

2.2. Groundwater Conditions

This section describes the groundwater conditions for PID and includes information for the entire Subbasin. Groundwater conditions within PID were developed in accordance with CCR Tittle 2 §354.16 and are described using publicly available data and work by Thomas Harder & Co. for the ETGSA GSP (Thomas Harder & Co., 2024c). **Chapter 2.2** of the *Subbasin Setting* describes groundwater conditions for the entire Subbasin and fulfills the regulatory requirements outlined in CCR Tittle 2 §354.16.

2.2.1. Historical Groundwater Levels

Groundwater levels were evaluated using publicly available data, local datasets from PID, and information included in the ETGSA GSP (TH&Co 2024a). There is some degree of uncertainty in which aquifer wells with historical water level data are screened. The following descriptions of groundwater levels across the Subbasin are based on *Section 2.2.1* of the *Subbasin Setting*.

2.2.1.1 Upper Aquifer

From approximately 1987 until 2015, groundwater levels in the Upper Aquifer wells consistently showed a downward trend. This occurred despite short periods of high rainfall, such as between 1995 and 1999 and in wet years like 2005 and 2011, which only temporarily caused levels to recover. Since 2015, however, groundwater levels in many Upper Aquifer wells across the Subbasin have generally stabilized, and some wells in the City of Porterville area currently show levels higher than those measured in 2015. Hydrographs showing historical groundwater levels across the area presented in **Figure 2-18a**.

Four Upper Aquifer hydrographs for monitoring wells within PID are presented in **Figure 2-18b**. Three of these wells (E0023, E0081, E0082) have records starting in 2019 with one well (R-11) have water level measurements going back to 1990. All three sites with records since 2019 have shown an increase in groundwater levels through 2024. Water levels were relatively higher in 2019, declining from 2020 through 2022 during drought conditions, with significant recovery since 2023. R-11 since 2019 has seen an increase in groundwater elevation. Groundwater elevations were stable through 2011, at which point significant declines occurred during the drought from 2012-2016. Groundwater elevations rebounded between 2017 and 2019, then again declined during the drought from 2020 through 2022. Recovery is observed again after wet conditions in 2023.

2.2.1.2 Lower Aquifer

Figure 2-19a illustrates groundwater level trends in wells that are perforated in the Lower Aquifer. These trends differ based on the well's location within the Subbasin. In the northwest area (Tri-County GSA) of the Subbasin, groundwater levels have demonstrated a downward trend from 1999 to 2023. Groundwater levels in the areas have declined from approximately -25 feet msl -175 feet msl during the drought from 2020-2022. In the southern part (Tri-County GSA) of the Subbasin, groundwater levels were relatively stable between 1987 and 2007, at which point water levels started to decline. Groundwater levels at this location have declined from approximate 50 feet msl in 1987 to -150 feet msl around 2023. A well located in the south-central portion of the Subbasin (DEID GSA) includes a lower aquifer well that has declined by

approximately 60 feet from 2010 through 2023. Groundwater levels at this site were at historic lows during the drought from 2012-2016.

No lower aquifer groundwater elevation data was available for PID. A figure depicting hydrographs from wells without construction are presented in **Figure 2-19b**. These wells appear to have groundwater elevations consistent with the Upper Aquifer wells.

2.2.1.3 Pliocene Deposits

Figure 2-19c presents two Pliocene Deposit monitoring wells and one Santa Margarita monitoring well in the area of Tule East, KTWD, and DEID. The Pliocene deposits are layers of siltstone containing minor interbedded sandstone that act to separate the underlying Santa Margarita Formation aquifer from the Lower Aquifer. KTWD has confirmed that some private domestic wells within their GSA are completed in this formation. Groundwater levels measured in wells exclusively perforated in the Pliocene deposits suggest that these levels are, at least in local areas, higher than those observed in either the Lower Aquifer or the Santa Margarita aquifer. As presented in **Figure 2-19C**, 24S26E1R1M and TSMW-6L have shown stable water levels over the past five years with groundwater elevations between 160 and 200 feet msl. These measurements in the Pliocene deposits are 140 and 260 feet higher than measurements made at the Santa Margarita monitoring TSMW-6SM which ranged from -80 to 40 feet msl. Lower Aquifer water levels across the subbasin range from approximately 100 feet msl in the eastern portion of the Subbasin to approximately -150 feet msl in the western portion of the Subbasin.

2.2.1.4 Santa Margarita Aquifer

Groundwater levels within the Santa Margarita Aquifer exhibit both seasonal and long-term trends (**Figure 2-19d**). Seasonal fluctuations can be significant, with levels varying by as much as 140 feet between the seasonal high and low periods, and these large seasonal differences are most pronounced during dry hydrologic conditions. On a longer-term basis, seasonal high groundwater levels have generally remained stable since records became available around 2013, with variations ranging from approximately 20 to 30 feet. Historically, groundwater flow in the Santa Margarita Aquifer in the southeastern part of the subbasin (specifically the KTWD area) was to the west/southwest. Although data is limited, comparisons of groundwater levels in different wells within the Santa Margarita Aquifer suggest that this west/southwest flow direction persists during the wet season (October to May). However, during the primary pumping season (June to September), groundwater levels indicate a reversal in flow, with water appearing to move eastward in the central KTWD area. Since 2020, groundwater levels in the Santa Margarita formation have ranged from -90 to 70 feet msl.

2.2.2. Contours of Equal Groundwater Elevation, Flow Direction, and Gradients by Aquifer

Groundwater elevations are generally lower in the western portion of the GSA in both the Upper and Lower Aquifers. Contours of equal groundwater elevations were obtained from Attachment 2 (Subbasin Setting) of the Tule Coordination Agreement (TH&Co, 2024a). These contours represent both seasonal high (spring) and seasonal low (fall) conditions for WY2022 and WY2024, representing dry and

wet conditions, respectively. There is some degree of uncertainty in groundwater flow directions due to the use of wells with unknown construction within the contour figures.

2.2.2.1 Upper Aquifer

Contours of equal groundwater elevations from the Tule Subbasin Basin Setting (Thomas Harder & Co., 2022; 2024b) for the Upper Aquifer are presented in **Figures 2-20a, 2-20b, 2-21a, and 2-21b**. Seasonal high (spring) and seasonal low (fall) conditions for the Upper Aquifer in WY2022 are presented in **Figures 2-20a and 2-20b**. WY2022 was designated as a Critically Dry year using the San Joaquin Valley Water Year Index (DWR 2024). Groundwater within the Subbasin flows east to west, from areas of recharge toward the existing pumping depression, which originates outside of the PID GSA, in the western-central portion of the Tule Subbasin.

Groundwater flow across the GSA during the spring of 2022 is toward the southwest, where there appears to be a cone of depression originating from the western portion of the Subbasin with an elevation of 20 ft amsl (**Figure 2-20a**). Across the PID GSA, groundwater elevations ranged from 340 feet above mean sea level (feet amsl) to the east and decline to about 260 feet amsl to the west. The groundwater level gradient to the southwest is approximately 24 feet/mile. Consistent with spring conditions, groundwater flow across the GSA during the fall of 2022 is generally to the southwest toward the cone of depression (**Figure 2-20b**). Groundwater elevations across the GSA during the fall of 2022 were approximately 340 feet amsl in the east and declined to the west to about 240 feet amsl. The groundwater level gradient during fall 2022 was approximately 20 feet/mile.

WY2024 was designated as an Above Normal year using the San Joaquin Valley Water Year Index (DWR 2024), with spring and fall conditions presented in **Figures 2-21a and 2-21b**. Groundwater flow patterns in WY2024 within the GSA are generally consistent with WY2022, with flow to the southwest, toward the cone of depression in the PIXID GSA. The cone of depression in the western portion of the Subbasin is present for both the spring and fall, with a groundwater elevation of 0 feet amsl localized in the western portion of the PIXID GSA. Groundwater elevations within the PID GSA were slightly higher during this Above Normal year, with elevations of approximately 380 feet amsl to the east and 300 feet amsl to the west. There appeared to be minimal variation between seasonal high and seasonal low conditions. During the spring and fall of WY2024, the groundwater flow gradient was approximately 20 feet/mile toward the southwest.

2.2.2.2 Lower Aquifer

Contours of equal groundwater elevations from the Tule Subbasin Setting (Thomas Harder & Co., 2022; 2024b) for the Lower Aquifer are presented in **Figures 2-22a, 2-22b, 2-23a, and 2-23b**. Spring and fall groundwater elevations for WY2022 are presented in **Figures 2-22a and 2-22b**. There is a higher degree of uncertainty for groundwater flow direction in the Lower Aquifer, compared to the Upper Aquifer, due to fewer wells with known construction within the Lower Aquifer. Contours of equal groundwater elevations within PID are projected based on surrounding wells outside of PID. Based on groundwater elevation for wells outside of PID, groundwater flow direction is consistent with the Upper Aquifer and is from east to west. A cone of depression can be observed in the Lower Aquifer during the spring of 2024 in the PIXID GSA, with a groundwater elevation of -100 ft amsl. No cone of depression is present during

the fall of 2024, nor in the spring or fall of 2022, though groundwater elevations are consistently lower than -100 ft amsl throughout the entire western portion of the Subbasin, outside of the PID GSA.

Spring and fall groundwater elevations for WY2022 are presented in **Figures 2-22a and 2-22b**. During the spring of WY2022, no pumping depression is observed in the Lower Aquifer, though groundwater elevation in the western-most portion of the Subbasin ranged from 0 ft amsl to -180 ft amsl. Groundwater elevations within the PID GSA during the spring were 300 feet amsl on the eastern boundary and approximately 200 feet amsl on the west, with a gradient of approximately 10 feet/mile (**Figure 2-22a**). During the fall, there was no major change to the direction of groundwater flow. Groundwater elevations within the GSA range from between 200 and 300 feet amsl on the east to 140 feet amsl to the west, with a gradient of approximately 27 feet/mile (**Figure 2-22b**).

Spring and fall conditions for WY2024 are presented in **Figures 2-23a and 2-23b**. During the spring of 2024, a cone of depression is observed in the western portion of the Subbasin with a groundwater elevation of -100 ft amsl. Groundwater elevations within the PID GSA were between 300 feet amsl to the east and 200 feet amsl to the west, with a gradient of approximately 20 feet/mile. During the fall of 2024, groundwater elevation in the western portion of the Subbasin ranged from 0 ft amsl to -180 ft amsl. Groundwater elevation in the vicinity of the spring 2024 pumping depression ranges from -140 ft amsl to -160 ft amsl. Within the PID GSA, groundwater elevation during the fall ranged from 400 to 300 feet amsl in the east to approximately 200 feet amsl in the west.

2.2.2.3 Vertical Hydraulic Gradients

There are currently no multi-cocompletion monitoring wells within PID. Based on the groundwater elevation contours, there is a downward gradient from the Upper Aquifer to the Lower Aquifer.

2.2.3. Change In Groundwater Storage

Section 2.3 of the *Subbasin Setting* describes the historical cumulative and annual change in groundwater storage for the entire Subbasin, from years WY1987 to WY2023. The average annual change in groundwater storage is estimated to be 192,800 AFY, with a cumulative total change of -7,000,000 AF.

Based on the water budget developed for PID GSA using the Tule Subbasin groundwater flow model, the average annual change in groundwater storage for the PID GSA is estimated to be -2,200 AFY when accounting for lateral groundwater flows. When discounting for subsurface inflows and outflows, PID is a net recharger of groundwater with an average annual increase of 6,200 AFY. Over the entire historical period through WY 2024, the cumulative change in storage -84,400 AF. The average annual ground water pumping simulated in PID was -23,600 AFY, which will be verified with implementation of groundwater metering programs. Groundwater pumping and change in storage values for PID are represented in **Figure 2-24**.

2.2.4. Land Subsidence

2.2.4.1 Historical Subsidence

Land subsidence in the Subbasin is attributed to the decrease in groundwater levels due to groundwater pumping in areas where the subsurface sediments are composed of thick sequences of fine-grained material, such as silt and clay (Lofgren and Klausning, 1969). Historical subsidence in the Subbasin prior to the early 1980s has been relatively well-documented. However, data in more recent decades have been limited due to a decrease in subsidence analysis. Subsidence has been evaluated based on studies that use a combination of the following data sources: benchmark surveys, extensometers, Interferometric Synthetic Aperture Radar (InSAR), and Global Positioning Systems (GPS).

Land subsidence based on InSAR data (Tre Altamira, 2025) collected throughout the Subbasin from January 2015 to January 2020 is presented in **Figure 2-25a**. This figure also includes the average pumping for each GSA over the historical period. Average pumping over the entire historical period was 23,600 (AFY) which was consistent with the average pumping from 2015 through 2020 (24,500 AFY). The InSAR data indicates that subsidence across the subbasin ranged from 0 feet (and minor uplift) along the eastern boundary to over 3 feet in the western/northwestern portion of the Subbasin. Starting in the northeast corner of LTRID and wrapping around to the southwest corner of TCWA GSA, there is generally less than 0.25 feet of subsidence. The rest of the subbasin resembles a cone of depression with the greatest amount of subsidence occurring in the central portion of the Subbasin between highway 43 and highway 99. Subsidence across the Subbasin appears to be consistent with lower groundwater levels in the western portion of the Subbasin. These areas correspond to areas with the most groundwater pumping and the lowest groundwater elevation (**Figures 2-20a through 2-23b**). Additionally, greater amounts of subsidence are also associated with the presence of the Corcoran Clay. Over the historical period, LTRID GSA with an area of 105,000 acres pumped on average 245,000 AFY (2.3 AFY/acre), and the PIXID GSA with an area of 71,300 acres pumped approximately 157,000 AFY (2.2 AFY/acre). Additionally, the areas where most subsidence is occurring are the areas where the Corcoran Clay is present west of Highway 99. Pumping numbers were obtained from annual report data and water budget tables included in the Tule Subbasin Setting (Thomas Harder & Co., 2024a).

Within PID, the areas north of PID generally experience less than 0.25 feet of subsidence. South of the River, there is a gradient of increasing subsidence to the southwest where up to 1.75 feet of subsidence occurred along the southwestern boundary with LTRID GSA (**Figure 2-25a**).

A subsidence profile based on InSAR data is provided to depict vertical displacement across an east-west transect of the Subbasin between 2015 to 2020, as shown in (**Figure 2-25b**). The subsidence transect which runs from the far eastern boundary of Tule East GSA, through PID GSA, and to the western boundary of LTRID GSA and the Subbasin. Over this 5-year period, the greatest amount of subsidence occurred between Highway 99 and Highway 43 which corresponds to lower water levels and GSAs with higher levels of pumping.

Within PID, there is a general gradient of increasing subsidence from east to west without any apparent hotspots within the GSA. The amount of subsidence substantially increases moving west of

the FKC. The greatest subsidence that occurred during this period was on the far western boundary of the GSA where total displacement was approximately 1.5 feet. Subsidence continues to increase moving west where a significant hot spot is present west of highway 99 and east of highway 43.

Data from a continuous GPS monitoring station (P056) and a USGS extensometer are presented in **Figures 2-26** and **2-27**. A UNAVCO continuous GPS monitoring station is typically constructed by installing a stable geodetic monument into bedrock or a stable concrete structure. The purpose of this station is to measure changes in land surface elevation that are directly related to land subsidence caused by groundwater pumping. The USGS extensometer consists of a 2-inch diameter steel pipe that is anchored within a 12-inch diameter well at a depth of 1,180 feet bgs. The well is perforated from 1,083 feet to 1,280 feet, and groundwater measurements are collected daily using a pressure transducer. GPS station P056 has the longest record with surface elevation measurements starting in November 2005. This station is located just outside the southern boundary of PID at the Porterville Municipal Airport. Extensometer (22S/27E-30D2) has the second longest data set with records starting in 2018 (USGS, 2025), and it is located south of PID on the eastern boundary of the SID GSA along the FKC. The last site, a GPS monitoring station (PORT) located in the city of Porterville, to the east of PID, has data since October 2021 (SOPAC-CSRC, 2025). To determine annual compaction from the extensometer and subsidence from the other two land surface stations, data from these sites are compared using January measurements in order to discount for any elastic subsidence.

Data for P056 is presented in **Figure 2-26**. From January 2006 to January 2020, the total vertical displacement was 2.55 feet. This figure also depicts the annual change in subsidence (secondary y-axis) and the water year type for each year (x-axis) based on the San Joaquin River Index. Subsidence was minimal (<0.1 foot/year) prior to 2012. Between 2012 and 2020, there were five consecutive Dry or Critical Dry Years, two wet years, and one below normal year, which led to an additional 2.15 feet of subsidence at P056. In 2016, the fifth year of one of California's worst droughts on record, there was an additional 0.44 feet of subsidence in one year.

Data from 22S/27E-30D2 (extensometer) and PORT (GPS station) are presented in **Figure 2-27**. Data collection for the extensometer began in June 2018 (USGS, 2025). From January 2019 to January 2020, this monitoring site recorded 0.32 feet of compaction. Extensometer data indicate a declining trend in vertical displacement prior to 2022. After 2022, vertical displacement plateaus with minor seasonal variation with a positive trend near the end of 2024 and beginning of 2025 (**Figure 2-27**). The PORT monitoring site had not been constructed prior to GSP implementation. Similar to the extensometer data, there vertical displacement shows a positive trend near the end of 2024 and beginning of 2025, suggesting a decrease in land subsidence.

In addition to InSAR, GPS, and extensometer data, subsidence has been monitored by surveying benchmarks, primarily in the vicinity of the FKC. Benchmarks along the FKC were surveyed by the FWA between two separate ranges of time: 1) from 1959 to the early 1980's, and 2) from 2017 to 2019. Survey data indicated that cumulative land subsidence along the FKC ranged from 1.7 ft where the canal and Tule River intersect near Porterville to approximately 9 ft of land subsidence near Deer Creek between 1959 and 2017.

2.2.4.2 Subsidence During GSP Implementation (January 2020 – January 2025)

Cumulative land subsidence based on InSAR data throughout the Tule Subbasin from January 2020 to January 2025 is presented in **Figure 2-28**. Similar to **Figure 2-25a**, this figure presents that average pumping for each GSA over the five-year period. Within PID, pumping from 2020 through 2024 was slightly higher than the historical average (26,900 AFY). The general pattern of subsidence across the Subbasin is consistent with the 2015 to 2020 period. The eastern portion of the subbasin experienced minimal to no subsidence, with the greatest amount of subsidence occurring in the west and northwest portions of the Subbasin. Starting in the northeast corner of LTRID wrapping around to the southern part of DEID, there is generally less than 0.25 feet of subsidence. Along the far eastern boundary from PID to the southeast corner of the subbasin, there is 0 subsidence. The rest of the subbasin appears to resemble a cone of depression with the greatest amount subsidence occurring in the west central portion between high 43 and highway 99 (approximately 3.6 feet of subsidence).

Consistent with the previous five-year period, the greatest subsidence is occurring in areas with more groundwater pumping and where the Corcoran Clay is present. Over this five-year period (2020-2025), the average pumping across the subbasin was generally consistent with the previous five years (2015-2020). Some notable changes include a significant decrease with LTRID to an average pumping amount of 193,000 AFY which is approximately 24,000 AFY less than what occurred from 2015-2020. PIXID also saw a significant decrease in pumping of approximately 31,000 AFY. GSAs with increases of pumping include Tri-County, SID, and DEID GSA.

Within PID between 2020 and 2025, all of the GSA north of the Tule River experienced less than 0.5 feet of subsidence. South of the Tule River, most of the GSA experienced between 0.5 and 1.25 feet of subsidence.

An east-west profile across the PID and the Subbasin is presented in **Figure 2-29**. This figure illustrates the difference in magnitude of subsidence that has occurred in the eastern and western portions of the Subbasin based upon cumulative InSAR data from 2020 through 2025. This transect from the east side of Tule East to the west side of LTRID GSA. This transect is consistent with the subsidence transect representing 2015-2020 (**Figure 2-25b**) but with a more apparent hotspot (i.e more subsidence) occurring between highway 99 and highway 43.

In addition to the land subsidence profile across the east-west transect between 2020 to 2025 (**Figure 2-29**), InSAR data collected and evaluated over one-year timeframes for each of these years are represented in **Figures 2-30a** through **2-30f**. For each profile, vertical displacement associated with land subsidence is represented beginning with January 1st of each designated year with the exception of 2025. **Figure 2-30f** represents land subsidence that occurred from February 1st, 2024, to February 1st, 2025. These figures show the drastic impact that water year types have on subsidence across the Subbasin and within PID. **Figures 2-30a** through **Figure 2-30c** representing years 2020 through 2022 all show a significant amount of subsidence occurring during dry years. Starting in 2020, the pattern of subsidence was consistent with previous years with minimal amounts occurring on the eastern side and greatest amount occurring in the west. Subsidence ranged from 0 to 0.87 feet (**Figure 2-30a**). The same pattern of subsidence continued through 2021 and 2022 exceeding 1 foot of subsidence in the western part of the Subbasin (**Figure 2-30b**

and **Figure 2-30c**). The annual subsidence drastically decreased across the Subbasin from 2023 to 2025. In 2023, most of the subbasin experienced less than 0.2 feet of subsidence. Within PID, almost the entire GSA saw zero subsidence. In 2024, subsidence slightly increased in the western part of the Subbasin with displacement values between 0.3 and 0.67 feet with very similar conditions occurred in 2025. In 2024 and 2025, PID experienced less than 0.1 feet north of the Tule River, and less than 0.2 feet along its southwestern border (**Figure 2-30d, e, f**).

Figure 2-26, as discussed in the previous section, presents vertical displacement data for P056 (SOPAC-CSRC, 2025). Post-GSP implementation, annual subsidence has decreased from what occurred prior to the drought from 2012 through 2016. The annual subsidence was still relatively high from 2020 through 2022, which were all Dry or Critically Dry Years, but 2023 saw the lowest annual subsidence since 2011, with less than 0.1 feet/year. From 2020 through 2024, the cumulative subsidence increased from -2.54 to -3.39 feet, or an average of 0.21 feet/year.

Figure 2-27, as discussed in the previous section, includes vertical displacement data from GPS station PORT and compaction data from the extensometer 22S/27E-30D2 (SOPAC-CSRC, 2025). PORT, which began measuring land surface elevation in 2021, has shown near-zero subsidence near the City of Porterville. These measurements are consistent with InSAR data for this same area. Extensometer 22S/27E-30D2, as of Spring 2025, has measured approximately 0.85 feet of compaction, which is consistent with the change in land surface elevation from InSAR. The InSAR data indicated a change in land surface elevation between 0.75 and 1 foot at the extensometer location between 2020 and 2025 (**Figure 2-27**).

As previously described and shown in **Figure 2-27**, the extensometer data represents a declining trend in vertical displacement between 2020 to 2022, which is indicative of compaction. After 2022, however, vertical displacement plateaus, with only minor seasonal variations, suggesting that the compaction rates have been decreasing and potentially stabilizing over time. Similarly, InSAR data represented as annual land subsidence profiles (**Figures 2-30a-30f**) show that land subsidence rates between 2022 to 2025 have decreased since the former time period of 2020 to 2022. Extensometer and InSAR data indicate that there is a direct correlation between compaction (extensometer) and vertical displacement (InSAR) such that land subsidence and compaction rates between 2022 to 2025 have decreased since the 2020 to 2022 time period. Additionally, land subsidence has been monitored, primarily in the northeastern region of the Tule Subbasin for the ETGSA Land Subsidence Monitoring Program (LSMP) (TH&Co., 2021). One of the objectives of the LSMP is to implement sustainable groundwater management measures in order to mitigate non-recoverable land subsidence along the FKC between 2020 – 2040. Additional details for this program are discussed in the ETGSA Land Subsidence 2021/22 and 2022/23 Annual Reports (TH&Co., 2023; 2024d). The ETGSA LSMP includes the collection of benchmark, GPS, extensometer, and InSAR data throughout a 4-mile-wide land subsidence monitoring area (SMA) centered around the FKC (**Figure 2-31**), and it is a subset of larger benchmark monitoring network that extends throughout the Tule Subbasin. In addition to the ETGSA, the SMA also encompasses portions of SID, TBID, PID, and along the boundaries of adjacent GSAs.

Benchmark identification numbers are indicated on **Figure 2-31**, which correlate with subsidence data from 2021 to 2025 provided in **Table 2-4**. Subsidence monitoring by means of benchmark surveys began

at varying times between 2020, 2021, and 2022. Vertical displacement associated with land subsidence were calculated based on annual benchmark surveys, which are represented in **Table 2-4**. All measurements were collected annually during summer months (June-August) of each year. Based on the surveys, cumulative land subsidence that occurred between 2021 to 2025 ranged from 0.31 ft (Benchmark ID: E0057_B_FKC) to 1.32 ft (P0094_B_RMS) over a four-year period. Additionally, 0.13 ft of uplift occurred in one location (E0085_B_RMS). Within the ETGSA subsidence management area, cumulative land subsidence was calculated on an annual basis (**Table 2-4**). There are 22 benchmarks within the area where survey data was collected in both the 2021-2022 timeframe as well as the 2024-2025 timeframe. Of these 22 benchmarks, 19 of the benchmark surveys indicated a decrease in land subsidence over time, while 3 benchmarks showed an increase in vertical displacement. For example, benchmark E0047_B_RMS within SID (**Figure 2-31** and **Table 4**), experienced 0.38 ft of land subsidence between 2021-2022, while in -0.19 ft (uplift) was measured between 2024-2025.

An evaluation of InSAR, GPS, and extensometer data indicates that levels of land subsidence and compaction within the timeframe of 2020 to 2022 were greater than land subsidence and compaction levels between 2022 to 2025. Additionally, benchmarks within the ETGSA monitoring area experienced an overall decrease in subsidence as 19 out of 22 benchmark surveys showed decreased levels of subsidence between the timeframes of 2021-2022 and 2024-2025. The overall benchmark data are consistent with the InSAR, GPS, and extensometer data in that land subsidence rates have been decreasing over time since 2020 or 2021.

2.2.5. Water Supply

PID operates under a long-term water service contract with the U.S. Bureau of Reclamation as part of the Central Valley Project's Friant Division. This agreement secures the district's access to both Class 1 and Class 2 water supplies, which are delivered through the Friant-Kern Canal from Millerton Lake at Friant Dam. The contract guarantees 15,000 acre-feet of Class 1 water each year, a highly reliable supply that is only curtailed in extreme drought conditions. In addition, the district is entitled to up to 30,000 acre-feet of Class 2 water annually, which is supplemental and available in wetter years when surplus flows exist. The contract itself is a long-term agreement that outlines delivery schedules, pricing, repayment provisions, and obligations between the district and the federal government. By tying Porterville Irrigation District directly to the Bureau of Reclamation's management of the Central Valley Project, the arrangement ensures both stability and flexibility in water supply. Class 1 water provides dependable irrigation for high-value crops, while Class 2 water offers additional capacity in years of abundance. This structure reflects the broader federal approach to balancing agricultural needs with California's variable hydrology, making the contract a critical instrument for sustaining farming communities in the district's service area. The district also supplements these supplies through agreements controlling a portion of Tule River water, averaging about 12,900 acre-feet annually.

The water supply for PID is discussed further in *Water Budget* section. PID's historical surface water supply is presented in **Figure 2-32**. Average surface water deliveries over the historical period was approximately 15,400 AFY.

2.2.5.1 Imported Surface Water and Distribution

PID is supplied with imported surface water via the FKC. The FKC runs north to south, along Road 208, along the eastern boundary of the GSA. Water supplied by the FKC is distributed within the PID by means of natural waterways, man-made ditches, unlined canals, and pipeline distribution systems.

2.2.6. Surface Water Features

Surface water features within the Subbasin include the Tule River, White River, Deer Creek, and Lake Success, as described in Chapter 2.1.5 of the *Subbasin Setting*. Artificial features include Lake Success and the FKC. Lake success is formed by Success Dam across the Tule River Canyon. The FKC is a man-made aqueduct used to convey imported water throughout the Subbasin. All natural waterways flow to the west from the Sierra Nevada Mountains.

The primary natural waterway within the PID GSA is the Tule River, which flows from the Lake Success westerly into the Tule Subbasin (**Figure 2-33**). It enters the PID GSA through its eastern boundary and flows west/northwest through the GSA before exiting through its western boundary.

2.2.7. Interconnected Surface Water

Interconnected surface water (ISW) systems are defined as surface water that is hydraulically connected to the underlying aquifer through a continuous saturated zone, and the overlying surface water is not completely depleted. The relationship between surface water and groundwater in the Subbasin can be characterized in three ways: the surface water gains water from groundwater (a "gaining stream"), the surface water loses water to groundwater (a "losing stream"), or it experiences both conditions spatially or temporally. A losing stream is considered "disconnected" if there is an unsaturated zone separating the surface water from the aquifer. Changes in groundwater levels due to pumping near a gaining stream can impact the flow within that stream. The exact locations and timing of ISW in the Tule Subbasin are currently unknown. However, an initial analysis consistent with The Nature Conservancy's ICON database identified three areas of potential ISW:

- **Upper Tule River Area:** From the subbasin boundary near Success Dam down to Road 192.
- **Upper Deer Creek Area:** From the subbasin boundary down to the Friant-Kern Canal.
- **Upper White River Area:** From the subbasin boundary down to Highway 65.

These areas are generally considered "Likely Connected - Losing" if the groundwater elevation is between 0 and 20 feet below the surface water elevation, indicating water is likely moving from the surface water body to the aquifer.

For the Tule River, Upper Aquifer groundwater levels below Success Reservoir Dam suggest a periodic connection with surface water, especially during wet hydrologic conditions (e.g. WY2023) when groundwater rose to within 10 to 25 feet of the land surface, near the streambed elevation. The nearest monitoring well in the Upper Deer Creek Area shows groundwater elevations within 15 feet of the streambed during high groundwater conditions (February 2023). Conversely, data for the Upper White

River Area is limited to one well outside the potential ISW area, where groundwater levels were around 250 feet below ground surface (bgs), which is too deep to be considered interconnected with surface water.

The lack of monitoring wells specifically constructed along the streambeds to monitor ISW is identified as a data gap. This gap is addressed in the Coordination Agreement by planning for the development and implementation of an Interconnected Surface Water Monitoring Plan. Potential areas of ISW are presented in **Figure 2-34**. Within PID, potential ISWs are along the Tule River to the east of the FK.

2.2.8. Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are natural communities that rely on groundwater that is shallow or discharge at the land surface for their survival. Potential GDEs in the Tule Subbasin have been identified using the California Department of Fish and Wildlife's (CDFW) Vegetation Classification and Mapping Program (VegCAMP) data. GDEs may be hydrologically linked to Interconnected Surface Water (ISW) systems, as ISW features like rivers and shallow groundwater are likely to support aquatic communities or species dependent on groundwater.

Within the Upper Tule River Area, most potential GDEs are concentrated between Success Dam and Martin Hill. Some groves of trees are also mapped in the Tule River channel between Martin Hill and the Friant-Kern Canal. These GDEs primarily consist of riparian trees such as Sycamore, Fremont Cottonwood, and Willow. In the Upper Deer Creek Area, the majority of potential GDEs are located east of Highway 65 and include species like Sycamore, Oak, and Willow. Similarly, in the Upper White River area, the potential GDEs are mostly situated within the upper three miles of the channel closest to the Subbasin boundary, featuring Sycamore, Oak, and Willow.

Potential GDEs within PID are all along the Tule River and are presented in **Figure 2-35**.

2.2.9. Groundwater Quality

Groundwater quality varies with depth across the aquifer system throughout the Subbasin. According to Thomas Harder & Co. (2024b; 2024c), the native groundwater quality is generally considered relatively good; However, groundwater quality issues have resulted from both regional point-source contamination and non-point source groundwater quality degradation.

Groundwater quality issues in the Subbasin have been evaluated based on the Maximum Contaminant Level (MCL) for drinking water beneficial uses. Throughout the Subbasin, naturally occurring and anthropogenic constituents of concern (COCs) that exceed the applicable regulatory standards based on MCLs have been exceeded. MCL exceedances are based on data provided by the California State Water Resources Control Board (SWRCB) Groundwater Ambient Monitoring and Assessment (GAMA) Program (SWRCB, 2025). COCs for the Subbasin along with the associated MCL or secondary MCL value are presented in **Table 2-5**.

Table 2-5. Constituents of Concern Minimum Thresholds in Groundwater		
Constituent	Units	Minimum Threshold
		Drinking Water Limits (MCL/SMCL)
Arsenic	µg/L	10
Nitrate as N	mg/L	10
Hexavalent Chromium	µg/L	10
Dibromo-3-chloropropane (DBCP)	ppb	0.2
1,2,3-Trichloropropane (1,2,3-TCP)	µg/L	0.005
Tetrachloroethene (PCE)	µg/L	5
Chloride	mg/L	500 (secondary)
Total Dissolved Solids (TDS)	mg/L	1000 (secondary)
Perchlorate	µg/L	6
Uranium	pCi/L	20 pCi/L

Descriptions of the above COCs are provided as follows:

Inorganic and Radioactive Constituents:

- Arsenic (As): Naturally occurring in rocks; also from legacy agriculture and industrial activity.
- Hexavalent Chromium (Cr[VI]): Derived from natural erosion, industrial plating, and wastewater byproducts.
- Uranium (U): Naturally present in soil/rocks; also linked to industrial and agricultural practices.
- Chloride (Cl): Found in natural minerals, wastewater, fertilizers, and saline water.
- Total Dissolved Solids (TDS): A measure of inorganic/organic substances from mineral dissolution, urban runoff, and agriculture.

Synthetic & Organic Compounds

- 1,2,3-Trichloropropane (1,2,3-TCP): A synthetic solvent and former soil fumigant.
- Dibromo-3-chloropropane (DBCP): A legacy soil fumigant (banned in 1979). Managed primarily by the State Regional Water Quality Control Board.
- Tetrachloroethane (PCE): An industrial degreaser introduced via storage tank leaks or improper disposal.

Nutrients & Industrial Ions

- Nitrate as N: Primarily from fertilizers, septic systems, and animal waste.
- Perchlorate: A manufactured ion used in explosives and industrial processes; typically enters groundwater via spills or landfills.

Figure 2-36 illustrates the MCL exceedances for each COC across the Subbasin over the last 20 years. Nitrate as N has been the most prominent across the Subbasin between 2005 to 2025 except for the southwestern and southeastern-most regions. Additionally, COC exceedances of arsenic, hexavalent chromium, 1, 2, 3-TCP, and uranium were detected from more wells in the western half of the Subbasin than the eastern half. Although chloride exceedances have not been detected since before 2005 (SWRCB, 2005), it remains a monitored COC and is included in this GSP.

MCL exceedances by well type is presented in **Figure 2-37**. Well types include domestic, irrigation, industrial, monitoring, municipal, and other. Most of these exceedances are associated with municipal and domestic wells

MCL exceedances in the vicinity of PID are presented in **Figure 2-38**. Within the PID GSA, Nitrate as N was only COC detected (SWRCB, 2025). **Table 2-6** lists the MCL exceedances within PID GSA, as well as the dates during which the contaminates were detected. During this time period, Nitrate as N exceedances were detected above the MCLs from 15 wells and 64 samples, of which 25 of the samples were collected after January 2015 (SWRCB, 2025). Nitrate as N is a commonly occurring non-point source COC detected across the Subbasin and within PID (Tule Basin Water Quality Coalition, 2017). Nitrate as N that exceeds the MCL of 10 mg/L have been detected between 2005 to 2025 in the north-central portion of the GSA. Exceedances of N and TCP have also been detected within the adjacent GSAs, particularly in the Lower Tule RIVE ID GSA near PID's western boundary (SWRCB, 2025). Additional constituents of concern (COCs) that were detected within the PID GSA between 2005 to 2025 but did not exceed the MCL for drinking water beneficial uses include uranium and total dissolved solids.

Point-source contaminants are also evaluated within the Tule Subbasin. Currently, 15 active cleanup sites have been identified in the Geotracker website within the Tule Subbasin, only one of which are in the PID GSA. Historical cleanup sites have been identified within the Porterville GSA boundaries that were associated with leaking underground storage tanks (LUSTs); However, the sites have since been closed with the exception of one LUST site within the central region of the GSA (Geotracker ID: T0610700099).

The Tule Basin Water Quality Coalition (TBWQC) operates as the third-party group under the Irrigated Lands Regulatory Program to address agricultural impacts to water quality within the Tule Subbasin. Additionally, the Tule Basin Management Zone also addresses nitrate exceedances within the Subbasin.

Additional constituents of potential concern include PFAS, which are manmade compounds that have historically been used in a variety of common products, including fire-fighting foams, clothing, carpets, cookware, etc. PFAS are also frequently detected in wastewater discharges. In April 2024, the United States Environmental Protection Agency (USEPA) published the National Primary Drinking Water Regulation (NPDWR) for six PFAS and established enforceable MCL's between 4 - 10 parts per trillion (ppt or ng/L), depending on the chemical. Under the NPDWR, public water systems must complete initial monitoring by 2027 and implement solutions that reduce exceedances of PFAS chemical MCLs by 2029. Additionally, the SWRCB issued General Order 2024-0002- DDW, which requires monitoring for PFAS pursuant to Health and Safety Code Section 116378. The GSAs will determine the impacts and degradation of groundwater by PFAS in the Tule Subbasin as data becomes available.