Tule Subbasin Setting

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1. Introduction § 354.12

The GSAs in the Tule subbasin have jointly prepared a comprehensive Basin Setting, the *Tule Subbasin Setting, attached as Attachment 2 to this GSP*. This section of the Plan describes information about the physical setting and characteristics of the basin and its current conditions by providing reference to the *Tule Subbasin Setting* and, when necessary, providing additional information that directly relates to the Agency.

A description of the Tule Subbasin's physical setting, including its location size, and jurisdictional areas, is described in the Introduction of **Chapter 2** of *Attachment 2 Tule Subbasin Setting*.

The physical setting as relates to the Agency within the Tule Subbasin and its Plan Area are described in **Section 1-4** of this Plan**.**

2. Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model for the Tule Subbasin is described in **Chapter 2.1** of the *Tule Subbasin Setting.* The regulatory requirements established by the SGMA Regulations (specifically 23 CCR §354.14) as they pertain to the Agency are addressed and fulfilled by the Hydrogeologic Conceptual Model*.* **Table 2-1** provides a cross-reference linking the various requirements of 23 CCR §354.14 with the identified section of the *Tule Subbasin Setting* and the corresponding section of this Plan. This Plan incorporates the full *Tule Subbasin Setting*, as Attachment 2, and summarizes details from Attachment 2 related to Agency specific conditions..

Table 2-1: Components of CCR §354.14

23 CCR	Section Title	Tule Subbasin Setting	TPDWD GSA Plan
N/A	Source of Data	2.1.1	
§ 354.14 (b)(1) & (c)	Geologic Setting	2.1.2	2.2.1
§ 354.14 (b)(2)	Lateral Basin Boundaries	2.1.3	2.2.2
§ 354.14 (b)(3)	Bottom of Basin	2.1.4	2.2.3
§ 354.14 (d)(5)	Surface Water Features	2.1.5	2.2.4
§ 354.14 (d)(6)	Imported Water	2.1.5.6	2.2.4.2
§ 354.14 (d)(4)	Areas of Groundwater Recharge and Discharge	2.1.6	2.2.5
§ 354.14 (b)(4)	Principal Aquifers and Aquitards	2.1.7	2.2.6
§ 354.14 (b)(4)(A)	Aquifer Formations	2.1.7.1	2.2.6.1
§ 354.14 (b)(4)(B)	Aquifer Physical Properties	2.1.7.2	2.2.6.2
§ 354.14 (b)(4)(C)	Geologic Structures that Affect Groundwater Flow	2.1.7.3	2.2.6.3
§ 354.14 (b)(4)(D)	Aquifer Water Quality	2.1.7.4	2.2.6.4
§ 354.14 (b)(4)(E)	Aquifer Primary Uses	2.1.7.5	2.2.6.5
§ 354.14 (b)(5)	Uncertainty in the Hydrogeologic Conceptual Model	2.1.8	2.2.7

1. Geologic Setting § 354.14(b)(1); § 354.14(c)

The Agency is located in the northeastern portion of the Tule Subbasin within the Tulare Lake Hydrologic Region (**Figure 2-1**, *Attachment 2 Tule Subbasin Setting)*. A series of coalescing alluvial fans that extends toward the center of the subbasin with localized lacustrine deposits at the terminus of the fans in the eastern portion of the subbasin underlie the Agency (**Chapter 2.1.2*;*** *Attachment 2, Tule Subbasin Setting).* Land surface elevations range from 600 feet above mean sea level (amsl) along the eastern boundary of the Agency to less than 425 ft amsl to the western edge of the Agency (see **Figure 2-4*;*** *Attachment 2 Tule Subbasin Setting).*

Two cross sections (A-A' and B-B') are used to describe the geologic features within the Tule Subbasin (see **Figure 2-4*;*** *Attachment 2 Tule Subbasin Setting).* Portions of the A-A' cross section trend through the Agency. Formations occurring in the Agency can be shown in **Figure 2-5*; Attachment 2*** *Tule Subbasin Setting.*

2. Lateral Basin Boundary § 354.14(b)(2)

The lateral Basin Boundaries for the Tule Subbasin are defined in DWR Bulletin 118[1] and include both natural and political boundaries. **Chapter 2.1.3** and **Figure 2-4** of Attachment 2 *Tule Subbasin Setting*, provide a detailed description of the lateral boundaries of the subbasin.

The Agency boundaries are generally defined by the political boundary of the Tea Pot Dome Water District except for the portions of the Tea Pot Dome Water District within the Porterville Community Management Area of the Eastern Tule GSA (see **Figure 2-3*; Attachment 2*** *Tule Subbasin Setting*).

[1] California Department of Water Resources, 2016

3. Bottom of Basin § 354.14(b)(3)

The definable bottom of the Tule Subbasin is described in **Chapter 2.1.4**. of the *Tule Subbasin Setting.*

The bottom of the basin beneath the Agency is approximately 700 ft below ground surface [bgs] west of the Subbasin boundary and up to approximately 1,500 ft bgs west of Highway 65. The Agency's bottom is generally defined by the granitic crystalline basement that occurs at depth (see **Figure 2-5*; Attachment 2*** *Tule Subbasin Setting*).

4. Surface Water Features § 354.14(b)(5)

The natural waterways within the Tule Subbasin consist of the Tule River, Deer Creek, and White River. These systems form in the Sierra Nevada Mountains east of the Tule Subbasin and flow westerly toward the lakebed of the historic Tulare Lake. None of these surface water features are located within or travers the area of the Agency.

The Friant-Kern Canal conveys imported water through a piped delivery system to growers within the Agency. Each of the major surface water features of the Tule Subbasin are described in further detail in **Chapter 2.1.5** of Attachment 2 *Tule Subbasin Setting* and those occurring within the Agency are listed below.

1. Tule River

The Tule River is the largest natural drainage feature in the Tule Subbasin. From its headwaters in the Sierra Nevada Mountains, the Tule River flows first into Lake Success and then, through controlled releases at the dam, flows through the City of Porterville, Porterville Irrigation District, and Lower Tule River Irrigation District where it is diverted at various points along the way. A significant diversion point is the Porter Slough, which flows to the north and semi-parallel to the main river channel and is used to convey surface water to various recharge facilities and canals. Downstream of Porterville, the Tule River ultimately discharges onto the Tulare Lakebed during periods of above-normal precipitation. Stream flow is measured via gages located below Success Dam, at Rockford Station downstream of Porterville, and at Turnbull Weir (see Figure 2-7***; Attachment 2*** *Tule Subbasin Setting*). From water years 1986/87 to 2022/23, releases from Lake Success to the Tule River, quantified in TRA annual reports as Tule River at Success Dam, has ranged from 5,967 acre-ft in water year 2014/15 to 512,118 acre-ft in water year 2022/23 with an annual average during this time period of approximately 119,746 acre-ft.

Releases of water below Lake Success dam are diverted from the Tule River channel at various locations in accordance with TRA (1966). Diversion points along the river are located at the Porter Slough headgate, Campbell and Moreland Ditch Company, Vandalia Water District, Poplar Irrigation Company, Hubbs and Miner Ditch Company, and Woods-Central Ditch Company. The lower portion of the Tule River channel is also used as a conveyance mechanism to convey imported water from the Friant-Kern Canal. Any residual stream flow left in the Tule River after diversions is measured at the Turnbull Weir, located at the west end of the Subbasin (see Figure 2-7***; Attachment 2*** *Tule Subbasin Setting*).

2. Imported Water § 354.14(b)(6)

Most of the water imported into the Tule Subbasin is from the Central Valley Project (CVP) and delivered via the Friant-Kern Canal (see Figure 2-7***; Attachment 2*** *Tule Subbasin Setting*). Imported within the Agency water is delivered to farmers via the piped distribution system.

5. Areas of Groundwater Recharge and Discharge § 354.14(d)(4)

Groundwater recharge occurs throughout the Tule Subbasin within stream channels, unlined canals, in managed recharge basins, and in areas of the subbasin with irrigated agriculture. Of those features, the Agency has managed recharge and surface water storage facilities. None of the other features exist within the Agency. According to the Soil Agricultural Groundwater Banking Index or SAGBI[2] (see **Figure 2-9*; Attachment 2*** *Tule Subbasin Setting*), areas generally suitable for recharge within the Agency occur along the stream channels and floodplains of the Tule River. Due to the depth of groundwater, there are no areas within the Tule Subbasin or the Agency where groundwater discharges at the land surface.

See ***Attachment 2 Tule*** *Subbasin Setting* **Chapter 2.1.6** for additional information regarding areas of groundwater recharge and discharge within the Tule Subbasin.

6. Principal Aquifers and Aquitards

1. Aquifer Formations § 354.14(b)(4)(A)

Of the five general aquifer/aquitard units described to be present in the subsurface beneath the Tule Subbasin, four occur within the subsurface of the Agency area (see **Chapter 2.1.7.1*, Figure* 2-5*; Attachment 2*** *Tule Subbasin Setting)*:

1. Upper Aquifer;
1. Lower Aquifer;
2. Pliocene Marine Deposits; and
3. Santa Margarita Formation/Olcese Sands/Tertiary Sedimentary Deposits.

The extent and depth these aquifers are defined within the Agency is visually represented on **Figure 2-5** in Attachment 2 *Tule Subbasin Setting*.

The upper aquifer and lower aquifer are the primary water-producing aquifers for production wells in the Agency. The upper aquifer occurs across the entire Agency area. This aquifer is generally unconfined to semi-confined. The upper aquifer occurs in the upper 200 to 300 ft of sediments within the Agency. The lower aquifer also extends across the entire Agency. The total depth of this aquifer ranges from approximately 300 to 500 ft bgs within the Agency. Additionally, some of

[2] California Soil Resource Lab, 2015

the Agency's wells may perforate the Pliocene Marine Deposits which occurs at depths from approximately 500 to 1,000 ft bgs within the Agency and the Santa Margarita Formation which occurs at depths from approximately 700 to 1,300 ft bgs within the Agency.

2. Aquifer Physical Properties § 354.14(b)(4)(B)

The principal water-bearing aquifers of the Tule Subbasin consist of permeable sand and gravel layers, interbedded with low-permeability silt and clay lenses. Shallower-saturated sediments are generally unconfined to semi-confined, whereas aquifers beneath the Corcoran Clay in the western portion of the Subbasin are confined.

The ability of aquifer sediments to transmit and store water is described in terms of transmissivity, hydraulic conductivity, and storativity. The quantitative values for each of these parameters (for both the upper aquifer and lower aquifer) and the process by which these values were developed or derived are discussed in **Chapter 2.1.7.2** of Attachment 2 *Tule Subbasin Setting*. Aquifer parameters were developed and assigned using short-term pump tests, long-term pump tests (24 hours or more at a constant rate), and values published in the literature.

Horizonal hydraulic conductivity for the upper aquifer within the Agency ranges from approximately 20 ft/day to greater than 80 ft/day with the highest permeabilities in the northeast portion of the Agency (see **Figure 2-11**, Attachment 2 *Tule Subbasin Setting*). The higher values in the GSA indicate more permeable sediments and the lower values in the GSA indicate less permeable sediments. Horizontal hydraulic conductivity values in the lower aquifer within the Agency range from no less than 10 ft/day to approximately 40 ft/day (see **Figure 2-12**, Attachment 2 *Tule Subbasin Setting*).

Storage properties of the upper aquifer are expressed in terms of specific yield since this aquifer is conceptualized as unconfined. Specific yield values range from approximately 0.05 to 0.20 in the upper aquifer within the Agency (see **Figure 2-13*;*** Attachment 2 *Tule Subbasin Setting)*. Areas of lower specific yield occur in the western parts of the GSA.

The lower aquifer in the Tule Subbasin is confined to semi-confined and, as such, storage properties for this aquifer are expressed in terms of storativity. Storativity is a measure of the volume of water an aquifer can release from, or take into, storage per unit of aquifer surface area per unit change in hydraulic head. Storativity values for the lower aquifer underlying the Agency range from 8.0e-06 to 1.5e-04, generally increasing from east to west (**Figure 2-14** of Attachment 2 *Tule Subbasin Setting*).

3. Geologic Structures that Affect Groundwater Flow § 354.14(b)(4)(C)

Chapter 2.1.7.3 of the *Tule Subbasin Setting* describes features throughout the entire subbasin that affect groundwater flow. There are no significant faults mapped within the Tule Subbasin that would affect groundwater flow; Corcoran Clay is the most significant feature to affect vertical groundwater flow in the subbasin. There may be communication between the upper and lower aquifers in areas where composite wells perforate both aquifer systems; such wells may also facilitate the recharge of the deep aquifer from the shallow aquifer.

4. Aquifer Water Quality § 354.14(b)(4)(D)

Groundwater quality varies across the Agency and with the depth in the aquifer system. The native groundwater quality is generally considered good and does not prevent its beneficial use throughout most of the Agency. Ambient total dissolved solids (TDS) concentrations generally range from 100 to 500 milligrams per liter (mg/L).

Groundwater quality issues in the Agency include both naturally occurring constituents of concern (COC) and anthropogenic (i.e. manmade) COCs. Constituents of concern were identified as those compounds/elements that exceed applicable regulatory standards for drinking water.

Naturally Occurring Constituents of Concern

The only naturally occurring COCs in the groundwater beneath the Agency are arsenic and uranium, both of which are below their respective regulatory limits (see **Figures 2-15a and b*; Attachment 2*** *Tule Subbasin Setting).*

Arsenic in groundwater is naturally sourced from the dissolution of rocks and minerals containing the element. The maximum contaminant level (MCL) for arsenic in groundwater is 10 micrograms per liter (μg/L). Arsenic concentrations in Upper and Lower Aquifer wells in and near the Agency have been below 5 μg/L (see **Figures 2-16a** and **2-17a**; Attachment 2 *Tule Subbasin Setting*).

Uranium is a naturally occurring COC sourced from rocks and minerals containing the element. The MCL for uranium is 30 picocuries per liter (pCi/L). Uranium concentrations in Upper and Lower aquifer wells in and near the Agency have been below 10 pCi/L (see **Figures 16b** and **17b)**; Attachment 2 *Tule Subbasin Setting*).

Anthropogenic Constituents of Concern

Anthropogenic COCs in the groundwater beneath the Agency include:

- TDS (Figures 2-15d, 2-16e and 2-17e),
- 1,2,3-trichloropropane (1,2,3-TCP) (Figures 2-15e, 2-16d and 2-17d),
- Dibromo-3-chloropropane (DBCP) (Figures 2-15f, 2-16f and 2-17f),
- Chloride (Cl) (Figure 2-15g),
- Perchlorate (Figure 2-15h),
- Nitrate as N (Figures 2-15i, 2-16g and 2-17g)

Total dissolved solids provide an indication of the dissolved mineral content of the groundwater. The TDS concentration in some isolated wells in the subbasin, including one at the Agency border near Vandalia Water District, has been detected above the maximum contaminant level (MCL) of 1,000 milligrams per liter (mg/L)(see **Figure 2-15d**; ***Attachment 2*** *Tule Subbasin Setting*), which is higher than ambient concentrations suggesting anthropogenic impact. Repeated crop irrigation and drying can concentrate salts in the soil zone, which become mobilized upon rewetting and increase the TDS of the groundwater. Elevated chloride concentrations are generally caused by the same land use.

Anthropogenic COCs whose concentrations in groundwater are often associated with agricultural land use (although they also have industrial sources) include 1,2,3-TCP, DBCP, and nitrate. 1,2,3-TCP and DBCP are organic chlorinated hydrocarbons that were historically used as soil fumigants in agriculture although both have been banned for this application. The MCLs are 5 nanograms per liter (ng/L) and 0.2 µg/L for 1,2,3-TCP and DBCP, respectively. 1,2,3-TCP has been detected at concentrations above its MCL in wells across the Agency (see **Figure 2-15e*; Attachment 2*** *Tule Subbasin Setting*). DBCP has been detected in one well, located near the Friant-Kern Canal, at a concentration exceeding its MCL (see **Figure 2-15f*; Attachment 2*** *Tule Subbasin Setting*).

Nitrate (NO3) concentrations in the Agency area range from less than 5 mg/L in the eastern portion of the Agency to greater than 10 mg/L in the western portion of the Agency (see **Figures 2-16g and 2-17g**, ***Attachment 2*** *Tule Subbasin Setting*). Nitrate is mobilized into the groundwater from leaching of applied fertilizers, dairy waste, and wastewater discharges. Nitrate concentrations in groundwater exceeding the MCL of 10 mg/L have been detected in wells located throughout much of the Agency (see **Figure 2-15i*; Attachment 2*** *Tule Subbasin Setting*).

5. Aquifer Primary Uses § 354.14(b)(4)(E)

Chapter 2.1.7.5 of ***Attachment 2*** *Tule Subbasin Setting* describes the predominant beneficial uses of groundwater in the subbasin as agricultural irrigation, with other beneficial uses including municipal water supply, private domestic water supply, livestock washing and watering, industrial and environmental.

Section 1.3.2.3 of this Plan details the primary water use sectors and water source types within the Agency.

7. Uncertainty in the Hydrogeologic Conceptual Model § 354.14(b)(5)

The primary sources of uncertainty in the hydrogeologic conceptual model are found in **Chapter 2.1.8**, and each applies to the Agency.

3. Groundwater Conditions

The regulatory requirements outlined in 23 CCR § 354.16 for describing the current and historical groundwater conditions of the Tule Subbasin are addressed and fulfilled throughout **Chapter 2.2** of Attachment 2 *Tule Subbasin Setting.*

Table 2-2 links the requirements of 23 CCR § 354.16 to the sections in ***Attachment 2*** *Tule Subbasin Setting* and the sections of this Plan that apply to and fulfill each regulatory component. This Plan provides a reference to the *Tule Subbasin Setting*, and when necessary, a brief summary that describes Agency specific conditions in the context of the subbasin as a whole.

Table 2-2: Components of 23 CCR § 354.16

23 CCR	Section Title	Tule Subbasin Setting	TPDWD GSA Plan
§ 354.16 (a)	Groundwater Occurrence and Flow	2.2.1	2.3.1
§ 354.16 (b)	Groundwater Storage	2.2.2	2.3.2
§ 354.16 (c)	Seawater Intrusion	2.2.3	2.3.3
§ 354.16 (d)	Groundwater Quality Issues	2.2.4	2.3.4
§ 354.16 (e)	Subsidence	2.2.5	2.3.5
§ 354.16 (f)	Interconnected Surface Water Systems	2.2.6	2.3.6
§ 354.16 (g)	Groundwater Dependent Ecosystems	2.1.7	2.3.7

1. Groundwater Occurrence and Flow § 354.16(a)(1); § 354.16(a)(2)

The groundwater elevation, flow, gradient, and regional pumping patterns in the Tule Subbasin are described in **Chapter 2.2.1** of Attachment 2 *Tule Subbasin Setting.*

In general, groundwater in the Agency flows from areas of groundwater recharge in the foothills in the east towards the west (see **Figures 2-22 and 2-23, *Attachment 2 Tule*** *Subbasin Setting)*.

In general, throughout the Subbasin groundwater levels in upper aquifer wells show a persistent downward trend between approximately 1987 and 2015 (see **Figure 2-24, *Attachment 2*** *Tule Subbasin Setting)*. The rate of groundwater level decline in the upper aquifer has lessened since 2015 and groundwater levels in some upper aquifer wells are relatively stable. In the lower aquifer, there are fewer wells with historical groundwater level data with which to evaluate historical trends (see **Figure 2-27, Attachment 2** *Tule Subbasin Setting)*. Groundwater levels in the subbasin are generally higher in the upper aquifer than in the lower aquifer, indicating a downward hydraulic gradient that may suggest possible recharge of the lower aquifer from the upper aquifer in some parts of the Agency – particularly in areas where composite wells perforate across both aquifers. Due to the sustainable water balance of the Agency, any groundwater level declines within the Agency are caused by pumping within the adjacent GSAs.

2. Groundwater Storage § 354.16(b)

Groundwater storage in the Tule Subbasin is described in **Chapter 2.2.2** of ***Attachment 2*** *Tule Subbasin Setting.* Within the Agency, as indicated in **Table 2** of **Appendix H** to ***Attachment 2*** *Tule Subbasin Setting*, the average annual change in storage between the period of 1986/87 and 2018/19 is estimated to be approximately +1,000 acre-feet/yr. Predominant sources of groundwater outflow within the Agency include agricultural pumping and subsurface outflow to other GSAs within the subbasin.

3. Seawater Intrusion § 354.16(c)

Seawater intrusion does not occur in the Tule Subbasin for reasons described in **Chapter 2.2.3** of ***Attachment 2*** *Tule Subbasin Setting.*

4. Groundwater Quality Issues § 354.16(d)

Groundwater quality was previously discussed in **Section 2.2.6.4** of this Plan and groundwater quality issues are further described in **Chapter 2.2.4** of ***Attachment 2*** *Tule Subbasin Setting*. There is one school, Hope Elementary School, within the Agency that is classified by the California State Water Resources Control Board GeoTracker website as an active site under the California Department of Toxic Substances Control (DTSC) (see **Figure 2-19** of Attachment 2 =*Tule Subbasin Setting*).

5. Subsidence § 354.16(e)

Per **Chapter 2.2.5** of ***Attachment 2*** *Tule Subbasin Setting****,*** historical and active land subsidence within the Tule Subbasin has been well documented. From 2015 through 2023, as much as 2.6 ft of land subsidence has been observed within the Agency's far western extent at the Friant-Kern Canal, as measured from InSAR data (see **Figure 2-32, Attachment 2** *Tule Subbasin Setting*). However, it should be noted that the far western extent of the Agency represents a very small portion of the agricultural lands that are within the Agency jurisdictional area, and those lands are surrounded by non-District lands which rely more completely on groundwater production to support agricultural activities. As a result, the observed subsidence in this area is not necessarily caused by groundwater production activities of these lands so much as the groundwater production activities of surrounding lands. Further, the rate of land subsidence within the majority of the rest of the Agency area is minimal to non-existent. The near-western portion of the Agency (near Highway 65) has had approximately 0.00 to 1.5 ft of subsidence during that time while the eastern side of the Agency has had zero subsidence with approximately 0.0 to 0.1 ft of uplift.

6. Interconnected Surface Water Systems § 354.16(f)

Surface water features are addressed in **Section 2.2.4** of this Plan, as well as in **Chapters 2.1.5** and **2.2.6** of ***Attachment 2*** *Tule Subbasin Setting.* In the Tule Subbasin, the exact location and timing of Interconnected Surface Water is not known. However, based on the best available data, which is the Nature Conservancy's Interconnected Surface Water in the Central Valley (ICONS) database, potential ISW conditions are restricted in the Tule Subbasin to the upper reaches of the Tule River, Deer Creek, and White River. Along the Tule River and Deer Creek, these conditions are most likely to occur east of the Friant-Kern Canal. The northern extent of the Agency is located approximately one mile from potential Tule River ISW conditions and the southern extent is less than one half mile from potential Deer Creek ISW conditions (see **Figure 2-10** of ***Attachment 2*** *Tule Subbasin Setting*). The connection between pumping within the Agency area, and depletions of ISW, is considered remote at this time due to this distance, but is considered a data gap (see ***Attachment 6*** *Tule Subbasin Interconnected Surface Water)*.

7. Groundwater Dependent Ecosystems § 354.16(g)

Groundwater Dependent Ecosystems are discussed in **Chapter 2.2.7** of Attachment 2 *Tule Subbasin Setting*. Groundwater-dependent ecosystems (GDEs) require shallow groundwater or groundwater that discharges at the land surface. **Figure 1-7** in **Section 1.4.8.1** of this Plan displays potentially groundwater-dependent ecosystems utilizing the DWR Natural Communities (NC) Dataset Viewer Map Application[3]. None of the identified potential groundwater-dependent ecosystems are located within the Agency.

4. Water Budget § 354.18(a)

The regulatory requirements outlined in CCR § 354.18 for describing the total annual volume of groundwater and surface water entering and leaving the Tule Subbasin, including historical, current, and projected water budget conditions, and the change in the volume of water stored are addressed, and fulfilled in **Chapter 2.3** of Attachment 2 *Tule Subbasin Setting*

Table 2-3 links the requirements of 23 CCR § 354.18 to the sections in the *Tule Subbasin Setting* and the sections of this Plan that apply to and fulfill each regulatory component.

Table 2-3: Components of 23 CCR § 354.18

23 CCR	Section Title	Tule Subbasin Setting	TPDWD GSA Plan
§ 354.18 (b)(1)	Surface Water Budget	2.3.1	2.4.1
§ 354.18 (b)(2)	Sources of Groundwater Recharge	2.3.2.1	2.4.2.1
§ 354.18 (b)(3)	Sources of Groundwater Discharge	2.3.2.2	2.4.2.2
§ 354.18 (d)(4)	Change in Groundwater Storage	2.3.2.3	2.4.2.3
§ 354.18 (d)(5)	Overdraft	2.3.2.4	2.4.2.4
§ 354.18 (d)(6)	Water Year Type	2.3.2.5	2.4.2.5
§ 354.18 (b)(7)	Sustainable Yield	2.3.2.6	2.4.2.6
§ 354.18 (c)(1)	Current Water Budget	2.3.3	2.4.3
§ 354.18 (c)(2)	Historical Water Budget	2.3.4	2.4.4
§ 354.18 (c)(3)	Projected Water Budget	2.3.5	2.4.5

A separate historical water budget was prepared for the Agency and is located in **Tables 1a**, **1b**, and **2** in **Appendix H** of Attachment 2 *Tule Subbasin Setting*.

As evidenced by those water budget tables, the Agency does not have an overdraft based on average hydrologic conditions from 1990/91 – 2009/2010 and, in fact is a net recharger in the subbasin by an average of 1,000 acre-feet per year. This is due to irrigation demand being met by annual precipitation, sustainable yield pumping, imported surface water and stored surface water. An annual average of 1,000 acre-feet of imported surface water, beyond irrigation needs, is recharged and stored in the aquifer to meet irrigation demand.

1. Surface Water Budget § 354.18(b)(1)

Chapter 2.3.1 of the *Tule Subbasin Setting* provides an overview of the Tule Subbasin's surface water budget and its components through a representation of historical inflows to and outflows from the subbasin. Inflow components for the surface water budget include precipitation, stream

[3] California Department of Water Resources, 2019

inflow, imported water, and discharge to the land surface from wells. Outflow components include infiltration of precipitation, evapotranspiration of precipitation from areas of native vegetation and crops, stream infiltration, canal loss, recharge in basins, return flow, and consumptive use.

Several sources of surface water outflow are also sources of groundwater inflow. Of those surface water outflows that provide groundwater inflow, many sources are associated with diversions undertaken in accordance with pre-existing water rights and/or purchased import water that is stored in the aquifer for the purpose of later extraction by the water rights holder or owner. These types of diversions are indicated with magenta-colored columns in Table 2-2b from the *Tule Subbasin Setting.* Surface water losses that become groundwater recharge and are associated with the Agency's imported water rights are accounted for as groundwater assets in the Tule Subbasin Coordination Agreement that are available only to the Agency. Surface water losses that become groundwater recharge and are not associated with pre-existing rights and/or imported water deliveries are indicated with blue-colored columns in Table 2-2b.

The Agency's historical surface water budget is a sub-budget of the total Tule Subbasin surface water budget. Evaluated over the 1986/87 to 2018/19 period, sources of surface water inflow within the Agency include precipitation and from the Friant-Kern Canal via the Agency's Class 1 and Class 2 contracts; and discharges from agricultural wells. Sources of surface water outflow include groundwater recharge resulting from areal precipitation, deep percolation of applied water, and evapotranspiration.

Over the period of 1986/87 to 2018/19 the average annual surface water inflow to the Agency was estimated to be approximately 12,000 acre-feet/yr (**Table 1a of Appendix H, *Attachment 2*** *Tule Subbasin Setting)* with an annual average surface water outflow of approximately 12,000 acre-feet/yr (**Table 1b** of **Appendix H,** Attachment 2 *Tule Subbasin Setting*).

1. Surface Water Inflow

1.4.1.1.1 Precipitation

Chapter 2.3.1.1.1 of the *Tule Subbasin Setting* describes the methodology used to determine annual average precipitation throughout the Tule Subbasin. Annual precipitation was derived from annual precipitation values recorded at Porterville Station (see **Figure 2-46***, Attachment 2 Tule Subbasin Setting)* and applied against the long-term average annual isohyetal map for the region (see **Figure 2-45***, Attachment 2 Tule Subbasin Setting)*, with total estimated precipitation varying within each isohyetal zone based on historical records.

The average annual precipitation within the Agency between the water years 1986/87 and 2018/19 is estimated to be 3,000 acre-feet/yr (see **Table 1a of Appendix H**, Attachment 2 *Tule Subbasin Setting*).

1.4.1.1.2 Imported Water

Imported surface water is delivered within the Agency from the Friant-Kern Canal (see **Table 1a** of **Appendix H**, ***Attachment 2 Tule*** *Subbasin Setting*). Additional information related to imported water in the Tule Subbasin is found in **Chapter 2.3.1.1.3** of Attachment 2 *Tule Subbasin Setting.*

For the period of 1986/87- 2018/19, imported water inflow into the Agency on an average annual basis was estimated to be approximately 5,900 acre-feet/yr (see **Table 1a** of **Appendix H**, Attachment 2 *Tule Subbasin Setting).*

1.4.1.1.3 Discharge to Crops from Wells

For the Tule Subbasin water budget and as described in **Chapter 2.3.1.1.4** of ***Attachment 2*** Tule *Subbasin Setting*, the water applied to crops was assumed to be the total applied water minus surface water deliveries from imported water and diverted streamflow (see **Figure 2-48**; ***Attachment 2*** *Tule Subbasin Setting).* Total crop demand was assumed based on estimates and an assumed average irrigation efficiency of 0.87. However, it should be noted that this irrigation efficiency is different by crop type and year and that the Tule Subbasin average is a volume-adjusted mean of these various irrigation efficiencies over time.

The estimated average annual discharge to crops from wells for water years 1986/87 to 2018/19 in the Agency was estimated to be approximately 3,000 acre-ft/yr (see **Table 1a** of **Appendix H**, Attachment 2 *Tule Subbasin Setting*).

2. Surface Water Outflow

1.4.1.2.1 Areal Recharge from Precipitation

Areal recharged for the Tule Subbasin is based on the Williamson Method, as described in *Williamson et al., (1989)*[4], that estimates net infiltration from annual precipitation falling the valley floor based on monthly soil moisture budgets based on records from the period of 1922-1971. For each year in the Tule Subbasin Water Budget, annual groundwater recharge was estimated for each isohyetal zone. It should be noted that the Williamson Method results in no groundwater recharge if annual precipitation is less than 9.69 inches per year. Further description of this method and areal recharge in the Tule Subbasin can be found in **Chapter 2.3.1.2.1** of Attachment 2 *Tule Subbasin Setting.*

For the period of 1986/87- 2018/19, areal recharge within the Agency ranged from 0 to 2,000 acre-feet per year, with an average annual volume estimated to be less than 1,000 acre-feet/yr (see **Table 1b** of **Appendix H,** Attachment 2 *Tule Subbasin Setting*).

[4] Williamson, 1989

1.4.1.2.2 Deep Percolation of Applied Water

Chapter 2.3.1.2.5 of Attachment 2 *Tule Subbasin Setting* describes the deep percolation of applied water from native waterways, imported water, recycled water, and native groundwater for the subbasin, including efficiencies that were used to determine the volume of water contributing to deep percolation compared to volume applied.

Table 1b of **Appendix H** of Attachment 2 *Tule Subbasin Setting* identifies sources of deep percolation of applied water within the Agency, which includes imported water and agricultural groundwater pumping. Each of these sources and the volume of water attributed to deep percolation are described below.

1. Deep Percolation of Applied Imported Water

The estimate of deep percolation resulting from imported water applied to crops is based on the total volume of imported water delivered to water agencies minus losses and recharge in the Agency. Deep percolation of applied imported water is assumed to be approximately 13 percent of the total applied water.

For the period of 1986/87- 2018/19, deep percolation of applied imported water within the Agency on an average annual basis was estimated to be approximately 1,300 acre-feet/yr (see **Table 1b** of **Appendix H*,*** Attachment 2 *Tule Subbasin Setting*).

2. Deep Percolation of Applied Native Groundwater for Agricultural Irrigation

The balance of agricultural irrigation demand not met by imported water or stream diversions is assumed to be met by groundwater pumping. The return flow of applied water from groundwater pumping is assumed to be 13 percent of the applied water.

For the period of 1986/87- 2018/19, deep percolation of applied native groundwater within the Agency on an average annual basis was estimated to be approximately 400 acre-feet/yr (see **Table 1b of Appendix H, Attachment 2** *Tule Subbasin Setting*).

1.4.1.2.3 Evapotranspiration

Evapotranspiration (ET) occurs in multiple forms and utilizing a variety of water sources within the Tule Subbasin, and its various occurrences within the Tule Subbasin are described by source in ***Chapter 2.3.1.2.6*** of Attachment 2 *Tule Subbasin Setting.*

Table 1b of **Appendix H** of Attachment 2 *Tule Subbasin Setting* summarizes evapotranspiration that occurs within the Agency including precipitation from crops and native vegetation, and agricultural consumptive use. Each of these sources and the volume of water attributed to evapotranspiration are described below.

1. Evapotranspiration of Precipitation from Crops and Native Vegetation

Chapter 2.3.1.2.6 of ***Attachment 2*** *Tule Subbasin Setting* describes ET of precipitation from crops and native vegetation. For the period of 1986/87- 2018/19, evapotranspiration of precipitation within the Agency on an average annual basis was estimated to be approximately 3,000 acre-feet/yr (see **Table 1b** of **Appendix H*,*** Attachment 2 *Tule Subbasin Setting*).

2. Agriculture Consumptive Use

Agricultural consumptive use and its method of estimation within the Tule Subbasin is described in **Chapter 2.3.1.2.6** of Attachment 2 *Tule Subbasin Setting.*

Types of and areas of crops grown in the Agency were estimated from land use maps and associated data published by the DWR for 1993, 1999, 2007, and 2014. These maps are visualized in **Figure 2-49** of Attachment 2 *Tule Subbasin Setting.* Consumptive use estimates were based on METRIC satellite data, supplied by California Polytechnic State University's Irrigation Training and Research Center.

For the period of 1986/87-2018/19, the estimated agricultural consumptive use of surface water within the Agency on an average annual basis was estimated to be approximately 4,600 acre-feet/yr and 3,000 acre-feet/yr from imported surface waters and discharge from wells, respectively (see **Table 1b of Appendix H,** Attachment 2 *Tule Subbasin Setting*).

2. Groundwater Budget § 354.18(b)(2)

The fundamental premise of the Tule Subbasin Groundwater Budget is as follows:

$$Inflow - Outflow = +/- \Delta S$$

In this equation, "ΔS" serves as "change in groundwater storage." The groundwater budget of the Tule Subbasin, as well as its component terms and methodology of development, are described in **Chapter 2.3.2** of Attachment 2 *Tule Subbasin Setting.* The accounting of the Agency's groundwater budget can be found in **Table 2** of **Appendix H** of Attachment 2 *Tule Subbasin Setting.*

1. Sources of Groundwater Recharge

Sources of groundwater recharge are described in Chapter **2.3.2.1** of ***Attachment 2*** *Tule Subbasin Setting*. Those sources of groundwater recharge that are present and occur within the Agency are identified and discussed below.

2.4.2.1.1 Areal Recharge

Groundwater recharge from precipitation falling on the valley floor in the Tule Subbasin was estimated based on Williamson et al., (1989). **Chapter 2.3.2.1.1** of Attachment 2 *Tule Subbasin Setting* describes areal recharge.

For the period of 1986/87- 2018/19, areal recharge within the Agency ranged from 0 to 2,000 acre-feet per year, with an average annual volume estimated to be less than 1,000 acre-feet/yr (see **Table 2 of Appendix H,** Attachment 2 Tule Subbasin Setting).

2.4.2.1.2 Groundwater Recharge from Imported Water Deliveries

Groundwater inflow of imported water occurs as deep percolation of applied water within the Agency. **Chapter 2.3.2.1.5** of Attachment 2 *Tule Subbasin Setting* describes groundwater recharge from imported water deliveries.

See **Sections 2.4.1.2.3, 2.4.1.2.4,** and **2.4.1.2.5.2** of this Plan for additional discussion on sources of groundwater recharge from deep percolation of applied imported water within the Agency.

For the period of 1986/87- 2018/19, groundwater recharge from imported water within the Agency on an average annual basis was estimated to be approximately 1,300 acre-feet/yr resulting from deep percolation of applied imported water within the Agency (see **Table 2** of **Appendix H**, Attachment 2 *Tule Subbasin Setting*).

2.4.2.1.3 Deep Percolation of Applied Water from Groundwater Pumping

Chapter 2.3.2.1.7 of **Attachment 2** *Tule Subbasin Setting* describes groundwater recharge from deep percolation of applied water from groundwater pumping.

See **Sections 2.4.1.2.5.3** and **2.4.1.2.5.4** of this Plan for additional discussion on deep percolation of applied water from agricultural and municipal groundwater pumping within the Agency.

For the period of 1986/87- 2018/19, deep percolation of applied water from groundwater pumping within the Agency on an average annual basis was estimated to be approximately 400 acre-feet/yr from groundwater applied from agriculture pumping (see **Table 2** of **Appendix H*, Attachment 2*** *Tule Subbasin Setting*).

2.4.2.1.4 Subsurface Inflow

Chapter 2.3.2.1.9 of Attachment 2 *Tule Subbasin Setting* describes the release of water from the compression of aquitards.

Subsurface inflow into the Agency occurs from both inter- -subbasin sources. For the period of 1986/87- 2018/19, groundwater inflow from subsurface inflow into the Agency on an average annual basis was estimated to be approximately 28,000 acre-feet/yr from other GSAs within the Tule Subbasin (see **Table 2** of **Appendix H*,*** Attachment 2 Tule *Subbasin Setting*).

2.4.2.2 Sources of Groundwater Discharge § 354.18(b)(3)

Chapter 2.3.2.2 of Attachment 2 *Tule Subbasin Setting* discusses sources of groundwater discharge or outflow within the Tule Subbasin. The source of groundwater recharge or outflow that is present and occur within the Agency is predominantly from agricultural groundwater pumping. Because there is only a de minimis amount of domestic and industrial pumping, and the Agency's water balance is already sustainable, only agricultural groundwater pumping is discussed below.

2.4.2.2.1 Agricultural Groundwater Pumping

Chapter 2.3.2.2.2 of Attachment 2 *Tule Subbasin Setting* describes groundwater discharge from groundwater pumping.

For the period of 1986/87- 2018/19, agricultural groundwater pumping within the Agency on an average annual basis was estimated to be approximately 3,000 acre-feet/yr (see **Table 2** of **Appendix H,** Attachment 2 Tule *Subbasin Setting*).

2.4.2.2.2 Subsurface Outflow

Subsurface outflow from the Agency flows out the Agency's boundaries into adjacent GSA's within the Tule Subbasin and is discussed in **Chapter 2.3.2.2.4** of Attachment 2 *Tule Subbasin Setting.*

For the period of 1986/87 - 2018/19, subsurface outflow from the Agency on an average annual basis was estimated to be approximately 26,000 acre-feet/yr to other GSAs within the Tule Subbasin (see **Table 2** of **Appendix H,** Attachment 2 *Tule Subbasin Setting*).

2.4.2.3 Change in Groundwater Storage § 354.18(b)(4)

The change in groundwater storage within the Tule Subbasin was estimated by comparing the groundwater inflow elements with the groundwater outflow elements of the groundwater budget.

For the period of 1986/87 – 2018/19, the cumulative change in groundwater storage across the Tule Subbasin was estimated to be approximately -6,497,000 acre-feet; on an average annual basis, equating to approximately -197,000 acre-feet/yr (see **Chapter 2.3.2.4** and **Table 2-3,** *Attachment 2 Tule Subbasin Setting).*

Within the Agency, the cumulative and average annual change in storage can be estimated by utilizing the fundamental premise of the groundwater budget (Inflow – Outflow = +/- ΔS) to compare the sources of groundwater recharge and groundwater discharge occurring and present, as described in **Sections 2.4.2.1** and **2.4.2.2.**

For the period of 1986/87 – 2018/19, the average annual change in groundwater storage within the Agency was estimated to be approximately +1,000 acre-feet/yr. This is due to irrigation demand being met by annual precipitation, sustainable yield pumping, imported surface water and stored surface water. An annual average of 1,000 acre-feet of imported surface water, beyond irrigation needs, is recharged and stored in the aquifer to meet irrigation demand.

The cumulative change in storage within the Agency over this time period is estimated to be approximately +36,000 acre-feet (see **Table 2** of **Appendix H,** *Attachment 2 Tule Subbasin Setting).*

2.4.2.4 Overdraft § 354.18(b)(5)

Average hydrologic conditions in the Tule Subbasin are represented by the twenty-year period from 1990/91 – 2009/10 (see **Chapter 2.3.2.4**, Attachment 2 *Tule Subbasin Setting).* Overdraft for the subbasin during this historically average representative period was estimated to be approximately -182,750 acre-feet/yr.

The Agency does not have an overdraft based on average hydrologic conditions from 1990/91 – 2009/2010. This is due to irrigation demand being met by annual precipitation, sustainable yield pumping, imported surface water and stored surface water. An annual average of 1,000 acre-feet of imported surface water, beyond irrigation needs is recharged and stored in the aquifer to meet irrigation demand.

2.4.2.5 Water Year Type § 354.18(b)(6)

Chapter 2.3.2.5 of Attachment 2 *Tule Subbasin Setting* states the following for water year type*:*

"All water year elements presented herein are based on a water year, which begins October 1 and ends September 30. Water year types with respect to hydrologic conditions (i.e. above average, average, or below average precipitation conditions based on Figure 2-28) are shown in the historical water budget tables (Table 2-2a, 2-2b, and 2-3)."

2.4.2.6 Sustainable Yield § 354.18(b)(7)

The term "Sustainable Yield" for the purposes of SGMA and GSPs developed under SGMA is defined by Water Code §107219(w) as: "*the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.*"

Chapter 2.3.2.6 of the *Tule Subbasin Setting* estimates the Sustainable Yield for the Tule Subbasin based on a model-generated groundwater budget that forecasts groundwater pumping and recharge conditions that result in no net negative change in storage between 2030 and 2070 and is not predicted to produce undesirable results (see **Table 2-4,** Attachment 2 *Tule Subbasin Setting*). The Tule Subbasin Sustainable Yield using this method is approximately 408,000 acre-ft/yr.

Apportionment of this Sustainable Yield is not equal across the GSAs in the subbasin. Many of the groundwater inflow elements of the groundwater budget are associated with water diverted in accordance with pre-existing water rights or purchased imported water that is stored in the aquifer for the purpose of later extraction by the water rights holder or owner. Sources of groundwater inflow for the purpose of storage in accordance with existing rights and/or imported water deliveries are indicated with magenta-colored columns in **Table 2-3** of Attachment 2 *Tule*

Subbasin Setting. Sources of groundwater recharge that are not associated with existing rights and/or imported water deliveries are indicated with blue-colored columns in Table 2-3. The portions of the water budget associated with pre-existing water rights or imported water are not available to all groundwater pumpers in the subbasin but are allocatable only in those GSAs in which the water rights holders are located.

As noted above, the GSAs in the Tule Subbasin have agreed that the basin-wide portion of the Sustainable Yield for the subbasin (i.e., excluding those portions that are individually allocable) should be divided first amongst the GSAs for purposes of development of their GSPs, and then amongst the various groundwater users within the GSAs according to the policies established within each GSP. It was further agreed that, at the GSA level, the basin-wide portion of the Sustainable Yield would be divided amongst each GSA by multiplying that GSA's proportionate areal coverage of the Tule Subbasin times the total subbasin portion of Sustainable Yield. This approach referred to as a "gross acreage" method of dividing the available Sustainable Yield, does not consider differences in historical uses, either on an areawide basis or by individual landowners or groundwater users. Through the public outreach process, it has been asserted that a more detailed and landowner-specific process, which includes an assessment of individualized historic use data, needs to be completed in order to allocate available Sustainable Yield in a manner that is consistent with groundwater rights, and legal concepts related to allocation of groundwater resources in an adjudication. In addition, it has been asserted that lands that have never produced groundwater or have not recently produced groundwater, should be excluded from any allocation process, at least initially. Those arguing for an allocation methodology that would account for these items have argued that it should be applied at both the GSA-level division of basin-wide Sustainable Yield, as well as within the GSA for the total GSA-available Sustainable Yield. This Plan does not make a determination of the validity of these assertions. Instead, this Plan has been developed with the understanding that the determinations of the Sustainable Yield that are available to the Agency and by extension, the landowners with the Agency jurisdiction are not intended to constitute a determination of water rights. This understanding is consistent with § 10720.5(b) of SGMA, which provides that nothing in SGMA or in a plan adopted under SGMA determines or alters surface or groundwater rights under common law. Any determination to divide the Sustainable Yield in any particular manner should not be deemed to conclusively determine the water rights of landowners.

However, this Plan recognizes that any decision to allocate Sustainable Yield, either on the GSA level or on an individual landowner level, involves a determination of the use of a resource that is the subject of individualized legal rights. It is the intent of this Plan that the manner in which Sustainable Yield has been allocated amongst GSAs and within this Plan be consistent with broad legal concepts of correlative rights use of a scarce resource (i.e, according to the relative ability to put the resource to a beneficial use), and therefore with broad legal concepts of groundwater rights of the overlying property owners. The gross acreage basis of dividing available basin-wide and GSA specific Sustainable Yield quantities represents the most readily available and implementable manner of honoring correlative rights because it is based on the well-documented assumption that beneficial uses of the lands of the Tule Subbasin are, for the most part, uniformly agricultural, and uniform in intensity of agricultural use. Furthermore, any individualized assessment that is based on historic use, even if it would be legally desirable or required in a legal process such as adjudication, is not capable of being used due to the current state of data keeping for the thousands of individual landowners that exist within the entire Tule Subbasin. A decision to use historic use as at least one factor, therefore, would delay indefinitely the adoption of any meaningful management plan.

For these reasons, the gross acreage approach will be used for the purpose of this GSA. At the same time, with the collection of additional data, refinements to the allocation methodologies will be considered in updates to this plan, to and including the potential use of historic pumping data if such data is both available and is agreed to be used as the basis for any further refinement of allocation methodologies.

It should be noted that the Tule Subbasin GSAs have agreed, and this GSP assumes, that the exclusion of water imported by an entity from the calculation of the Sustainable Yield of the Subbasin applies to imported water that is used for groundwater recharge or water banking purposes. The recharged or banked imported water retains its characterization as imported water even after it is used for recharge or banking purposes, and therefore is accounted for as being for the benefit of the importing entity, and not an addition to Sustainable Yield.

3. Current Water Budget § 354.18(c)(1)

The surface and groundwater budgets for the Tule Subbasin for the 2018/19 water year are described in **Section 2.3.3** above and their full accounting can be found in **Tables 2-2a, 2-2b,** and **2-3** of Attachment 2 *Tule Subbasin Setting*. For 2018/19, total groundwater inflows were approximately 904,000 acre-feet and total groundwater outflows were approximately 521,000 acre-feet.

For the Agency, the surface and groundwater budgets for the 2018/19 water year are shown in **Tables 1a, 1b, and 2** in **Appendix H** of Attachment 2 *Tule Subbasin Setting*. For 2018/19, total groundwater inflows were approximately 41,000 acre-feet and total groundwater outflows were approximately 35,000 acre-feet. The large amount of inflows and outflows are due to subsurface groundwater flows through the GSA from and to other areas, as it moves east to west from the higher elevations to the lower, flatter elevations of the subbasin. The Agency is but a small footprint in a much larger surrounding area.

4. Historical Water Budget § 354.18(c)(2)(A); § 354.18(c)(2)(A); § 354.18(c)(2)(C)

Chapter 2.3.4 of the *Tule Subbasin Setting* provides an evaluation of the availability or reliability of past surface water deliveries and the aquifer response to water supply and demand trends relative to water year type. The historical surface and groundwater budgets for the Tule Subbasin, as assessed over the water years 1986/87 – 2018/19, with corresponding water year type, are shown in **Table 2-2a, 2-2b** and **2-3** of Attachment 2 *Tule Subbasin Setting.*

The Agency's historical surface water and groundwater budgets are assessed over the same period and are accounted for in **Tables 1a, 1b,** and **2** in **Appendix H** of Attachment 2 *Tule Subbasin Setting* and summarized throughout **Section 2.4** of this Plan.

5. Projected Water Budget § 354.18(c)(3)(A); § 354.18(c)(3)(A)

Chapter 2.3.5 of Attachment 2 *Tule Subbasin Setting* discusses methodologies, and information used to develop the Tule Subbasin projected water budget in the Groundwater Flow Model, incorporating planned projects and management action of each of the nine (9) GSAs for achieving sustainability (See **Tables 2-6 and 2-7**, Attachment 2 Tule Subbasin Setting). The projects and management actions were incorporated into the groundwater flow model of the Tule Subbasin for the projected time period from 2020 to 2070 in order to assess the sustainability of planned actions, assess the interaction of the planned actions to groundwater levels between GSAs, and estimate Sustainable Yield of the subbasin.

The model forecasts also incorporated adjustments to the hydrology and water deliveries to account for potential climate change. Baseline Tule River flows, Friant-Kern Canals deliveries, and State Water Project's California Aqueduct deliveries used in the future projections for the model were adjusted to account for projections of future climate change. Adjustments were applied based on output from DWR's CalSim-II model, which provided adjusted historical hydrology for major drainages and imported supplies based on scenarios recommended by DWR Climate Change Technical Advisory Group. Climate change adjustments to hydrology and surface water deliveries were applied over two time periods within the SGMA planning horizon, as defined by California Water Commission (2016):

1. A 2030 central tendency time period, which provides near-term projections of potential climate change impacts on hydrology, centered on the year 2030, and
2. A 2070 central tendency time period, which provides long-term projections of potential climate change impacts on hydrology, centered on the year 2070.

For imported water supplies from the Friant-Kern Canal, TH&Co utilized projected delivery schedules from the Friant Water Authority (Friant Water Authority, 2018). The projected water deliveries include adjustments to supplies associated with the planned San Joaquin River Restoration Project (SJRRP). Adjustments to Friant-Kern Canal supplies to account for climate change and SJRRP were applied beginning in 2025. The adjustments were applied incrementally between 2025 and 2030 such that the full adjustments were in effect in 2030. TH&Co applied the 2070 central tendency time period climate-related adjustments to imported water deliveries in the Tule Subbasin model projection for the period from 2050 to 2070.

The projected surface and groundwater budgets for the Tule Subbasin, as assessed over the water years 2020 to 2070, are shown in **Table 2-8a**, **2-8b,** and **2-4** of Attachment 2 *Tule Subbasin Setting.*

Projected surface and groundwater budgets for TPD GSA over the same time period (2020-2070) are provided in **Table 3a**, **3b,** and **4**, of **Appendix H** to Attachment 2 *Tule Subbasin Setting.*

5. Management Areas § 354.20(a); § 354.18(c)

The regulatory requirements outlined in CCR § 354.20 for describing the management areas within the Tule Subbasin for defining different minimum thresholds and operating to different measurable objectives are addressed and fulfilled in part in **Chapter 2.4** of Attachment 2 *Tule Subbasin Setting*, and **Section 1.4.3**, with supplemental information to meet the regulator requirements provided in this section. The Agency has only one agricultural management area and is not subdivided into any other management areas.

Table 2-4: Components of 23 CCR § 354.20

23 CCR	Section Title	Tule Subbasin Setting	TPDWD GSA Plan
§ 354.20 (b)(1)	Criteria for Management Areas	2.4.1	2.5.1
§ 354.20 (b)(2)	Minimum Thresholds and Measurable Objectives	2.4.2	2.5.2
§ 354.20 (b)(3)	Monitoring Pan	2.4.3	2.5.3
§ 354.20 (b)(4)	Coordination with Adjacent Areas	2.5.4	2.5.4

1. Criteria for Management Areas § 354.20(b)(1)

Chapter 2.4.1 of Attachment 2 *Tule Subbasin Setting* discusses the Tule Subbasin management areas, most of which are associated with communities that provide municipal water supply. These communities have been delineated separately because the beneficial use of the groundwater produced within the management areas (municipal supply) differs from the beneficial use of groundwater in a majority of the subbasin (agriculture). There are no communities within the Agency that provide municipal water supplies and therefore, the Agency has no community management areas.

2.5.2 Minimum Thresholds and Measurable Objectives § 354.20(b)(2)

Section 3.5 of this Plan provides the rationale, methodologies, and information relied upon to set minimum thresholds and measurable objectives and the established minimum threshold and measurable objectives as they relate directly to the Agency.

2.5.3 Monitoring Plan § 354.20(b)(3)

The Tule Subbasin GSAs have developed a subbasin-wide monitoring plan, which describes the monitoring network and monitoring methodologies to be used to collect the data to be included in Tule Subbasin GSPs and annual reports. The subbasin-wide monitoring plan is included as Attachment 1 to the Coordination Agreement. Separate monitoring networks have been established for groundwater levels (see **Figure 2-52** of Attachment 2 Tule *Subbasin Setting*), groundwater quality (see **Figure 2-53** of Attachment 2 *Tule Subbasin Setting*), land subsidence (see **Figure 2-54** of Attachment 2 *Tule Subbasin Setting*) and interconnected surface water. For each monitoring network, the monitoring plan describes the monitoring features included in the plan, the monitoring procedure to be followed to collect the data, and the monitoring frequency. The monitoring plan also includes an assessment of data gaps and a data management plan.

Section 4 of this Plan provides more detail regarding the Agency monitoring and analysis.

2.5.4 Coordination with Adjacent Areas § 354.20(b)(4)

Chapter 2.4.4 of Attachment 2 *Tule Subbasin Setting* discusses coordination with adjacent basins to the Tule Subbasin. **Section 3.5** of this Plan discusses how minimum thresholds and measurable objectives were set for each sustainability indicator to avoid causing undesirable results in adjacent basins.