SECTION 2

2.4. Water Budget

Detailed water budget information is documented in *Chapter 2.3* of the *Subbasin Setting*. These budgets are derived from the Tule Subbasin Groundwater Flow Model, covering the period from Water Year (WY) 1987 through WY2024.

This section summarizes inflows and outflows components for the Subbasin and the TBID GSA. The water budgets for the Subbasin and TBID are divided into a surface water system water budget and a groundwater system water budget. Water budget tables are highly detailed and identify inflow and outflow components by source of water (e.g., evapotranspiration (ET) and deep percolation from Deer Creek). Water budget results for the Subbasin are presented in *Tables 2-2* and 2-3 in the *Subbasin Setting*. TBID water budget results in included in this document and presented in **Tables 2-5** through **2-7** with a schematic of the different inflow and outflow components for the TBID water budget is presented in **Figure 2-38.**

2.4.1. Surface Water Budget

The surface water budget for the Subbasin is described in *Chapter 2.3.1* of the *Tule Subbasin Setting*. Inflows to the surface water system include precipitation, applied imported surface water (irrigation), discharge from wells, and surface water inflows. Surface water budget for the Subbasin is presented in *Table 2-2a* in the *Subbasin Setting* and for TBID is presented in **Table 2-5**. Surface water outflow includes recharge from precipitation, streambed infiltration and surface water outflows, canal losses, deep percolation of applied water, and evapotranspiration (ET). Surface water outflows for the Subbasin are presented in *Table 2-2b* for the Subbasin and for TBID are presented in **Table 2-6**. The surface water outflows are color coded to show different components that are included with the estimate for native yield.

- Blue: Groundwater inflows to be included in the native yield estimate
- Magenta: Groundwater inflows to be excluded from the native yield estimate
- Yellow: Surface water or groundwater outflows not included in the native yield estimate.

2.4.1.1 Surface Water Inflows

Surface water inflows are for TBID presented in **Table 2-5**.

2.4.1.1.1 Precipitation

The methodology used to determine annual average precipitation in the Subbasin is described in *Chapter 2.3.1.1.1* of the *Tule Subbasin Setting*. Annual precipitation values for the Subbasin were estimated based on the long-term average annual isohyetal map and using the annual precipitation data from the Porterville Station.

Across the Subbasin, the total annual precipitation ranged from 147,000 AF to 761,000 AF with an average of 361,000 AFY. The total annual precipitation within TBID ranged from 3,900 AF to 25,200 AF between WY1987 to WY2024, with an average of 12,000 AFY.

2.4.1.1.2 Stream Inflows

Stream inflows into the Subbasin include inflows from the Tule River, Deer Creek and the White River. To the north of TBID is the Tule River. Flows in the Tule River are controlled through releases from Lake Success, which are documented in the TRA annual reports. During the historical water budget period, flows released from Lake Success ranged from 8,820 to 439,125 AF with an average value of 120,100 AFY. Deer Creek flows through TBID. Inflows from Deer Creek into the Subbasin are measured at Fountain Springs by the USGS. Over the historical water budget period, values have ranged from 2,000 to 88,000 AF with an average of 18,400 AFY. The White River located south of TBID is based on the USGS stream gage station near Ducor. The estimated inflow into Subbasin from the White River ranged from 250 to 37,000 AF with an average of 6,000 AFY.

Deer Creek first crosses the Tule East GSA before entering TBID GSA. Flows into TBID are estimated based on the calculated infiltration, evaporation, and diversions that occur prior to TBID. Annual inflows into TBID ranged from 2,000 to 88,400 AF with an average of 18,200 AFY.

2.4.1.1.3 Imported Water

Surface water is imported into the Subbasin and TBID GSA via the FKC. Data from the USBR Central Valley Operation Annual Reports were compiled to calculate the average amount of imported surface water, as described in *Chapter 2.3.1.1.3* of the *Tule Subbasin Setting.* TBID holds a long-term contract for 29,000 AFY of Class 1 water from the Friant Division. Water from the FKC is diverted at the Terra Bella Pumping Plant located near Milepost 104.

For the entire Subbasin, surface water deliveries ranged from 18,900 to 587,400 AF with an average of 352,900 AFY. Within TBID, surface water deliveries ranged from 12,000 AF to 23,200 AF with an average of 18,200 AFY.

2.4.1.1.4 Discharge to Crops from Wells

Chapter 2.3.1.1.4 of the *Subbasin Setting* describes the water applied to crops from wells to be the total applied water minus imported surface water delivers and diverted streamflow. Estimates of crop ET were used to estimate total crop demand, with an assumed irrigation efficiency of 79 percent.

Across the Subbasin, the average groundwater pumping over the historical period was 651,000 AFY. Within TBID, the simulated groundwater pumping ranged from 0 AF to 19,100 AF with an average of 9,300 AFY. The volume of groundwater pumping is an overestimate based on feedback from TBID. Groundwater pumping within TBID is typically on the order of 2,000 AFY or less (S. Geivet, Personal Communication).

2.4.1.1.5 Municipal Deliveries from Wells

Chapter 2.3.1.1.5 of the *Subbasin Setting* describes the methodology used to determine the average annual groundwater production for municipal use within the Subbasin for the historical period. Groundwater pumping for municipal supply is conducted by the City of Porterville and other local communities including Terra Bella. The average municipal pumping across the Subbasin over the historical period was 19,600 AFY. For TBID the average pumping was 900 AFY.

2.4.1.2 Surface Water Outflows

Surface water outflows for TBID are presented in **Table 2-6**.

2.4.1.2.1 Areal Recharge from Precipitation

Areal recharge from precipitation on the Subbasin valley floor was estimated using the methodology developed by Williamson et al. (1989). As part of a regional hydrogeological study of the California Central Valley, Williamson et al. developed a monthly soil-moisture budget for the Sacramento and San Joaquin Valleys based on a 50-year period of record (1922–1971). This budget accounts for potential evapotranspiration, assumed plant root depth, soil moisture-holding capacity, and precipitation.

In this model, monthly precipitation that exceeds both potential evapotranspiration and soil-moisture storage is categorized as net infiltration to the groundwater system. These results were simplified into a linear regression model, known as the Williamson Method, to estimate net infiltration from annual precipitation:

$$PPT_{ex} = (0.64)\ PPT - 6.2$$

Where:

- PPT_{ex}: Excess Annual Precipitation (net infiltration/recharge) in ft/yr.
- PPT: Total Annual Precipitation in ft/yr.

For the Subbasin, groundwater recharge from precipitation ranged from 0 to 241,000 AF with an average of 33,000 AFY. For TBID, the areal recharge from precipitation ranged between 0 to 9,000 AF, with an average of 1,500 AFY.

2.4.1.2.2 Streambed Infiltration

As discussed in 2.4.1.2 of this GSP, the three primary surface water bodies in the Subbasin are the Tule River, Deerk Creek, and the White River. Streambed infiltration from each of these surface water bodies is discussed in full detail in 2.3.1.2.2 of the *Subbasin Setting.* Average recharge from the Tule River was 19,700. Average recharge from Deer Creek over the historical water budget period 11,500 AF. Average recharge from the White River was 5,800 AF. The average annual streambed infiltration before within TBID for the historical period is estimated to be 1,000 AFY, ranging from 100 to 4,500 AF.

2.4.1.2.3 Canal Losses

Chapter 2.3.1.2.3 of the *Subbasin Setting* contains a detailed description and methodology to calculate canal losses for the entire Subbasin. Canal losses are attributed to three sources, water from the natural surface water bodies (Tule River and Deer Creek) diverted to unlined canals, and water losses from imported water from the FKC.

For the entire Subbasin, losses from Tule River water diversion were on average 23,300 AFY, losses from water from Deer Creek was on average 2,500 AFY, and losses from imported water was on average 52,800 AFY. No measurable canal losses are accounted for in the TBID water budget.

2.4.1.2.4 Deep Percolation of Applied Water

The deep percolation of applied water for the entire Subbasin is described in detail in *Chapter 2.3.1.2.5* of the *Subbasin Setting*. Sources of water for irrigation include the Tule River, Deer Creek, imported water, recycled water, and groundwater. Sources of deep percolation within TID include imported water and agricultural irrigation from groundwater pumping.

Across the Subbasin, deep percolation from Tule River water on average 22,000 AFY. Deep percolation from water diverted off of Deer Creek was 1,100 AFY. Deep percolation of imported water was approximately 96,900 AFY. Groundwater pumping contributed the greatest amount of deep percolation with an annual average of 148,200 AFY. Within TBID, sources of deep percolation include imported surface water and groundwater. For imported water, annual values ranged from 1,900 to 10,500 AF with an annual average of 4,000 AFY. Deep percolation of applied groundwater for agricultural use ranged from 0 to 2,600 AF with an average 1,200 AFY. Deep percolation of applied groundwater from municipal pumping ranged from 400 to 600 with an average of 570 AFY.

2.4.1.2.5 Managed Recharge in Basins

Over the historical water budget period for the entire Subbasin, native Deer Creek water used for artificial recharge was on average 2,300 AFY. Recharge of Deer Cree water occurs in TBID within the western non-contiguous portion of the GSA (**Figure 2-32b**). Deer Creek recharge ranged from 0 to 7,000 AF with an average of 1,300 AFY.

2.4.1.2.6 Evapotranspiration

Sources of ET for the entire Subbasin are described in detail in *Chapter 2.3.1.2.6* of the *Subbasin Setting*. Sources of ET within TBID include precipitation from crops and native vegetation and agricultural consumptive use, including groundwater pumping and imported surface water.

Evapotranspiration of Precipitation from Crops and Native Vegetation

ET of precipitation is estimated to be equal to total precipitation minus areal recharge and includes estimates for both crops and native vegetation.

Over the historical period, ET from precipitation for the entire Subbasin was on average 328,000 AFY. Within TBID, ET from crops and native vegetation ranged from 3,900 to 16,200 AF with an average of 10,600 AFY.

Agricultural Consumptive Use

Agricultural consumptive for the entire subbasin includes all sources of irrigation excluding precipitation. The methodology used to estimate agricultural consumptive use within the Subbasin is described in *Chapter 2.3.1.2.6* of the *Subbasin Setting*. ET from agricultural consumptive use within TBID is calculated separately for imported water and groundwater (pumping) for the historical period.

For the entire Subbasin, the estimated average annual agricultural consumptive use was 724,000 AFY. Within TBID, ET from agricultural consumptive use of imported water ranged from 5,200 to 16,700 AF with an average of 12,500 AFY. As previously discussed, the estimated ET from groundwater pumping is overestimated. Based on the model results, ET from groundwater pumping ranged from 0 to 18,000 AF with an average of 8,700 AFY.

2.4.1.2.7 Deer Creek Surface Water Outflows

Surface water outflow within the Subbasin for Deer Creek is described in *Chapter 2.3.1.2.7* of the *Subbasin Setting.* At the time this document was developed, surface outflow estimates for Deer Creek were not available. During years of above normal precipitation, residual flow in Deer Creek has flowed into Homeland Canal which is in the western portion of Subbasin.

Surface water outflows of TBID were estimated based on the surface water inflows minus diversions and deep percolation. Surface water outflow through Deer Creek ranged from 1,600 to 87,200 AF with an average of 17,100 AFY.

2.4.2. Groundwater Budget

As shown in **Table 2-7**, the groundwater budget for the Tule Subbasin tracks all water entering and leaving the system. This balance is defined by the core equation:

$$Inflow - Outflow = \pm \Delta S$$

Inflows for the groundwater budget consists of areal recharge from precipitation, streambed infiltration, managed infiltration of water in basins for the purpose of groundwater storage, canal losses, return flows of applied irrigation water, and subsurface inflows. Groundwater outflows include all groundwater pumping (agricultural) and subsurface outflows. The subsurface inflow and outflow components in the groundwater budget are excluded when determining whether the water budget is balanced, and therefore, groundwater pumping is directly compared to all in-GSA recharge components.

Following the format of the surface water budget tables, the groundwater budget (**Table 2-7**) distinguishes between different water sources using specific colors:

- Blue: Groundwater inflows to be included in the native yield estimate

- Magenta: Groundwater inflows to be excluded from the native yield estimate
- Yellow: Surface water or groundwater outflows not included in the native yield estimate.

A chart describing the average annual values for each inflow and outflow component of the groundwater budget is presented in **Figure 2-39.** Average inflows were 44,800 AFY while the average outflows were 46,600 AFY. The average change in storage from WY1987 to WY2024 was a decline of -1,800 AFY. When excluding subsurface inflows and outflows, the average change in storage was a decline of 500 AFY.

2.4.2.1 Groundwater Inflows

Most of the groundwater inflow components are equal to the items described in the *Surface Water Outflow Section 2.4.1.2.* The only additional component to groundwater inflow is subsurface inflows.

2.4.2.1.1 Area Recharge from Precipitation

Areal recharge for the Subbasin is described in *Chapter 2.3.2.1.1* of the *Subbasin Setting*. Additional details are provided in section 2.4.1.2.1 of this GSP. For TBID, the areal recharge from precipitation ranged between 0 to 9,000 AF, with an average of 1,500 AFY.

2.4.2.1.2 Streambed Infiltration

Streambed infiltration for Deer Creek across the Subbasin is discussed Chapter 2.3.2.1.3 of the *Subbasin Setting*. Additional details are provided in section 2.4.1.2.2 of this GSP. For TBID during the historical period streambed infiltration from Deer Creek was an average of 1,000 AFY, ranging from 100 to 4,500 AF.

2.4.2.1.3 Canal Losses

Canal losses for imported water across the Subbasin are discussed in Chapter 2.3.1.2.3 of the *Subbasin Setting*. Additional details are provided in section 2.4.1.2.3 of this GSP. No measurable canal losses are accounted for in the TBID water budget.

2.4.2.1.4 Return Flows from Applied Water

Return flows are from both applied surface water and groundwater. Groundwater recharge from applied groundwater is discussed in *Chapter 2.3.2.1.7* of the *Subbasin Setting*. For imported water within TBID, annual values ranged from 1,900 to 10,500 AF with an annual average of 4,000 AFY. Deep percolation of applied groundwater for agricultural use ranged from 0 to 2,600 AF with an average 1,200 AFY. Deep percolation of applied groundwater from municipal pumping ranged from 400 to 600 with an average of 570 AFY. More details on return flows are provided in section 2.4.1.2.4 of this GSP.

2.4.2.1.5 Managed Recharge in Basin

Over the historical water budget period for the entire Subbasin, native Deer Creek water used for artificial recharge was on average 2,300 AFY. Recharge of Deer Creek water occurs in TBID within the western non-contiguous portion of the GSA (**Figure 2-32b**). Deer Creek recharge ranged from 0 to 7,000 AF with an average of 1,300 AFY.

2.4.2.1.6 Subsurface Inflows

Chapter 2.3.2.1.9 of the *Subbasin Setting* describes subsurface inflow for the entire Subbasin. Average inflows into the Subbasin from adjacent subbasin was on average 75,000 AFY. This does not account for flows between GSAs within the Subbasin. For TBID, subsurface inflow from other GSAs ranged between 24,400 and 39,300 AF with an average 30,100 AFY. As discussed in the *Groundwater Conditions* section of this GSP and presented in **Figures 2-20** through **2-23**, groundwater flow is generally east to west or northeast to southwest which would suggest that most of the water flowing out of TBID is to the west where a cone of depression is located within the Subbasin.

2.4.2.1.7 Mountain Block Recharge

Mountain block recharge is the infiltration of precipitation and snowmelt into bed rock along the eastern boundary Subbasin. Over the historical period for the entire Subbasin along the eastern boundary, mountain front recharge was approximately 33,000 AF. Within TBID, the average mountain block recharge was 5,100 AFY.

2.4.2.2 Groundwater Outflows

2.4.2.2.1 Agricultural Groundwater Pumping

Chapter 2.3.2.3.2 of the *Subbasin Setting* describes agricultural groundwater pumping throughout the entire Subbasin. Groundwater pumping for the entire subbasin was on average 651,000 AFY. Within TBID agricultural groundwater pumping for the historical period ranged from 0 AF to 19,100 AF, with an average of 9,300 AFY. For municipal pumping, groundwater ranged between 700 and 1,000 AF with an average of 900 AFY.

As previously stated, the groundwater pumping simulated in the flow model is an overestimate and actual groundwater pumping is less than 2,000 AFY.

2.4.2.2.2 Subsurface Outflows

Subsurface outflows for the Subbasin are described in *Chapter 2.3.2.3.4* of the *Subbasin Setting*. For the entire Subbasin, the average subsurface outflow was approximately 82,000 AFY. This does not account for flow between GSAs within the Subbasin. Within TBID, subsurface outflows into adjacent GSAs ranged from 23,900 to 56,300 AF, with an average of 36,300 AFY, which is greater than the average inflows of 33,400 AFY.

2.4.3. Current Water Budget

The current water budget for TBID is presented in the historical water budget tables as the most recent water year (**Table 2-5** through **Table 2-7)**. In WY 2024, the total groundwater inflow into the GSA was approximately 44,800 AF and the total groundwater outflow was 46,400 AF. Change in storage was a decrease of approximately 9,600 AF.

2.4.4. Projected Water Budget

To achieve long-term sustainability, a projected water budget was developed for the Tule Subbasin, incorporating the specific projects and management actions proposed by each of the GSAs. The projected water budget is for the time period 2025 through 2070. Using a groundwater flow model for the 45-year projection period, the subbasin aimed to:

- Verify Sustainability: Assess whether planned actions successfully meet sustainability goals.
- Analyze GSA Interactions: Evaluate how groundwater levels in one GSA are affected by the actions of neighboring GSAs.
- Determine Sustainable Yield: Estimate the maximum amount of water that can be withdrawn annually without causing undesirable results.
- Climate Change Integration

The model accounts for future climate variability by adjusting baseline hydrology and water deliveries. These adjustments—derived from the DWR's CalSim-II model and recommendations from the Climate Change Technical Advisory Group—affect three primary water sources:

1. Tule River flows
2. Friant-Kern Canal deliveries
3. State Water Project (California Aqueduct) deliveries

Climate-related adjustments to hydrology and surface water deliveries were applied over two distinct planning horizons:

- 2030 Central Tendency: Provides near-term projections of climate impacts on hydrology, centered on the year 2030.
- 2070 Central Tendency: Provides long-term projections of potential climate impacts, centered on the year 2070. These adjustments were applied to the model projection for the period from 2050 to 2070.
- Imported Water Supply Adjustments

For supplies arriving via the Friant-Kern Canal, TH&Co utilized delivery schedules from the Friant Water Authority (2018). These projections account for two major factors:

1. San Joaquin River Restoration Project (SJRRP): Projected deliveries include adjustments associated with this restoration effort.
2. Implementation Timeline**:** Adjustments for climate change and the SJRRP begin in 2025.
    - Changes are applied incrementally between 2025 and 2030.
    - The full suite of adjustments reaches 100% implementation by 2030.

The projected groundwater budget for TBID is presented in **Table 2-8.**

2.4.5. Sustainable Yield [PLACEHOLDER – will be updated as SMCs/PMAs are finalized]

TBID was previously a member of the ETGSA, which developed a groundwater accounting system to track groundwater use and implement a groundwater allocation program. This ETGSA program allowed for pumping in excess of the sustainable yield through 2035 (**Table 2-9**). These percentages allow for pumping in excess of the sustainable yield and are referred to as transitional pumping credits. In an effort to achieve sustainable conditions and address subsidence, as of WY2025, TBID has foregone all transitional pumping credits, limiting pumping to the sustainable yield, ten years sooner than what was originally agreed to by the ETGSA and the rest of the Tule Subbasin.

Table 2-9. Percentage of Historical Annual Avg. Use Allowed Above Sustainable Limit per 2024 ETGSA GSP

2021-2025	2026-2030	2031-2035	2035-2040
90%	80%	30%	0%

The sustainable yield for TBID is 0.99 AF per acre. The historical average pumping for TBID is 10,600 AFY or 0.76 AFY per acre. Although the ETGSA planned on having a glide path to achieve the sustainable yield allocation by 2035, TBID elected, through Resolution No. 2024-09-01, to disregard the glide path and achieve the sustainable yield pumping allocation in WY2025. This action also eliminated the ability of landowners within the TBID to use transitional pumping credits in future years.