifer thickness (B) and hydraulic conductivities (K), which are discussed in Section 1.3. The groundwater-level gradient (I) for individual boundary segments were derived from the groundwater-level map for 2022 (Figure 2.3).

Based on these factors, the subsurface inflow for a boundary segment is derived from the relation:

$$Q = KBLI$$

where Q is the inflow and L is the segment length. The cumulative inflow is the summation of the individual boundary-segment inflows.

2.2.2 Groundwater Outflows

Groundwater Pumping

Total annual agricultural water use in the District is estimated to be 184,000 acre-ft per year, as discussed previously, which is supplied from surface-water deliveries and groundwater pumping. While groundwater pumping in the District is not metered, data are collected on surface-water deliveries. Therefore, an estimate of groundwater pumping can be derived as the difference between total water use and surface-water applications, where the surface-water application is the surface-water delivery less the conveyance loss from the delivery point to the field.

A conveyance loss of 22 percent is assumed for surface-water deliveries from a diversion point (District boundary) to a field. This percentage was derived as follows: Based on operational experience of the District, the conveyance loss from the Stanislaus River to a grower within the District is about 30 percent of the diversion from the river. The conveyance loss from the Stanislaus River to the District boundary is about 10 percent of the diversion at the river. By subtraction, the conveyance loss from the District boundary to a grower is 20 percent of the diversion at the Stanislaus River. Correspondingly, the conveyance loss within the District is 22 percent (20 percent divided by 90 percent) of the delivery at the District boundary.

The surface-water delivery to the District boundary during the 2022 irrigation season was 0 acre-ft prior to conveyance losses within the district, which translates to a pumping reduction of 0 acre-ft (0 x (1 – 0.22)). The resulting pumping estimate for the year in the District is 184,000 acre-ft (irrigation requirement of 184,000 acre-ft less surface-water delivery of 0 acre-feet). The pumping reduction represents an in-lieu groundwater recharge of 0 acre-ft. However, the conveyance losses within the District result in additional groundwater recharge of 0 acre-ft. Correspondingly, the result of the surface-water deliveries is to produce effective in lieu recharge of 0 acre-ft, which is the delivery at the District boundary.

The 184,000 acre-ft of annual District water use does not include domestic use, which is small compared to agricultural use. The District bills approximately 750 customers for groundwater usage. Most of these consume the water for agricultural and domestic purposes, but some are agricultural entities that use groundwater for irrigation only. Based on the limited population of the area, domestic use is estimated to be approximately 1,000 acre-ft annually, which is less than 1 percent of the total use.

Subsurface Outflow to Areas Adjacent to the District

Subsurface outflow occurs along the northern District boundary, according to the groundwater elevations shown on Figure 2.3. Historically, groundwater flows were westerly across the District, as shown on Figure 2.1. Due to groundwater pumping in the

District and adjacent areas over the past 70 years, groundwater levels and the general direction of groundwater flow have changed. Groundwater now generally flows northwesterly across the District. Based on the methodology used to compute subsurface inflows, the subsurface outflow is about 22,500 acre-ft for 2022.

Other Groundwater Outflows

Other groundwater outflows include groundwater use by native vegetation or crops from a shallow groundwater table (groundwater outflows to shallow groundwater evapotranspiration). However, such groundwater use is considered negligible because groundwater levels within the District generally are 15 ft or more below the ground surface, which is assumed to be below rooting depths of vegetation.

2.2.3 Groundwater Storage

Groundwater storage is the amount of groundwater in the aquifer and is estimated as the product of the specific yield, aquifer thickness, and area within the District boundaries. The aquifer thickness fluctuates directly with groundwater-level fluctuations. Correspondingly, the volume of stored groundwater increases when groundwater levels rise, and it decreases when groundwater levels decline. Groundwater levels decline when groundwater outflows exceed groundwater inflows, and they rise when the opposite occurs. Groundwater levels in the District rose during 1994-2000. However, groundwater levels from 2000 to 2013 show no long-term trend, even though groundwater levels fluctuate from year to year (Figure 2.4). From 2013 to 2022, groundwater levels decreased to approximately 1980 levels.

2.2.4 Accumulated Change in Groundwater Storage

Accumulated change in groundwater storage is the volumetric change in groundwater storage underlying the District over a long period of record. A record of groundwater elevations in 1908 is included in the USGS report referenced earlier (see Figure 2.1). These levels are much higher than current groundwater levels shown on Figure 2.3. The volume of water required to refill the aquifer volume between current groundwater levels and those presented in the 1908 report is considered the accumulated change in groundwater storage. The accumulated change in groundwater storage was estimated by calculating the difference in groundwater storage between the 1908 and 2022 groundwater levels. Using a specific yield value of 9.5 percent (Brown & Caldwell 1985, see Section 1), the estimated accumulated change in groundwater storage between water years 1908 and 2022 is a loss of approximately 722,000 acre-ft.

2.2.5 Past Annual Change in Groundwater Storage

Past annual changes in groundwater storage are estimated on a long-term basis (10 years) and on a short-term basis (since the previous water year).

10-Year Average Change in Groundwater Storage

Average annual changes in groundwater storage are estimated by calculating the average change in groundwater storage over the past 10 years (Water Code Section 75574 (a)). The 10-year average annual change in groundwater storage was estimated using well data from spring 2012 and spring 2022 (shown in Table 2-1). The accumulated change in groundwater storage was estimated by calculating the difference in groundwater storage between the 2012 and 2022 groundwater levels. Applying the specific yield of 9.5%, the estimated accumulated change in groundwater storage between water years 2012 and 2022 is approximately a loss of 180,000 acre-ft, which corresponds to an average annual decrease of 18,000 acre-ft/yr over the past 10 years. A graphical representation of the 10-year change in groundwater storage is shown on Figure 2.5. Spring 2012 groundwater levels were subtracted from the spring 2022 groundwater levels. The change in groundwater levels are shown with a color flood throughout the District area. As shown on this figure, the average groundwater level decrease between spring 2012 and spring 2022 was approximately 25.9 ft within the District boundaries. The change in groundwater levels ranges geographically from a maximum increase of about 2 ft, to a maximum decrease of about 52 ft.

Change in Groundwater Storage between Spring 2021 and 2022

Between 2021 and 2022, groundwater levels in the District decreased on average despite widespread minimal increases, with an estimated decrease in groundwater storage of about 13,800 acre-ft. The average groundwater level decrease between spring 2021 and spring 2022 was approximately 2 ft within the District boundaries. The change in groundwater levels range from a maximum increase of about 29 ft, to a maximum decrease of about 24 ft. Figure 2.6 illustrates this change in groundwater storage with a color flood similar to Figure 2.5. Spring 2021 groundwater levels were subtracted from the spring 2022 groundwater levels to develop Figure 2.6. The decrease in storage in 2022 is likely the result of decreased water deliveries in 2022 and increased demand for pumping.

2.2.6 Projected Change in Groundwater Storage for Water Years 2023 and 2024

The change in groundwater storage beneath the District is strongly influenced by the components that make up the groundwater balance, as described in Section 2.2. The general tendency is for groundwater storage to increase with increased precipitation as shown on Figure 2.7. This occurs not because precipitation is the primary cause of storage changes but because it is an index to irrigation demand, groundwater pumping, boundary underflows, and other components of the water budget for the District. While a general positive correlation exists between the annual change in groundwater storage and the annual precipitation, the correlation is not sufficient to develop a useful predictive relation.

Groundwater levels and the corresponding groundwater storage have been generally static since 1980. Groundwater levels have fluctuated from year to year, but they do not display a general upward or downward trend since 1980. Correspondingly, the expectation is that groundwater levels within 2023 and 2024 will follow the trend over the last decade. Considering that water year 2023 has been relatively wet into the month of March, it seems likely that precipitation for 2023 will be at or above average, which means that short-term groundwater levels are more likely than not to be higher than in 2022. Generally, if precipitation in 2023 is normal or above normal, the expectation is that higher groundwater levels will occur. If the precipitation is less than normal, the expectation is that lower groundwater levels will occur. The annual average groundwater-level change in particular years has ranged from a rise of less than 5 ft (2006) to a decline of more than 6 ft (2015), and the groundwater-level changes for 2023 and 2024 most likely will be within that range.

SECTION 3

Surface Water Deliveries

In December 1993, the District signed a 40-year water supply contract with USBR for 80,000 acre-ft per year from New Melones Reservoir. The contract calls for 49,000 acre-ft per year of firm yield, and up to an additional 31,000 acre-ft on an interim basis. During the 1995 growing season, the District took delivery of its first surface water. Within the 2022 irrigation season, the District received 0 acre-ft of surface water for irrigation.

Importation of water from New Melones Reservoir is intended to halt the decline of groundwater levels underlying the District. Past studies have predicted that importation of 80,000 acre-ft of surface water may result in groundwater levels rising to pre-1960 levels (Brown and Caldwell, 1985). So far, the District has received a maximum annual delivery of 40,000 acre-ft from USBR in one irrigation season. Recently, surface water deliveries to the District were closer to an average of 17,000 acre-ft per year. Currently, groundwater levels are still 50 to 70 ft below the spring 1960 levels. The District is currently evaluating its options for developing and implementing an in-District conjunctive-use program to further utilize potential future surface-water deliveries.

3.1 Surface Water Availability in 2023

As of February 2023, the District anticipates receiving more than the 2022 delivery of 0 acre-ft of surface water from the New Melones Reservoir delivered by the USBR. The actual amount available will depend on the storage in New Melones Reservoir, USBR strategies for the delivery of contract water, and the number of landowners willing to purchase and use new surface water supplies. These estimated volumes are subject to change.

3.2 Water Required to Replenish District Groundwater Supplies

Groundwater storage within the District has declined by about 722,000 acre-ft during 1908-2022. That storage decline has resulted from the aggregate effects of surface-water and groundwater use with the Eastern San Joaquin County Subbasin. Part of that storage depletion was a necessary element of agricultural development within the Eastern San Joaquin County Subbasin. Prior to development, the groundwater basin was in an equilibrium state such that long-term natural recharge balanced the long-term natural discharge. The recharge was from streams and precipitation, and the discharge was to streams and phreatophytes. With development, groundwater levels changed under the influences of recharge from irrigation applications, discharge from groundwater pumping, increased recharge from streams, and decreased discharge to streams and phreatophytes. Those influences appear to have produced a new equilibrium such that the long-term recharge balances the long-term discharge.

This condition is suggested by the generally static groundwater levels that have occurred since 1980 (Figure 2.4). However, the equilibrium corresponds to groundwater levels within the Eastern San Joaquin County Subbasin that are lower than for the pre-development condition, and lower than the 1960 condition.

The current equilibrium corresponds to a particular operational condition with respect to the utilization of the Subbasin. The geographic pattern of groundwater levels corresponds to a geographic pattern of pumping lifts and pumping costs required to use groundwater. Furthermore, the pattern of groundwater levels defines the operational storage within the Subbasin, where the operational storage is water available for use during periods of surface-water shortages. The available storage depends on limitations associated with aquifer thickness, well depths, saline intrusion from the San Joaquin River, and the potential for upward saline intrusion from marine rocks underlying the Eastern San Joaquin County Subbasin. These limitations are tied to the equilibrium of groundwater levels. If groundwater levels were higher, such as the 1960 groundwater levels, the limitations would be less restrictive and the operational storage would be larger. If groundwater levels were lower, the limitations would be more restrictive and the operational storage would be smaller.

Were long-term surface-water deliveries or groundwater pumping within the Eastern San Joaquin County Subbasin to change, a new equilibrium would be established, which would be characterized by different groundwater levels and a different availability of operational storage. That change would have an associated cost and benefit. An increase in groundwater levels can be produced by increasing recharge to the Eastern San Joaquin Subbasin or reducing groundwater pumping. The most direct approach to achieving this would be to increase surface-water utilization. It cannot be achieved by improved conveyance or irrigation efficiency, because conveyance losses and the deep percolation of applied water produce ground water recharge. A reduction in irrigation demand is offset by a corresponding reduction in recharge.

While California Water Code 75560 requires the reporting of the water volume required to replenish groundwater supplies, the reestablishment of the 1908 groundwater levels and corresponding groundwater storage is not an appropriate goal. Groundwater-storage depletions are a necessary and unavoidable result of groundwater development. The optimal management of groundwater within the District and the Eastern San Joaquin County Subbasin involves establishing target groundwater levels that correspond to adequate operational storage, pumping lifts, and groundwater quality. The current equilibrium most likely is sustainable, and it may represent a near optimal condition for the long-term, year-to-year, and seasonal operation of the Subbasin. Nevertheless, previous investigations have suggested that somewhat higher groundwater levels might be optimal (CDM, 2008), and additional work is needed to determine optimal target groundwater levels.

The groundwater system underlying the District is part of the larger Eastern San Joaquin County Subbasin. Groundwater conditions underlying the District are the result of water-use patterns both within the District and throughout the Subbasin. While increased surface-water use within the District would result in higher groundwater levels within the District, that increased surface-water usage would result in addition groundwater-level benefits in areas adjacent to the District. Likewise, increased surface-water usage within adjacent areas would result in benefits within the District.

Table 2-1
District and Nearby Wells: 2012 to 2022 Spring and Fall Groundwater Elevations

Well	Twn/Rng	Well ID	Easting	Northing	Agency	GL	S'12	F'12	S'13	F'13	S'14	F'14	S'15	F'15	S'16	F'16	S'17	F'17	S'18	F'18	S'19	F'19	S'20	F'20	S'21	F'21	S'22	F'22
1M2	1N7E	01N07E01M02M	661420	4203050	SJC	50	-45.2	-50.2		-53.5	-50.5		-54.5	-70.0	-62.0	-71.0	-67.0	-70.0	-54.0	-74.0				-73.0	-50.7	-52.3	-50.7	-75.0
2G1	1N7E	01N07E02G01M	660615	4203462	SJC	50	-38.1	-43.0	-41.2	-45.3	-43.9		-48.5	-61.5	-59.5					-18.5	-47.5			-8.5				
11M1	1N7E	01N07E11M01M	659699	4201449	SJC	46.3	-31.3	-40.7	-36.7	-37.3	-35.4	-41.7	-43.7	-56.2	-49.7													
13J2	1N7E	01N07E13J02M	662813	4199938	SJC	58.5	-44.5	-46.5	-52.5																			
14J2	1N7E	01N07E14J02M	661229	4199616	SJC	49.7	-34.6	-36.6	-43.1	-44.6	-38.1	-46.6		-52.1	-45.6	-62.6		-59.6	-42.6	-50.6			-83.6	-61.6	-56.6	-60.1	-62.6	-67.6
14L1	1N7E	01N07E14L01M	660449	4198881	DWR	47	-36.6	-39.1	-36.7	-40.7	-36.9	-47.9	-39.5	-51.7	-45.8		-47.1	-48.9	-41.8	-51.1	-42.4	-49.9	-43.3	-52.8				
15M2	1N7E	01N07E15M02M	658071	4199476	SJC	38	-26.1																					
20G1	1N7E	01N07E20G01M	656033	4198274	SJC	29	-19.8	-21.2	-23.0	-21.0		-22.3			-23.0		-24.0	-20.0		-21.0		-19.0	-16.0	-18.0	-17.0	-19.0	-17.0	-28.0
21R1	1N7E	01N07E21R01M	657923	4197713	SJC	37	-25.0			-26.9	-24.5	-30.2				-26.8			-25.0			-27.0			-28.0		-27.0	
24A1	1N7E	01N07E24A01M	662818	4199144	SJC	58.4	-35.6					-48.6																
24R1	1N7E	01N07E24R01M	662743	4197734	SJC	57.5	-38.5	-53.5	-40.5	-51.0	-41.5	-50.5	-50.0	-60.0						-53.5				-58.5	-55.5	-58.5	-52.5	
26H3	1N7E	01N07E26H03M	661321	4196786	SJC	50	-30.2	-34.4		-36.0	-33.3				-40.0		-38.0	-35.0	-41.0	-47.0				-44.0				
32A1	1N7E	01N07E32A01M	656508	4195689	DWR	29.5	18.7	-14.6		-21.4	-17.6	-22.9	-20.4	-22.9	-21.6	-24.4	-18.4	-19.8	-15.9	-21.6	-14.5	-16.9	-14.5	-18.8	-16.7	-21.1	-18.4	-23.8
2B1	1N8E	01N08E02B01M	669861	4204294	DWR	84	-33.3	-42.9	-36.2	-45.5	-40.0	-54.8	-42.3	-61.7	-48.1	-42.3	-50.1	-56.6	-50.2	-57.8	-48.3	-57.1						
2J1	1N8E	01N08E02J01M	670304	4203277	DWR	86	-31.0	-40.5	-38.3		-40.5	-53.2	-40.2	-53.8	-46.7		-48.1	-55.2										
3P1	1N8E	01N08E03P01M	668237	4202735	SJC	80	-39.0	-49.5	-50.5																			
4E1	1N8E	01N08E04E01M	665883	4203326	SJC	69.5	-44.0	-56.0	-47.0	-57.0																		
7M1	1N8E	01N08E07M01M	663011	4201361	SJC	61.4	-45.1		-49.6	-59.1	-50.2																	
9L1	1N8E	01N08E09L01M	666715	4201728	DWR	71	-44.6	-50.7	-43.7	-52.9	-54.1	-58.2	-64.1	-63.2	-55.9		-58.0											
13J1	1N8E	01N08E13J01M	672438	4200261	SJC	94.8	-20.6	-30.9	-28.2	-34.8		-37.7	-38.2	-45.2	-46.7	-62.2		-52.7		-67.7	-48.7	-35.7			-39.8	-49.3		
13Q1	1N8E	01N08E13Q01M	671877	4199737	DWR	90.5																						
15J1	1N8E	01N08E15J01M	669134	4199947	DWR	82	-31.7	-38.9	-35.9	-42.8	-39.0	-46.7	-42.2		-48.9	-55.4	-49.2	-54.5	-44.2	-55.2	-45.9	-53.3			-48.6	-57.9	-51.8	-62.6
16G1	1N8E	01N08E16G01M	667048	4200333	SJC	79.5	-33.9	-42.6	-40.2	-45.9	-42.5	-50.0	-49.7	-56.2	-47.3	-58.4	-49.7	-52.7	-63.7	-60.7	-48.7		-42.7	-39.0	-53.1	-61.3	-56.5	-68.3
16H2	1N8E	01N08E16H02M	667557	4200307	SJC	80	-32.3	-41.2	-39.2	-45.4	-41.0	-49.1	-46.5	-55.5	-46.1	-57.1	-51.5	-79.5	-77.0	-107.5	-48.3	-67.5	-49.5	-57.6	-50.8	-60.1	-55.3	-67.3
16P1	1N8E	01N08E16P01M	666819	4199364	DWR	73	-31.6	-41.5	-35.8	-44.3		-49.3	-41.5	-54.9	-45.9		-48.3	-52.3										
18A2	1N8E	01N08E18A02M	664306	4200812	SJC	68	-35.0	-43.5	-40.5	-50.0	-42.1	-51.5	-55.0	-58.0	-56.5	-74.5	-57.5	-56.0	-60.5		-61.5							
22J1	1N8E	01N08E22J001M	669131	4198405	SJC	80	-30.7	-39.9	-34.5	-44.4	-39.0	-47.5	-48.0	-54.5	-44.5	-57.5		-44.0	-40.5	-49.5								
26A2	1N8E	01N08E26A02M	670899	4197713	SJC	88.7	-19.2	-28.7	-23.8	-33.2				-48.3	-35.3				-34.3									
27R2	1N8E	01N08E27R02M	669373	4196488	SJC	78	-24.2	-33.3	-27.6	-37.3	-31.7	-41.4	-41.5	-47.0	-37.0				-40.0	-67.0		-48.0				-51.8		
28K1	1N8E	01N08E28K01M	667014	4196789	DWR	71	-25.7	-36.6	-32.6	-38.2	-36.3	-43.3	-48.1	-50.0	-45.6		-51.3	-58.9										
29M2	1N8E	01N08E29M02M	664715	4196560	SJC	64.1					-37.0	-46.0	-43.0	-53.0	-42.0				-65.0	-111.0	-43.0		-35.0		-46.0			
33H1	1N8E	01N08E33H01M	667472	4195355	SJC	71.6																						
35F1	1N8E	01N08E35F01M	670055	4195615	SJC	81.3	-18.4	-27.4	-25.9	-31.9	-30.5	-38.3		-42.9	-41.9	-64.9	-56.9	-62.9	-69.9	-86.9		-55.9		-61.9	-54.9	-73.9	-67.9	-76.9
35R2	1N8E	01N08E35R02M	671097	4195063	SJC	82	-22.0	-25.5	-20.0	-27.0	-23.5	-39.0	-33.0	-37.5														
36F1	1N8E	01N08E36F01M	671873	4195843	SJC	87	-13.1	-21.4	-17.5	-25.2	-20.4	-35.5	-35.0	-34.0	-26.9	-58.0	-53.0	-60.0	-53.0	-71.0	-30.0	-51.0		-38.0	-31.0	-40.0	-42.0	
1C1	1N9E	01N09E01C01M	681027	4204674	SJC	191	15.4	15.0	14.9	14.4	14.1	-8.7	-4.7	-2.7	-32.7													
5B1	1N9E	01N09E05B01M	675027	4204484	DWR	139.5	-14.5	-17.6	-16.3		-18.8	-22.0	-20.9	-27.7	-25.7	-27.0	-28.5	-31.6										
5J1	1N9E	01N09E05J01M	675680	4203740	SJC	156	-8.6	-12.5	-26.5	-14.5	-12.7	-17.5	-20.5	-22.5	-18.7													
6N1	1N9E	01N09E06N01M	672404	4202896	SJC	118.5	-26.5	-34.7	-34.5	-36.8	-32.8	-44.5		-59.0	-58.0										-54.0	-60.0		
13D1	1N9E	01N09E13D01M	681151	4201460	SJC	142	18.6	15.6	8.5		15.3	4.0	0.0	9.0	1.0				13.0	-9.0				1.8		-3.0		
15B2	1N9E	01N09E15B02M	678501	4201283	SJC	120	6.4	-2.1		-4.1		-8.0	-4.7							-23.5		-24.5						
17D1	1N9E	01N09E17D01M	674413	4201127	SJC	103	-16.2	-24.9	-21.0	-28.8	-23.2	-31.0	-33.5	-37.5	-39.5	-39.5	-42.5		-30.5	-53.5				-52.5	-43.5			
17M1	1N9E	01N09E17M01M	674425	4200484	SJC	102.2	-15.9	-25.1	-18.0	-28.8	-23.2	-31.0	-35.5	-40.0	-46.5	-39.5	-38.0	-50.5	-43.5	-43.5		-55.5		-58.5	-37.1	-44.4	-40.4	-53.6
17R2	1N9E	01N09E17R02M	675759	4199793	DWR	105																						
19C1	1N9E	01N09E19C01M	673327	4199626	SJC	98.5	-20.0	-28.5	-24.0	-32.2	-27.5	-31.7	-34.0	-41.6	-43.0	-44.0	-58.0	-57.5	-69.0	-76.0	-45.0	-60.0	-63.0	-64.0	-53.0	-68.0		
21J1	1N9E	01N09E21J01M	677123	4198622	DWR	114				-4.9			-2.7	-12.1				-15.6										
22G2	1N9E	01N09E22G02M	678318	4199204	SJC	118																						
26A1	1N9E	01N09E26A01M	680433	4198101	DWR	125	18.6	13.2	12.4	10.8	7.4	4.2	3.9	2.0	6.2	-1.9	5.4	2.7										
29R1	1N9E	01N09E29R01M	675889	4196844	SJC	105	-0.5	-10.0	-4.0	-12.5	-8.0	-14.5	-13.5	-19.3	-13.5		-19.5		-16.5	-35.5		-38.5		-40.5	-32.5	-34.5	-37.5	-39.5
30C5	1N9E	01N09E30C05M	673427	4197832	SJC	96	-8.7	-17.2	-29.2	-21.0	-16.7	-24.7	-18.7	-31.2	-22.2	-35.2	-52.7	-33.7	-33.2	-43.2	-27.2	-41.2		-44.2	-32.7	-41.2	-46.7	-51.7
31J1	1N9E	01N09E31J01M	674102	4195360	SJC	96.8	-1.2	-8.1	-4.5	-11.0		-28.4	-30.0									-38.5		-26.7	-20.2			
35K1	1N9E	01N09E35K01M	680064	4195921	DWR	165	6.3	14.3	14.3	5.4	5.2	1.2	3.2	1.6	1.4		1.2	-0.6										
36P1	1N9E	01N09E36P01M	681390	4195074	SJC	147.2																						
1J1	1S7E	01S07E01J01M	663067	4193648	SJC	53.4	-19.8	-26.3	-30.6	-28.4	-26.3		-27.6	-44.6			-45.6	-37.6	-40.6	-41.6	-42.6	-37.6	-41.6		-48.6	-41.6	-41.6	

Table 2-1
District and Nearby Wells: 2012 to 2022 Spring and Fall
Groundwater Elevations

Well	Twn/Rng	Well ID	Easting	Northing	Agency	GL	S'12	F'12	S'13	F'13	S'14	F'14	S'15	F'15	S'16	F'16	S'17	F'17	S'18	F'18	S'19	F'19	S'20	F'20	S'21	F'21	S'22	F'22
2J1	1S7E	01S07E02J01M	661486	4193360	SJC	45.5	-22.7	-29.6	-26.0	-31.0	-28.9	-35.0		-44.0														
3D1	1S7E	01S07E03D01M	658463	4194207	SJC	36.5																						
5A1	1S7E	01S07E05A01M	656525	4194136	SJC	28.9																						
8J2	1S7E	01S07E08J02M	656432	4191805	SJC	30.9	-0.8	-3.2	-2.5	-6.1	-5.6	-11.8		-14.0	-10.0	-11.6	1.0	-4.0		-14.0	-4.0	-8.0	-3.0		-8.0	-13.0	-10.0	
9Q1	1S7E	01S07E09Q01M	657900	4191161	DWR	35	4.2	0.2	1.6	-1.8	-2.2	-6.6	-2.7	-11.8	-5.2	16.0	-5.1											
10A1	1S7E	01S07E10A01M	659902	4192511	DWR	41	-7.9	-15.1	-10.5	-17.5	-14.1	-22.2	-15.7	-26.5	-18.1	-30.3	-14.5	-22.7	-15.2	-26.5	-14.6	-23.0	-16.6	-26.1				
12H1	1S7E	01S07E12H01M	663124	4192088	SJC	51														-32.0								
13J1	1S7E	01S07E13J01M	663258	4190162	SJC	48	-3.4	-9.2																				
14M1	1S7E	01S07E14M01M	660439	4190092	SJC	42.4	2.4	1.0	1.9	-0.4	-1.2	-8.2	-4.1	-9.1	-7.1		-15.1	-9.1		-19.1			-9.1	-19.1		-23.1		
14P3	1S7E	01S07E14P03M	661010	4189767	SJC	43.7	1.7	-1.8	-2.5	-2.3				-10.8	-8.8	-14.8		-10.8		-33.8				-15.8				
15F2	1S7E	01S07E15F02M	659270	4190555	SJC	39.4	1.8	-1.9	-0.1	-6.6	-3.6	-11.6	-5.6	-16.6	-11.6	-14.1	-18.6	-10.6	-6.6	-21.6	-11.6	-11.6	-6.6	-13.6	-14.6	-21.6	-24.6	
4R1	1S8E	01S08E04R01M	667937	4193318	SJC	70.5	-19.5	-28.3	-21.7	-28.8	-25.4	-33.5	-37.5	-49.2	-48.0	-66.0		-63.5		-60.0	-35.0			-40.3	-35.8	-42.4	-60.0	
5A1	1S8E	01S08E05A01M	666269	4194334	SJC	65.1		-29.4	-23.9	-35.4	-27.8	-39.4		-43.4	-34.4	-76.4	-54.4	-72.4	-79.4	-91.4			-38.4	-42.4	-62.4	-69.4	-63.4	-102.4
5R1	1S8E	01S08E05R01M	666346	4192986	SJC	64	-22.2	-28.7				-32.8	-39.3	-46.4	-37.8	-64.8	-55.8	-39.8	-58.8		-35.8		-34.8	-54.8	-59.8	-43.0	-63.8	-81.8
6D1	1S8E	01S08E06D01M	663328	4194343	SJC	55.4	-21.8	-27.3	-31.1	-28.5	-28.0	-29.0	-31.1	-42.1	-34.1	-41.7	-32.1	-35.1	-38.1					-39.1				
8J1	1S8E	01S08E08J01M	666257	4192168	DWR	62.7																						
9Q1	1S8E	01S08E09Q01M	667723	4191412	SJC	64.6	-11.9	-17.9	-13.9	-20.7	-17.3		-18.9	-28.7	-20.9		-32.9	-36.9	-41.9	-46.9			-34.9	-46.9	-29.9	-40.9	-48.9	
11F1	1S8E	01S08E11F01M	670400	4192624	SJC	81.9	-10.0	-17.6	-18.1	-21.7	-16.7	-24.9	-22.9	-29.9	-29.9	-32.7		-33.9	-23.9	-43.9	-39.9	-31.9	-18.9	-29.9	-26.7	-35.2	-39.9	
14B1	1S8E	01S08E14B01M	670868	4191442	SJC	82.6	-3.7	-1.2	-4.2	-10.9	-6.7	-19.7	-8.7	-21.2	-18.7	-64.7	-32.7	-33.2	-21.2	-28.7	-24.7	-29.7		-32.7	-27.7	-30.2	-29.7	-64.7
15A1	1S8E	01S08E15A01M	669424	4191402	DWR	73.5	-9.6	-28.0	-23.5	-31.9	-13.9	-34.5	-29.6	-39.3	-19.1	-24.9	-20.4	-27.1	-20.0	-31.5	-23.4	-29.5	-23.5	-31.5				
15P1	1S8E	01S08E15P01M	668892	4189945	SJC	70.2	-3.6		-8.0																			
19R1	1S8E	01S08E19R01M	664790	4188192	SJC	55.8	6.8	-0.7	-2.7	-4.7										-12.7								
20B1	1S8E	01S08E20B01M	665935	4189431	SJC	58	-3.2	-7.3	-8.2	-11.7	-9.2	-14.7	-19.2	-17.7	-13.7				-18.7			-23.2	-22.2	-27.2	-23.2	-28.2	-31.2	-45.2
23A1	1S8E	01S08E23A01M	671166	4189605	SJC	82.2		-5.0					-5.5		-6.5				8.5	25.5		14.5						
25Q1	1S8E	01S08E25Q01M	672506	4186904	SJC	90.5	25.0	21.6																				
27A1	1S8E	01S08E27A01M	669799	4188173	DWR	75	9.7	5.0	7.3	2.6	3.5	-1.1	1.5	-3.6	-0.6	-4.0	-1.9	-6.2	-1.1	-6.7	-2.8	-7.1	-8.0	-10.0				
2R1	1S9E	01S09E02R01M	680870	4193566	SJC	162	35.3	28.1	32.3	24.6	29.0	21.3		9.8	23.5						-18.7							
5H2	1S9E	01S09E05H02M	675981	4194459	SJC	105	8.0	1.5	4.5		0.6	-7.0	-6.5	-11.0	-4.2		-27.0	-20.0		-33.0	-7.0	-35.0	-11.0	-20.1	-11.6	-19.5	-21.0	-30.0
7A1	1S9E	01S09E07A01M	674250	4193153	SJC	97.7	2.7	-3.5	-2.6	-7.8	-4.2	-11.3	-7.3		-6.3	-35.3	-39.3	-37.3	-32.3	-21.3	-12.3	-23.3	-16.3	-21.1	-15.4	-23.2	-24.3	-81.3
7N1	1S9E	01S09E07N01M	673111	4191785	SJC	96.2	6.7	0.2	0.1	-4.5	-0.4	-7.8	-8.3	-10.3	-6.3	-30.3		20.7	-31.3	-32.3	-17.3	-28.3		-16.3	-10.9	-19.0	-13.3	
9R1	1S9E	01S09E09R01M	677492	4191674	SJC	125	20.3	13.3	15.7	7.8	13.3	5.3	2.8	-5.1	-0.2	-19.7	-0.7	-3.7	-16.7	-20.7				-8.7	-3.7			
11J2	1S9E	01S09E11J02M	680790	4192249	SJC	132	40.9	34.8	36.2	31.5	34.6	22.2			28.5		17.2							17.6				
14K1	1S9E	01S09E14K01M	680518	4190861	DWR	140	43.9	43.3	40.1	38.3	37.0	32.8	32.8	32.6	35.9	32.0	31.1	31.5										
18R3	1S9E	01S09E18R03M	674344	4190369	SJC	103.8	16.4	8.7	11.0	4.1	9.9	2.0	8.0			-47.0									-0.6	-15.4		
19Q2	1S9E	01S09E19Q02M	673852	4188369	SJC	97.5	20.0	15.5	15.6	12.3	14.5	8.4	12.0	6.0	12.0	5.0		-7.0	9.0	3.0	1.0	2.0	-11.0	1.3	4.7	-0.7	-7.0	-47.0
21J2	1S9E	01S09E21J02M	677891	4188820	SJC	120	41.8	38.2	39.1	35.1	36.3	31.0	31.5	27.5	30.6			22.5		24.5	26.5	23.5		21.8	24.1	20.3		
28M2	1S9E	01S09E28M02M	676428	4187326	SJC	117		37.2	38.7																			
29M2	1S9E	01S09E29M02M	674810	4187382	SJC	103	33.2	30.1	31.5	28.4	28.6	26.0	27.0	21.5	23.5			31.0	22.5					20.5				

Notes:
Elevations are given in feet above mean sea level.
Northings and Eastings are UTM Projections (NAD '83, Zone 10N) and were provided by San Joaquin County Water Control District or Department of Water Resources.
Data source: San Joaquin County Water Conservation District and the DWR Water Data Library web page.
A blank entry indicates that no valid measurement was made during the time period.
X: anomalous data, not used for this analysis.
In cases where data are collected more frequently than in the spring and fall, the data point collected most closely to the other seasonal data was used.
Spring 2022 water level data are plotted on Figure 2-3.
SJC - San Joaquin County
DWR - Department of Water Resources
GL - Ground Surface Elevation

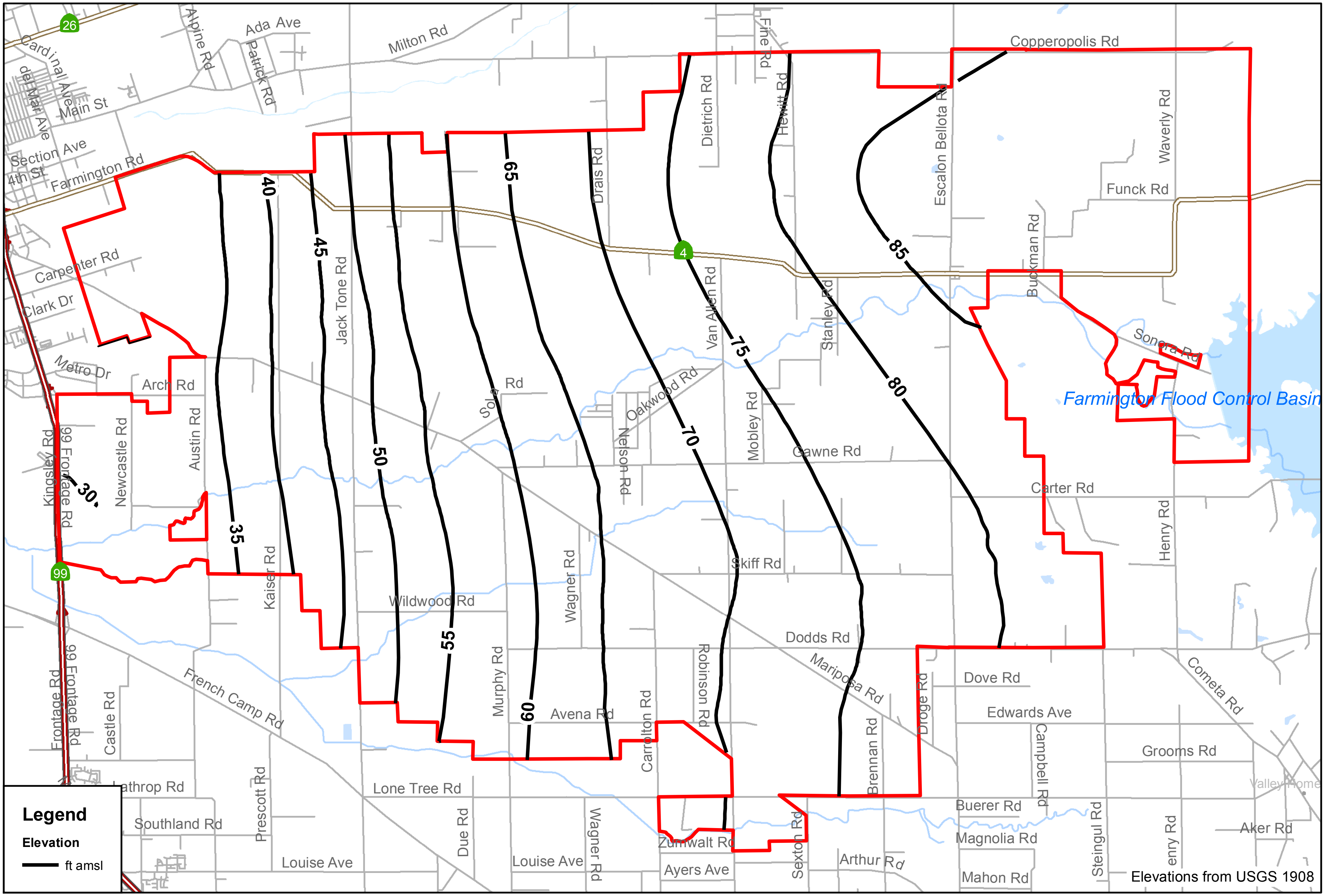
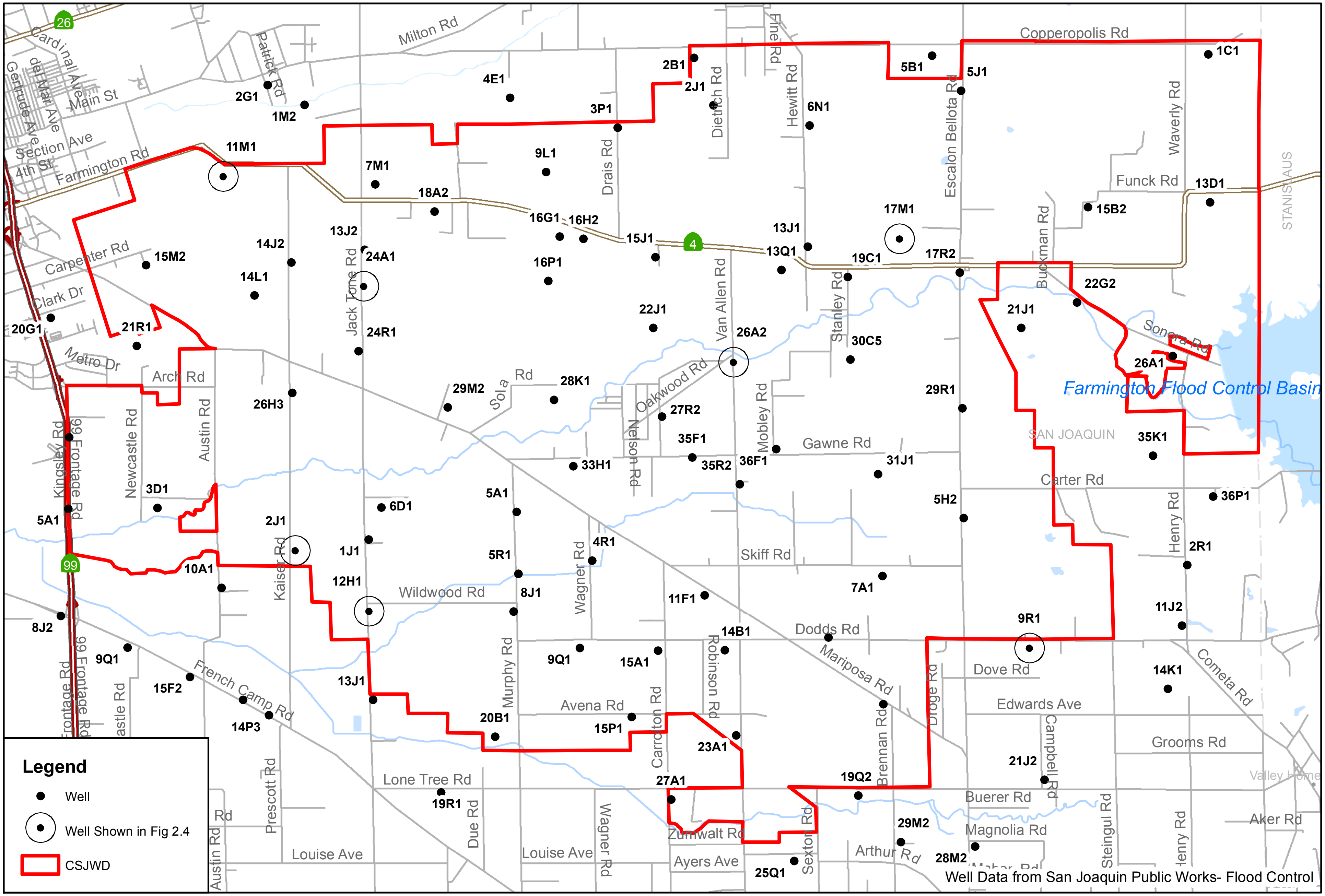
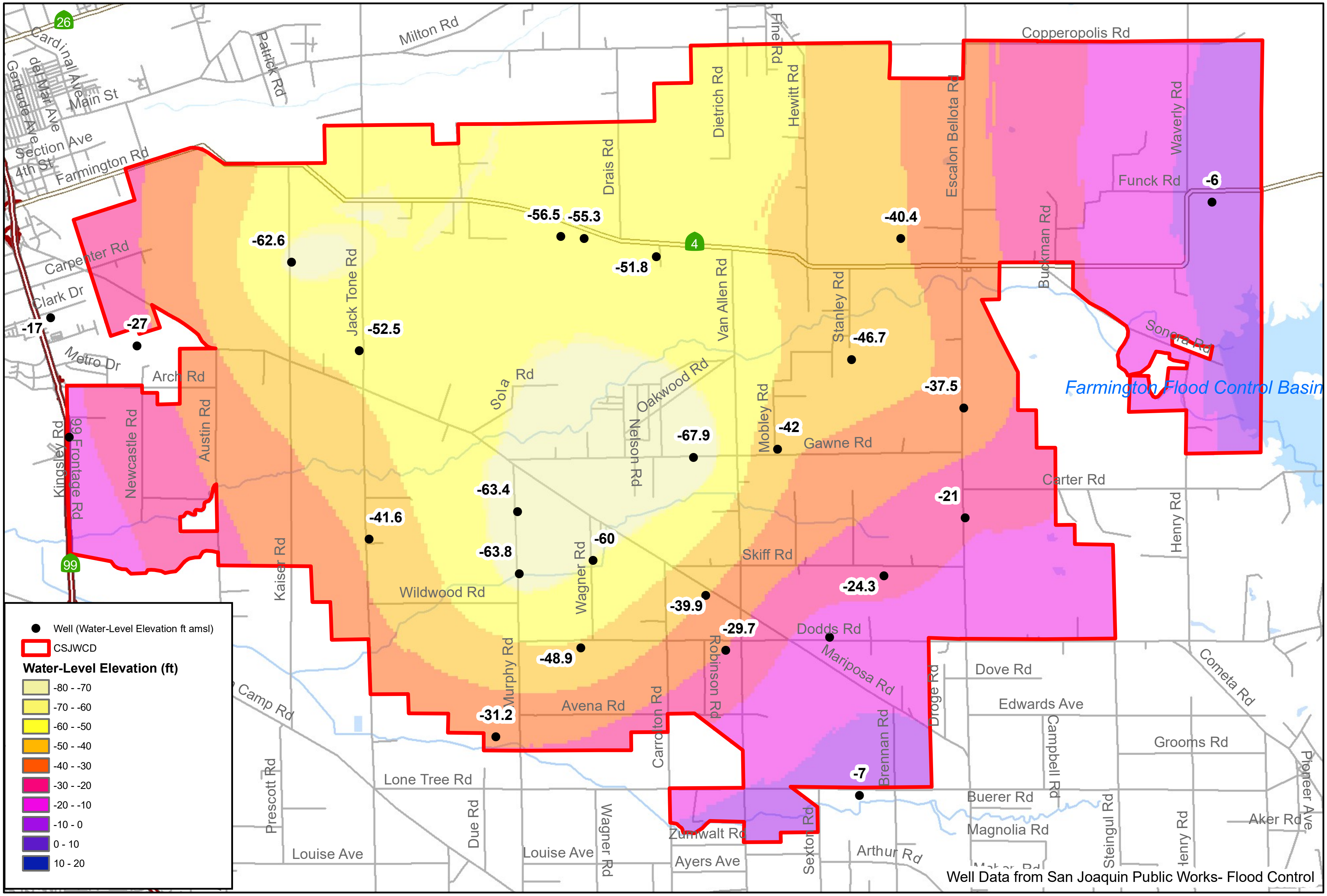


Figure 2.1 1908 Groundwater Elevation Contours



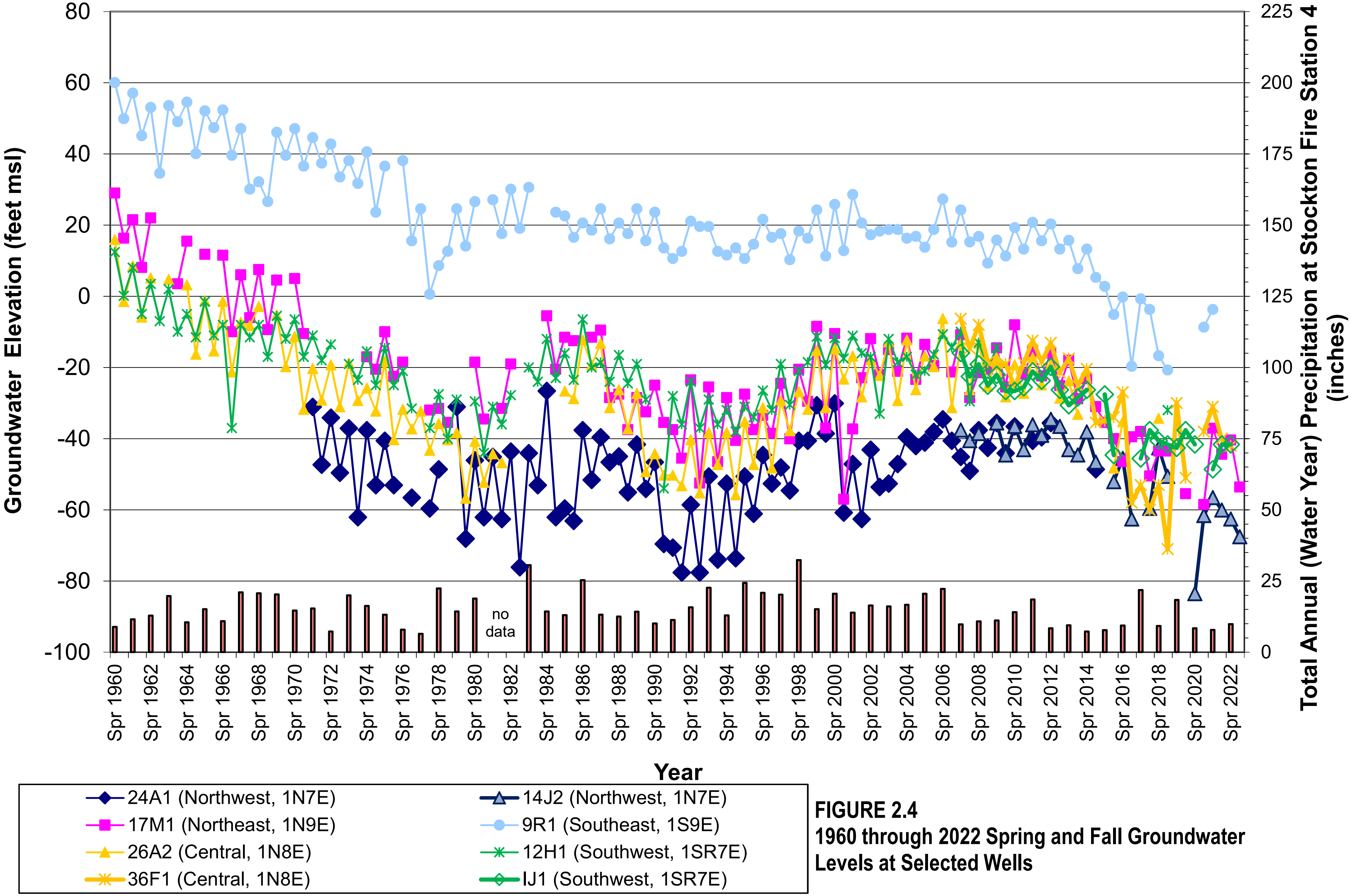
Well Data from San Joaquin Public Works- Flood Control

Figure 2.2 Groundwater Level Data Well Locations



Well Data from San Joaquin Public Works- Flood Control

Figure 2.3 Spring 2022 Groundwater Elevations



See Figure 2-2 for well locations

FIGURE 2.4
1960 through 2022 Spring and Fall Groundwater Levels at Selected Wells

Note: Precip. data from the Stockton WSO, CA gage was used for WYs 2013, 2017, and after.

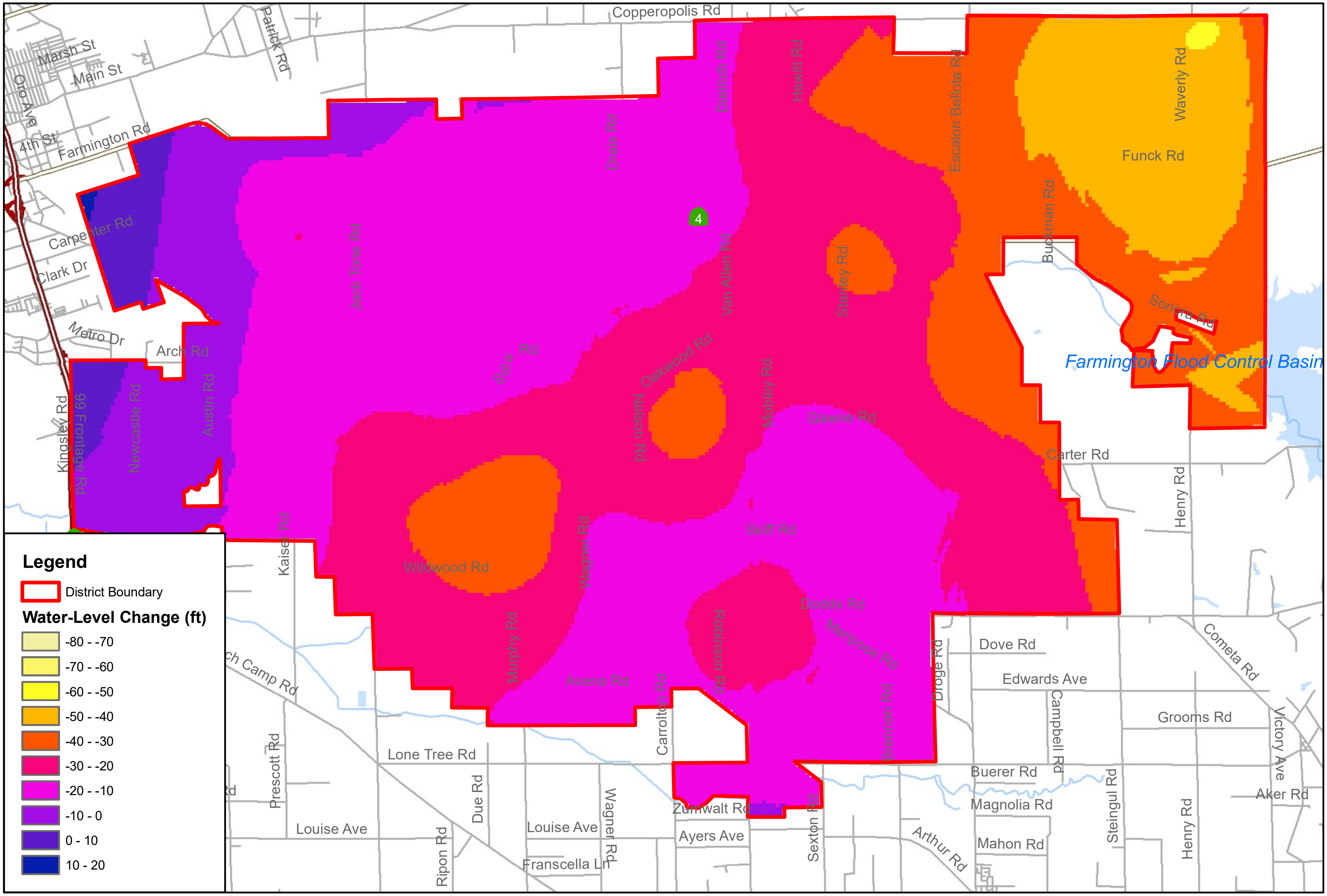


Figure 2.5 Change in Groundwater Levels between Spring 2022 and Spring 2012

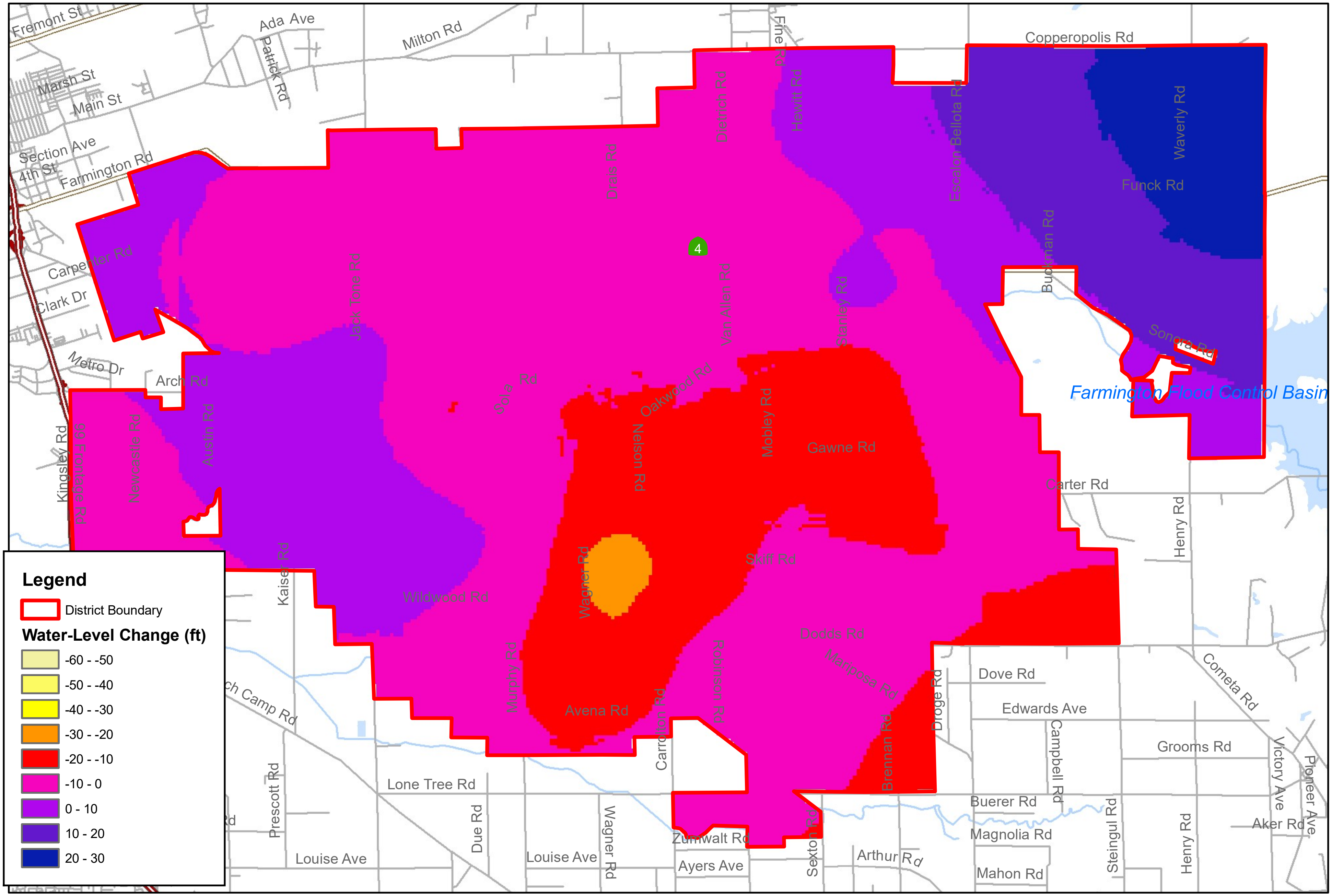


Figure 2.6 Change in Groundwater Levels between Spring 2022 and Spring 2021

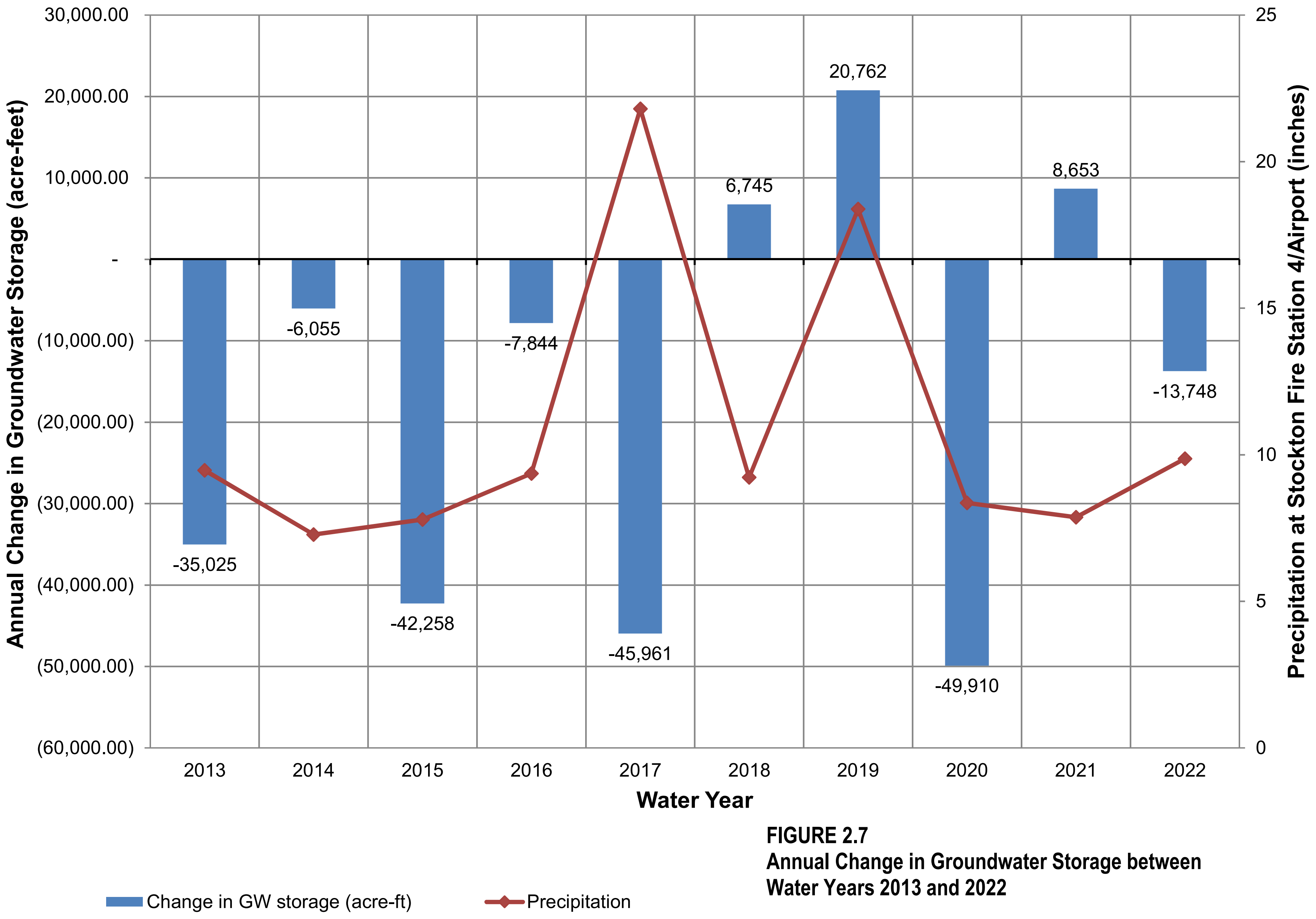


FIGURE 2.7
Annual Change in Groundwater Storage between Water Years 2013 and 2022

SECTION 4

Summary of Findings

This report is developed pursuant to California Water Code Sections 75560 - 75574, which require the District to formulate specific interpretations for the groundwater conditions of the District and the amount of water required to replenish groundwater storage losses. These are summarized below with respect to requirements of Water Code Section 75574(a) through 75574(j):

a. Groundwater storage within the District has displayed a downward trend over the last 10 years. Groundwater storage decreased by about 18,000 acre-ft per year over the last 10 years. Correspondingly, average groundwater levels decreased by about 2.6 ft per year. This 10-year average decrease is largely the result of the several years of below-average precipitation (2012 – 2016, 2018, and 2020 – 2022) and corresponding increases in pumping demand.

b. Groundwater storage within the District decreased by about 13,800 acre-ft during water year 2022 (July 2021 through June 2022). Correspondingly, average groundwater levels decreased by about 2 ft that year.

c. Groundwater storage within the District for water years 2023 and 2024 is expected to follow the trend since 1980, except that groundwater storage will fluctuate about the trend from year-to-year, depending on precipitation and surface-water supplies. Storage will decrease if the annual precipitation and surface-water supplies are below normal, and it will increase if they are above normal. The precipitation during water year 2023 is expected to be above normal, and overall surface-water supplies are expected to be above normal. The expected net effect during 2023 is for increased storage.

d. The accumulated storage depletion on the last day of water year 2021 is 708,000 acre-ft (1908 through June 2021).

e. The accumulated storage depletion on the last day of water year 2020 is 722,000 acre-ft (1908 through June 2022).

f. Presuming that the future surface-water deliveries to the District from the USBR will be about 33,000 acre-ft per year before conveyance losses, the future groundwater pumping will be about 158,000 acre-ft per year.

g. The non-agricultural groundwater usage is about 1,000 acre-ft per year, and the future usage is expected to be about the same.

h. The expected surface-water deliveries to the District from the USBR for 2023 are about 33,000 acre-ft. However, the actual deliveries to the District will depend on precipitation during the remainder of the 2023 wet season and the decisions USBR makes with respect to deliveries.

i. The amount of water required to replenish the groundwater within the District to 1908 levels would require groundwater inflows to exceed groundwater outflows by 722,000 acre-ft.

j. The District has a contract with the USBR to receive 49,000 acre-ft per year of firm yield and an additional 31,000 acre-ft per year on an interim basis. To date, the USBR has not made the full contract supply available. The District will purchase at least the amount obligated by contract. The District received 0 acre-ft in 2022, and it expects to receive 33,000 acre-ft in 2023.

SECTION 5
References

Brown and Caldwell Consulting Engineers, 1985 *Eastern San Joaquin County Groundwater Study*, prepared for the San Joaquin County Flood Control and Water Conservation District.

Camp Dresser & McKee (CDM), 2001, *Water Management Plan Phase 1 – Planning Analysis and Strategy*, prepared for San Joaquin County Flood Control and Water Conservation District.

Camp Dresser & McKee (CDM), 2008, *Integrated Conjunctive Use Project*, prepared for Northeastern San Joaquin County Groundwater Banking Authority.

Engineering Science, 1987, *Redraft Loan Application Report* (New Melones Supply), prepared for the Central San Joaquin Water Conservation District.

San Joaquin County Department of Public Works, 2004, *Eastern San Joaquin Groundwater Basin Groundwater Management Plan* prepared for the Northeastern San Joaquin County Groundwater Banking Authority.

San Joaquin County Flood Control and Water Conservation District, 2011, *Semi-Annual Groundwater Report, Spring 2011.*

U.S. Geological Survey (USGS), 1908, *Preliminary Report on the Ground Waters of San Joaquin Valley*, *California*, Water Supply Paper 222.